

Technology Information Management Applied To Rail Transportation System

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Abstract

Throughout its evolution the railway transport system has become a complex specialized system, with remarkable characteristics and under conditions of economic efficiency superior to the other means of transportation. By connecting all counties through a sole network, rail transport plays an important role in the economic, political and strategic life of the country. This role is emphasized by the fact that on its optimal running depend the economic agents' supply with raw necessities and materials, the population's rapid supply with consumer goods, the ensuring of passenger transportation. Any delay or disturbance in the railway traffic yields deep repercussions on the entire social life flow.

This article has been given over to the conclusions held by the research on the information regarding the main activities and resources of the Romanian rail transport system.

Key words: infrastructure, railway transport capacity, railway management

J.E.L. classification: O18, M12

1. Introduction

In specialty literature the railway transport system is analyzed as a set of processes which seek to optimize the overall railway operation management performance. The railway technology played a pivotal role in the development of freight and passenger transport, thus, from a speed of about 29 km/h, trains run nowadays with over 280 km/h; Moreover, rail transport is characterized by a high degree of safety and security. Considering all these aspects, the European Union has given priority to the development of Community rail transport, the more so since, in terms of energy, the cost per unit shipped is much lower than for road transportation. Another argument supporting the advantage of rails implies transport on electrified lines, which are not fuel dependent. In this regard, Romania makes an eloquent case as the electrified rail network covers about one third of the total network and rail transport on the electrified system represents 53.6% of the total transport capacity.

In order to apprehend the main activities and resources of the rail transport system, it is important to define rail transport. A narrow meaning presents rail transport as a special type of service, in the sense that it can neither be stored nor preserved, being carried out under special conditions to cope with the apex of demand (Simut, 2001, p.32). Broadly speaking, railway transport encompasses any public transit and freight shipment set in motion by railway transport operators by use of railcars on the railway infrastructure.

The main activities in rail transport are:

- The commercial operation of freight movement and public transport.
- The railway infrastructure maintenance and repair.
- The commercial operation of ancillary assets.

Depending on the main activities in rail transport, several types of railway management are distinguished, namely:

- The management of the maintenance activity specific to the railway infrastructure.
- The management of train traffic control.

- The management of the commercial operation regarding public transit and freight shipment.
- The management of the main organizational tasks: human resources, financial management and control, traffic quality and safety.

A challenge railway leadership encountered was the identification of the way to use railway as a mechanism to support the economic and social development by efficiently organizing all types of railway activities management. In order to allow the continuous use of the railway network in safe and secure conditions, the top management of the railway companies aims to maintain and improve the railway infrastructure and, through this, to contribute to the commercial capitalization of freight and passenger traffic.

2. Theoretical background. Current technologies used within a train yard and their impact on the human resources training

By connecting all counties through a sole network, rail transport plays an important role in the economic, political and strategic life of the country. This role is emphasized by the fact that on its optimal running depend the economic agents' supply with raw necessities and materials, the population's rapid supply with consumer goods, the ensuring of passenger transportation. Any delay or disturbance in the railway traffic leads to deep repercussions on the entire social life flow.

As trends in rail transport imply increasing tonnage and speed, in order to ensure transport safety, they need to comply with the principle that prohibits two or more trains on the same traffic sector and at the same time. Following this principle, train traffic is organized so that the transport distance be subdivided into smaller distances, further applying the principle of prohibiting access of two or more rail vehicles at the same time on each portion thus created. This division allows the increase in the degree of parallelism in the railway transport activity and enables the growth of the transport capacity while maintaining the safety and security restrictions. For this reason, the railway network is divided into mains, traffic sections, traffic distances and sectioning points. Train traffic coordination is carried out by specialized personnel such as traffic operators for each *traffic section*, which designates the portion of the main or secondary track where the same traffic characteristics are maintained, respectively the same number of trains of different categories.

A traffic section is extended between two departure yards and comprises several arrival yards. The sub-divisions of the transport distance are called traffic distances and are sectioned by sectioning points where train junctions and surpassings take place. The sectioning points are established according to the volume of goods and passengers, the number of trains, the needs for service for localities and economic agents. In the specialty literature, the sectioning points are classified as per the activity unfolded and their technical endowment, such as: rail stations, halts, signal boxes and automatic block signaling (Caraiani, 2008, p.142).

The railway station is the most important section point due to its large size and, simultaneously, it represents a subunit in the organizational structure of a railway branch, having its own personnel qualified to execute the technical and commercial operations needed to carry out transport activities.

