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RAIL AND MULTIMODAL FREIGHT: A PROBLEM-ORIENTED SURVEY (PART II-1)

Summary. This paper includes a problem-oriented survey addressed at rail and multimodal freight, where the main objective is to discuss recently published works and documents dealing with drayage, rail haul, transhipment and standardisation. The general concepts are outlined and questions for further discussions are identified. Since, this work is a problem oriented survey; it does not explicitly focus on the available scientific instrumental that has been applied in dealing with rail and multimodal freight. However, throughout the description methods and approaches are addressed, where it is of interest. Please, note that this paper is the Part II-1 Problem-Oriented Surveys dedicated to rail freight issues of today.

ЖЕЛЕЗНОДОРОЖНЫЕ И МУЛЬТИМОДАЛЬНЫЕ ГРУЗОПЕРЕВОЗКИ: ПРОБЛЕМНО-ОРИЕНТИРОВАННЫЙ ОБЗОР (ЧАСТЬ II-1)

Аннотация. Эта статья посвящена проблемно-ориентированному обзору, относящемуся к железнодорожному и мультимодальному фрахту, где главная цель состоит в том, чтобы проанализировать недавно изданные работы и документы, связанные с платой за перевозку, железнодорожными перевозками, перегрузкой и стандартизацией. Подчеркиваются общие понятия и указываются вопросы для дальнейших обсуждений. Хотя данная работа является проблемно-ориентированным обзором, она не сосредотачивается исключительно на доступном научном инструментарии, который может быть применен к железнодорожному и мультимодальному фрахту, однако обращается по методам описания и подходам везде, где это представляет интерес. Пожалуйста, отметьте, что эта статья является частью II-1 проблемно-ориентированного обзора, посвященного проблемам железнодорожных грузоперевозок в настоящее время.

1. MULTIMODAL FREIGHT TRANSPORTATION

The *multimodal* nature of the freight transportation service is nowadays being realized and therefore the global tendencies are towards Co-, Inter- and Multi-modal freight transportation services. This phenomenon has ousted and pushed aside the concept that each of the basic transport modes, *i.e., rail, road, air, waterborne*, be considered separately. It appears that the current concept is that *the freight transportation service is provided by a* ***system*** *that consists of various transport modes where complex relations exist between the transport modes involved and between the transport modes and* *their customers.* Therefore, in order to address these issues other frameworks should be established and methodologies followed.

The focus of this work is kept on rail, assuming the rail freight modes as the backbone of providing freight transportation services, especially in providing long distance services. The aim is to better understand the role of rail in the framework of the multimodal freight transportation and communicate the findings. The multimodal freight transportation system has another face, where new concepts of analysis should be employed. Actually, one will deal here with more complex issues and challenges. As reported in [1] "*one must consider in more details the variety of ways to supply transportation services. Modes, for example, may be identified not only by the infrastructure they use, but also by the service type (e.g., unit, intermodal, or general trains), the organization (e.g., Less-Than-Truckload carriers operating hub-and-spoke networks with consolidation versus Full-load motor carriers offering customized services), vehicle type or product (e.g., container ships, tankers, general cargo ships), the scope of the firm (e.g., coastal navigation versus long-haul maritime shipping), and so on*".

A literature review on "*National and International Freight Transport Modes*" is provided in [2] which is based on a four steps modelling concept that consists of: 1) *Production and Attraction; 2) Distribution; 3) Modal Split;* and *4) Assignment*. More specifically, the following definitions are given:

- *Production and Attraction*: the quantities of goods to be transported from the various origin zones and the quantities to be transported to the various destination zones are determined (the marginals of the origin–destination (OD) matrix). The output dimension is tonnes of goods. In intermediate stages of the production and attraction models, the dimension could be monetary units (trade flows);
- *Distribution*: the flows in goods transport between origins and destinations (cells of the OD matrix) are determined. The dimension is tonnes;
- *Modal split:* the allocation of the commodity flows to modes (e.g. road, train, combined transport, inland waterways) is determined;
- *Assignment:* after converting the flows in tonnes to vehicle-units, they can be assigned to networks (in some models this is about assigning truck flows together with passenger cars to road networks).

