BRAIN. Broad Research in Artificial Intelligence and Neuroscience
ISSN: 2068-0473 | e-ISSN: 2067-3957
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2023, Volume 14, Issue 1, pages: 596-627 | https://doi.org/10.18662/brain/14.1/437
Submitted: July 5th, 2022 | *Accepted for publication:* March 6th, 2023

Strategic Forecast for Rail Freight Transport in Romania using the Relevant Tree Method and Scenario Method

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Abstract: *The paper focuses on the use of strategic forecasting using the Relevant Tree Method and the Scenario Method for rail freight transport in order to achieve the objectives established in the European Green Deal.*
The Relevant Tree Method shows that the solution for stimulating rail freight traffic in Romania consists in increasing the allocation of funds for the modernization works of the railway infrastructure. Thus, an important part of the internal freight traffic will be transferred from the road system to the railway. "The modernization of the railway infrastructure involves major works to modify the infrastructure, which will improve its overall performance", according to the Law 202/2016.
On the other hand, the emergency plan resulting from the use of the Scenario Method shows that if the conditions for the development of the external environment for the organizations in the rail freight transport sector end up being very favourable, it is required to adopt some measures in time, for the employment personnel in this sector, so as to increase the competences of organizations in this field. Thus, it is necessary to grant motivating salary packages, which also include professional training programs, as well as capitalizing on access to know-how, which will be favoured by European funds. This will avoid the wear and tear of locomotives and wagons, but also of equipment and installations.

Keywords: *multimodal freight transport; Relevant Tree Method; Scenario Method; Sustainable and Smart Mobility Strategy; European Green Deal; knowledge economy.*

How to cite: Scarişoreanu, D.I., & Ghiculescu, L.D. (2023). Strategic Forecast for Rail Freight Transport in Romania using the Relevant Tree Method and Scenario Method. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience, 14*(4), 596-627. https://doi.org/10.18662/brain/14.1/437

1. Introduction

Extreme heat waves, global drought, melting glaciers or fires that consume large areas of forest are some of the signs of climate change. To combat these threats, the EU has developed the Green Deal, setting ambitious targets. One of these is to "reduce greenhouse gas emissions from the transport sector by 90% by 2050 so that the EU can achieve climate neutrality", as stipulated in the European Green Deal. In this sense, rail transport is encouraged, because is the most sustainable means of transport. "In 2018, rail transport accounted for only 0.4% of both greenhouse gas emissions and CO2 emissions from transport", according to Report from the Commission to the European Parliament and the Council, Seventh monitoring report on the development of the rail market under article 15(4) of Directive 2012/34/EU of the European Parliament and of the Council (European Commission, 2021a). The Sustainable and Smart Mobility Strategy (European Commission, 2020) provides that: "Rail freight traffic will increase by 50% by 2030 and double by 2050". The provisions of the European Green Deal and of the Sustainable and Smart Mobility Strategy have been taken over in the Romanian legislation. Thus, the Romanian Government published the Action Program for the development of the railway infrastructure and the modal shift to the railway of passenger and freight transport flows. Transport represents one of the main sources of pollution (Romanian Government, 2021). That is why it is necessary to use multimodal transport of goods. One of the important criteria regarding the choice of the mode of transport to be used should be the impact on the environment, meaning how polluting the respective mode of transport is (Grondys, 2019). For example, in the United States, 5 billion barrels of oil are consumed annually for the transport of goods and passengers, which means that an important amount of greenhouse gases is emitted (Sullivan at al., 2018). On the other hand, the economic growth of a country depends on the transport sector. (Crainic & Laporte, 1997). Economic activities and the development of trade worldwide depend on this sector (Jansuwan et al., 2021). For any Government, the increase in the volume of transport of the main goods, which implies an increased amount of greenhouse gases, is the main indicator for rethinking the transport system, so that it becomes sustainable (Solvay et al., 2018). Recently, more and more freight transport undertakings are carrying out studies in order to reduce CO2 emissions. These studies show that, in order to achieve a sustainable transport, the use of less polluting modes of transport and the optimization of goods transport systems must be taken into account (Pamucar et al., 2022). Also, in a

knowledge economy, where technology is advancing rapidly, the freight transport sector must keep pace with innovations in this field, which can mitigate the negative environmental impact of transport. The paper proposed the identification, using the Relevant Tree Method, the solutions for stimulating rail freight traffic in Romania and how to implement them. Also, with the help of the Scenario Method, three scenarios were elaborated, the most probable scenario was established and the reserve plans were prepared. The use of another forecasting method, namely the Content Analysis Method, represents a future research direction, to identify the major trends in the evolution of this sector.

Forecasting is a component of the organization's planning function, which falls under strategic management. The goal of forecasting is to correctly anticipate the future and, on this basis, formulate strategies to respond to possible changes in the external environment that the organization will face in the future. For example, the Scenario Method is used for the purpose of developing the organization's strategies, as a result of anticipating the evolution of events and reducing risks (Ghiculescu & Vulturescu, 2015).

A business's competitive advantage depends on knowledge. Knowledge management helps businesses to select, associate and transfer information and knowledge needed for business development (Hron, 2018).

In the 21st century, in which technological development has registered a rapid advance, access to information and the use of knowledge are necessary conditions for business development. In a competition that is becoming tighter, it is difficult for a business to survive without relying on knowledge workers and knowledge management. Strategic management has become indispensable for any type of business, having to be periodically adapted to new market information.

Currently, the knowledge economy imposes on companies new business structures so that they can be competitive (Ferreira et al., 2020). On the other hand, the connection between strategic management and the Knowledge Economy must be emphasized. We are in a new era, based on knowledge networks, which requires new (extended) strategic management approaches (Leibold et al., 2002).

Knowledge management is found within the daily activities of a company (Chen, 2022). In this century, knowledge is the key element. Competitive economies are focused on the knowledge economy. But sustainable development remains the biggest challenge. This targets large time horizons, which requires knowledge and foresight (Širá et al., 2020). Many times, the knowledge economy is described as a solution to transform

society so that economic growth is high and sustainable, but also as a possibility to solve problems related to resource scarcity and climate change (Rezny et al., 2019).

In the present case, the use of strategic forecasting methods, which lead to obtaining a sustainable competitive advantage, aims to reduce CO2 emissions. The methods by which the proposed objective can be achieved, namely the encouragement of the railway transport of goods, but also the processes that contribute to the achievement of the proposed objective are analyzed. Afterwards, the strategy to be adopted is elaborated so that the proposed targets can be reached.

