

FINAL PROJECT

Definition of a national safety regulation for the operation of passenger trains in Brazil

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Foreword

The topic developed by our team for the final project of the International Training Program “Rail Transportation Management” is the “***Definition of a national safety regulation for the operation of passenger trains in Brazil***”. This arises from the fact that currently each operator in the country adopts its own operational standards. The development of new interregional trains in Brazil in an envisioned future justifies the definition of common standards, for the sake of operational safety and efficiency gains due to economies of scale. Furthermore, common standards will foster the interoperability, as local services tend to increase their reach and interregional networks spread along different metropolitan areas.

The team responsible for developing this project is comprised by professionals from a metro operator (Metrô Brasília) and two national entities representative of the passenger trains’ operators (ANPTrilhos/ National Association of Passenger Rail in Brazil) and the transport sector as a whole (CNT/Confederação Nacional do Transporte).

Table of Contents

List of Abbreviations.....	<u>444</u>
List of Figures.....	<u>444</u>
List of Tables.....	<u>444</u>
1. Brief description of the chosen topic.....	<u>555</u>
2. Research Results.....	<u>777</u>
3. Hypotheses.....	<u>999</u>
4. Generate Ideas.....	<u>101010</u>
5. Preliminary Remarks.....	<u>131313</u>
5.1. Theoretical Foundation.....	<u>131313</u>
5.2. Theoretical Background.....	<u>141414</u>
5.2.1. <i>European Union</i>	<u>141414</u>
5.2.2. <i>United States of America</i>	<u>171717</u>
5.3. Critical Review.....	<u>181818</u>
5.4. Scope and Limitations.....	<u>191918</u>
5.5. Literature Review.....	<u>202020</u>
6. Cost Benefit Analysis.....	<u>222222</u>
7. Risk Analysis.....	<u>242424</u>
8. Project Plan, Implementation Plan.....	<u>262626</u>
9. Financial Plan.....	<u>292929</u>
10. References.....	<u>303030</u>

List of Abbreviations

AEIF	European Association for Railway Interoperability
ANTT	National Land Transportation Agency (Brazil)
BNDES	National Bank for Economic and Social Development (Brazil)
CSI	Common Safety Indicators
CSM	Common Safety Methods
CST	Common Safety Targets
ERTMS	European Rail Traffic Management System
FRA	United States Federal Railroad Administration
ISO	International Organization for Standardization
Km	Kilometers
TSI	Technical Specifications for Interoperability
USDOT	United States Department of Transportation

List of Figures

<i>Figure 1 – Pros and Constrains summary</i>	23
<i>Figure 2 – Costs and benefits</i>	23
<i>Figure 3 – SWOT Matrix</i>	24

List of Tables

<i>Table 1 – SWOT Analysis</i>	25
<i>Table 2 – Implementation Plan</i>	28

1. Brief description of the chosen topic

The transport of passengers by rail in Brazil, in the recent decades, has neither kept pace with the accelerated growth of Brazilian regions and cities, nor fulfilled the demands of their population – neither within the cities nor between them. Therefore, due to this lack of enough mass transport supply, the large urban centers are becoming increasingly congested, which reduces citizens' mobility and leads to the overall loss of quality of life and productivity. Thus, the connection between the cities, in general, relies solely on roadway and air transport.

The urban sprawl, stimulated by the increasing car ownership, has extended the urbanized areas in a disorderly way, due to a lack of proper planning and supervision. The physical boundaries between Brazilian major cities and their neighbouring cities has faded and, instead of isolated, many of them are now gathered in extensive metropolitan areas. These arrangements demand a great effort of planning and integration among the public bodies and agents in charge of designing the transport networks, since these networks usually scatter over different municipalities, interconnecting them.

The Brazilian urban rail passenger transport networks amount currently to 1,064 km long, spread in 11 States and the Federal District. These networks are operated by 15 companies, 7 of which are private. Regarding the regional and interregional transport, Brazil has only two passenger transport lines¹, which are shared with cargo transportation, for 1,525 km in total.

Besides these two mentioned lines, the national rail network in Brazil is exclusively dedicated to the freight transport. This network was split into several regional networks in the 1996-1998 period and is now exploited, under concession, by private companies. Thus, each of these systems is independent and, in each of them, the transport operation and the infrastructure's maintenance are made by the company that holds the concession – although the right of passage is allowed to other companies, subject to certain conditions.

Since each company operates mostly in isolation, each one has its own operation rules, safety standards, and contingency measures. In this sense, there is a variety of equipment and systems adopted in each of the different operating companies. Much of this difference is explained by the cargo load, the type of merchandise carried, the operational characteristics and the architecture of each system. However, the existence of different standards can lead to diseconomies of scale, since each company, when doing the right of passage, shall comply with two or more different sets of norms and standards.

It should be stressed that Brazil has not developed yet a comprehensive regional and interregional passenger rail network, considering medium or high speeds. In this way, surveys from the National Bank for Economic and Social Development (BNDES²) estimate a perspective of 46 potential projects on this transport typology – three of which are being currently evaluated for implementation by national and local instances of government.

Given the large number of existing projects and the inceptive political will to develop the regional and interregional passenger rail network, which, in the future, tends to be integrated into a major network between the main metropolitan areas, economic centers and Brazilian capital cities, it is of utmost importance that the basis for a common set of operational and safety standards are defined at an early stage of the planning.

¹ Estrada de Ferro Carajás (located in Pará and Maranhão) and Estrada de Ferro Vitória a Minas (located in Minas Gerais and Espírito Santo).

² “Banco Nacional de Desenvolvimento Econômico e Social” in Portuguese.

Considering the current situation in Brazil, this work aims to propose the terms of a federal regulation that defines the basic principles that must rule the operational safety of the passenger rail transportation throughout the national territory, for the purposes of safety and the guarantee of protection of its users.

2. Research Results

The surveys and analyzes carried out during this study allowed us to confirm the two hypotheses raised, which showed that Brazil does not have a national legislation that defines the minimum requirements for the operational safety of trains of passengers throughout the national territory and that the establishment of a common set of minimum safety requirements is important for the overall safety of passengers.

Based on this first result, the study advanced the analysis of the international benchmark, considering the existing regulations both in the European Union and in the United States of America, allowing to verify that in all cases there are specific legislations, which deal with operational safety. The surveys showed, in general, that a minimum set of requirements was defined for the railway market, which includes common safety indicators, methods and targets. Several technical specifications for interoperability were defined, with the concern about its technical and economic justification.

Based on the survey of global best practices, this study brings a proposal in the terms of a Federal regulation that defines the basic principles that must rule the operational safety of the railway transport of passengers in Brazil, for the purposes of safety and the guarantee of protection of its users. The main points of the proposal are: establishing a minimum set of requirements which includes common safety indicators, methods and targets, that must be followed by interregional railroads or interoperable ones and the requirements for continuously checking the operators' adherence to the established legal provisions, the terms of the periodic inspection of the railways and the penalties for non-compliance.