It seems that, by one or another reason, in [2] *Supply Models* are not touched. These models should deal with the level of production capability of the integrated freight transportation system and introduce a fundamental component of the multimodal freight transportation. Also a short literature review on freight transportation models is provided in [1]. There, it is argued that in applied freight transportation models, the resolution is often sequential, that is to say that demand and supply models are established, and then the assignment procedure is performed. It is also reported that "the *scientific and practical knowledge of demand modelling is very high. With regards to supply modelling and assignment/simulation, the knowledge gap is large",* meaning that contributions at this front will be expected in the forthcoming future.

Speaking of inter-modal freight transport, where rail mode is explicitly involved, in [3], 92 publications have been reviewed in order for the characteristics of the inter-modal research community and scientific knowledge base, focusing on inter-modal "rail-truck" literature to be identified. There eight research categories have been distinguished, where five are based on typical characteristics of inter-modal freight transport, two are related to the transport economical and policy context and lastly defined is a category as "miscellaneous''. These eight research categories are employed and followed as a basis for the description provided below, where the purpose is twofold*: to report about recent papers and contributions that fall within each of the foregoing eight categories* and *to additionally elaborate on other concepts and avenues for further research* in the context of freight transportation services by rail. It should be noted that this discussion is divided into two consecutive parts involving Part II-1 and Part II-2. Part II-1 comes next focussing on Drayage, Rail haul, Transhipment and Standardisation. Part II-2 shall focus on Multi-actor chain management and control, Mode choice and pricing strategies, Intermodal transportation policy and planning, and Miscellaneous and is envisaged to come in another paper.

1.1. Drayage

Drayage is the operation fulfilled by truck between a terminal and shippers or receivers. They have some distinct features, which differ from simple pick up and delivery to/from rail and road transport. The trucks are also known as Drayage trucks or heavy-duty trucks used to transfer freight short distances between loading/unloading terminals, near-port rail yards, and local distribution centres. Drayage operations of poor quality deteriorate the entire inter-modal service and thus generate origin to destination costs that have to be avoided. This might shake the profitability of the inter-model transportation service and thus its competitive value. Therefore, research is needed in order for better-low-cost-drayage operations' schemes to be identified and tested in the shape of case studies, where the truck trips can be integrated in more effective manner aiming reliable service and reduction of the "*empty run"*. Actually, this task is more appropriate to take place within Urban Distribution Schemes and City Logistics, but one thing of interest might be that one should search for other ways ("*environmental-friendly*") to fulfil *Drayage Operations*, to the extent possible, such as Urban and Suburban Corridors dedicated to freight, Shuttles, Light Rail Freight Urban distribution systems, or new generation Electric "*Green*" Vehicles or Conveyor Belt Systems of big dimension. It appears that such a discussion has not received the necessary attention so far.

Some recent papers on "*Drayage operations*", where mostly optimization techniques are discussed, are e.g.:[4], [5] and [6].

1.2. Rail Haul

Rail Haul is, in general, where the service is fulfilled by rail and normally, this is "*from terminal to terminal*" within the *door-to-door* inter-modal (or multimodal) service. So, if we cut the service into pieces focusing only on "*from terminal to terminal*" services, we would be able to study in isolation the rail participation in fulfilling the inter-modal service and thus better understand its role. This suggests that the *decomposition approach* can be applied adequately in analysing and evaluating the performances of the inter-modal transportation system. The entire system is decomposed into components. One is able to study in detail the behaviour of each component but must not neglect that all the components belong to one complete system. The components of this complete system influences each other, thus the final product produced by the system is dependent on the performances of each component. Consequently, the global impact must be always considered.

Next, in organizing the rail haul being part of the inter-modal service, one recalls the three classical decision making levels of management ([7], i.e., strategic, tactical and operational), but within the context of rail participation in inter- and multimodal freight transportation. In [3] and [8] a discussion is open on addressing planning issues in intermodal freight transport by providing literature reviews. An update to this discussion was provided in [9] by further discussing accomplishments and perspectives.

