

# Recent Developments with Single Wagon Load Services, Policy and Practice in Europe

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**Abstract**—This research aims to gain an understanding of how Single Wagonload (SWL) services, policy and practice can benefit from the implementation of scientific methods and information technologies. For the purposes of this research a discussion on EU rail freight transport and current SWL trends is presented. An evaluation of EU rail freight policy is offered, followed by a discussion on policy measures to assist SWL growth. A review of scientific methods and models for rail freight planning is also presented that concludes that there is a need to update freight planning models in order to better support decisions for effective rail freight services and address current rail freight needs. An overview of information technology available for SWL is offered as well that suggests that it is possible for information communication technologies (ICT) implementation to benefit SWL operations, namely the level of efficiency. A lack of standards and integration should be addressed, however, in order for SWL and rail freight in Europe to gain further benefits.

## INTRODUCTION

TECHNICALLY a rail freight service can be classified by two theoretical structures, as follows: a “point to point” structure and a “hub and spoke” structure. “Point to point” structures are typical for direct trains, shuttle trains and block trains. On the other hand “hub and spoke” structures are typical for feeder trains and liner trains (multi-stopping trains). Both structures have advantages and disadvantages. Whilst point to point structures provide direct access to demand destinations and hence require less inventory as well as static and dynamic resources in place these structures are restricted to serve a specific type of freight and may not take advantage of the maximum technical capacity of the system. Hub and Spoke structures require more inventory as well as static and dynamic resources to provide a service. Hub and spoke structures are not as flexible as point to point structures and are characterized by reassembly processes with freight trains at hubs such as shunting and marshalling yards which can delay overall throughput and travel times [6], [14], [15], [18], [20]. Whilst this characteristic introduces a certain level of complexity in providing the service, hub and spoke structures tend to better utilize the existing technical capacity of the system. They were designed to serve “less

than train load” demand, where consolidation of loads is concentrated in designated areas of the railway network. Due to consolidation, economies of scale can be experienced in the long term. Single Wagon Loads (SWL) are served by hub and spoke structures.

The scientific methods used to study SWL operations, planning and practice include: rail freight systems design: optimization of empty runs: analysis and optimization of yard performance: reallocation of resources: evaluation of rail freight network policy and strategy. The implementation of these methods to concrete cases within railway administrations has led to significant improvements of the freight service performance in the past. Over the last two decades rail freight systems in Europe have experienced significant changes [13] [14]. These changes have been caused by variation in European industry and manufacturing both due to the Single European Market, expansion of the EU to the former Comecon states and globalisation to the Pacific Rim. Factories have been relocated to take advantage of qualified but less expensive manpower. This situation has led to variation in the characteristics of the loads in Europe [28]. Wagons designed and manufactured to transport coal, chemicals, paper, pulp and other loads from heavy industry have reduced and containerised traffic of finished, semi-finished and palletized products have grown in absolute and relative terms. In order to respond adequately to this change the rail freight systems have to adapt accordingly. New concepts, philosophies, designs, technologies and systems are needed to ensure railway freight companies in Europe transform and respond to the challenge of this changing market. Scientific methods will need to be updated to provide the analytical support to study changes in rail freight systems and suggest suitable ways for improvements [14].

The objective of this paper is to discuss the current situation with Single Wagon Load (SWL) services in Europe and to gain an understanding of how SWL services, policy and practice can benefit from scientific methods and information technologies. The rest of this paper is organized as follows: Section II provides an overview of rail freight transport in the European Union and a discussion on EU rail freight policy is presented in Section III. Section IV provides a summary of Scientific methods and models for rail freight

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planning, followed by Section V where a discussion on Information Communication technologies (ICT) for SWL is presented.

RAIL FREIGHT TRANSPORT IN THE EU

Eurostat, the official EU statistics, have demonstrated that rail freight transport in the EU has fallen over the last five years. It fell 17% from 2008-2009, totalling 366 billion tonne-kilometres in that year. Many in industry would argue that this phenomenon is due to the economic crises that impacted business.

OECD ITF data demonstrated that tonne kilometres have fallen by 30% in countries such as Poland, Bulgaria, even Germany in the second quarter of 2009 in comparison with the second quarter of 2008 [23]. Figure 1 shows in quarters seasonally adjusted freight traffic served by rail in the EU. The fall in performance between Q3\08 and Q3\09 is apparent.