The technological process in a railway station is referred to in the specialized literature as the set of measures that establish in detail all the operations necessary for the handling of wagons and trains as well as the execution order for these operations, focusing on their synchronized execution (Tanasuica, 2001, p.33). The technologies conducted in a train station, determining the structure and number of employees required, depend on the activity in the station, that is, whether the station is open to freight and passenger traffic simultaneously or specializes in traffic types. Depending on the character of the activity performed, on the development of the station, they are divided into arrival yards, departure yards and classification yards.

The railway technologies used in the **arrival yards** include the following operations:

- *for servicing train traffic*: receiving and dispatching trains; junctions and pre-crossings; local trains maneuvers; trains technical inspection and brake test;
- *for servicing passenger and freight traffic*: passenger boarding and disembarkation; travel documents issuing; registering and delivering luggage, packages and goods.

The technologies used for the railway activities in the **departure yards**, where the trains are set up for dispatching, include the following operations:

- *for servicing train traffic*: performing all operations as in the arrival yards; direct trains and local freight trains configuration and disassembling; passenger trains ensuring local traffic configuration and disassembling.
- *for servicing passenger and freight traffic* the same operations as in the arrival yards are performed.

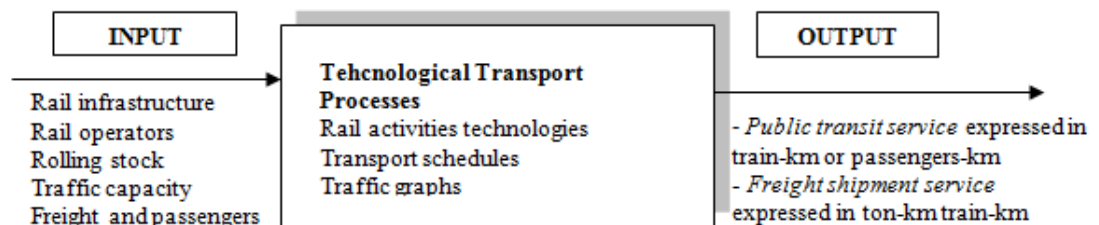
In the **classification yards**, the technical operations and those intended for traffic servicing have the same character as in the departure yards, differing by the larger workload. Characteristic to the classification yard is the trains and freight wagons handling through disassembling operations by means of the triage device and train configuration operations.

3. Analysis of the components of the railway system

The exploitation of the railway infrastructure as a technical structure is carried out via three sectors of activity, namely traffic, lines and facilities. These sectors are distinct, but altogether concur to the rail traffic operation in terms of safety, security and comfort for the beneficiaries. At the organizational structure level, the railway activity sectors are classified in divisions. The Tracks Division ensures, through specialized personnel, the activity of maintenance for the line, track devices, works of art with machines and rolling stock necessary to achieve this purpose. The Facilities Division ensures the maintenance and repair of the signaling-centralization, electric traction powering and telecommunications facilities. The Traffic Division ensures the development of the traffic activity, organizing train traffic on the railway infrastructure through a specialized direction called regional traffic regulator - RCR and local traffic regulators - RC, that is they allow transport operators' access on the public railway infrastructure and offer its transit and processing capacities.

The overall rail transport system is made up of the inputs, transport processes and outputs illustrated in figure no. 1.

Figure no. 1. Elements of rail transport system



Source: Author's contribution

The following elements embody the input of the railway transport system: railway infrastructure, freight and passengers to be transported, railway operators, rail cars, train station capacities. These resources are engaged in the system through technological processes of transport, as a result of complying with the technologies specific to the rail stations' activities, transport schedule, traffic graphs and technical plan for the stations operation, outputs materialized in the provided transport service for the freight and riders entrusted (Daneci-Patrau, 2013, p.81). I consider that, of all the components of the railway transport system, the railway infrastructure is the most important resource of this system together with the highly qualified human resource.

As stated by a reputable specialist, the railway infrastructure consists of all the elements necessary for the movement of rolling stock, stations, buildings and telecommunications and signaling installations used to carry out a railway transport in conditions of passenger safety and safety of goods transport (Buciumanu, 2012, p.97). The most important element of the railway infrastructure is rail tracks. Their most common classification refers to: current tracks, located between the train stations and the tracks nearby, which fulfill several roles in terms of movement, maneuver, connection or pending.

In exchange for the authorization to transport goods and people by rail, private railway operators pay a fee for the use of railway infrastructure, called TUI.