Thus, the use of knowledge management can revolutionize the transport sector. The result: a less polluting, safer transport, the number of accidents being reduced thanks to the new technologies, but also cheaper, which implies lower costs for the final consumers as well. And, investments in the railway infrastructure will increase the speed of traffic on the railway in Romania, so that railway transport will become a fast mode of transport.

2. Relevance Tree Method

The elements to be ordered within the tree structure are (see Figure 1):

1. The main objective pursued;
2. Methods by which the proposed objective can be achieved;
3. The processes that contribute to the achievement of the objective.

Thus, in the first stage, the theme of the forecast was established, which will be placed at the top of the tree: What is the solution for the stimulation of rail freight traffic in Romania, so that a good part of the internal freight transport which is currently transported in a proportion of 70% on the road network to be carried out in the future on the railway and inland waterways.

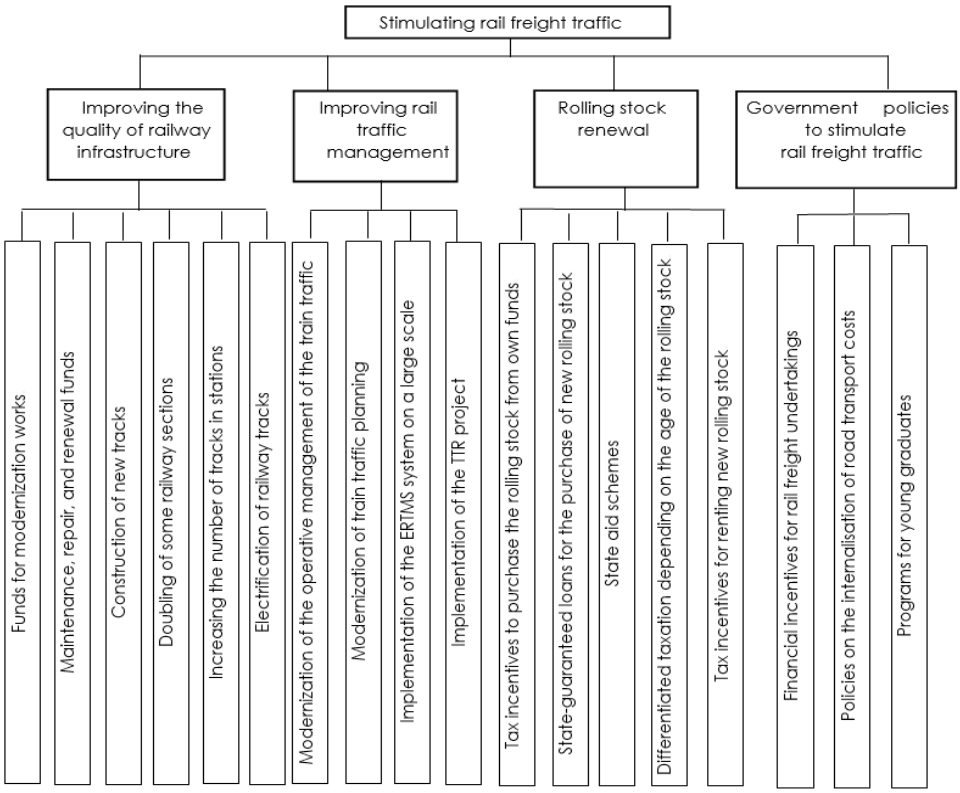

Figure 1. Relevance Tree for traffic stimulation freight railway
Source: Authors' own conception

The second stage concerns the methods for increasing the rail freight traffic, and the third stage refers to the processes that contribute to the achievement of the objective.

Each method will be assigned a degree (coefficient) of relevance, the necessary condition being that:

$$M1 + M2 + \cdots + Mn = 1$$

Thus, the following degrees of relevance were assigned:
M1-0,28
M2-0,31
M3-0,19
M4-0,22.

$$M1 + M2 + M3 + M4 = 1$$

Identically, degrees will be assigned to the processes, the necessary condition being that on each level (method) of the tree:

$$P1(M1) + P2(M1) + P3(M1) + P4(M1) + P5(M1) + P6(M1) = 1$$
$$P1(M2) + P2(M2) + P3(M2) + P4(M2) = 1$$
$$P1(M3) + P2(M3) + P3(M3) + P4(M3) + P5(M3) = 1$$
$$P1(M4) + P2(M4) + P3(M4) + P5(M4) = 1$$

The following grades were assigned to the processes, according to Table 1.

Table 1. Assigning degrees of relevance

Relevance notes				
Degree of relevance	M1	M2	M3	M4
P1(M1)	0,0308	-	-	-
P2(M1)	0,0784	-	-	-
P3(M1)	0,0252	-	-	-
P4(M1)	0,0336	-	-	-
P5(M1)	0,0392	-	-	-
P6(M1)	0,0728	-	-	-
P1(M2)	-	0,0465	-	-
P2(M2)	-	0,0465	-	-
P3(M2)	-	0,062	-	-
P4(M2)	-	0,155	-	-
P1(M3)	-	-	0,0342	-
P2(M3)	-	-	0,0342	-
P3(M3)	-	-	0,0513	-
P4(M3)	-	-	0,0342	-
P5(M3)	-	-	0,0361	-
P1(M4)	-	-	-	0,0616
P2(M4)	-	-	-	0,099
P3(M4)	-	-	-	0,0594

Source: Authors' own conception

The next step is to calculate MixPj (Mi) products and complete Table 2.

Table 2. Relevance notes

Relevance notes				
Degree of relevance	M1	M2	M3	M4
P1(M1)	0,0308	-	-	-
P2(M1)	0,0784	-	-	-
P3(M1)	0,0252	-	-	-
P4(M1)	0,0336	-	-	-
P5(M1)	0,0392	-	-	-
P6(M1)	0,0728	-	-	-
P1(M2)	-	0,0465	-	-
P2(M2)	-	0,0465	-	-
P3(M2)	-	0,062	-	-
P4(M2)	-	0,155	-	-
P1(M3)	-	-	0,0342	-
P2(M3)	-	-	0,0342	-
P3(M3)	-	-	0,0513	-
P4(M3)	-	-	0,0342	-
P5(M3)	-	-	0,0361	-
P1(M4)	-	-	-	0,0616
P2(M4)	-	-	-	0,099
P3(M4)	-	-	-	0,0594

Source: Authors' own conception

The last step is to sort the product values in descending order. The highest value of the products is the most possible evolution of the case studied.