Fig.1 Freight transported by rail in million tonne kilometres; Source: OECD/ITF

In 2005 Single Wagon Loads (SWL) systems have shown to serve approximately 40% of the European rail freight market. Five years later, however, in 2010 Eurostat have indicated a 10% decline of SWL services in Europe, as shown in Figure 2.

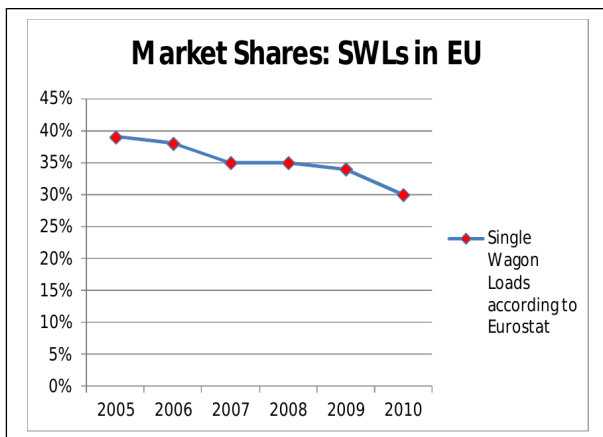


Fig. 2 A decline of Single Wagon Loads in EU; Source: Figure produced using Eurostat

Generally speaking, however, it appears that freight transport in EEA countries has indicated a positive trend, where road and aviation have shown the largest increase [27], [28]. Freight volumes transported by road transport has shown a significant increase in the EU 12. Many would argue that this is due to the fact that the road transport has successfully developed its performance while keeping costs at relatively low levels.

Figure 3 compares freight volumes transported by road and rail in million tonne - kilometres from 1995 until 2007. It should be noted that the volumes transported by road seem to have increased by more than 20% in the EU-12, for the period in question.

One may question the plausibility of this argument but it has been argued that the geographic orientation of the market in Europe has been reallocated from East to West; where the railway infrastructure has not been in place to ensure suitable connections to the new demand origins and destinations. This situation allowed road transport to grow as an alternative by limiting business opportunities for rail.

Railway companies have experienced significant levels of non-utilization of their static and dynamic resources. What has been observed is that many shunting and marshalling yards in Eastern Europe operate at 10 -15% of their operational capacity, putting into question their existence in the future. Companies such as Faiveley and Bombardier have made many of their employees redundant and shut down departments supporting freight services.

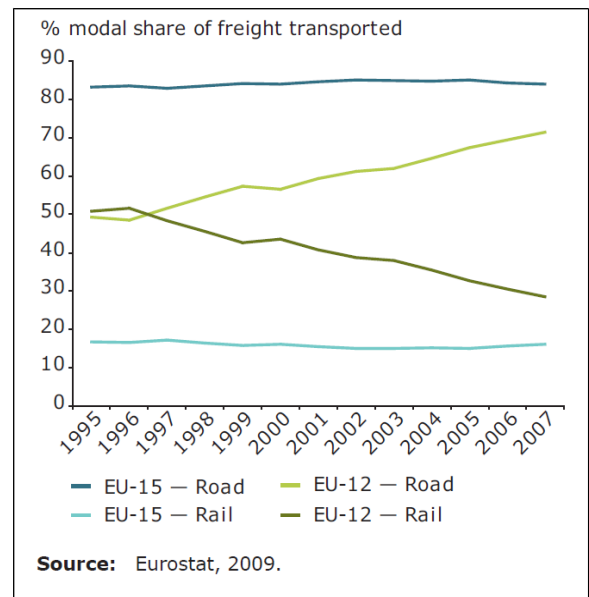


Fig. 3 Freight Volumes by Road and Rail in EU; Source: TERM 2009

Railway administrations such as SNCF and Trainitalia have revealed their strategic intentions to steadily reduce SWL services, believing that by doing so they will reduce massively their inventory and operating costs in the long term.

The rail alliance X-Rail with members: CD Cargo, CFL cargo, DB Schenker Rail, Green Cargo, Rail Cargo Austria, SNCB Logistics and SBB Cargo signed a cooperation agreement to boost Single Wagon Load services in Europe, aiming to implement a cross-border production standard that includes: ensuring reliable service and up to 90 % delivery on time for SWL services provided by X-Rail partners; ensuring absolute transparency and seamless information sharing among X-Rail partners using active information systems; ensuring swift response to enquiries. All of these sound promising, the statistics, however, have not shown a positive result yet.