The rolling stock of the rail transport system consists of locomotives, freight wagons and passenger transit wagons. Locomotives ensure the traction of freight and passengers trains on the traffic sections, as well as the maneuvering operations at the stations. All locomotives recorded build up the inventory of locomotives in a park. The appearance of several types of wagons with constructive and functional characteristics adapted to the nature of the goods was generated by the diversity of requirements in public freight transport. As a result, the wagon inventory park was formed, represented by all these types of freight wagons together with the passenger wagons.

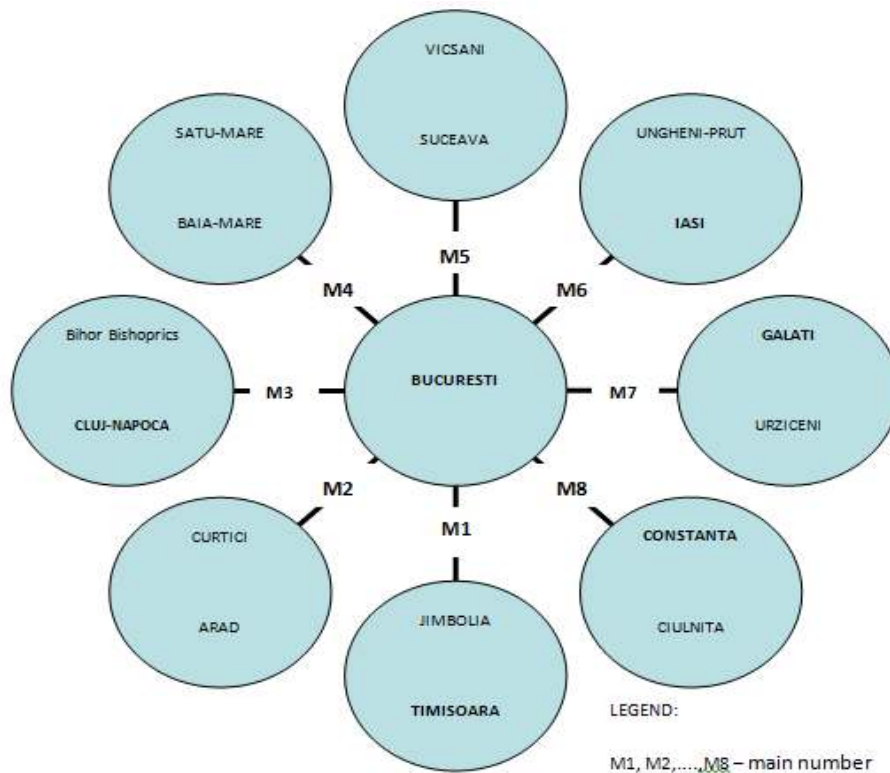
The traffic capacity reveals the maximum number of direct freight and passenger trains running on a traffic section track over twenty-four hours. This capacity depends on several factors: the condition and type of the railroad, the number and length of the parking railroads in the station, the type of operational facilities and the traffic scheduling.

Depending on their economic importance and traffic extent, railways are classified as follows:

- *rail mains*, which ensure the connections between the capital and main cities of the country and those with the transport systems pertaining to the neighboring countries;
- *main railroads*, of great economic value because they connect the capital and main cities of the country, being partially included in the railway mains;
- *secondary railroads* serve certain urban areas and ensure their connection with the main railroads and rail mains.

The railway network in our country comprises eight territorial areas served by eight rail mains, each being run by a branch of the railway infrastructure public management company. The current configuration of the railways is displayed in figure no. 2.

Figure no.2. Rail mains in Romania



Source: Author's contribution

The evolution of the important quantitative indicators of the railway infrastructure was analyzed and it is presented in table no. 1, for identifying the place of railway transport in the Romanian transport system.

Table no 1. Quantitative indicators of railway infrastructure

INDICATORS	M.U.	1999	2009	2019
NUMBER OF TRAIN STATIONS	km	1420	1101	979
TRACKS LENGTH SPAN	km	22567	22247	20347
ELECTRIFIED TRACKS LENGTH	km	3680	3885	3971
ELECTRIFIED TRACKS PERCENTAGE	%	32.4	35.1	36.8
RAIL NETWORK DENSITY	Lkm/1000 km ²	47.7	46.8	45.9
TOTAL LENGTH OF RAIL NETWORK		11349	11058	10821

Source: www.cfr.ro, accessed in 20.04.2020

The indicator correspondent to the length of the railway network in our country presents at the end of 2019 a percentage of 36.8% electrified line of the total length of the railway network, continuously increasing since 1999 and a density of the network of 45.9 l km/ 1000 km² decreasing in recent years due to the diminution of the total length of the network, which amounted 10821 km of railway line. At the same time, due to the constraint of the railway transport activity, the number of railway stations has decreased by one third in the last twentieth years, from 1420 stations in 1999 to 979 functional units at the end of 2019.