In the present situation, P2 (M1) - Funds for the modernization works of the railway infrastructure has the highest value, respectively 0.0784.

Modernization of railway infrastructure involves major infrastructure modification works, which improve its overall performance[1]. Thus, the interventions regarding the modernization of the railway infrastructure are equivalent to those regarding the renewal from the perspective of returning to the normal maintenance cycles, but they are superior to them from the perspective of the effects on the traffic speed on the railway infrastructure. Such interventions are much more expensive than renewal and therefore, in

[1] Art.17[2] of Law 202/2016 on the integration of the Romanian railway system in the single European railway area

principle, such an option is used in the context of the obligations assumed by the Romanian state towards the EU regarding the modernization of the TEN-T network and, especially, the modernization of the European rail freight corridors infrastructure, according to Romanian Railway infrastructure development strategy 2021-2025 (Ministry of Transport and Infrastructure of Romania, 2020).

3. Scenario Method

After the financial crisis of 2007-2008, there has been increased concern for the use of scenario analysis in business and management research. The purpose was to use this method to deal with uncertainty (Tiberius et al., 2020). And, the SARS-CoV-2 crisis made the Scenario Method increasingly used in business (Kraus et al., 2020).

In this paper, the Scenarios Method was used, being analyzed two important landmarks: the main determinants of the general external environment and the specific impact factors that can determine the increase of rail freight traffic.

The steps of applying the qualitative Scenarios Method are the following:

a) description of the existing environment through the main determinants;

b) internal analysis;

c) elaboration of the three scenarios;

d) determination of impact factors;

e) elaboration of the scenario matrix;

f) establishing the most probable scenario;

g) preparation of reserve plans (Ghiculescu&Vulturescu, 2015).

3.1. Description of the existing external environment

The description of the existing environment is based on the establishment of the main determinants of the forecasting phenomenon, respectively the stimulation of the movement of freight trains. The PEST analysis consists in examining the political, economic, socio-cultural and technological factors, which constitute the macro-environment and describe the overall picture of the environment in which the respective activity takes place, in this case the rail freight transport.

The political criterion includes aspects:

- national legislation - by transposing EU legislation, rail freight is supported in order to reduce carbon emissions; Government policies - Action program for the development of rail infrastructure and the modal

shift to rail and freight flows mentions "the EC`s recommendation to establish public service obligations for rail freight and compensation from public funds of the difference in costs and revenues. In the case of rail freight, it is desired to implement instruments similar to those provided for in Regulation (EC) no. 1370/2007, for the railway transport of passengers, respectively for the compensation of the public service obligations";

- European legislation - EU policy encourages rail freight, considered to be environmentally friendly (European Green Deal);

- labour law - certain legislative changes may affect organizations engaged in the carriage of goods by rail, such as the Law on certain measures for the continuation of employment by persons who meet retirement conditions, which prohibits the cumulation of pensions-salary for public employees and increases, optionally, the retirement age to 70 years. These provisions caused the dissatisfaction of the railway undertakings whose shareholder is the state, which sounded the alarm regarding the acute crisis of locomotive drivers. Thus, the locomotive drivers employed within these companies retire at the age of 65, and subsequently, they are employed by the freight railway undertakings, with private capital, thus being able to cumulate the salary with the pension. State-owned railway undertakings have pointed out that the provisions of this law encourage the migration of labour force from the state to the private sector, to the detriment of state-owned companies in the field, making it difficult for them to function properly and thus affecting competition in rail transport market;

- competition law - protects the maintenance and stimulation of competition and a normal competitive environment and sanctions actions and acts that restrict, prevent or distort competition. "Railway transport undertakings are granted, under fair, non-discriminatory and transparent conditions, the right of access to the railway infrastructure in Romania, in order to operate any type of rail freight services. That right shall include access to the infrastructure connecting sea and inland ports"[2];

- trade policies – "trade policy is an exclusive competence of the EU"[3], Romania being a member state. This means that it is the EU, not the Member States, that legislates on trade and concludes international trade agreements. "The Union shall comprise a customs union which shall cover all trade in goods and which shall involve the prohibition between Member States of customs duties on imports and exports and of all charges having equivalent effect, and the adoption of a common customs tariff in their

[2] Art.10, paragraph (1) of Law 202/2016 on the integration of the Romanian railway system in the single European railway area

[3] Art. 3 paragraph (1), letter e) of The Treaty on the functioning of the European Union

relations with third countries.[4]". Trade relations are designed to create better business opportunities and remove barriers to trade.

- financing and grants - projects related to the development of railway infrastructure benefit from EU funding through the Transport Operational Program 2021-2027 (Ministry of European Funds of Romania, 2020) and through the European Interconnection Mechanism (European Commission, 2021b);

The economic criterion includes:

- macroeconomic developments:

• economic cycles - the quantity of goods transported by rail depends on the evolution of industrial/agricultural production in that year. A special situation is the pandemic period;

• Gross domestic product (GDP) trends - a decrease in GDP has a negative impact on rail freight transport;

• interest rate - the increase of interest rates may influence the decision of rail freight undertakings to purchase new rolling stock on the basis of bank loans or may decrease the demand for certain products/materials and, implicitly, the demand for their transport;

• market liquidity - increasing market liquidity leads to an incentive for low-cost loans, which could stimulate railway freight companies to purchase new locomotives and wagons and the state to borrow money from the market to carry out infrastructure projects railway;

• inflation rate - the increase of the inflation rate, which leads to a decrease of the purchasing power of the population, correlated with the decrease of the production and of the construction sector and, implicitly, of the demand for transport of goods and construction materials;

• exchange rate - the depreciation of the national currency (leu) in relation to the main currencies benefits exporters, which can lead to an increase in demand for rail goods transport;

• unemployment rate - the increase of this indicator attracts a decrease of the population's income and the reduction of consumption, which determines a decrease of the demand for the railway transport of goods;

- availability and costs of energy - the price of energy is included in the production costs of goods, consequently, the increase of the price of energy leads to the price-growth of products and implicitly to a fall of demand, having a negative impact regarding rail freight transport;

- international economic situation - constraints on global transport capacity or the production of intermediate goods (example microchips, with

[4] Art.28 of The Treaty on the functioning of the European Union

a significant impact on the Romanian automotive industry, leading to a decrease in production and demand for freight transport) (National Bank of Romania, 2021); the effect of the SARS-CoV-2 pandemic on the world economy.