It is important to note that, as verified in the benchmark study, the local and interregional networks are predominantly existing, eventually with different operational and safety standards. Given this fact, the costs of adaptation or renewal of these networks arising from the definition of common standards is not negligible. So, as in other countries, this study recommends that a sound approach for the proposed regulatory act would be restricting the scope to the interregional passenger trains.

On the other hand, both the Cost Benefit analysis and the Risk Analysis indicated very positive factors for the implementation of the new legislation in Brazil, considering that the gains coming from the regulation of the operational safety requirements, in the specific case studied, are greater than the risks to be faced, especially considering that the interregional rail market is still very little explored in Brazil.

In order to establish the new regulation, the preview studies showed that the most appropriate legal instrument was the issue of a Ministerial Order. The studies also showed that, generally, to elaborate and implemented a measure like that, it would take about 577 days in a process.

To conclude the analysis, the financial impact carried out in the study showed that, in general terms, the cost of implementing the legal measure in Brazil is very small, given the benefit generated throughout the country. Specifically, in the Brazilian case, where currently there are only two companies operating in the interregional rail market, and they already accomplish to the safety topics proposed at this work. the measure implementation cost is very low.

Even if in the future, after the complete definition of the requirements of the federal safety legislation of the operations, there is a need to adapt the existing operators, the impacts on the market will be minimal, as it is currently not well developed. However, it should be in mind that, over time, these costs may rise as a result of an eventually disorderly growth of the market, which will make harmonization based on legal requirements have a greater financial impact.

Thus, based on the results presented throughout the work, it is possible to verify that:

1. Brazil does not have a legislation that standardizes the minimum safety requirements throughout the Country;
2. Its definition is important and meets the best global practices for interregional rail transport;
3. The best instrument for its adoption is a Ministerial Ordinance, which will take, on average, 577 days to be implemented;
4. There are more benefits than costs for their implementation and the risks are small; and
5. The financial cost of its implementation is linked to the adaptation of existing operators to the new rules and is a small cost, since there are currently only two operators established in the market that meet the established requirements.

For all of the above and based on the results obtained throughout the study, it is recommended the implantation of a federal regulation that defines the basic principles that must rule the operational safety of the passenger rail transportation throughout the national territory, for the purposes of safety and the guarantee of protection of its users.

3. Hypotheses

Considering the current situation of development and regulation of the Brazilian rail market for passenger transport – both urban and regional –, the hypotheses raised by this study are that (1) ***Brazil does not have a national legislation that defines the minimum requirements for the operational safety of trains of passengers throughout the national territory*** and (2) ***that the establishment of a common set of minimum safety requirements is important for the overall safety of passengers***. Once the hypotheses are confirmed, the project seeks to recommend the minimum requirements that should compose such regulation.

To confirm the hypotheses, two analyses were performed. The first one was the data survey on the existing national legislation on rail passenger transport operation and its coverage, considering specific operational and safety requirements, seeking to identify the minimum standards. The second analysis sought to identify the existing theoretical basis on the establishment of common railway safety requirements and its importance for the safety of the operation of rail transport of passengers.

Since the hypotheses have been confirmed and there is no legislation in Brazil defining the minimum requirements for ensuring the safety of passenger trains throughout the national territory, a recommendation has been proposed on the requirements that should be included in a new legislation. In order to build up this recommendation, the following analyses were carried out:

- Survey of the theoretical basis on the pillars of railway safety, seeking to verify the requirements that must be included in the whole railway operation, aiming at guaranteeing the integrity of the equipment and users of the system; and
- Survey of the international benchmark, regarding the requirements for operational safety in the case of rail passenger transport.

Based on the surveys carried out and the critical analysis of the material found, considering also the characteristics of the rail sector in Brazil, the terms of a national legislation were recommended to establish the minimum requirements for the operational safety of passenger trains throughout the country.

In addition to the recommendation, cost-benefit and risk analyses were carried out to identify the costs, benefits and risks involved in the government's decision to implement such legislation once it will have an impact on existing operators and the market already established in Brazil.

Finally, considering the planning of the implementation of such legislation in the country, an analysis was carried out on the possible scenarios, within the Brazilian legislation, for the enactment of a national law.

4. Generate Ideas

In general terms, this chapter contains a brief analysis of Brazilian legislation, in the light of the laws and regulations that deal with rail and subway transportation of passengers in the national territory, seeking, in the end, to confirm part of the hypothesis, which deals with the lack of legislation that defines the minimum requirements for ensuring the safety of passenger trains throughout the national territory.

The division of legislative competence between the federation bodies complies with the principle of the predominance of interest, whereby the Union is responsible for matters in which the national interest prevails; the States are responsible for matters of regional interest and the Municipalities for matters of local interest, which will always abide by the Constitution, in compliance with the so-called principle of constitutional supremacy. This way, the analysis of the legislation, provided in this chapter, was conducted under the point of view of these legal premises.

The Brazilian Federal Constitution is the set of fundamental laws that organize and govern the functioning of the country, considered the maximum and mandatory law among all citizens, serving as a guarantee of their rights and duties. In September 2015, with the enactment of Constitutional Amendment nº 90, this regulation came to guarantee transportation as a social right. The theme was included in the Federal Constitution, which already provided as citizens' rights: education; health; feeding; work; dwelling; leisure; safety; security; social security; protection of motherhood and childhood; and assistance to the vulnerable ones.

The constitutional guarantee of transportation as a fundamental right of the citizens may favor the elaboration of public policies that prioritize this sector, either from the perspective of the expansion of the service provision, the guarantee of its quality or its cost (tariff), whichever is the transport mode. However, for the purposes of the analysis carried out here, we can state that this Constitutional Amendment has had, so far, no connection to any specific policy or requirement dealing with safety rail operations.

Out of the Constitutional level, Federal laws have precedence, or priority, over State and/or Municipal laws, encompassing important aspects of the routine of the country. Thus, States and Municipalities are free to legislate, but must follow the requirements imposed by the Federation, in the domains related to its competence.

This way, under the Federal legislation, the rail sector is regulated by the Decree nº 1.832/1996, which enacted the national regulation for the railway transport in Brazil³. This regulatory act rules the railway undertakings in charge of construction, operation and commercial exploitation of railways, including their relation with public administration and the safety in the railway services. The decree states that the construction, operation and commercial exploitation of railways in Brazil are subject to concession by the "Union" (Federal level) (Article 2º), and the circulation in any branch of the Brazilian railway system depends on the previous authorisation from the granting power (Article 3º, § 1º).

According to the Decree, the railway undertakings are subject to the supervision and inspection by the Ministry of Transportation⁴, either directly or indirectly (Articles 4º and 65). This Ministry is responsible for enacting safety norms for the railway transport and supervising their compliance by the operators (Article 5º).

³ The Decree nº 1.832/1996 was enacted the March 4th, 1996 and revoked the Decree nº 90.959/1985.