In general, one would be tempted to treat the rail participation here as a typical conventional rail freight system and this may help. But, it may also mislead because there are significant differences in terms of production schemes and allocation of resources in the network, equipment, infrastructure and resources in the inter-modal terminals, rolling stock and transport units (actually, the freight is either container or trans-trailer), the operating personnel should possess new skills. Therefore, the question of organizing the rail freight operation within the inter-/multimodal service is currently not discussed in a satisfactory way and further is:

- Being debeted but Neither sufficient knowledge nor sufficient experience is available, so far;
- Requiring a significant scientific effort accompanied with practical studies in order to provide the most appropriate instrumental for dealing with its specificities.

Now, some issues for discussion about the three classical decision making levels will be pointed out:

***Strategic level*:** When one speaks of design and construction of the physical inter-modal network and location of rail facilities for inter-modal services, it appears unclear the right concept to be followed in terms of *number* and *dimension* of inter-/ multimodal terminals.

A paper on the problem of optimally locating rail/road terminals for freight transport was provided (see [10]) with an application to the Iberian multimodal network. Next, discussed in [11] is the development of an integral model for the evaluation of road-rail intermodal freight hub location decisions employing an agent based modelling approach. The design for an agent based model is explored by using a case study of intermodal freight hub location decisions in South East Queensland of Australia.

A number of questions remain unanswered, however. Should one consider a few terminals of big dimension over the network that are characterized with high processing capacity and big storage areas or just on the contrary, meaning one should consider many terminals of small dimension that are specialized in fulfilling specific services? Or, one should aim to implement the scheme where having one terminal of big dimension per region and a number of satellite terminals of small dimensions spread around the region. Actually, this issue would to some extent fall within the scope of *Supply Models* following the concept that *ensure more processing capacity in order to attract more demand.* Let us be remained that *Supply Models* applied to freight transportation are not yet developed in a satisfactory way. Either way, before starting with the models there is a number of critical points that one has to consider. The terminals of big dimension involve a significant amount of resource (both static and dynamic). These facilities are very expensive to build and further are even much more expensive to maintain basing upon the fact that these facilities are of importance but *not-revenue-giving* elements of the system, and normally the "*tons of money*" spent in building terminals are recognized as "*sunk-investments"*. On the other hand, however, terminal of big dimension concentrates the *whole frontline working force* (i.e., operations staff) of the region to act in one place only, meaning all the shunting, inspections, manoeuvring, picking up and setting out inter-modal transport units are concentrated in one place only and thus there is no need of operations crews to be dislocated and spread around the region fulfilling operations out of their home terminal and spending time in travelling.

Terminal of small dimension is not as expensive as terminal of big dimension. However, such a terminal does not possess the advantages of the terminals of big dimension seen in level of production. Consequently, this issue appears to be dependent firstly upon the specific needs of the region in question and secondly upon the specific needs of the inter-modal network. Critical leverages and factors appears to be the demand for this type of service (i.e., a number of clients, both current and potential, to be served within the given region), "*attracting demand by improving supply*", expected overall profit from the inter-modal service, all costs being incurred for providing the service and maintaining the infrastructure, all benefits (both social and industrial) being experienced, some negative effects such as externalities, e.g.. All these figures have to be analysed over time, meaning long term horizon forecasting is needed. Basing on these critical leverages and factors, one would conclude that the *instrumental of economics* followed by *event-based simulation models* for performance evaluations at mezzoscopic level of analysis would score quite well and suggest the right concept to be followed when one speaks of design and construction of the physical inter-modal network and location of rail facilities for inter-modal services. There are a very few contributions found in the literature at this front. For instance, in [12] reported at the time was that "*Freightliner's experience during almost 20 years of service is that small and medium-sized terminals are less costly per unit to operate and provide the shipper with a higher quality of service than do large terminals"*. On the other hand, argued in [13] was that satellite terminals located close to a hub of big dimension, performing some of the functions of this major facility, may be a means of ensuring that the major transport terminals can cope with traffic expansion without having to undergo major site expansion. However, there are questions that remain unanswered such as: *What is the specific function of each Satellite terminal? What resources should a Satellite terminal employ? What are the precise location determinants of satellites? How far from the main terminal can they be located? How about a satellite operation versus other alternatives,* where evaluations of performance, comparison studies and economic analyses might be of interest?