The social criterion considers:

- demographic developments - the aging of the population leads to a decrease in the number of active population, causing a crisis in the labour market. At present, rail transport is facing such a situation, the workforce is aging and vocational training capacity is reduced, according to Railway monitor 2019/2020 (Romanian National Railway Supervisory Council, 2021);
- revenue distribution - does not significantly affect rail freight transport;
- social mobility - does not significantly affect rail freight transport;
- changes in the lifestyle of the population - does not significantly affect rail freight transport;
- attitudes and opinions of consumers - do not have a significant impact on rail freight transport;
- consumerism - the increase of consumption determines an increase of the railway transport of goods;

The technological criterion includes:

- development of competitive technology - profile companies develop innovative IT solutions for real-time monitoring of freight transport, IT solutions for business development of rail freight operators, such as IT solutions that mediate collaboration between companies seeking transport services and those carrying out freight transport, improving freight transhipment technologies, telematics applications for rail freight (TAF TSI), etc.;
- research funding - research is essential for the development of new competitive products, both in terms of locomotives and wagons, as well as traffic management systems, etc.;
- technology transfer speed - is very important, the technology transfer speed influencing both the development of new products and new solutions for railway traffic management;
- moral attrition rate - currently, nearly all of the locomotives and wagons of of freight transport undertakings is older than 30 years (over 60% of the total rolling stock) (Romanian National Railway Supervisory Council, 2019). Thus, some companies have decided to withdraw from circulation the rolling stock with age and major moral wear. In this case we will apply the PEST analysis (see Figure 2).

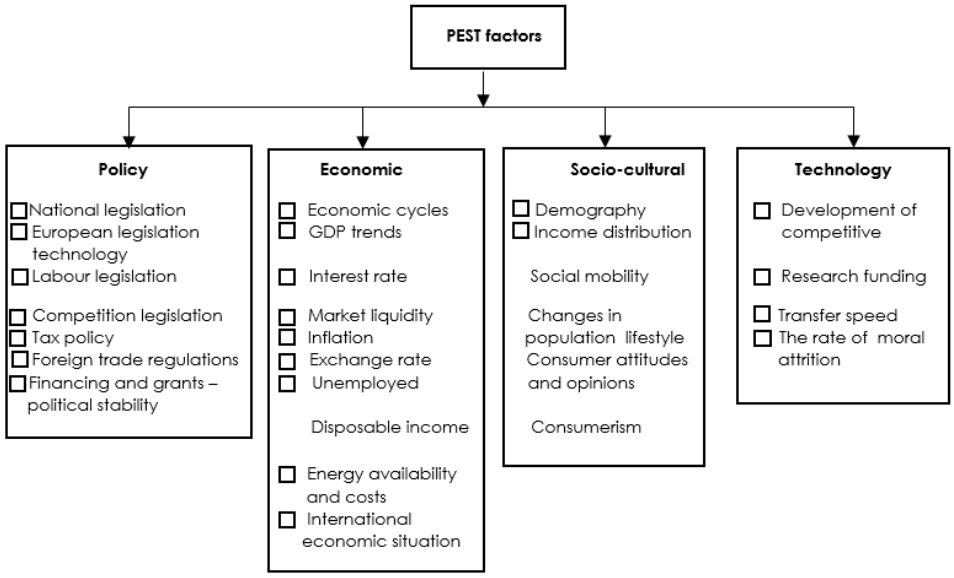

Figure 2. PEST analysis
Source: Authors' own conception

3.2. Internal analysis

An internal analysis is required to establish the main relevant drivers and subsequently the impact factors on rail freight transport. The internal analysis is based on a checklist (see Figure 3).

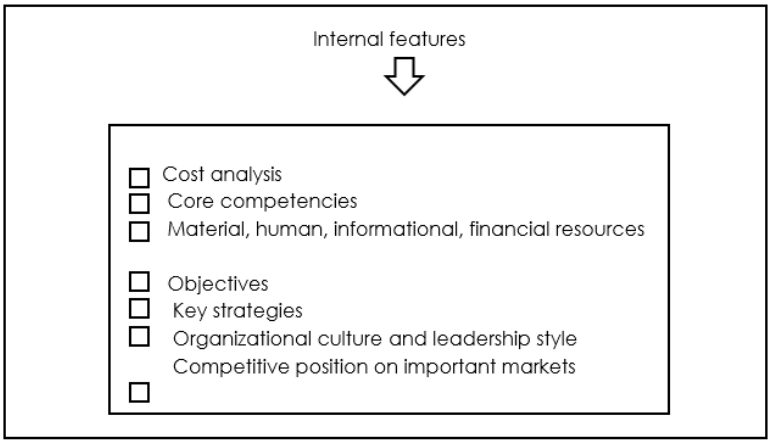

Figure 3. Internal analysis
Source: Authors' own conception

The internal characteristics of rail freight transport, which can be considered relevant are:

- the cost analysis shows a continuing concern of rail freight undertakings to reduce operating costs in order to increase the profitability of the business. On the other hand, the costs for the maintenance and repair of railway infrastructure are limited, the budget being undersized;

- the financial resources are insufficient and come, in the case of the freight railway undertakings from the contracts concluded with the beneficiaries of these services, own resources, from bank loans, leasing, European grants, etc. At the same time, the financial resources needed to finance the maintenance and repair of railway infrastructure and modernization are limited. These come, on the one hand, from the national budget and, in the case of modernization works, from the EU budget, plus co-financing from the national budget.

- material resources are still low, in the case of rail freight undertakings. As for the railway network, it is extensive, covering all regions of the country;

- the staff working in the railway sector has a high average age;

- information resources (know-how) are large;

- the essential competencies are related to the continuous decrease of costs, modernization and the growth of the perceived use value;

- the objectives are explicit at sector level;

- the key strategies are defined at European level, through the European Green Deal, in order to establish the single European space;

- organizational culture and style correspond to development through coordination;

- the competitive position of rail freight transport in relation to other modes of transport is unbalanced by the non-internalization of external costs in the case of road transport (European Commission, 2019).