Recent developments within the European railway private sector have suggested that there might be a business opportunity with SWL service in Central Europe. Over the last five years, companies such as Transpetrol for instance have changed their business model moving from block trains transporting grain and cereals to SWL services with chemicals. It is in question, however, if the railway private sector in Europe has reached its breakeven point and is now capable of covering its full operational costs in providing SWL services. It is also as yet unclear what is the level of quality of service (QoS) provided by the railway private sector in Europe.

#### RAIL FREIGHT POLICY IN THE EU

In the early 90s it was believed that market liberalisation for increased competition in the rail sector would create a plausible environment for the European railways to grow. It appears, however, that this concept struggles to prove useful due to a number of existing market barriers imposed by different permit requirements of the single EU member countries.

In its White Paper 2011: “Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system” the European Commission identified a set of goals and concrete initiatives for the next decade to build a competitive transport system in Europe to increase mobility, remove major transport-related barriers in and between member states, reduce the need to use oil for transport in Europe, reduce carbon emissions and promote alternative environmental friendly energy resources and last but not least, increase employment in Europe. More specifically key rail freight-related goals include: by 2050 – connect all seaports to rail freight system; by 2030 – shift 30% of road freight over 300km to rail and waterborne; by 2050 – shift more than 50%; a complete deployment of ERTMS; as well as rail freight corridors as the backbone of EU freight system. The European Commission is also determined to identify policy options to promote SWL and increase rail freight competitiveness and market share in Europe.

In reality, however, what is observed is that rail freight volumes continue to remain unstable; inadequate utilization of existing rail freight system capacity; new technologies have not been implemented; as well as huge diseconomies of

scale. Therefore many are of the opinion that there is a high risk of losing “critical mass” for rail freight services in Europe.

Aware of the current situation the European Commission intends to identify and implement a set of policy measures to create a more favourable environment for the growth of SWL services in Europe. More specifically, this set of measures ought to help understand the importance of SWL for EU Industry; identify shortcomings in current legislations; promote new legislative initiatives; look for alternatives to assist SWL through its inclusion in the Marco Polo programme; identify new business models and develop new production schemes for SWL low-cost services; identify and research adequate last mile solutions – “door to door”; promote automation in rail freight; design new technologies – including modern freight wagon design; improve conditions and reassess the meaning of capillary infrastructure for reliable and seamless SWL operations.

A double approach has been suggested as a starting point to integrate measures to increase economics of scale by introducing new production methods. New production methods for SWL services are intended to: provide operating patterns to respond adequately to new market demands; promote SWL service into new market segments; and hence improve quality competitiveness of European rail freight.

The expected outcome from the new production methods is a SWL service that improves productivity; reduces costs per out-put unit; and improves cost competitiveness of European rail freight.

*Is the production method a problem?* Single wagon load services are viewed as less than train load traffic, meaning the daily needs of clients for transport cannot feed a full train. To serve such clients regional road locomotives are used to collect and distribute loaded and empty wagons in the regions these locomotives are assigned to operate. In order to form a full train, individual assignments in the form of wagon sets are brought to an assembly point. Let us be reminded that an assembly point can be: an interchange; a goods yard, a shunting yard, a marshalling yard and/or a gravity yard. Assembly points are the hubs in the railway network, where a massive consolidation of freight flows is observed. A typical SWL system in a region consists of a number of demand origin and destination points and one assembly point. The assembly point functions as a collection-distribution centre consolidating loads from the demand origin and destination points in its region. Assembly points also receive and serve flows from other regions and that is why they are considered as gates for freight to their regions.

Railway systems serving single wagon loads normally require specific equipment for loading and unloading, which in many cases involves capital investments by the client, if other financial mechanisms such as Public Private Partnerships (PPPs) are not in place.

Due to its nature SWL is a network-based service involving a number of consecutive interdependent

operations. The quality of the service provided depends on the execution of every single operation part of the service. That is why the decisions on providing SWL services ought to be made globally, service-wide and in an integrated manner considering the global network impact on the service.