More research at this front is required, desirably underpinned with practical successful implementations.

Tactical Level: Let us be reminded that at this level the transportation companies fulfil their medium term plans based on adapted production schemes. Within the context of inter-modal transportation services, the disciplined operation is an imperative. Consequently, optimized plans and detailed schedules that consider carefully the real time for execution of each operation are needed. However, before to begin with the plans and the schedules, one must clarify the *Structure of Service.* (!) Immediately these two questions arise:

a) *What is the Structure of Service*?
b) *Which is the Most Appropriate Structure of Service*?

Known structures of service are: Point-to-Point and Hub-and-Spoke

Other structures of service, called advanced operating forms for which a discussion in terms of rail freight services has just begun are:

- Collection-and-Distribution (how to collect and how to distribute);
- Direct Trains operating between two demand origins/destinations;
- Liner Trains similar to the Multi-stopping trains moving in one direction only but operating in shorter distances;
- Shuttles-Shuttles Operations (Overnight and/or Over day) similar to Block-Trains.

Note that all the foregoing structures must be fulfilled over networks equipped with adequate infrastructure, which is a task at Strategic Management Level; e.g. where the service requires a freight train to cross a city, combinations of subterranean rail corridors dedicated to freight transportation might be of interest.

Other questions facing political and tactical decisions are: When do the freight trains move? Do they move during the day or during the night? Shall we stick with the historical hierarchy and keep running passenger trains during the day and freight trains during the night? … Following the new concepts and policies about Green Rail Network giving priority to freight – what is the impact of these new concepts and policies at national level and how shall the local freight transportation service be provided?

A very important issue is: what is the production scheme in operation? Therefore, comprehensive research at this front is needed that would identify appropriate production schemes for intermodal and multimodal freight transportation services and would further provide the instrumental required in dealing with this issue based on evaluation/comparison analysis that work through adequate system performance measures considering real situations, involvement of stockholders, expert appraisals and the like.

A very interesting discussion on distance and time as factors of competitiveness of intermodal transport was generated in [14], where reviewed is the relevance of the factors, evaluates time models in practice, compares network distances and times in alternative bundling networks with geometrically varied layouts, and points out how these networks perform in terms of vehicle scale, frequency and door-to door time. This work is a solid foundation for further research at this front.

Operational Level: This management level is dedicated to the management of the operation itself or in other words this is the execution of the service, meaning the frontline operation. Therefore, this level involves tasks such as: Vehicle Routing, Daily Reallocations and Redistributions of Resources, Scheduling of Jobs, Schemes for Loading Vehicles, Daily Operations and Control in Terminals, Management of Conflicts and Disturbances on the transportation network, etc. This area of research is relatively new and any contributions within the context of operational management of the rail haul are welcome. A recent discussion on “Planning Problems in Intermodal Freight Transport: Accomplishments and Prospects” is provided in [9], where concluded is that a research field for the future is the cooperation between actors in the intermodal transport chain. This is a big challenge at operational level. One would like to know more about the controlling mechanism of the chain and how the seamless (or close to seamless) operation will be guaranteed every day. Integrated management “REAL-Time” operation support systems are needed to support and monitor the execution of “every day” service and thus facilitate and optimize the management of the frontline operation.

1.3. Transshipment*: Rail–Rail terminals; Road–Rail terminals; and Port (maritime)-Rail terminals*

By deduction this issue should begin with a distinction among the types of intermodal terminals, as follows:

1. *Rail – Rail terminals* – the transhipment is executed from rail to rail;
2. *Road – Rail terminals* – the transhipment is executed from road to rail and vice versa; and
3. *Port (maritime) - Rail terminals* – the transhipment is executed from waterborne to rail and v.v.

Rail – Rail terminals: These are the so called Trans-/or Uni-modal terminals, where the typical rail yards (flat-shunted yards, hump yards and gravity yards) fall within this category the operation is typically seen in reassigning the transported freight or unit. Having in mind that the intermodal transport unit has characteristics that differ from the typical freight car, a different way of fulfilling the transhipment shall take place here. According to the best of our knowledge the most recent contribution discussing modelling issues of rail - rail transhipments is [15]. We are not aware of other similar and accessible papers or contributions. We are aware of a recent paper on implementation of innovations in rail freight transhipment (see [16]), where provided is a discussion on *"Why are the majority of innovations in rail terminal transhipment not adopted, and how can this be improved?"* .

