Information and Telecommunications Technology – Factor of Sustainable Rail Development

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Abstract: *Among today's modes of transportation, rail remains of great interest because of its explicit advantages arising from the fact that it is the least polluting and most environmentally friendly. These are just some of the reasons why, in recent years, the European Union strategies seek to develop and implement programs to revive Community's rail transport. The paper makes a brief analysis of the economic impact of the implementation of information and telecommunication technologies in railway transport, technologies that can contribute significantly to the achievement of sustainable, competitive and reliable transport.*

Keywords: railway, ICT, sustainable development, sustainable transport, transport strategy

JEL Classification: L91, L96, Q55, R40

1. Introduction

Transport is one of the keys to success for building European Union's Single Market because it contributes to the implementation of two of its fundamental aims: the free movement of persons and the free movement of goods.

European Union calls for more efficient use of existing infrastructure and more environmentally friendly transport. Ensuring environmental sustainability of European transport and energy is a goal that can not be achieved without combining several policies that support and complement each other and by involving increasingly more actors (representatives of the transport sector, government administration and citizens).

Because transport is a complex system that depends on multiple factors, including the pattern of human settlements and consumption, the organization of production and the availability of infrastructure, intervention in this sector must be based on a long-term vision of mobility sustainable people and goods.

The European Economic and Social Committee considers competitive, reliable, and cost-effective fluidity as a prerequisite for economic prosperity in Europe and that free movement of people and goods is one of the fundamental freedoms of the EU. In this context, transport should greatly contribute to achieving the objectives of Europe 2020 strategy.

This paper presents a brief analysis of the actions taken at EU level in the first decade of this century to revitalize rail transport.

Applying information and communication technologies (ICT) to European rail transport meant the implementation of the European Rail Traffic Management System ERTMS (European Rail Traffic Management System). This paper makes a brief presentation of the European Rail Transport Management System ERTMS, of the economic benefits resulting from its implementation at the European level and as well as in Romania.

2. European Transport Policy in the First Decade of the XXI Century

Transport is an essential component of the European economy. The Transport branch as a whole accounts for about 7% of GDP and more than 5% of total employment in the EU[40]. European transport policy (PET) has contributed to a mobility system that, efficiently and effectively, is comparable with the most economically advanced regions of the world. The ETP has stimulated economic and social cohesion and promoted the competitiveness of European industry [2], thus contributing significantly to the implementation of the Lisbon agenda for growth and jobs. [7]

Regarding the objectives of the sustainable development strategy, however, the results of the first years of the XXI century were more limited: thus, in the 2007 report on progress, shows that the European transport continues to be on a sustainable trajectory for several reasons [6], such as:

• The Trans-European Networks Policy (TEN-T) significantly improved coordination between Member States in planning infrastructure projects;

• Extending TEN to the new Member States based on investments that preceded expansion, highlighted the points where structural and cohesion funds should intervene to complete their infrastructure deficits;

• In the rail sector, the regulation adopted in December 2007 provides ample passenger rights;

• The separation of transport growth from GDP growth, one of the objectives of the 2001 White Paper and of the renewed (in 2006) EU Sustainable Development Strategy[41], was carried out for passengers transport.

The goal of European transport policy is to establish a sustainable transport system that meets society's economic, social and environmental needs and encourages the achievement of an inclusive society and a fully integrated and competitive Europe. Current trends and future challenges point to the need to satisfy a growing demand for 'accessibility' in the context of growing concerns towards sustainability. In this context, we highlight a number of priorities, including: better integration of different transport modes as a way to improve the overall efficiency of the system and accelerate the development and application of innovative technologies.

3. Rail Transport in the European Union and in Romania

The European Community strives to create the conditions for an efficient rail sector and to adapt it to the requirements of the single market. In this respect, it was suggested the introduction of an operating license to provide uniform access to infrastructure and it was established a system to allow infrastructure capacity to be allocated on a non-discriminatory basis and for users to pay the actual cost of the facilities they use.

In recent decades, in Europe, rail declined especially for freight transport. Following the financial crisis, the share of rail freight fell by 19% in 2009 compared to 2007. In 2010,

[40] Of GDP contribution, 4.4% came from transport services, which provides 8.9 million jobs, and the rest from production of transport equipment, which employs 3 million persons.

