Transportation Research Part C 18 (2010) 807–820

Contents lists available at ScienceDirect

Transportation Research Part C

journal homepage: www.elsevier.com/locate/trc

Issues on railway wagon asset management using advanced information systems

Athanasios Ballis *, Loukas Dimitriou

School of Civil Engineering, National Technical University of Athens, Athens, Greece

ARTICLE INFO

Article history:
Received 15 December 2008
Received in revised form 2 June 2009
Accepted 2 September 2009

Keywords:
Railway empty wagon management
System surveillance
Estimated time of arrival
Optimal allocation
Mathematical simulation
Genetic Algorithms

ABSTRACT

Wagon fleet is an essential component of the railways business. Motivated by the recent concern on freight wagon management in Europe and based on the experience from the deployment and pilot demonstrations of an advanced wagon management system in Europe, the current work presents main technological and organizational issues associated with a wagon pool, created and used by a railway operator partnership. The results include the identification of the essential hardware and software requirements for the implementation of such a system (user/wagon reservation, track-and-trace and energy-saver equipment, loading/unloading sensors, wagon dispatching and delay management functionalities) as well as the outcome of the investigation of significant organizational aspects of the system (imbalance between wagon offer and wagon demand, fair allocation of benefits among the users of the system, savings that can be achieved thanks to estimated time of arrival information, consideration of reliability metrics into the optimal empty wagons allocation problem).

1. Introduction

The revitalization of rail freight transport is among the key priorities of the European Transport Policy (EC, 2001a). To this aim, various initiatives have been undertaken for the improvement of the various parameters that affect the performance of the railway system, among them the management of the railway wagon fleet. European wagon fleet consists of Railway owned wagons and privately owned wagons. Railway owned fleets are owned and managed by the railway operators themselves. Wagons are subject to an agreement providing for common use. There is a presumption that an empty railway owned wagon should be sent, preferably loaded, back towards its home railway. Furthermore, wagon pools have been set up for railway owned wagons (e.g. the EUROP pool) where participating railways put in wagons which are then used in common. Privately owned wagons are the property of their owners and are managed by their wagon owners. Today, some 180,000 privately owned railway wagons operate on Europe's railway networks. They must be attached to the fleet of a UIC (the worldwide organisation of cooperation for railway companies) member railway if they need to run freely across other UIC railways (EC, 2001b). A railway operator that receives a private wagon must send, after unloading, the wagon to its owner, as soon as possible.

The "return to sender" policy reduces the efficiency of wagon redistribution while on the other, the common use of wagons has its own drawbacks: the RIV Regulation governs the reciprocal use of wagons, and also concerned with the use of railway assets and so lays down arrangements for re-use of railway owned wagons and arrangements for payment for hire of railway owned wagons by other railways. Nevertheless, the fact that the railway with possession of wagons (owned by

* Corresponding author. Tel.: +30 210 772 1235; fax: +30 210 772 2404.
E-mail addresses: abal@central.ntua.gr (A. Ballis), lucdimit@central.ntua.gr (L. Dimitriou).

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doi:10.1016/j.trc.2009.09.003

another railway) has control meant that railways investing in wagons had no effective control over their assets. They will be paid for the use of their wagon under the RIV charging system, but not for loss of opportunity (EC, 2001a).

Significant effort is currently given to improve the above unsatisfactory situation, towards a wagon management schema based on private sector finance criteria with bilateral agreements on fair prices being paid to the owner for the use of his wagons by others. Synergies among railway operators have been identified as an opportunity to increase rail freight productivity. To this aim, the European Commission (EC) funded a number of research works among them the WagonLink, CroBIT and F-MAN projects in order to investigate the deficiencies of the wagon management system and propose solutions for its advancement. WagonLink developed a wagon reservation system which offers an interactive map of wagon searching which should be completed within one hour. This way, the participating railroad companies have the possibility to communicate their wagon demands and offers. The Cross Border Information Technology (CroBIT) project introduced a data exchange platform along European rail corridors (door-to-door approach) that will offer tracking and tracing of goods as well as automatic notification in case of deviations from the schedule (EC/DG Research, 2003b).