⁴ This Ministry was turned into the Ministry of Infrastructure in the current mandate.

The decree also states, regarding the operational safety:

- The location of crossing levels is to be defined by the railways undertakings, in accordance to the current norms (Article 10). In addition, the crossings between railways and roadways is to be defined under mutual agreement between the parties (Article 10, § 2º);
- The railway undertakings shall install protection and safety devices along their right-of-way (Article 12);
- The railway undertakings shall be ready to act in case of emergency due to the railway transport service (Article 13);
- The railway undertakings shall register the accidents in their lines, warehouses and other premises (Article 15).

The decree states that the railway operators shall adopt technical, administrative, safety and education-related measures in order to assure the regularity of the service, to guarantee the integrity of passengers and goods, and to prevent accidents (Sections III and IV, Article 54). However, despite the cited safety-related references, the decree remains quite vague, with no more than generalistic instructions for the railway undertakings. There are no minimum requirements or parameters for the different systems involved in the railway operation. Furthermore, we found no record that the Ministry has, in fact, enacted safety norms for the railway transport of passengers.

It is noteworthy that the National Department of Transport Infrastructure⁵, a public body binded to the Ministry of Infrastructure, is currently developing the National Institute of Railway Research⁶, which, among other objectives, will aim at the elaboration of technical norms and certification.

Following that, the supervision and inspection of the railway undertakings has, to a certain extent, been encompassed by a transport authority, created in 2011. The National Land Transportation Agency (ANTT⁷) was created through the Law nº 10.233/2001, and was binded to the Ministry of Transportation. Among other issues, this agency is in charge of the supervision of the railway transport of cargo and passengers along the National Routes System⁸ and its related operational assets.

The competences of the agency include the development of norms and regulatory acts related to the exploitation of routes and terminals, and the definition of standards and technical norms related to the land transport⁹ of special and hazardous goods (Article 24). Regarding specifically the railway transport of passengers, the agency's duties comprise the articulation with the States, Federal District and Municipalities in order to harmonise the exploitation of local transport networks (metros and urban trains) and the networks under the jurisdiction of the agency (Article 25) – the national networks, which were given, under concession, to exploitation by private companies.

The survey at ANTT for regulatory acts which are related to the safety of the railway transport of passengers resulted in one resolution only. The Resolution ANTT nº 359/2003 defines the procedures needed to provide the railway transport of passengers for touristic purposes, in a non-regular basis. This act states that the service shall be previously authorised by the Agency, which demands, among other documents, a technical report which states that the rolling stock meets the safety requirements for this service (Article 2º).

⁵ “Departamento Nacional de Infraestrutura de Transportes” in Portuguese.

⁶ “Instituto Nacional de Pesquisas Ferroviárias” in Portuguese.

⁷ “Agência Nacional dos Transportes Terrestres” in Portuguese.

⁸ “Sistema Nacional de Viação” in Portuguese.

⁹ This includes both road and rail transport modes.

These non-regular services are subject to *ad hoc* authorisations, under specific regulatory acts, known as “orders”, or “portarias”, in Portuguese. These orders from the Agency define the safety-related conditions to be followed, such as maximum speed, allowed operation hours, shared traffic with cargo trains (eventually interrupting these trains during the transport of passengers), blockage of level crossings, etc.

Thus, starting from a Federal analysis, under the focus of railway safety, it is possible to confirm the first part of the hypothesis pointed out in this study, stating that Brazil does not have a national legislation that defines the minimum requirements for operational safety of passenger trains throughout the national territory. The fact is each transport operator, named by the legislation as "Railway Administrator" or "legal entity that provides the service", must define its own systems and respective operational requirements, to guarantee the safety of operations, to prevent accidents and to safeguard the human life.

5. Preliminary Remarks

With the confirmation of the first part of the hypothesis, previously set out, the second part of the analysis aims at verifying the importance of establishing minimum operational safety requirements for the transport of passengers, which is addressed through the analysis of the theoretical basis.

Once this analysis is made and the second part of the hypothesis is confirmed, this chapter starts with the analysis of the best global practices in terms of the definition of safety requirements, in order to propose the terms of a federal regulation that defines the basic principles that must rule the operational safety of the railway transport of passengers throughout the national territory, for the purposes of safety and the guarantee of protection of its users.

5.1. Theoretical Foundation

Safety on a railway system depends on three main pillars, which are:

- People
- Machine / technology
- Regulations

The first pillar comprehends not only train operator itself but also other railway workers such as dispatchers, track maintenance personnel, commuters and other people involved directly with trains operation. The second pillar refers to the machines themselves, including trains, permanent way equipment, electrical, mechanical and pneumatic devices, etc. The third pillar is related to regulations in general, including laws, acts, regulatory texts, guidelines, directives, instructions.

The interaction among them without neglecting any of these items may cause imbalance on the system and consequently, result in an incident with unpredictable consequences. To avoid any of these consequences, it is necessary to prioritize the best practices that can lead to a safe operation culture.

The establishment of minimum requirements for safe operation of trains is a main issue on the present work. These parameters are essential for trains operation without major accidents that could result in severe damages and loss of human lives. It is based on five basic protection targets of train operation that can minimally set train circulation in the absence of an inadmissible risk, which are:

- Protection against Counter movements – from a second station, a train is allowed, although the route is occupied;
- Protection against subsequent rides – a faster train follows a slower one or a train approaches another which has stopped;
- Protection against flank rides – a train on shunting movement is conducted and crashes through a switch connection into the flank of another train;
- Protection against moving a switch – a train moves over a switch or another track element and may cause a derailment;
- Protection against risks by 3rd parties – an unsecured railroad crossing is in the path of the train (crossing level).

These five protection targets are basic to lead to a safe operation even if the break distance is higher than 1000m. Through the application of these targets, speeds over 160km/h are possible, once it can improve track operation. These targets must be accomplished by the installation of train and permanent way equipment, with mechanical and electric interlockings.

These apparatuses must be accredited and calibrated by terms and requirements from Brazilian or international regulation authorities. The protection targets must also be developed by operational rules, guidelines and instructions that will guarantee that none of these five targets will be disrespected during train operations and shunting movements.

The introduction of these five targets of safe train operations in a national law can contribute to the development of a safety culture prior to the establishment of the lines themselves. It can be a primary way of effective communication of rules to all the target groups (users, operators, managers, etc.) and other stakeholders. It can also uniformize the basic operational safety rules in the whole Brazilian territory, avoiding the regionalization of safe rules that could lead on a misunderstanding of safety standards and procedures from an operator to another. It is essential on the development of a safety culture to all operators of rail passenger transport nationwide.

These five targets of safety rules are a primary way to determine general passenger and operational safety standards. It is also fundamental that these five targets are common for the different railway systems to be established in national territory.

It relates the five targets directly to the second hypothesis proposed in this present work, once they guarantee a minimum operational safety rules, fundamental for the preservation of passengers' integrity, independently whose will be the future operators of Brazilian regional railroads.