Railway freight networks involve a massive amount of static and dynamic resources to provide SWL services. These resources are characterized by sunk costs therefore keeping them non-utilised is unacceptable. Utilisation of resources is intimately connected with demand for service and customer satisfaction. Customer satisfaction is dependent on service reliability. Being aware of these dependences, more than 10 years ago, the European Commission addressed in its White Paper – European Transport Policy for 2010: Time to Decide (COM 2001), published in 2001 that factors causing railways to lose its market share are: lack of infrastructure suitable for modern services; lack of interoperability between networks and systems; constant search for innovative technologies; shaky reliability of the service provided, which is failing to meet customers' expectations. As a result of this situation, a set of “*remedy actions*” has been launched by the European Commission to revitalize the European railway sector by creating an integrated, efficient, competitive and safe railway area as well as set up a network dedicated to freight services.

Recalling service reliability, recent studies suggested that shaky reliability of freight service by rail in Europe might be caused by problematic cycles involving tactical management, operations and commercial sales of rail companies [16], [20]. It has been observed that due to incomplete methodologies for planning SWL services by rail that disregard the maximum processing capacity of the assembly points in the railway network, railway companies have been producing unworkable schedules making it difficult for the operations to execute the service on time. The outcome of such a situation is a service characterised with unpredictable variability, high operating cost and a very shaky reliability. That is why methodologies for planning SWL services should not be neglected because they have a significant impact on the level of quality of service (QoS) provided. These methodologies ought to be studied, improved and considered when policy measures for promoting SWL services are developed with the aim to increase rail freight competitiveness and market share in Europe; and this is where models for rail freight planning play an important role; discussion of which comes in the next section of this paper.

#### SCIENTIFIC METHODS AND MODELS FOR RAILWAY FREIGHT PLANNING

Since the beginning of collaboration between academia and the rail industry, scientific methods and models have been developed and used to improve rail freight planning, management and performance.

Models and methods for rail transportation have been organized in three management levels, namely: strategic, tactical and operational [3], [6], [7], [15], [18].

Strategic management level is where the global orientation of the railway company is decided. Strategic decisions of purchasing new rolling stock and/or undertake a significant investment, for instance, to build a new shunting yard are made. Models and methods to support decisions for strategic management of rail companies employ rail infrastructure development and rail network design (physical network), analysis of demand and development of long term forecasts, optimization of investment choice, evaluation of technical resources and implementation of technologies.

The tactical management level involves the development of long term operating plans, schedules and timetables. Normally these plans are developed twice a year specifying the tactical orientation of the railway company, service organisation and allocation of resources in the railway network. Models and methods that support tactical decisions involve rail network design (service network), organization of empty run, distribution of freight train flows, evaluation of yard policy, evaluation of line policy, as well as the organisation of freight train movement in the rail network.

Operational management level provides the service on a day-to-day basis. Within this level, short term plans are developed and executed. Freight trains are rescheduled subject to client's weekly request for service. Train crews are managed in a way to ensure the daily request for service is fulfilled. Cancellation of trains and rescheduling of road locomotives to train sets are also dealt with at this management level. Models and methods that support operational decisions for rail freight services are those providing real-time simulation, optimisation and analysis of railway systems capacity and reallocation of resources. Decisions at this management level should be made fairly quickly to avoid delays and undesirable disruptions during the execution of the service with freight trains in the railway network.

Scientific methods and models have been developed using knowledge from a large scheme known as *Operations Research* (O.R.). O.R. include a combination of analytical and holistic techniques sourced from a series of theories and practice such as: analysis and optimisation of graphs and networks, linear programming, dynamic programming and mixed integer programming, queueing networks, heuristics, event-based simulations, systems design, risk assessment, system performance analysis and the like. In the core of every model lies a computational algorithm replicating the logic behind the rail freight system behaviour.

For example a typical rail network problem involves the development of an efficient cost effective plan for the movement of freight trains and wagons in a railway network subject to network design and characteristics, distribution of freight train flows, yard policy (reassembling of freight trains), line policy (blocking), and scheduling (both crews and locomotives). Such a problem requires a significant

computational effort and time to be solved which would be merely impossible without the aid of advanced computer-aided design systems (or DSS) as well as software products such as ARENA, SIMUL8 and other general event based simulation platforms.