Road – Rail terminals: Within the context of intermodal freight transportation services the operation with freight trains must follow strict fixed schedules consisting of detailed information for the freight train movement. Therefore, both the arrivals and the departures of each train to fulfil services in any terminal being part of the intermodal network is planned and thus known in advance. In normal daily situation, if the operation fulfils these schedules, problems are not expected to occur. Another question is whether the schedules are reliable or not, but this discussion shall not be open here.

The truck arrivals and departures to the terminals are not defined specifically in advance. In the usual practice, truck arrival/departure patterns are determined by the train timetable, the terminal working hours and by the market conveniences. The organisation of truck activities plays an important role in determining terminal capacity and performance (see also [17]).

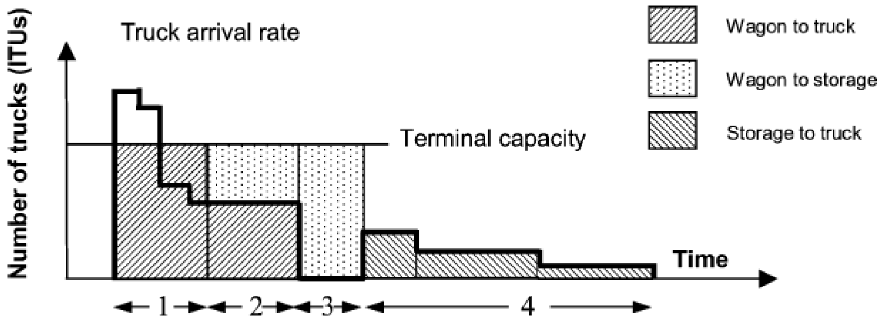

Fig. 1. Four Phases: describing the unloading/loading operations within the rail–road terminals
Source: Ballis A. and Golias J. (2002, pp. 598) this figure is there introduced as: "*Typical four crane phases of crane work",* and probably adapted from somewhere else

Рис. 1. Четыре фазы: описание операций разгрузки/погрузки в пределах терминалов железной дороги
Источник: Ballis A. and Golias J. (2002, pp. 598) этот рисунок там описан как: "*Типичные четыре фазы работы подъемного крана подъемного крана",* и вероятно может быть использован от где-то в другом месте

Let us be reminded, as shown in Fig. 3, that there are four phases describing the unloading/loading operations within the rail – road terminals, (refer also to [17], [18]), as follows:

- ➢ The first phase starts when the unloading operations start, usually following arrival of the train or after the terminal opens (in the case of trains arriving at night). In general, a significant number of trucks are already present and the unloading operations are concentrated in servicing these trucks. During this phase, direct transhipments from wagon to truck are carried out. After some time, truck arrival rate falls and the handling equipment is using the idle times to tranship load units to the storage area,

- This second phase is a mixture of direct unloading from train to truck and indirect transhipments (wagon to storage and storage to truck),
- The third phase is pure wagon to store transhipment. This operation completes train unloading so that shunting operations or operations imposed by the floating system can be performed,
- The fourth phase, the trucks are loaded indirectly from store.

The foregoing four phases apply to all rail - road terminals, but, as also addressed in [17], the duration of each phase differs significantly. The trickiest part characterized with unpredictable variability is the arrival/departure pattern of the trucks. Therefore, the focus should be on providing a reliable mechanism by which the variability in truck arrivals and departures can be reduced and controlled with the purpose of converting the intermodal terminal operation into more synchronized one without experiencing idle times and oversaturation and hence diseconomies of scale. There are few works suggesting efficient truck booking systems that could lead to predictable and controllable truck arrival/departure patterns ''adjusted to Intermodal Transport Units (ITUs) availability'' which reduces the indirect transhipment movements in comparison to those of the currently used ''adjusted to train arrival'' truck patterns (refer to [17], [19]).