The current work is focusing on the research work and the findings of the F-MAN project that investigated the potential and requirements of a system offering real-time track-and-trace and wagon management functionalities (see Section 2). The project concluded in the technical and organizational requirements of such a system and deployed a prototype that has been tested by French, Portuguese and Slovenian Railways. In addition, model-based mathematical analysis (see Section 3) has been used to allow for the understanding of the wagon management system potential and risk. This analysis has been initiated within F-MAN workload and complemented through the academic work of the authors. The conclusions are presented in the final section.

2. Organizational and technical requirements for the management of wagon fleets

A typical rail transport action involves many actors: In the beginning of the chain there is the customer (sender, consignee, shipper or forwarder) that cooperates with the Order Manager providing him all relevant information for the desired transport of goods (e.g. nature of goods, origin and destination of goods, date and place of loading and departure, freight type and quantity or wagon type and quantity, etc.). The Order Manager is responsible to translate the customer request in a precise and coded order to the Fleet Manager as well as to inform his customer in case of problems during transport, to check the time that wagons are kept by the consignee, to do a repartition of charges and ensure the transport in cooperation with the Fleet Manager. The Fleet Manager receives the customer's order and proceeds with the required actions for the coordination of the specific transport. His main responsibility is to optimize wagons productivity, thus to satisfy the demand of empty wagons by balancing the wagon resources on the network based on information concerning empty wagon locations (idle or foreseen idle at a specific date), timetables, train delays, trains rerouting, etc. Part of this information is obtained from the Operational Manager (who is responsible to operate a transport service on the railway and to guarantee the transport of wagon) as well as from the Train Operating Company that in cooperation with the Infrastructure Manager allocates timetable slots, locomotives, drivers and schedules the inspection of wagons before their departure (EC, 2002).

Wagons are provided by railways or private wagon operators upon customer request, unless the customer owns his own wagons. They may be supplied for single journeys, or leased to the customer for defined periods of time. Wagon management is performed by authorized railways personnel. In its everyday operations the Fleet Manager has to exchange information with the various actors involved in the realization of a transport order, negotiate bookings and perform last-minute changes by making phone calls, sending and receiving faxes and to allocate the idle wagons to the required transport requests according to their attributes (wagon type in relation to cargo characteristics, availability, mileage, time till maintenance, cost, etc.) based on his experience and, if available, on the support of custom made software applications. Fleet Management is further complicated by the fact that there are many spatially separated and independent Fleet Managers each one focusing on their own needs and responsibilities. As a result, a Fleet Manager that has sent a number of his wagons in international trips is anxiously waiting for their return (to be used in other transport requests) while these wagons may remain idle at the disposal of other Fleet Managers.

At present, no integrated wagon fleet management exists in Europe. Tracking is generally based on data provided by train control management, while the distribution of empty wagons is carried out by dispatchers relying on past experience rather than real time data. This works relatively well at the national level since it is based on established procedures between national operators and infrastructure managers to assure empty wagon supply. As soon as wagons cross borders, however, the number of interfaces increases, leading to poor wagon utilization, especially when the players speak different languages (Kuhla et al., 2003). This is quite typical in European transport as, for example, a rail trip from Holland/Netherland to Greece must cross Germany, Austria, Hungary, Romania and Bulgaria or alternatively Germany, Austria, Slovenia, Croatia, Bosnia Hercegovina, Serbia and F.Y.R.O. Macedonia.

In order to cope with the above deficiencies the F-MAN project investigated the requirements of a system that offers real-time track-and-trace and wagon management functionalities for a wagon pool accessible by its registered users (EC, 2003a). The research concluded that the essential components of such a system are a wagon reservation scheme, on-board equipment, a prediction mechanism for the time of the wagon arrival at destination station and a suitable asset management software. These components are presented in Fig. 1 and analytically discussed in the following sections.