[41] *National Railway Company*, International, www. sncfr.ro

the overall performance in the EU-27 was estimated at 389 billion tons-kilometers, an increase of 7.9% compared to 2009. This increase reflects the recovery of rail freight after the economic crisis (which ended a sustained period of growth in recent years).

After a period of sustained growth, in early 2009, railway performance (in passenger-kilometers) began to be affected by the economic crisis. However, the rail passenger transport remained less affected than rail freight, and had a slight recovery in 2010 and 2011. Thus, the EU-27 results of passenger transport continued to increase, by about 3 billion passenger-kilometers, between 2010 and 2011 (+0.7%).

The main cause of this situation is that the rail sector is not as competitive as road transport. Rail transport is less secure than road transport regarding the delivery terms, which are less predictable for railways. In recent years, on some international routes, delivery terms (which are very important to many sectors) have doubled or even tripled. This is mainly due to very long stops along the way, because other trains (especially passenger services) have priority, and to complicated border procedures (locomotives and train crews must be changed due to differences in signaling systems and traction from one country to another, and so on).

Railroads have unique advantages: it is a safe and clean transport and a train can carry the load of 50-60 trucks. Railway infrastructure covers a lot of territory and it is generally in good condition but it no longer fits customer requirements.

Romania currently has a national transport system (infrastructure, transport, transport operators, etc.) in terms of both functional structure and services provided, at the average level of the standard conventional transport systems in Europe, able to deal with the current needs of domestic and international users.

Overall, the public transport infrastructure networks (roads, railways, waterways, navigable channels, sea and river ports, airports) connect all localities of the country to the national transport and international transport systems.

After a "disordered" evolution, with each mode of transport developing autonomously and independently, in recent years there has been some "settlement" in the development of the various modes of transport in Romania. In spite of the major changes made so far, the transportation system in Romania still owes to the "old ways" of the system in which it was designed and built.

Romania's position at the intersection of numerous roads connecting Western and Eastern Europe as well as Northern Europe and the South, and its position on the transit axis between Europe and Asia is a reference to consider when designing transport policy.

Romanian Railways have the duty to bring the national railway infrastructure to the European level of technical and operational parameters, to be a compatible and interoperable part of the future trans-European rail network.

While European Union’s 2007-2013 main objective for rail is to ensure a more balanced distribution of transport and environmental protection and to increase accordingly the share of the total transport market from 6% to 10% for passenger transport, and from 8% to 15% for freight transport, for the same period, Romania’s major railway objective, is to keep a balanced transport market share maintaining the values of 25% of all goods and 35% of all passengers.

Railway infrastructure is currently in a difficult technical condition due to significant debts for cyclic maintenance and repair of lines, installations and buildings and for modernization works, shortcomings caused by the lack of necessary funds. In recent years the traffic capacity was reduced due to insufficient funds for railway infrastructure current repair works.

The interoperability of the conventional rail network (TEN-T and outside TEN-T) with the European rail network will be achieved when introducing monitoring system elements necessary to the ETCS (European Train Control System) in the track and rolling

stock onboard engine, electronic interlocking to upgrade the centralizing system for railway stations, developed informatic systems for all railway stations located on the interoperable railway network in Romania, a developed telecommunications network to provide support, the implementation of data transmission railway systems in all railway stations located on the interoperable railway infrastructure in Romania, the implementation of the National Center for centralized control of the railway traffic on the Romanian territory, and last but not least, retrofitting energy-supply facilities of the contact line.

These actions will lead to a better market coverage and to better transport accessibility for passengers to the main transport routes through the interconnection of regional services and to increased passenger wagon loading on main and regional routes.

4. Intelligent Transport Systems in the Railway

Technological innovation will be an important contributor to the solution of the transport. Rail Traffic Management systems can optimize network utilization and improve safety [3].

"Intelligent Transport Systems" mean applying information and communication technologies (ICT) to transport. These applications are developed for different transport modes and for interaction (including intermodal platforms).

For air transport, SESAR[42] will provide the framework for the implementation of a new generation of air traffic management, on inland waterways are available River Information Services (RIS)[43] to manage waterway utilization and freight and passenger transport, the railway network is gradually introducing the European Rail Traffic Management System (ERTMS) and Telematic Applications for Freight (TAF).