Recent contributions are provided by [20 - 23]. The most contributions in the literature that deal with *Road – Rail* terminals are mainly focused on providing an optimal design for these facilities looking at the terminal layout, storage capacity, the handling equipment as well as operating strategies. In [23] e.g., focus on optimized loading patterns for intermodal trains is made. This subject falls within effective terminal operating strategies for loading trains with containers in an optimized way so that better utilization of the carrying capacity of the trains can be achieved.

Studies that deal with the level of liability among the actors' involved, business relationship as well as actors' behaviour in doing business, have not been found, however.

Port (maritime) - Rail terminals: Here the focus is also on design and efficiency, where what-if approaches and performance analyses are mainly employed. Another challenge is to study the impact of instituting new systems involving innovative technologies. E.g., analysed in [24] was the impact of instituting Automated Storage and Retrieval Systems (AS/RS) on the operations of a prototype maritime container terminal through a 3D simulation model. Normally, the proposed new system is simulated and thus compared with the existing one. For the comparison key-variables such as throughput, space utilisation, resource utilisation, etc., are defined and observed.

Recent contributions are presented e.g., [25], [26] and [27].

An interesting discussion on *Inland container logistics and Interports* is provided in [28]. There the provided is an introduction of the term "*interport*" as intermodal and logistic inland node[1] (this term is known as *Freight village* or *Logistic centre*) followed by a case study about the interport – seaport system in Campania, a region lying in Southern Italy, focusing on the interport - seaport railway connections. A preliminary presentation for an optimisation empirical network model for the distribution of maritime containers through Campania ports and interports is also regarded. By the intended future interport model, is aimed both economic advantages and disadvantages that shippers and carriers may enjoy in routing their maritime containers through the interports to be highlighted.

This sounds feasible and falls to some extent within the scope of *Mode choice,* discussion of which comes in RAIL AND MULTIMODAL FREIGHT: A Problem-Oriented Survey (Part II-2).

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[1] Iannone at el. (2007, pp. 5 - 6): … *The term "interport", which indicates a particular type of inland freight center, has been informally put into force in 1970 during a round table on "Land, maritime, rail and air freight centres" held in the city of Padua (in Veneto region, Northern-Western Italy), while in international bibliography interports come under different terms, such as "plataformes logistiques" (France), "guterverkehrszentren" (Germany), "transport centres" (Denmark), "freight villages" (United Kingdom), "rail service centres" (Netherlands), "centrales integrales de mercancías" (Spain). Instead, in Japan, Singapore, China and the USA, the most common and widely used term to indicate an interport is "logistic centre". Therefore, there is no unanimous definition of this kind of inland freight node and in some cases differences between countries exist not only in terms, but as far as the concepts and detailed solutions are concerned as well. …*

1.4. Standardisation

The unified vehicle dimensions and loading units will contribute to more simplified and flexible intermodal operations. This will have a positive effect on the intermodal service provided, the intermodal efficiency is expected to be on the increase and the operators/actors involved in the intermodal chain will experience cost savings.

Realizing such benefits the European Commission has pointed out in its agenda (consult [29]) the following initiatives:

- Study the options for a modification of the standards for vehicle weights and dimensions and consider the added value of updating Directive 96/53/EC;
- Update the 2003 proposal on Intermodal Loading Units to technical progress;
- Establish a mandate for standardising an optimal European Intermodal Loading Unit that can be used in all surface modes;
- Examine the compatibility of loading units used in air transport and other modes, and, if appropriate, make proposals.

The unification of the vehicle dimensions and loading units cannot go without inventing, testing, constructing and implementing new technologies. In this context several European projects have been conducted aiming at investigating new loading units and technologies for improving the intermodal efficiency. Provided in [30] is a brief presentation of some of the contributions made through EU projects, for instance:

- **InHoTra** is an EU project (5th RTD Framework Programme) which goal was to develop, construct and test new transhipment machines that can tranship boxes (containers and swap bodies) in the horizontal direction under the rail catenary. With this feature makes it possible to develop new terminal layouts and new services (e.g. liner trains);
- **COST 339/EUROCONT** is an EU project (available at www.cordis.lu/cost-transport/src/cost-339.htm , consulted on Nov. 26. 2008) which idea was to develop new loading units which can be used for partial loadings and fit to common equipment and vehicles in intermodal transport. This project dealt with smaller boxes (such as: small containers and logistic boxes) for intermodal transport with the purpose of elaborating European standard for small boxes.