Rail transport places second as mode of transport in the economy after road transport, as per the indicator corresponding to transported goods, shipping annually approximately 49.5 million tons of goods out of the total of roughly 380.5 million tons, which represents about 13.6% on the market for freight transported in Romania, as observed in table no. 2.

Table no. 2. Market quota evolution for main freight transport modes

Transported goods, out of which: (%)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
SNTF Marfa	17.2	20	19.7	18.9	18.4	15.8	13.5	11.7	10.6	8.7	7.8
Private transport operators (OTF)	0	0	0.2	0.6	0.8	2.4	3.5	3.8	4.26	4.8	5.6
TOTAL rail	17.1	20	19.9	19.5	19.2	18.4	17	15.7	15.1	14.5	13.6
Road	75.7	73.6	73.8	73.6	74.4	74.5	75.7	77.4	78.7	79.4	77.8
Naval	5.94	4.94	4.59	4.87	4.32	4.87	5.25	4.39	3.82	3.77	5.95
Aerial	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.2	0.4
Pipe	1.06	1.36	1.71	1.83	2.08	2.03	2.05	2.01	2.08	2.03	2.45
TOTAL	100	100	100	100	100	100	100	100	100	100	100

Source: www.mt.ro, accessed in 30.04.2020

The market share of rail freight transport in Romania has gone down from 17.2% in 2009 to 13.6% in 2019. The market share value the National Rail Freight Company SNTF Marfa, had has decreased from 100% in 2000, when it was the only railway company operating on the freight rail market, to 58.2% in 2019 for the capacity of goods transported expressed in tons-kilometers and to 48.6% for the freight route expressed in train-kilometers. Since 2011, the freight rail market has been divided between SNTF Marfa and the twenty-seven private rail operators which were licensed for freight rail transport. During this time, the market share held by SNTF Marfa plummeted from 17.2% for goods transported in 2009 to 7.8% in 2019. As regards the type of ownership, rail transport was entirely a state public transport until 2001, both in terms of the freight transported and its route. In the Romanian rail transport system, the private rail operators, OTF's, started to operate - from 2001 until the end of 2019 the freight operators owning about half of the market for goods transported by rails, respectively since 2005 the passenger OTF's, which currently carry

about one third of the total number of passengers.

In the last three years the freight and passenger transport by rail has decreased continuously. These decreases have numerous causes such as: the attenuation of family incomes due to budget cuts, the closure or liquidation of some economic agents, the orientation of some companies towards road transport, the general decrease of the production of large companies.

Due to lack of necessary funds, the public railway companies were forced to partly lay off staff, limit the expenses to cover the necessary operation, reducing the budget in regard to maintenance, repairs and investments in order to maintain a relatively stable balance. The price paid for this balance was in the form of significant technical losses resulting from the high wear of all railway installations. The degree of railway traffic safety has decreased, generating direct consequences in the volume of services provided, with the decrease of budgetary allocations from the total revenues for the maintenance of the transport infrastructure.

4. Conclusions

Because it is difficult to achieve cooperation in time and space of labor, assets and means of work, the production process in rail transport is complex and these three elements are in constant motion. This requires the existence in the railway operation of the variable elements represented by the transport needs and climatic conditions. Therefore, each railway operator uses the most appropriate and practically possible rules and measures to simultaneously meet the quality requirements required for transport: safety, speed, comfort and, finally, the lowest cost.

The particularities of the specific activities of railway transport are highlighted by the following aspects:

- The train traffic takes place without interruption regardless of the season and at any time, which requires a perfect coordination of all sectors of railway activity.
- The outcome of the productive work is not a new commodity, but a service; freight transported by rail not only preserves all its properties, but also increases its value.
- The railway network spans over an extended area, with a close interdependence between the different railway sections and units.
- The railroads represent a means of mass transport, ensuring the most favorable position in terms of traffic safety.
- The variety of activity sectors within the railway transport sector forms a mechanism which, although quite complicated, creates a unitary whole and requires the use of a qualified personnel to operate the rail infrastructure and facilities.

Specific to the railway transport system is the existence of large masses of goods under movement that contain significant amounts of kinetic energy.

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