3.3. Elaboration of the three scenarios

Three scenarios are constructed so that the first will be developed based on current trends, but will be adjusted to take into account future disruptive events, and the other two scenarios will project possible alternative visions into the future, as shown in Table 3.

Table 3 The characteristics of the three scenarios in the case of the evolution of the rail freight sector

Current number	1. Development based on current trends	2. Stunting development due to political and economic dysfunctions	3. Strong development based on favorable economic trends
1	Ecological mode of transport, which is stimulated by legislative measures at national level	EU sanctions for non-compliance with relevant EU legislation; loss of EU funding due to lack of funds needed to co-finance railway infrastructure projects	Ecological mode of transport, which is stimulated by legislative measures at national level
2	Ecological mode of transport, which is stimulated by legislative measures at EU level	Ecological mode of transport, which is stimulated by legislative measures at EU level	Ecological mode of transport, which is stimulated by legislative measures at EU level
3	Labour legislation encourages the migration of labour from the state to the private sector, to the detriment of railway operators with state capital, making it difficult for them to function properly; this affects competition in the rail transport market; Also the Railway Staff Statute Law, whose entry into force has been postponed, provides for the reduction of the retirement age by five years for all railway staff, but certain professional categories will also benefit from special working conditions.	Labour legislation encourages the migration of labour force from the state to the private sector, to the detriment of railway undertakings with state capital, making it difficult for them to function properly; this affects competition in the rail transport market	Labour legislation encourages young graduates to get employed in the railway sector, and to profile companies to develop their activity by creating new jobs;

4	Competition law encourages competition on the rail freight market	Political and economic dysfunctions affect fair competition on the rail freight market	Competition law encourages competition on the rail freight market
5	Fiscal incentives to support rail freight (Ministry of Transport and Infrastructure, 2021)	Waiver of tax incentives to support rail freight	Fiscal incentives to support rail freight
6	EU trade policy to create better trade opportunities and remove barriers to trade	Certain economic sanctions imposed by the EU on trading partners and the denunciation of cooperation agreements	EU trade policy to create better trade opportunities and remove barriers to trade
7	Projects related to the development of railway infrastructure benefit from EU funding through the Transport Operational Program 2021-2027 and through the European Interconnection Mechanism	The amount of funding and grants for railway infrastructure development projects is considerably reduced	The amount of funding and grants for railway infrastructure development projects is increasing considerably
8	Romania's economy is experiencing an economic contraction caused by the SARS-CoV-2 crisis and the state of the world economy	Internal economic recession	Internal economic recovery
9	GDP growth	GDP decline	GDP growth
10	The interest rate is rising	The interest rate is rising	The interest rate is falling
11	Excess liquidity in the market	Lack of liquidity in the market	Excess liquidity in the market
12	Rising inflation	Rising inflation	Decreased inflation
13	Stable exchange rate	Volatile exchange rate	Stable exchange rate
14	Low unemployment rate	Increased unemployment rate	Low unemployment rate

15	Rise the price of energy	Rise the price of energy	Decreases the price of energy
16	Moderate pace of global economic growth (European Central Bank, 2022)	Moderate pace of global economic growth (European Central Bank, 2022)	The world economy is experiencing sustained growth
17	Reduction of the active population	Reduction of the active population	Increasing the active population by attracting the diaspora and migrants against the background of economic growth
18	Decreased consumption	Decreased consumption	Increasing consumption
19	The accelerated dynamics of technological progress	The accelerated dynamics of technological progress	The accelerated dynamics of technological progress
20	Decreased research funding	Decreased research funding	Increasing research funding
21	High speed technology transfer	Low technology transfer speed	High speed technology transfer
22	Rising of the rate of moral attrition	Rising of the rate of moral attrition	Rising of the rate of moral attrition

Source: Authors' own conception

Scenario 1: Development based on current trends on several components: legislative measures at national and European level to support rail freight, European funding and grants for projects aimed at developing rail freight transport and a high dynamic of technological progress.

The European Green Deal and the Strategy for Sustainable and Intelligent Mobility, the provisions of which are gradually being transposed into national law, including through the National Recovery and Resilience Plan (PNRR), support the creation of green freight transport. Thus, a substantial part of the 75% of domestic freight transport that is currently carried out by road needs to be reoriented towards rail and inland waterway transport.

By national Decision no. 1312/2021[5], the Investment Program for the development of transport infrastructure for the period 2021-2030 was approved, which aims, among others, at the construction of 3274.8 km of railway related to the primary network and 1228 km related to the secondary network. On the other hand, labour legislation encourages the migration of labour from the state to the private sector, to the detriment of state-owned railway operators, making it difficult for them to function properly. Thus, competition on the rail transport market is affected, although the competition law protects, maintains and stimulates competition on the rail freight transport market.

The main economic determinants have unfavourable actions: the Romanian economy registers an economic contraction caused by the SARS-COV-2 pandemic and the state of the world economy, although GDP is rising, inflation is rising, as is the cost of energy. The other economic determinants (moderate pace of global economic growth, rising interest rates and energy costs), although unfavourable, do not counterbalance the strong development trend of the rail freight sector, which is strongly supported at EU level, including through grants.

Socio-cultural determinants are generally unfavourable due to the reduction of the active population, the aging labour force in the railway system and the decrease in consumption.

Technological determinants contribute to the evolution of the rail freight sector at European and, implicitly, national level.

Scenario 2: Development slowdown due to political and economic dysfunctions. Against the background of political and economic dysfunctions, which result in non-compliance with EU legislation in the field, the EU imposes sanctions on Romania, leading to loss of EU funding, including due to lack of funds for national co-financing of railway infrastructure projects.

Economic determinants mark an economic decline at the national level, strongly affecting the development of the rail freight sector.

Socio-cultural determinants show the same negative trend of reducing the potential of human resources in the field and decreasing consumption.

Technologically, although worldwide the dynamics of development is still high, at the national level, there is a strong gap with the world.

[5] regarding the modification of the Government Decision no. 666/2016 for the approval of the strategic document General Transport Master Plan of Romania

Scenario 3: Strong development based on favourable economic trends. At the opposite pole of the previous scenario, there is the last scenario, which through most of the determinants, leads to the accelerated development of the rail freight sector.