European Management System ERTMS for rail transport is a major industrial project developed by six members of the UNIFE Association (the Association of the European Rail Industry): Alstom Transport, Ansaldo STS, Bombardier Transportation, Invensys Railway Group, Siemens Mobility and Thales in close cooperation with the European Union stakeholders interested in railway GSM-R industry.

The purpose for implementing ERTMS is to replace national command and control systems for trains, and to create a single European railway system with increased competitiveness.

Currently, in the European Union, there are more than 20 train control systems. Each train used by the national railway company shall be equipped with at least one system, but sometimes more, for traffic to be carried safely in that country.

As a unique European Train Control System, ERTMS is designed to gradually replace the existing systems not compatible throughout Europe. This will bring considerable benefits to the railway, which will lead to the strengthening of international freight and passenger transport.

Also, ERTMS is the most advanced train control system in the world and brings significant advantages in terms of maintenance cost, safety, reliability, punctuality and traffic capacity. This explains why ERTMS is increasingly used outside Europe, and it became the train control system in countries such as China, India, Taiwan, South Korea and Saudi Arabia.

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[42] SESAR: *Single European Sky Air Traffic Management Research* (Program Management Research Single European Sky ATM).

[43] River Information Services (RIS)

ERTMS contributes to increased competitiveness of the rail, allowing the system to compete with other modes of transport such as road. ERTMS will allow interoperability throughout the European rail network.

5. The Economic Implications of Implementing ERTMS

Ø at European level

Through the Trans-European Transport Network (TEN-T), the development and implementation of the European Rail Traffic Management System (ERTMS) and technical specification related to telematics applications for freight contributes to the development of interoperability and to a better integrated management railway infrastructure in Europe. While implementing ERTMS, for example, were defined corridors oriented to international freight. Creating these corridors allows the development of an active collaboration between infrastructure managers. In this context, they took the initiative to group within an organism called RailNetEurope, which provides services to international freight operators and fosters the collaboration, in terms of capacity management, between infrastructure managers.

Economic considerations for the implementation of ERTMS are derived from three main reasons:

- *increasing* rail *capacity and performance* by taking a volume of passenger and freight off road transport, thereby eliminating bottlenecks, while reducing the complexity of track systems and the costs and delays due to road traffic accidents;
- *interoperability*, which will allow trains to operate safely and effectively under control systems provided in part or whole, by different companies. This will lead to greater mobility for trains across Europe and not in only, and to competitive public procurement;
- *safety* - ERTMS is a system that provides automatic train protection, further reduces the incidence and consequences of the signals at danger (SPADs). Even if installing System Protection and Prevention for trains (Train Protection and Warning System (TPWS)) significantly mitigates the risks, when implementing the ERTMS also, it provides an additional signal in the train cabin, which represents a major step forward for train leaders, especially at high speeds in inclement weather. ERTMS is actually a requirement for trains to travel at over 200 km/h This is a safety requirement, but it also allows ERTMS to generate commercial benefits in this area. Higher levels of ERTMS will facilitate better management of "possessions" for their track and will require less infrastructure, which will lead to reduced risks to workers in this sector.

Assessing the investment required to implement ERTMS, should consider the following objectives:

- *economic* - identify the optimal solution for ERTMS implementation. A review of the costs and benefits and, in particular, the economic benefits of the improved capacity and performance and reduced cost of re-signaling. Increasing the number of passengers transported by rail will require increasing the number of trains, with associated train service costs, but this are assumed when estimating the benefits of ERTMS deployment. Economic benefits through implementing ERTMS accrue to rail users by cutting crowding and delays, as well as benefits to road users by taking the rail part of the passenger / cargo transported previoulsy by road.
- *compliance with the directives of the European Commission* on interoperability;
- *safety* - a means to provide more ATP to reduce the incidence and consequences of the signals at danger (SPADs).

As an innovative and unique signaling system, ERTMS greatly facilitates cross-border movement. With a high performance of its signaling system, ERTMS allows significant increases in traffic along the railway networks, and proves to be an effective solution to absorb the demand for freight and passengers.

Ø in Romania

Developing a national plan for the implementation in Romania of the ERTMS / ETCS, started from the signaling strategy based on current facilities and future upgrades, and on the allocated funds for this area [1].