5.2. Theoretical Background

Following the theoretical foundation on railway operational safety and its related normative implications, we present two case studies regarding the establishment of common safety standards for the railway operations – in the European Union and at the United States. These cases were selected due to their similarities with the Brazilian case, in terms of scale of the territory and diversity of regions, either they are countries or states. The outcomes from the survey on these cases were appropriated in a benchmark approach, as shown later in this chapter.

5.2.1. *European Union*

The European Union's policy for the railway transport aims at the creation of a single market for the rail services. The competition and the standardisation within this sector have been fostered since 2001 with the enacting of four Railway Packages. These packages encompass a number of standards on technical, managerial, safety and market-oriented issues, in order to achieve the interoperability along the national railway systems in that continent. These common rules are intended to hinder the distortions on competition and to ease the access of new entrant operators.

The relevance of that policy derives from the fact that the railway operation relies on the compatibility between the characteristics of the infrastructure and those of the rolling stock. Besides this, the interoperability, performance levels, safety, quality of service and general cost of the rail systems depend on the efficient interconnection of the information and communication systems of the different infrastructure managers and operators.

Under this framework, the Council Directive 2001/16/CE, which is no longer in force, was enacted to address the interoperability of conventional trains. The directive leads to the definition of a minimum level of technical harmonisation, in order to allow the 'safe and uninterrupted movement of trains which accomplish the required levels of performance for

the lines'. This harmonisation would be achieved through the so-called Technical Specifications for Interoperability (TSIs), defined as 'the specifications by which each subsystem is covered in order to meet the essential requirements for interoperability of the trans-European conventional rail system'. These specifications encompass the driving and safety of trains, the signalling, the telematics applications for freight, the training of the personnel, the freight wagons and the noise emissions.

According to the directive, the railway subsystems shall permanently comply with the TSIs, which would be gradually implemented up to a specific date of entry into force. Some exemptions, treated as specific cases, were foreseen, such as new lines or upgrading existing lines at an advanced stage of development. The development of the TSIs would be carried out by a joint body representing the infrastructure managers, the railway companies and the industry. The European Association for Railway Interoperability (AEIF) was designated as this joint representative body. This development shall comprise a technical and economic justification, and an overall cost-benefit analysis of implementation of the TSIs, regarding the impact for all the operators and economic agents involved. Additionally, the associations and bodies representing users shall be consulted during the drafting and review phases of the TSIs.

The directive defines a number of essential requirements, including safety-related ones, which are quite general, such as follows.

“The parameters involved in the wheel/rail contact must meet the stability requirements needed in order to guarantee safe movement at the maximum authorised speed.”

Furthermore, each subsystem has its own safety-related requirement, as follows (to the infrastructure):

“Appropriate steps must be taken to prevent access to or undesirable intrusions into installations.”

The Council Directive 2001/16/CE was replaced by the Council Directive 2004/50/CE, which extended its reach to the whole European rail network, in order to comply with the openness of markets to the national and international transport of goods and to the international transport of passengers.

The Directive 2008/57/CE, currently in force, modified the previous directives, and covers both high-speed and conventional trains. It broke down the rail system into the following subsystems: infrastructure, control-command and signalling, energy, rolling stock, operation and traffic management, maintenance and telematics applications for passenger and freight services. The directive states that a procedure for authorisation of vehicle types should be set up and that one authorisation should be sufficient for the whole Community rail network.

The development of the first group of TSIs has been mandated to the European Association for Railway Interoperability. Afterwards, the task of drafting and revising TSIs was entrusted to the European Union Agency for Railways, established by the Regulation (CE) n° 881/2004. This agency is in charge of harmonising, registering and controlling the TSIs for the European railway system and settling common safety objectives thereof. The agency is also responsible for issuing authorisations for the placing on the market of railway vehicles and for issuing single safety certificates for railway undertakings.

Another major initiative on the harmonisation of train control and communication system in Europe is the European Rail Traffic Management System – ERTMS, under development. This system aims at ensuring interoperability throughout the rail system in Europe.

The railway undertakings are obliged to bear a license, in order to provide rail transport services, as defined in the Directive 2012/34/EU. These licenses, subject to periodic renewals, are issued by the national authorities in each country, and demand the fulfilment of requisites on reputation, financial capacity, and professional capability.

Furthermore, the Directive 2004/49/EC states that the national safety rules should gradually be replaced by rules based on common standards, established by TSIs. This directive defines that common safety indicators (CSIs), common safety methods (CSMs), and common safety targets (CST) shall be adopted. It defines also that licensed railway undertakings should hold a safety certificate, in order to be granted access to the railway infrastructure. This certificate should give evidence that a proper safety management system has been established by the railway company, and that this company complies with applicable safety standards and rules. Each Member State shall also establish a safety authority and an accident and incident investigating body. The following transport modes and networks might be excluded from implementing the directive: (a) metros, trams and other light rail systems; (b) networks that are functionally separate from the rest of the railway system and intended only for the operation of local, urban or suburban passenger services, as well as railway undertakings operating solely on these networks; and (c) privately owned railway infrastructure that exists solely for use by the infrastructure owner for its own freight operations.

The common safety indicators include indicators relating to accidents (such as number of level-crossing accidents), incidents and near-misses (such as number of broken wheels and axles), consequences of accidents (such as deaths and injuries), technical safety of infrastructure and its implementation (such as percentage of level crossings with automatic protection), and management of safety.

Finally, we cite the Directive (EU) 2016/797 and the Directive (EU) 2016/798, which are related, respectively, to the interoperability of the rail system within the European Union and to the railway safety. The first directive outlines the drafting, adoption and review of TSIs, and states that railway subsystems and vehicles shall comply with these technical specifications. It also defines the essential requirements for interoperability (including the safety ones) and rules for the placing on the market of interoperability constituents, the railway subsystems, the conformity assessment bodies, and the registers (of vehicles and infrastructure).

The second directive establishes a common regulatory framework for the railway safety in the European Union, regarding the harmonisation of safety rules, the safety certification of the railway undertakings, and the duties of national safety authorities and accident and incident investigating bodies. It also determines that the European Union Agency for Railways shall address recommendations to the Commission on the drafting and revision of common safety methods, targets and indicators. Both directives exempt metros, trams, and other light rail systems, which are subject to local technical requirements only.

In short, we highlight, from this case, that the European Commission and the European Parliament have developed a common regulatory framework for the Union, regarding the railway operational safety. These public bodies make up a statutory level which is, somehow, upper and broader to the Member States – countries with their own national legislation and different technical specifications. This legal apparatus and its economic and safety-related consequences would hardly have been achieved otherwise, had each country negotiated bilaterally these legal agreements with its neighbour countries. We consider that some of the good practices in this case shall be stressed, in order to be eventually replicated for the passenger trains operation in Brazil. First of all, a minimum set of requirements was defined for the railway market, which includes common safety indicators, methods and targets. A number of technical specifications for interoperability was defined from a joint body representing the sector's stakeholders, with the concern about its technical and economic justification. The mandatory licenses and safety certificates for railway undertakings can be

requested in one single authority or agency and be valid for the whole Community. Furthermore, its possession implies the company beholder fulfils some requisites, such as maintaining a proper safety management system and complying with applicable standards and rules. Finally, a common procedure for authorisation of vehicle types eases the traceability – in such intertwined markets – and exempts the redundant efforts of requesting authorisations in every different country.