Preliminary synthesis

After going through the first three stages of the qualitative method of the scenarios, the following preliminary conclusions result, based on the analysis of the evolution of the main determinants:

1. The scenario based on current trends shows a development of the rail freight sector through the influence of most political, economic and technological determinants. Socio-cultural determinants generally act by slowing down the process.

2. The scenario constructed as a result of political and economic dysfunctions indicates an economic decline at the national level, which strongly affects the development of the rail freight sector, and technologically, although globally the development dynamics are still high, at the national level, there is a strong gap with the world.

3. The scenario based on the favourable trends of the determinants in all categories, political, economic, social and technological, illustrates a development trend of the rail freight sector.

4. From this phase of the application of the qualitative scenario method, it is necessary to endorse the development of the railway network and, implicitly, of the rail freight sector, through national and European policies, including by providing the necessary funding, given that the infrastructure railway is a natural monopoly. According to Article 8 (1) of Directive 34/2012[6], "Member States shall develop their national railway infrastructure, taking into account, where appropriate, the general needs of the EU, including the need to cooperate with neighbouring third countries". Also, through the renewal of national and European policies, the renewal of the rolling stock park can be stimulated.

At the same time, through national policies, labour legislation should encourage young graduates to work in the railway sector, and thus profile companies to develop their activity, creating new jobs.

3.4. Determination of impact factors

Impact factors represent the likely action exerted on the rail freight sector by the main determinants of the forecasted phenomenon (increase in

[6] on the establishment of the single European railway area

rail freight traffic), using the qualitative method of scenarios, as presented in Table 4.

Table 4 Impact factors of the increase in rail freight traffic

Impact factors	Corresponding main determinants	Scenarios		
		1	2	3
(A) costs of organizations in the rail freight sector	5,6,10,11,12,13,15	Costs increase progressively (most of the main determinants lead to increased costs)	Costs are rising significantly	Costs fall significantly
(B) bargaining power of the buyer of rolling stock, plant and equipment	1,2,6	It grows progressively	It grows significantly	It grows significantly
(C) supply of rolling stock, installations and equipment	2,6,13,19,21	It grows progressively	It grows slowly	It grows significantly
(D) financial resources	5,7,9,10,11,12	Grow progressively	Progressively decrease	Grow significantly
(E) resources humanity (specialists)	14,17	Continuous decline	Sharp decline	Sharp growth
(F) competence in the field	19,21	Continuous decline	Sharp decline	Progressive growth
(G) financing sources	7,9,20	Progressive growth	It decreases progressively	Growing significantly
H)acces to know-how	19,20,21	Progressive facilitated	Slowly facilitated	Progressive facilitated
(I) equipments life	19,21,22	It decreases progressively	It decreases progressively	It decreases progressively

Source: Authors' own conception

In order to establish the impact factors, specific elements of internal analysis of the organizations operating in the rail freight sector were taken into account.

For example, in Scenario 1 - Development based on current trends, costs (A) are influenced by the following determinants:

5. Fiscal incentives to support rail freight transport (Action program for the development of railway infrastructure and the modal shift to the rail of passenger and freight transport flows) (Ministry of Transport and Infrastructure of Romania, 2021). Thus, the granting of fiscal incentives to railway undertakings is an important element in the states' policy to support rail freight transport so that the EU strategies are met (Marzano et al., 2018). At the same time, the application of a policy of charging CO2 emissions for users of transport services could change their behaviour regarding the choice of transport modes. Thus, the policy of granting subsidies to reduce CO2 emissions could encourage rail transport (Li & Zhang, 2020);

6. EU trade policy to create better trade opportunities and remove barriers to trade;

10. Increasing the interest rate;

11. Excess liquidity in the market;

12. Rising inflation;

13. Stable exchange rate;

15. Increasing the cost of energy.

The above-mentioned determinants act on impact factor A in opposite directions, but with different weights. For example, tax incentives to support rail freight are a breath of fresh air for rail freight undertakings, and EU trade policy to create better trade opportunities and remove barriers to trade stimulates international freight transport, including on the railway. Stable exchange rate means maintaining certain costs at a constant level with the previous period (costs related to TUI, for international transport of goods, costs for certain utilities, import of parts, installations, equipment or rolling stock, etc.). Also, the excess liquidity in the market allows companies in the sector to grow and the state to borrow, from the domestic market, at low prices. However, the situation is atypical, in the sense that, although there is excess liquidity in the market, the interest rate is rising, as is inflation. The infusion of European funds can counterbalance, to some extent, high interest rates and rising inflation. However, increasing the cost of energy leads to more expensive chains for the entire economy. It can be appreciated that on the whole, determinants 5, 6, 7 and 11 causes a decrease in costs, but

are dominated by the action of determinants 10, 12 and 15 which act in the opposite direction.

In the case of scenario 2 - Development slowdown due to political and economic dysfunctions, the main determinants are:

5. Waiver of tax incentives to support rail freight;

6. Certain economic sanctions imposed by the EU on trading partners and the denunciation of cooperation agreements;

10. The interest rate is rising;

12. Rising inflation;

15. Increasing the cost of energy.

Regarding scenario 3 - Accelerated development based on favorable economic trends, the main determinants are:

5. Fiscal incentives to support rail freight transport (Action program for the development of railway infrastructure and the modal shift to the rail of passenger and freight transport flows);

6. EU trade policy to create better trade opportunities and remove barriers to trade;

8. The interest rate is declining;

12. Decrease in inflation;

15. Decreasing the cost of energy;

17. Increasing the active population by attracting the diaspora and emigrants.

We make the following observations:

- Factor (B) the bargaining power of the buyer of rolling stock, plant and equipment increases even in the unfavourable scenario, being supported at European level, as rail transport is considered an environmentally friendly mode of transport. On the other hand, membership of the European common market increases the supply of suppliers as well as competition between them. Last but not least, the EU's trade policy of creating better trade opportunities and removing barriers to trade brings new opportunities for the purchase of rolling stock, facilities and equipment at competitive prices;

- Factor (C) the supply of rolling stock, installations and equipment has a similar behaviour due to the high dynamics of the current technological progress, which cannot be slowed down by internal political and economic factors, regardless of the scenario;

- Factor (D) financial resources is decisively influenced by determinants such as fiscal incentives granted to support rail freight, GDP growth (funds for research and education expressed as a percentage of

GDP) and the level of inflation; when these determinants tend to decrease (scenario 2) causes a progressive decrease in financial resources;

- Factors (E) human resources (specialists) and (F) skills in the field are directly influenced by the reduction of the active population, unemployment rate, dynamics of technological progress and speed of technology transfer;

- Factor (G) sources of funding is decisively determined by the level of GDP, European funding allocated to projects for the development of railway infrastructure and funds allocated to research from the state and EU budget; in the case of scenario 2, these determinants have a significantly decreasing trend;

- Factor (H) access to know-how is mainly influenced by the high dynamics of technological progress, which is manifested in all three projected scenarios; the trend of this factor can be slightly changed by other determinants, such as the increase in funding for research and the speed of technology transfer, which are at opposite poles in scenarios 2 and 3;

- Factor (I) equipment life is the result of the irreversible action of technological determinants whose manifestation is the same in all scenarios.