Recent developments with scientific methods and models for rail freight planning have been discussed for instance in [6], [9], [14], [20]. Specific software platforms for simulation of rail systems have been developed. Such packages are for instance OpenTrack, ERTMS/ETCS Traffic Simulators, RailSys as well as Villon.

Network optimisation methods developed to analyse and improve different aspects of complex rail systems have been recently reported in [9], [11], [21], [24], [26]. Optimization of working cycles of track tamping machines for efficient maintenance have been discussed by Santos and Teixeira in [26]. A mathematical model to optimize the design of a high speed freight distribution network in the US has been presented by Pazour et al. in [24]. A state of practice survey on real-time optimized equipment distribution systems has been conducted by Gorman et al. [11]; the authors discuss current practice of North American freight rail industry.

The literature suggests that railways are a field of active research. A good number of methods and models for rail planning have been developed and applied to support decisions within railway administrations around the world. The railway sector in Europe has now been restructured. Apart from a few exceptions, railway administrations are not massive corporations any more, instead many railway companies share responsibilities to provide the service required. Infrastructure and operations do not belong to one body therefore are not managed by a single authority. Decisions for rail freight services are bonded by contracts. If contracts are unfulfilled, penalties apply.

Railway freight operators compete for business but still they provide a network-based service where decisions should be made globally, in an integrated manner. Although railway freight operators act in a highly competitive environment decisions should be made collectively and arbitrated by rail infrastructure managers to guarantee access to physical networks.

Railway companies in Europe have now more flexible management patterns characterised with lighter structures which may not need long term planning to generate healthy income and ensure the company's existence.

The railway freight sector in Europe has been influenced by new production patterns, new technologies and innovative logistics principles. Multi-modal transport has gained a significant popularity transporting more and more lorries on trains. Programmes such as Marco Polo encouraged modal shift from road to rail providing financial support for the implementation of new technologies such as rail and freight modular platforms, horizontal transshipment, systems for tracking and tracing goods and containers, systems providing paperless information flows and the like. More specifically, the EC's Marco Polo initiative aims to free Europe's roads of an annual volume of more than 20 bil-

lion tonne-kilometres of freight, the equivalent of more than 900 000 trucks a year travelling in Central-Western Europe. Truck companies are invited to present projects to transfer freight from road to rail (or on to short-sea shipping routes or inland waterway), where the focus is on reducing road transport by offering support services such as decision support systems, control and common information management platforms as well as training programmes for pre-qualification of staff. According to the EC's official information channels the Marco Polo programme budget for 2007 - 2013 is €450 million. Although in action, the impacts of such initiatives have not yet been evaluated, which suggests it is uncertain to what extent a progress has been made.

Urban freight by rail has been introduced and tested in a few European cities. A few examples of such initiatives are Amsterdam Metro system – City Cargo, Cargo Tram in Zurich, a feasibility study on moving urban freight by using the Newcastle Metro system. Truck Trains have been suggested as a modern technology allowing rapid and flexible freight services by rail. It is as yet unclear however if tram and metro can carry cargo efficiently and provide an environmentally friendly alternative for freight distributions in urban and suburban areas [22]. On the other hand Truck Trains may provide the technology needed to serve effectively “less than train loads” on the European railway networks, there are no evidences, whatsoever, if the market have taken up the concept and put it into practice.

Demand patterns of rail freight services in Europe have changed. They are now characterised by smaller consignments, smaller shippers and smaller freight forwarders. Longer and heavier freight trains shall operate less and less in the European market in near future. Instead, this production scheme will play an important role in transporting freight from Asia to Europe and v.v. using Trans-Siberian route and other Europe-Caucasus-Asia transport corridors. In Europe Low Density Higher Value (LDHV) goods currently present a challenge. One cannot tell at the moment, whether or not the European freight railways will seize this emerging opportunity, however. Adequate technical and organisational changes are needed to redesign the rail freight systems in Europe to respond logically to customer needs.

These changes within European rail freight, suggest that the orthodox model of running freight railways is no more, which introduces an imminent challenge of great importance to the scientific gentry that insists that the existing methods and models for rail freight planning be reviewed and updated accordingly to meet the rail freight current needs in Europe.

Demand patterns need to be reviewed. Demand models need to be corrected to capture all the products suitable for rail as well as the business role of customers, freight forwarders and other transport provides (i.e. potential collaborators).