Thus, for large stations was considered necessary to introduce electronic interlocking installations (type SIMIS W-SIEMENS L90 respectively ESTW type RO - ALCATEL compatible for connecting to the ERTMS / ETCS) and for small stations were produced two versions of computerized operating stations for interlocking installations (CED).

Because equipment evolution is increasingly spectacular and the pressure to reduce maintenance costs is increasingly powerful, the National Railway Company "CFR" SA, included in its strategy a project for electronic interlocking systems development for small and medium stations [5].

The implementation of ERTMS / ETCS is based on a number of railway specific requirements; therefore in Romania the requirements can be classified as:

• *superior requirements* covering essential requirements for ERTMS / ETCS;

• *operating requirements* that describe the need for the ERTMS / ETCS in terms of operations that are carried out to the rail;

• *functional requirements* of the system ERTMS / ETCS.

For reasons of cost and given the size of the railway stations, in Romania, initially, are equipped with ETCS only signals on direct lines and stations and BLA signals.

Important benefits related to the implementation of electronic interlocking systems are:

▪ achievement of all the possible routes of movement and maneuver for a given configuration of the station, which gives greater flexibility to traffic management;

▪ providing opportunities for changes and adjustments during operation, without the need for significant periods of time when the system is turned off;

▪ increasing the safety of rail traffic;

▪ ensuring maximum reliability of the system thus enabling reduced maintenance activity;

▪ effective preventive and corrective maintenance activities computer assisted, including diagnostic functions and fault location;

▪ reduction in operating costs by reducing the system items that require periodic adjustments such as relays;

▪ providing technical support for the development of rail traffic management by incorporating interlocking system as a subsystem in ERTMS / ETCS.

Through the rail modernization program has been implemented the integrated project for Romanian Railways exploitation management informatization - IRIS (Integrated Railway Information System) [4].

IRIS program is a component of the railway rehabilitation program financed by BIRD and it was ment to increase the competitiveness of the Romanian railways in the context of free access to the European railway system. The main objective of the project was to optimize and automate a number of key activities and to build a rail information infrastructure capable of supporting further development.

XSELL project is an upgraded version of the electronic sales system for booking and selling seats. The implementation solutions by SC Rail Informatica S.A allow rail to provide additional economic and procedural advantages and procedures for its clients: it is cheaper than imported solutions, it is already in operation and it answers Romanian specific requirements and it is suitable for any passenger rail operators.

CFR uses a new type of engine, equipped with command and control systems of last generation (computer traction, engine frequency control systems (the chopper)).

The performances of such technologies have proven extremely high and therefore they got a broad generalization on the rail market.

6. Conclusions

Advanced information and communication technologies can contribute significantly to achieve a sustainable, competitive and reliable rail.

ERTMS is the most advanced train control system in the world and it brings significant advantages in terms of maintenance cost, safety, reliability, punctuality and traffic capacity. This will bring considerable benefits to the rail sector, leading to strengthened international freight and passenger transport.

ERTMS contributes to increasing the competitiveness of the rail, which makes this system to compete with other modes of transport such as road. The ERTMS system allows interoperability throughout the European rail network.

Romanian Railways have a duty to integrate the national railway infrastructure to the technical and European level operational parameters, to be compatible with and an interoperable part of the future trans-European rail network.

ETCS implementation-Level 1 in Romania lowers the costs by reducing the exploitation of items that require periodic adjustments, gives traffic management a greater flexibility, increases rail traffic safety, ensures maximum reliability of the system to thus enable the reduction of maintenance activity, and also effective preventive and corrective maintenance activities computer assisted, including diagnostic functions and fault location.

The introduction of ETCS-Level 1 offers also some important advantages: improved security, interoperability, increased comfort of the passenger transport through optimized braking and reduced specific consumption of traction power, and reduced brake wear.

Current sizing of digital railway telecommunications networks services provides the necessary full range of domestic rail infrastructure to rail operators and companies working in the railway sphere.

Synchronous and asynchronous transmission rail networks can provide the logistics to extend IT & C projects of national and local operators in areas with a low density of supply of services: voice, data, video and value-added services (Internet, teletext, videotex, facsimile, mail voice).

Railway telecommunication networks' great advantage is given by the conditions imposed by the railway area beneficiaries where communications are up for decision (concurring to traffic safety), are secure and operate on the principle "backup backup".

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