3.5. Elaboration of the scenario matrix

The impact factors (A ... I) are positioned in the scenario matrix (see Figure 4). The matrix includes two variables: the probability of occurrence of the phenomenon and its strategic importance. The indices of the impact factors correspond to the three scenarios.

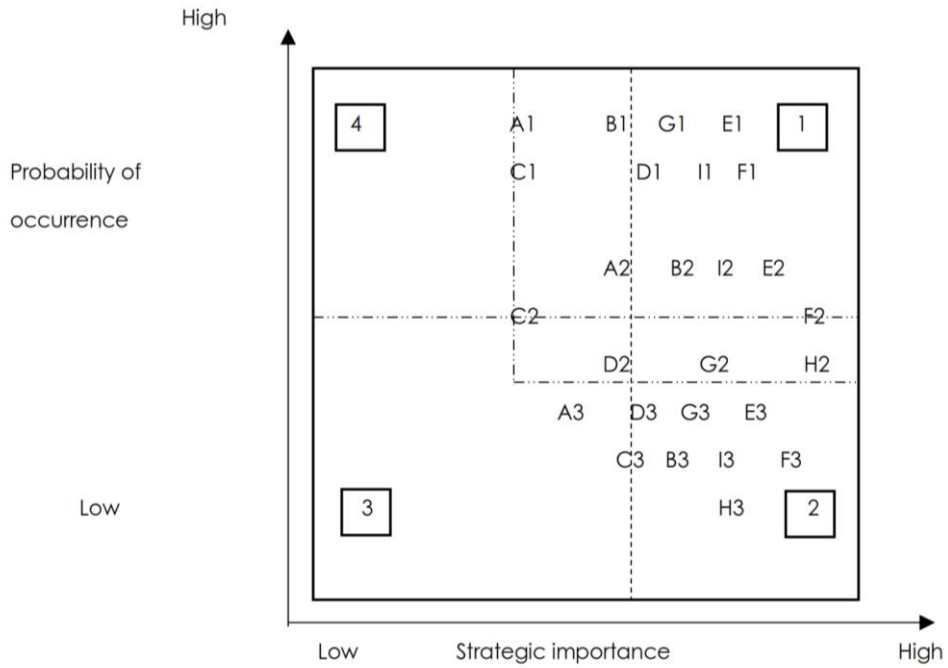

Figure 4. Scenario matrix - increasing rail freight traffic

Source: Authors' own conception

In the matrix of scenarios, the four rectangles differentiate the impact factors as follows:

1. Impact factors of strategic importance and high probability of occurrence;
2. Impact factors of great strategic importance, but low probability of occurrence;
3. Impact factors of low strategic importance and low probability of occurrence;
4. Impact factors with high probability of occurrence, but low strategic importance.

3.6. Establishing the most likely scenario

In order to establish the scenario, the impact factors located in rectangle 1, which have a high strategic importance and a high probability of occurrence, are most likely taken into account. In addition, this rectangle is extended to the one delimited by the lines indicating values of the matrix

variables higher than 40%, as these impact factors are considered to be of interest.

In the present case, the most likely scenario can be described as follows:

- The costs of organizations in the field increase simultaneously with the increase of financial resources and funding sources;

- The increase in financial resources is closely linked to the increase in funding sources, with a focus on European funds allocated for the development of this sector;

- The bargaining power of the purchaser of rolling stock, installations and equipment will increase progressively, in parallel with the supply of rolling stock, installations and equipment and with the sources of financing. These are closely linked to the progressive facilitation of access to know-how, due to the high dynamics of the technological process, which leads to an accentuation of the moral wear of the equipment and to the decrease of their life;

- A real problem, difficult to solve, remains that of the continuous decrease of human resources and skills in the field. The solution is economic growth, a situation in which the active population would increase by attracting Romanian citizens, who are currently working abroad and emigrants. On the other hand, the increase of skills in the field would be stimulated by amending labour legislation, which will encourage young graduates to work in the railway sector. In this way, the profile companies will develop their activity being created new jobs.

The probability that organizations in the field will have lower costs is a low one. A reduction in these costs would be closely linked to the reduction of funding resources, by reducing funding sources. Or it is unlikely, given the EU's strategy for sustainable and smart mobility, which is accompanied by a multi-annual budget for the development of this sector.

3.7. Preparation of backup plans

In order to develop the reserve plans, the impact factors located in rectangle 2 are taken into account, with emphasis on factors E3 ... I3. Although they have a low probability of occurrence, they are of great strategic importance and, if they occur, they should not be taken by surprise.

In this case, the contingency plan is as follows: If the conditions for the development of external freight organizations in the rail freight sector end up being very favourable, it is required to adopt some measures in time, for the employment personnel in this sector, so as to increase the competences of organizations in this field.

Thus, it is necessary to grant motivating salary packages, which also include professional training programs, as well as capitalizing on access to know-how, which will be favoured by European funds. This will avoid the wear and tear of locomotives and wagons, but also of equipment and installations.

4. Conclusions

● The Relevant Tree Method shows that the solution for stimulating the rail freight traffic in Romania, so that a substantial part of the internal freight transport, currently performed on the road system to be transferred on the railway network, consists in increasing the allocation of funds for the modernization works of the railway infrastructure. "The modernization of the railway infrastructure involves major works to modify the infrastructure, which will improve its overall performance", according to art.3, paragraph 17^2 of Law 202/2016.

● The methods for increasing rail traffic and how to implement them are as follows:

1. Improving the quality of railway infrastructure

a) increase of the funds allocated for the maintenance, repair and renewal works of the railway infrastructure, in order to eliminate the speed restrictions, increase the traffic speed and improve the safety of the railway traffic.