The following analytical methodology might be of interest to structure the service components and decision making levels of the system:

- Generation of business – to capture the commercial aspects of the business including business models and marketing;
- Demand patterns/models – to identify and specify the needs for service, type of products, O/D trips and iterations, time for delivery, etc.;
- Grants and Contracts – to price the service and specify terms and conditions for providing it; integration with other transport modes falls under this component as well;
- Supply patterns/models – to set up the strategic and tactical orientation of the company as well as the operations model;
- Execution of service – to provide the service in accordance with the specified terms and conditions;
- Customer satisfaction – to collect feedback, analyse the levels of customer satisfaction and take measures.

Figure 4 shows graphically the combination of service components and decision-making levels as well as the structure of their interdependence.

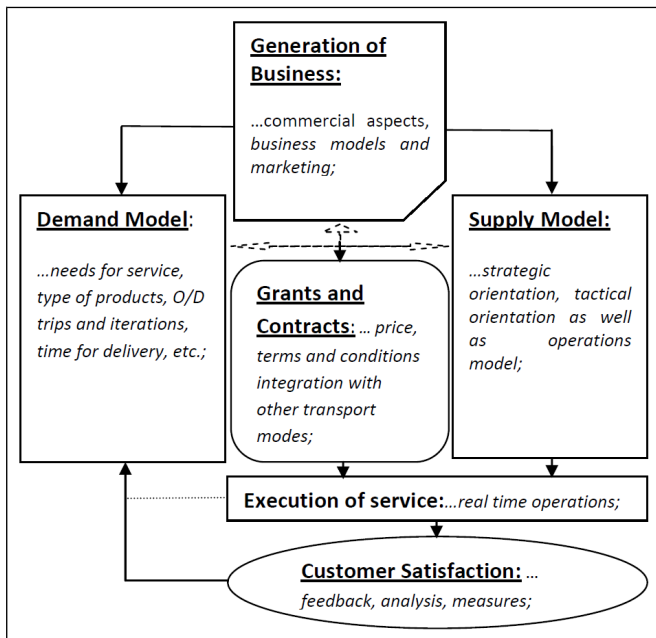


Fig. 4 Analytical Methodology depicting service components and decision making levels;

A number of surveys have been conducted to analysis the current needs of rail industry. The interested reader is referred to EU co-funded projects such as TUNRail and RiFLE. These surveys suggested that skilled managers are needed to manage the railway systems effectively, fulfil customer expectations and generate more business. Therefore future work patterns should also employ university-based, multi-disciplinary research approach for railway system design involving advanced computer-aided design systems (CAD). The application of CAD to railway management, organization, design and training is broadly in sharing, storing and managing real time simulations with

trains both freight and passengers, which facilitates planning and decision-making, allows railway managers to better understand the complexity of the railway systems and to run it efficiently, promote dialog among competitors and creates foundation for different railway authorities to benchmark their performance for more sustainable, efficient and profitable railways.

#### INFORMATION TECHNOLOGY FOR SINGLE WAGON LOAD SERVICES BY RAIL

During the past two decades, advancements in Information Communication Technology (ICT) have led to a number of developments in ICT for freight transport. This has been reflected in the literature, as a review of recent publications suggests there are a growing number of studies which address the role of ICT in freight transport [8], [10], [12], [25]. Research developments indicate that the number of ICT applications within freight transport have increased rapidly in recent years due to a reduction in cost and the provision of technology which is able to support a wider range of interests. A rise in the number of businesses implementing ICT technologies to facilitate efficient transportation of goods has been observed, this includes the implementation of a range of technologies such as: global positioning systems (GPS), Electronic Data Interchange (EDI), dedicated short range communications (DSRC), Radio and onboard sensors. Currently, several standalone systems have been implemented which aim to increase efficiency in rail freight and rail freight operations, as yet no standardised ICT system for rail freight exists.

Individual cases which demonstrate ICT developments which have been implemented within railway freight are a number of technologies for fleet management, asset control, and intermodal operations. F-Man, an FP5 collaborative project produced a prototype to be implemented for fleet management and asset control in SWL operations. The concept consists of the following key modules: Tracking System Module (TSM) to locate wagons throughout Europe, through the use of on board sensors and GPS receivers. It is also possible to retrieve wagon status information (loaded, unloaded, and moving).; The Data Processing Module (DPM) which provides an estimate of the Expected Time of Arrival (ETA) for each wagon, and supplies information regarding wagon history.; The Asset Management Module (AMM) which facilitates order processing, wagon selection to comply with the clients request, trip organisation and data logging and the Graphical User Interface (GUI) which presents the wagon position and operational data on geographical maps for use by the fleet manager. Despite plausible results during the demonstration of the concept in Portugal, Spain, France & Italy, at the end of the project the system was not implemented, however, the potential benefits to SWL operations of this concept should be recognised.