5.2.2. United States of America

We present in this topic a survey of regulatory acts on the passengers' railway transport at the national level for the United States of America. This way, the railway transport in the United States is regulated by the Federal Railroad Administration (FRA), which is binded to the U.S. Department of Transportation (USDOT). This agency regulates the safety of the American railway system and fosters the development of the intercity passenger rail.

The Rail Safety Improvement Act of 2008 defined the following orientations, amongst other ones, regarding the improvement of the railway safety nationwide: railroad safety strategy; railroad safety risk reduction program; implementation of positive train control¹⁰; State action plans; minimum training standards and plans; and development and use of rail safety technology. The positive train control shall encompass each Class I railroad carriers¹¹ and entities providing regularly scheduled intercity or commuter rail passenger transportation.

The Passenger Rail Investment and Improvement Act of 2008, approved by the Congress, enacted that each State¹² may prepare and maintain a State Rail Plan, elaborated and approved by State rail authorities. Regarding the recommendation on elaborating these State plans, the FRA issued in 2013 the State Rail Plan Guidance. This guidance states that there should be a coordination of the preparation of the State Rail Plan with other planning efforts, at both the statewide/nonmetropolitan and metropolitan area levels. The purposes of such a plan shall include to set forth State policy involving freight and passenger rail transportation, including commuter rail operations. The publication also explains the process to be followed in developing state rail plans, including minimum content requirements, a standardized format, and FRA's review and acceptance process.

All States are also encouraged to participate in the development of multi-state rail plans, as appropriate, in addition to the required State rail plan. In this matter, some Regional Rail Planning Studies are currently being developed¹³. These plans contain a common, long-term vision for regional passenger rail service and the required infrastructure network based on existing conditions, projections of future demand, and the optimal role for rail service in a multi-modal transportation context. They include the finding that the definition of operational and safety standards should be a priority for these regions – areas of need for multi-state coordination¹⁴.

¹⁰ This term means a system designed to prevent train-to-train collisions, over-speed derailments, incursions into work zone limits, and a train movement through a switch left in the wrong position.

¹¹ This classification designates the railroad carriers with the highest operational revenues – as compared to Classes II and III.

¹² The country is composed of 50 states.

¹³ Southwest Multi-State Rail Planning Study, Southeast Regional Rail Planning Study, and Midwest Regional Rail Planning Study.

¹⁴ Overview of Regional Rail Planning (FRA).

The aforementioned Passenger Rail Investment and Improvement Act of 2008 also stated that the FRA should 'develop a long-range national rail plan consistent with approved State rail plans and the rail needs of the Nation (...) in order to promote an integrated, cohesive, efficient, and optimized national rail system for the movement of goods and people'. This National Rail Plan is currently being developed.

The FRA also released the High-speed Passenger Rail Safety Strategy, establishing safety standards and program guidance for high-speed rail; applying a system safety approach to address safety concerns on specific rail lines; and ensuring that railroads involved in passenger train operations can effectively and efficiently manage train emergencies¹⁵.

The Fixing America's Surface Transportation Act of 2015 (FAST Act) contains some passenger rail safety requirements, as follows. It requires, for instance, all passenger railroads to install inward-facing cameras to better monitor train crews and assist in accident investigations, and outward-facing cameras to better monitor track conditions. The Act also requires passenger railroads to install alerters on older locomotives and develop speed limit action plans. FAST Act also made changes to State Rail Plan requirements, including specifying that a state-approved rail plan be submitted every four years for acceptance by FRA, rather than the previously allowed five years¹⁶.

In short, we highlight, from this case, that, despite the definition of safety improvement acts at the Federal level, with general orientations for the passengers' railway transport, there seems to be a prevalence of the State level on this matter. In comparison to the European case, the definition of common standards and the enforcement of harmonisation for the railway sector in the different States seem to be in an earlier stage of development at the United States. This becomes more evident when we consider that the State rail plans were elaborated prior to the National rail plan, and this one should be consistent with approved State rail plans. Thus, this seems to be a bottom-up approach, instead of the top-down one adopted in Europe. Furthermore, the States in the US define their own regional plans, in a fragmented approach to the national railway system.

5.3. Critical Review

Considering the analysis made on the previous topics, it proves necessary the development of a legislation that includes the minimum safety requirements for passengers' trains in Brazil even before the establishment of regional rails lines throughout the country.

It is proven by the vast collection of laws, acts, directives and regulations met in Europe and at the United States, considering passenger safety and safe operations in passengers' lines. A long development time has been spent in these countries to implement a safe culture and to promote the adhesion to it. The outcome of this effort is that the trains that operate regionally can be assured on safety standards that are common to all neighbor countries sharing passenger railroad services.

The indication of minimum requirements to be accomplished by train devices and permanent ways are decisive on preventing accidents between trains operating on the same lines, as well as easing the flow on the railway operation.

¹⁵ High-speed Passenger Rail Safety Strategy (USDOT, 2009).

¹⁶ Fixing America's Surface Transportation Act. Public Law 114-94-Dec. 4, 2015.

5.4. Scope and Limitations

As stated previously, the directives on railway safety and interoperability at the European Union encompass the interregional rail network, and basically exclude the either local transport systems – such as metros, trams and other light rail systems – or the isolated ones. The urban or suburban passenger services are also exempted from the coverage of these regulatory acts.

On the other hand, in the United States, both the recommendation on the positive train control and the guidance on the elaboration of the State rail plans include, besides the statewide/nonmetropolitan level, also the metropolitan area level (commuter rail passenger transportation).

In both case studies, the local and interregional networks are predominantly existing, eventually with different operational and safety standards. Given this fact, the costs of adaptation or renewal of these networks arising from the definition of common standards is not negligible.

Since the survey on this project was not focused at the operational characteristics of the railway systems of each Member State or State, we cannot estimate the actual impact of the standardisation measures in the case studies. Regardless this methodological shortcoming, we can indeed relate the survey outcomes with the Brazilian case. As stated previously, the interregional railway systems in Brazil are yet to be developed. The State level legislation on this matter is not an issue as well. Furthermore, given the local systems (metros, trams and suburban trains) have very dissimilar characteristics in Brazil, we believe that a sound approach for the proposed regulatory act would be restricting the scope to the interregional passenger trains. Thus, the newly developed systems would benefit from the economies of scale and avoid the economic burden of adaptation for the existing local networks.