However, as argued in [3] m*ore standardisation in the intermodal chain could save costs. These cost savings will appear only when all actors participate in the agreements. As long as one actor continues to use own sized equipment, load units and information, cost savings will not be apparent. In the process of standardisation, all actors must be convinced of the benefit to them.*

Let us be reminded that one of the most important considerations in the inter/ multimodal freight transportation is the extent to which every transport mode will generate cost savings for the other modes involved. Consequently, if the entire intermodal chain is seen as a combined firm that consists of a number of mergers/actors, then merger analysis might be of interest. Such analysis have shown that when the fixed cost of producing quality decreases – the consumer welfare increases. An interesting approach is presented in [31]. By unified vehicle dimensions and loading units all the actors in the intermodal chain will experience fixed cost savings which is of prime interest to them. Further research dedicated to investigate and analyse in detail how standardization contributes to Fixed Cost Savings in a short and long run (e.g., in dynamic context) in terms of intermodal freight transportation is needed. Once plausible results are obtained, exploitation and dissemination activities should be conducted in order to make known these results to all actors involved in the intermodal chain. Results showing Fixed Cost Savings would motivate the actors to change their old practices. This will also have a positive effect on the decision-making process towards complete standardisation seen in optimal European vehicle dimensions and intermodal loading units that can be used in all surface transport modes.

2. SYNTESIS AND A FEW QUESTIONS FOR DISCUSSION

The Multimodal Freight Transportation concept is that the services is provided by a system that consists of various transport modes; all modes together form a complete freight logistic chain, where complex relations exist between the transport modes and the transport modes and their clients. And the rail freight system is one of the transport modes involved in these complete freight logistic chain. Multimodal Freight Transportation is a relatively new area that has emerged recently. Therefore, many different tasks within freight logistic chains are even yet undefined. A list of topics for discussions should consist of:

1. At either end of the freight logistic chain are the operations fulfilled normally by trucks between a terminal and shippers or receivers. These operations are called Drayage Operations and are executed within urban and suburban city areas. From the very first glance, heavy-dirty trucks are neither pleasant to citizens nor to the city environment. Therefore, an interesting question for discussion is: are there any other ways ("*environmental-friendly*") to fulfil *Drayage Operations* such as Urban and Suburban Corridors dedicated to freight, Shuttles, Light Rail Freight Urban distribution systems, or new generation Electric "*Green*" Vehicles or Conveyor Belt Systems of big dimension?
2. The freight transportation service between terminals is normally fulfilled by Rail. A number of questions follow:
   a) In terms of network design and terminal capacity, what is the right concept to be followed? How the network is designed? What should be the number of terminals, what should be their capacity? Should one consider a terminal of big size and a number of satellite yards or just having terminals of medium size in the entire network?
   b) In terms of planning the service, what is the structure of service and which is the most appropriate structure of service? What is the production scheme to be employed?
   c) In terms of providing the service what is the controlling mechanism of the chain and how the seamless (or close to seamless) operation will be guaranteed every day? Is not there a need for integrated management "REAL-Time" operation support systems to support and monitor the execution of "every day" service and thus facilitate and optimize the management of the frontline operation?
3. Transhipment in terminals, rail-rail, rail-road, rail-port: Are these terminals well designed for the purposes of the intermodal network? What is the upper level of the terminals' production? How about the concept of inteports/freight villages and how do these facilities function? How about the level of liability among the actors involved, business relationships and the actors' behaviour in doing businesses in the freight villages?
4. Standardisation of loading/unloading units simplifies the operation and hence all the actors involved in the freight logistic chain experience improvements. Not all the actors grab the idea, however. This is because, we know little about how standardization contributes to Cost Savings in a short and long run (e.g., in dynamic context). Favourable results showing Cost Savings through standardisation would motivate the actors to change their old practices. This will also have a positive effect on the decision-making process towards complete standardisation seen in optimal European vehicle dimensions and intermodal loading units that can be used in all surface transport modes.

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Received 10.12.2008; accepted in revised form 14.06.2009