In the early 1990s several railway organisations with support from the EU, proposed a new European rail traffic management system (ERTMS). This was developed as a

result of a number of rail accidents due to signal failure and a lack of an EU standard for control, command and signalling within rail services. ERTMS is comprised of the following two components: European Train Control System (ETCS) and Global System for Mobile Communication- Rail (GSM-R). ETCS is comprised of two ICT components, namely: one onboard the train and one trackside. Train speed is controlled through the comparison of actual train speed with the maximum permitted speed, if the train is exceeding the maximum speed, information will be transmitted via the trackside component and the brake will be automatically applied. ERTMS has three levels of deployment, as follows: Level 1 deployment began in 2004, benefits were expected to provide additional interoperability and increased safety levels; Level 2 is currently being implemented, it is envisaged that along with the benefits provided by level 1, it will provide the potential for line capacity increase; It is anticipated that, deployment of level 3 will commence at the end of 2012. Although promising, it is as yet unclear how ERTMS will be implemented to facilitate shunting operations in rail freight yards.

Technology developments to be employed in asset control and the tracking and tracing of wagons in SWL operations are discussed in [4], where several approaches are proposed, as follows: electronic tags to be mounted on the wagons which are read by a number of transponders situated alongside the railway line, rail wagon tracking through GPS tracking of the locomotive and recording the wagons assigned to each locomotive and GPS and communication devices attached to each wagon.

Also for use in tracking and tracing, the use of active radio frequency identification (RFID) tagging is discussed in [1]. RFID tags have been employed as they have the potential to improve rail freight operations through the real time tracking of rail vehicles and cargo. RFID tagging in rail freight operations has been observed in Scandinavia and the USA. Although the results of tracking and tracing have indicated an increase in freight operation efficiency, there are still a number of questions to be addressed, including battery life, cargo security and tag implementation across a whole fleet.

Freightwise, an FP6 collaborative project produced a framework employing ICT to facilitate the flow of information and in turn to improve the management across the following three sectors of the freight industry: transport management, traffic and infrastructure management and administration. The framework proposes a standardised number of processes and information packages in order to plan, execute and complete the transshipment of goods in a paperless system. However, it is not clear whether the framework could be implemented for SWL operations, as it is focused on intermodal services, with the aim to support modal shift.

A number of fleet management systems are discussed in [4]. WagonLink, for instance, which offers an interactive map of wagon searching, in order that participating railroad

companies have the possibility to communicate their wagon demands and offers. Cross border information technology (CroBIT), a data exchange platform, which provides the ability to track and trace goods.

To the best of our knowledge a number of brokerage systems for SWL fleet management have been presented, as yet no standard EU brokerage system for SWL has been implemented. While the benefits of an ICT, rail freight collaboration must be acknowledged, the current lack of standardisation, conversion of raw data into useful information and integration between existing systems should be taken into account. It is therefore proposed that further research should be carried out on these aspects, in order to enhance the results of the rail freight, ICT partnership.

## CONCLUSION

Due to its complex nature Single Wagon Load services will always hold a fascination for policy makers, stakeholders, managers, scientists and modellers. This paper presented an overview of recent developments of SWL services, policy and practice in Europe. Statistics showed that rail freight trends in Europe continue to remain unstable. The European Commission is determined to intervene through a set of policy measures that would create a plausible environment of the European freight railways to grow. The market, however, has experienced major change. Demand patterns are now characterised by smaller consignments, smaller shippers and smaller freight forwarders. Therefore the orthodox rail freight production patterns need revision, which presents new challenges to engineers and scientists to develop innovative technologies, models and methods of next generation freight service by rail. It has also been shown that, if implemented, ICT developments would facilitate the management of complex rail freight operation and hence improve the quality of service provided. Common IT standards are also needed to ensure efficient data exchange and service integration along the European logistics chains.

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