In addition, we recommend the extension of competencies of the National Land Transportation Agency, in order to cope with the definition of regulatory acts and technical norms for the new railway services. It should also be created a joint representative body, with members from the railway undertakings, the industry, and the public sector, to elaborate and update the technical specifications.

Based on the surveys carried out, which pointed out the best practices for the harmonization of international regulations, it is important to develop a common regulatory framework for the Union in Brazil, regarding the railway operational safety. This federal legislation must make up a statutory level which is, somehow, upper and broader to the States – which would continue to have their own state legislation and different technical specifications.

Confirming what was originally planned, it was not possible in this study to propose in detail each item of legislation to be applied to the Brazilian case, especially considering the specificities of each point to be included in a legislation like that. Thus, as in the case of the American and European markets, it is recommended that the government studies and detail the rules in order to publicize the specific terms of a federal regulation.

As the federal legislation should be followed by all States, it is recommended that the elaboration of its terms start from a working group, with the participation of the federative entities, specifically created for this purpose.

However, although the study does not allow to detail the terms of the legislation to be applied to the Brazilian case, the surveys conducted show us some ways to be followed for regulatory purposes in the Brazilian case. First of all, the legislation should define a minimum set of

requirements which includes common safety indicators, methods and targets, that must be followed by interregional railroads or interoperable ones. Secondly, it is important that the requirements of the legislation to be elaborated should also consider the need to verify the adherence of operators to established legal provisions, the need for periodic inspection of railroads and the establishment of penalties for non-compliance

it is important to note that although the definition of common standards and the application of harmonization for the railway sector in the different Brazilian states is still not being developed, the country is in an ideal stage for its implementation. With few interregional operators and a market still not heavily established, the country has a great opportunity to seek the rules that will be applied in the near future, when the sector is expanding in Brazil.

5.5. Literature Review

Safety is a very important issue in any transportation mode and, particularly, in rail transportation it is almost a fundamental law. While the 'safety level of rail transport is far higher compared to other transport modes' (PROFILLIDIS, 2006. pg. 425), there is room for further increase in rail safety levels.

According to EN 2016, safety is defined as 'freedom from unacceptable risks'. Risk, on its turn, is defined as 'a combination of damage and probability of its occurrence' (STEENBERGEN; VAN GELDER; MIRAGLIA; VROUWENVELDER, 2014, pg. 3026).

In fact, accidents are the result of combinations of various factors such as the number of trains, the number of passengers and freight, safety equipment (signaling and speed control), surrounding environment and human factors. There's no doubt companies care about the accidents and deploy great effort to tackle these issues and provide safe transport.

The underlying question on this proposal is about the level of commitment with these issues. It is important from a government perspective, or from any regulatory body, to concern about this. Nowadays, in Brazil, as aforementioned, much of the responsibility on the operation's safety relies on the railway undertakings, which are in charge of defining its level. This justifies the importance in defining minimum safety requirements to these companies, in order to provide standardization, reliability and safety to operators, providers and customers.

For this reason, the own market recognizes the importance of fostering standardization, especially concerning safety, security and quality of the products and services provided by any company. The ISO¹⁷ technical norms, as well as many other standardization certifications, are considered by many investors when analyzing companies and their markets. This certainly stresses the importance of developing common safety standards and reflecting them in public policies, such as the one proposed in this work.

In the European legal framework, the aim is to:

"introduce competition in the rail market, rationalize and reduce public subsidies, reduce costs and transform railways to customer oriented businesses, achieve interoperability, strengthen safety, boost high speeds and take advantage of the more environmental performance of railways" (PROFILLIDIS, 2006, pg. 44).

¹⁷ International Organization for Standardization.

It is clear that the European rationale values the relation with customers, safety, competition and interoperability. In reality, it tackles the many stakeholders involved in this process and the market as well, delivering a very encompassing legislation.

In the American model of legislation, the regulation of the transport sector in the United States of America was developed by the Interstate Commerce Commission, which was later replaced by the Surface Transportation Board. The objectives pursued by this regulation are: “ensure that rail carriers have trackage rights to operate on another carrier’s infrastructure; reduce tariffs, particularly when complaints for market dominance and power have been addressed; address quality; control exit, under specific circumstances, from the market; approve or decline mergers in the rail industry or impose conditions (i.e. trackage rights) on the merger, to promote competition” (PROFILLIDIS, 2006, pg. 52).

As well as in the European model, the American model values the safety issues, the competition and the interoperability – which is the integration between different rail networks.

With these two examples, it is possible to notice the pillars that are being considered in this proposal, confirming its motivations, which are: giving customers confidence in rail transport safety, stimulating market in health conditions to all competitors, establishing a secure relation between rail companies and governmental sector, pursuing standardization, assuring decreases on accident rates and fatalities, and achieving an overall safety rate improvement.

6. Cost Benefit Analysis

The proposal of every new implementation has the cost-benefits analysis as an important step. Before implementing any new policy, it is important to discuss what are the pros and constrains of the new measure, how much it is going to be spent and what are the benefits coming from this.

Considering the proposal of a federal regulation to rule safety in rail passenger transportation, these pros must be considered:

- Talking about safety is also talking about good image of the company to users and investors, what attracts them.
- Safety is a relevant issue evaluated by stakeholders when they consider investing or relating themselves with the company, even more when this means bonding their image to the company's image.
- Taking care of safety is an essential part of the company's effort to realize the constitutional guarantee of transportation as a fundamental right of the citizens.
- Standardization, one of the pillars of the federal regulation, means to enable integrating different systems, create a unique rail network (or, at least, a number of compatible and linked rail networks).
- It is not feasible to monetize human lives, however, the efforts to eradicate accidents or to minimize chances of fatalities is undoubtedly worth enough to be taken.
- Considering that running any rail service is essentially linked to adopting safety measures, building a federal regulation means standardizing practices and, with this, selecting the best options in order to avoid negligence or superfluous efforts, to save money from companies.

The proposal's constrains are:

- Some companies, especially in the beginning of the new regulations' validity, must show themselves less interested in investing in rail transport. Possibly, it will be necessary to give companies tax breaks in the first years.
- Regulation bodies will need to expand their audit staff to supervise companies. Also, minimum standards must be created by regulation bodies, together with all stakeholders, in order to create a regulation healthy for all involved with it.
- On operation and maintenance visions, sometimes, improving safety is inversely proportional to fast transport. Considering this, it is possible that the regulation causes delays or lower operational or maintenance performances in order to assure safety, in some cases.