"Insufficient funding for the maintenance, repair and renewal of railway infrastructure has led to its progressive degradation and an increase in the overall wear and tear of infrastructure components. Renewal deadlines for railway infrastructure items have increased significantly, reaching over 60% for most railway subsystems. At present, the current state of the railway infrastructure is an important limiting element of train performance", according to Romanian Railway infrastructure development strategy 2021-2025. The network average of the maximum allowed speeds represents 70.7% of the projected maximum speed.

b) increase of the funds allocated for the modernization works, to increase the traffic speed and the safety of the railway traffic;

c) the construction of new railway tracks to streamline traffic and ensure a better connection between different areas of the country, on the railway;

d) the doubling of some sections of the railway, on which the traffic is carried out on a single wire, especially on the sections with congested infrastructure, in order to streamline the traffic;

e) electrification of railway tracks, which are currently unelectrified;

f) increasing the number of tracks in the railway stations.

The modernization of Corridor 4 has led to a reduction of more than 40% in the number of tracks in the stations, affecting, in particular, freight trains. For example, at Constanța Port Zona B station, the loss of train parking capacity leads to blockages in freight train traffic, with an impact on transport costs (Employers' Organization of Private Railway Companies in Romania, 2021).

2. Improving rail traffic management

Rail traffic management is a limiting factor in the commercial speed of trains, as the lack of adequate technical support makes it virtually impossible to manage the disturbances efficiently. Moreover, the technical inability to effectively manage traffic disruptions leads to further limitation of planned speeds in order to ensure some reserves that can be used to limit delays. The most important weaknesses and performance limitations are in the field of operational traffic management and in the field of medium and short term traffic planning, according to the Romanian Railway infrastructure development strategy 2021-2025.

The railway infrastructure manager in Romania, CNCF CFR SA "has as main object of activity the development, management and maintenance of the railway infrastructure, including traffic management, monitoring and control of signalling", according to the Romanian law OUG 12/1998[7].

Thus, the following actions are needed to improve the management of rail traffic:

a) the modernization of the operative management of the train traffic based on a technical support that implements intelligent decision support solutions is likely to increase the efficiency of traffic recovery solutions in case of disturbances, regardless of the extent of the disturbance and its degree of complexity;

[7] According to Article 1, paragraph (10), letter b of the OUG 12/1998 regarding the transport on Romanian railways and the reorganization of the National Society of Romanian Railways

b) the modernization of medium and short term train traffic planning based on intelligent IT decision support solutions leads to the increase of the planned commercial speed being targeted, in particular, the rail freight transport, where the lowest level of planned speeds and longer delays as is state in Romanian Railway infrastructure development strategy 2021-2025;

c) implementation of the European Rail Traffic Management a System (ERTMS) system on a large scale for improving railway traffic control and for rising the speed of trains;

d) implementation of The Redesign of the international Timetabling Process (TTR project), so that, on the rail freight corridors the infrastructure capacity will increase.

3. New, high-performance wagons and locomotives

Improving the railway infrastructure, including increasing the length of the electrified railway network, as well as implementation of the ERTMS system on a large scale on the Romanian rail network, will lead to the renewal of the locomotives and wagons of rail freight undertakings. This will enhance the safety of rail traffic (reducing the number of incidents and accidents on the railway), but also savings for rail undertakings as new types of electric locomotives can use the locomotive braking system. Recovery braking allows the recovery of a considerable amount of energy, which is charged to the contact line. Thus, railway undertakings become producers of renewable energy.

The rolling stock can be renewed as follows:

a) Tax incentives for rail freight undertakings purchasing new rolling stock from their own funds;

b) State-guaranteed loans for the purchase of new rolling stock;

c) Through state aid schemes, this could be initiated by the Ministry of Transport and Infrastructure. Currently, only the acquisition of new rolling stock for passenger transport is funded by National Recovery and Resilience Plan;

d) Fiscal incentives for rail freight undertakings that rent new rolling stock from specialized companies;

e) Differentiated taxation, depending on the age of the locomotives and wagons used by the rail freight companies.

4. Government policies to encourage rail freight transport

a) financial incentives for freight undertakings so as to encourage rail transport.

The Action Program for the Development of Railway Infrastructure and the Modal Transfer of Passenger and Freight Transport Flows mentions the recommendation of the European Commission (EC) to establish public service obligations for rail freight transport as well as compensation from public funds the difference in costs and revenues. Thus, in the case of rail freight, it is desired to implement instruments similar to those mentioned in Regulation (EC) no. 1370/2007, for the railway transport of passengers, respectively for the compensation of the public service obligations.

b) policies on the internalisation of road transport costs, so that there is fair competition between road and rail transport;

c) programs for young graduates in order to be employed in the railway sector (a similar program was funded for young farmers[8], and employees in the IT and construction sectors benefited from certain tax facilities).

● From the use of the Scenario Method it results that the scenario can most likely be described by:

a) increasing the costs of organizations in the field, while increasing financial resources and funding sources;

b) increase in financial resources, which is closely linked to the increase in funding sources, with a focus on European funds allocated for the development of this sector;

c) the progressive increase of the bargaining power of the buyer of rolling stock, installations and equipment, in parallel with the supply of rolling stock, installations and equipment and with the sources of financing; they are closely linked to the progressive facilitation of access to know-how, due to the high dynamics of the technological process, which conduct to the rise in moral wear and tear of equipment and a decrease in its life span;

d) the continuous decrease of human resources and skills in the field; the solution is economic growth, a situation in which the active population would increase by attracting Romanian citizens who are currently working abroad and emigrants; on the other hand, the increase of skills in the field would be stimulated by amending labour legislation, which will encourage young graduates to work in the railway sector.

In this case, the reserve plan is as follows: if the conditions for the development of the external environment for the organizations in the rail freight transport sector end up being very favourable, it is required to adopt some measures in time, for the employment personnel in this sector, so as to

[8] "Support for the installation of young farmers" program, developed by the Agency for the Financing of Rural Investments

increase the competences of organizations in this field. Thus, it is necessary to grant motivating salary packages, which also include professional training programs, as well as capitalizing on access to know-how, which will be favoured by European funds. This will avoid the wear and tear of locomotives and wagons, but also of equipment and installations.

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