Figure 1 – Pros and Constrains summary

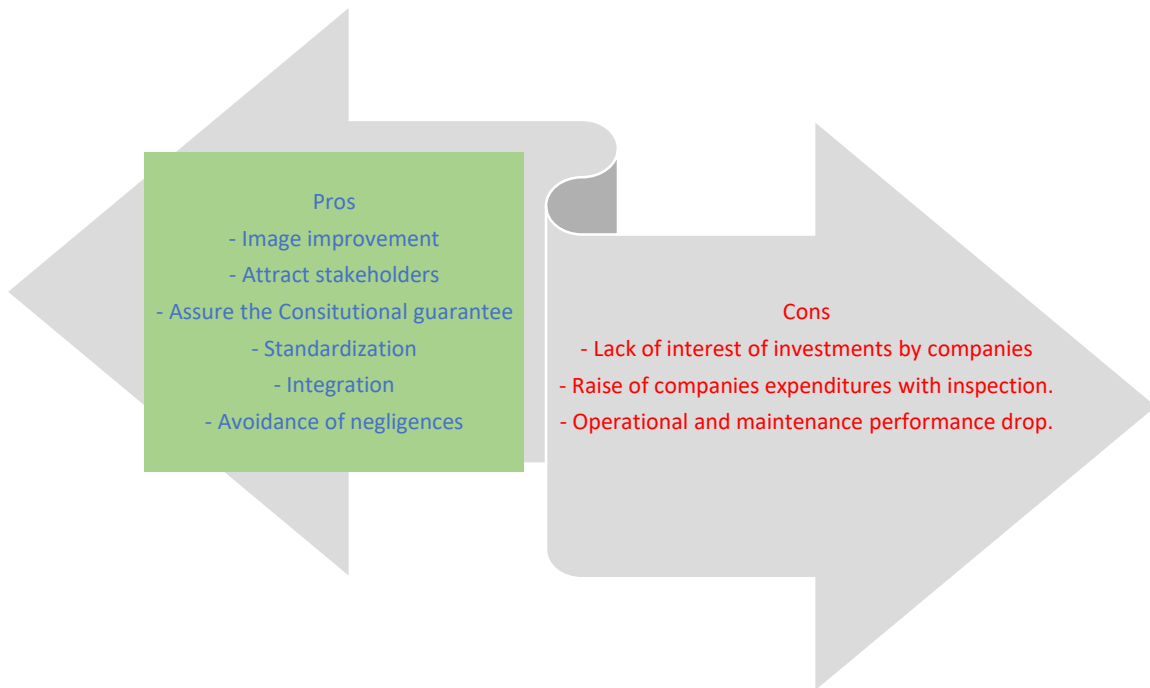
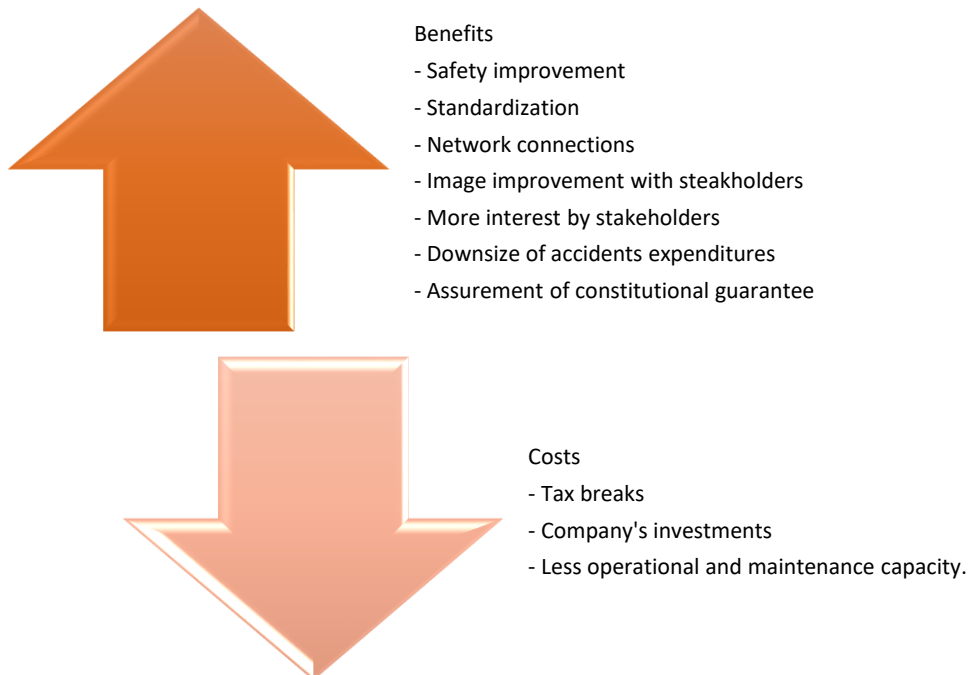


Figure 2 – Costs and benefits



7. Risk Analysis

Environmental analysis is a critical part of the strategic management planning process. The SWOT matrix is a tool used to identify the strengths, weaknesses (internal vision) and opportunities and threats (external vision), consisting in an *“analytical tool which should be used to categorize significant environmental factors”* (Pickton; Wright, 1998, p. 101).

Understanding the environment where any proposal is going to take place is truly important. In fact:

“So-called environmental scanning and environmental analysis (although many may use alternative terminology) are considered such a fundamental and basic part of the business planning process that the need to carry them out is accepted without question. There are few, if any, who would deny the inherent value of, and necessity for, an understanding of the business environment as a precursor to management decision making although there is only mixed evidence to suggest that businesses carry out such environmental auditing very well” (Pickton; Wright, 1998, p. 101).

Considering this, it is important to define this scenario to the legislation proposed, from the point of view of the legislator:

Figure 3 – SWOT Matrix

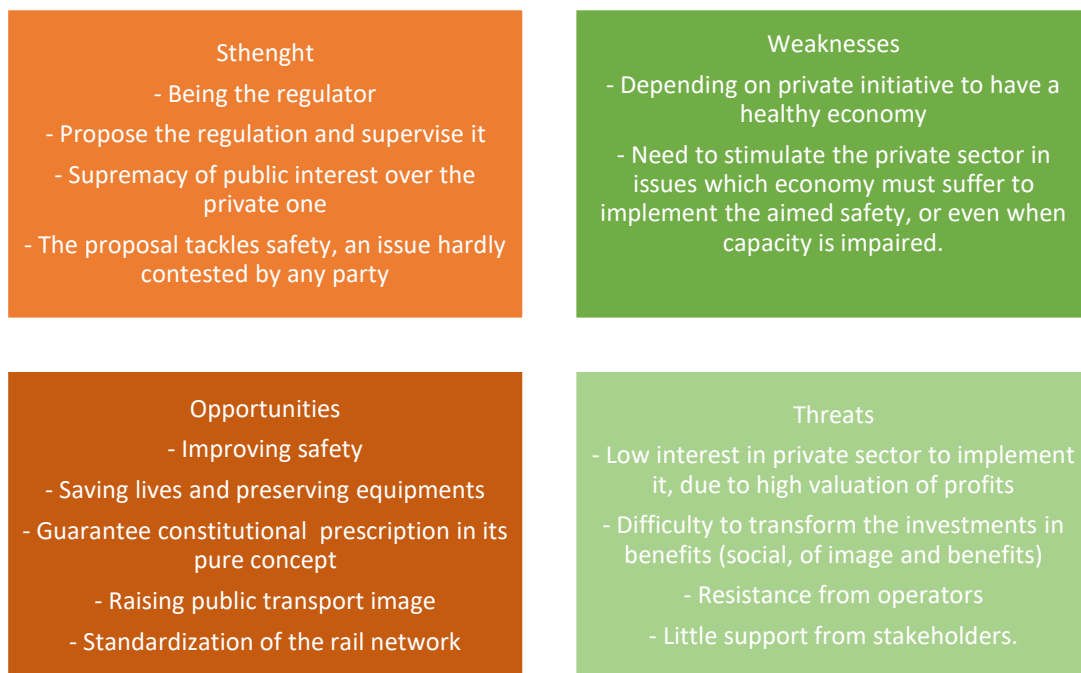


Table 1 – SWOT Analysis

SWOT Analysis Analysis of Internal Factors		Analysis of External Factors	
		Opportunities	Threats
Strengths	<ul style="list-style-type: none"> - Propose regulation to improve safety - Being an active part of guaranteeing the constitutional prescription 	<ul style="list-style-type: none"> - Tax breaks - Turn public the effort to make rail transportation safer. - 	
Weaknesses	<ul style="list-style-type: none"> - Stimulate private sector to be an active defendant of safety standards in society. - Expose how those measures can protect also companies' assets (human and equipment) 	<ul style="list-style-type: none"> - Negotiation with private sector and stakeholders 	

8. Project Plan, Implementation Plan

In order to define the implementation plan for this proposal, it is first necessary to define which normative instrument is to be adopted by the Brazilian government, since each of them follows a different rite and procedure. In addition, the appropriate instrument depends, fundamentally, on the legal competence to deal with the subject, which is defined by the national legal order.

Analyzing the Brazilian legislation related to railway safety throughout the national territory, it is verified that Decree nº 1832/1996, in its article 5, defines as a competence of the Ministry of Transport, now Ministry of Infrastructure, the creation of safety standards for rail transport and its supervision. In this way, starting from the level of competence determined by this Decree, it is verified that the regulation of the basic principles that must govern the operational safety of rail passenger transport, throughout the national territory, must start from the Ministry of Transport itself.

In this sense, in order to put into practice, the proposal to establish minimum operational safety requirements, for rail passenger transportation, bringing the detail of the established through the Presidential Decree to light, the instrument chosen to be used is a Ministerial Order.

In the case of detailing the criteria for the railway safety of passengers throughout the national territory, in order for this Ministerial Ordinance to be approved, it is necessary to consider in the Plan of Implementation, firstly, to present the proposal to the Ministry, which will decide about its pertinence and relevance. The proposal will be presented to the Transport Secretary affects the transport area, who will meet with the Minister to decide whether to proceed or not, his analysis. For this first approach and decision, it is estimated a deadline of 30 days.

If the Ministry decides to evaluate the standard, its first action will be to establish a Ministerial Working Group to identify and propose the criteria to be established by the legislation. This working group is formed within the Ministry sphere and can count on the participation of guests from other bodies. There is no general rule establish in terms of the duration of the Working Group, but considering the work carried out as a starting point for the definition of railway passenger safety criteria, it would be advisable to work with a minimum period of 12 months. As a final product, the Working Group would present a draft of the minimum safety requirements for rail passenger transport.

Following the completion of the studies promoted by the Working Group, the proposed final draft will be submitted to the Legal Counsel of the Ministry, which will evaluate the terms proposed by the document in relation to its constitutionality and legality, may suggest changes and submit an opinion by its approval, or not. There is no deadline for the analysis of the Legal Consultancy, but it works with an expectation of at least 60 days.

If the opinion does not recommend approval of the document, the process goes to the Office of the Minister, who may request changes or adjustments in the document prepared. This feedback process does not have a definite deadline, but should it occur, a base of 60 days should be considered, after which a further 30 days should be considered for a new evaluation and approval by the Legal Counsel of the Ministry.

Once approved, the document goes to the Office of the Minister, where the Ordinance will be signed. The signature act is simple, however, considering the ministerial priority, the political component and the other measures to be implemented, it is estimated a period of 30 days for its signature. After signing, the act must be published in the *Diário Oficial da União* (Official Gazette of the Union), so that it may have legal effects. In order to fit your graduate to the edition of the

Official Gazette, a period of two more days is expected. Upon its publication in the Official Gazette, the proposed measure will take effect.

The following is a schematic view of the implementation plan of the proposed measure, which will have an estimated duration of 577 days.

Table 2 – Implementation Plan

Step	Responsible	Duration (day)	Implementation Plan																				
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Presentation of the proposal	Rail Sector	1	●																				
Analysis of the proposal	Government Secretary	29	→	●																			
Proposal of criteria	Ministry Working Group	365	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	
Legal Analysis	Legal Advice Ministry	60												→	●								
Documentary review	Government Secretary	60																		→	●		
Legal Approval	Legal Advice Ministry	30																			→	●	
signature of regulation	Minister of State	30																				→	●
DOU Publication	Government Secretary	2																				→	●
Estimated time frame for implementation of legislation		577																					●

9. Financial Plan

The Financial Planning of any new application should be part of the company's strategy, with the purpose of supporting decision-making in the present, analyzing and controlling the impacts that will occur in the future. With financial planning it is possible to carry out the analysis and control of the resources that will be generated, allowing to make better decisions regarding current and future investments and financing.

However, taking into consideration that the present work is based on the proposition of a national safety regulation for the operation of passenger trains in Brazil, it is fundamental to consider that, in this case, the application will be the construction of a federal legislation for the entire Brazilian territory that defines and regulates the minimum safety requirements of interregional rail operations. Thus, a possible financial plan must consider, on the one hand, the costs of the Brazilian government with the new legislation and, on the other hand, the costs that must be absorbed by the market to adapt itself to the new rules established.

In the first case, it is very difficult to establish specifically the costs of the Brazilian government for the study and establishment of new Brazilian legislation, since the governmental structure is already fully constituted and serves to the development of all the activities promoted by it. In this case, since all costs for this action would already be included within the current governance structure, it can be considered that there will be no additional costs to the Brazilian government, due to the implementation of new legislation in Brazil.

In a second moment, it is necessary to evaluate the impacts that will be generated to the already existing operators in the market and the costs that they will have to adapt to the new rules to be established. This analysis is fundamental and must be considered even before the new legal regulation is published, since in already fully established markets the costs of adapting local agents to the new requirements of a law can be so high that they make it impossible to enforce them.

With regard to this second point, it is important to consider that, in accordance with what was originally planned, it was not possible in this study to propose in detail each item of legislation to be applied to the Brazilian case. However, although the study does not allow to detail the terms of the legislation to be applied to the Brazilian case, the surveys conducted show us some ways to be followed for regulatory purposes in the Brazilian case, that should include common safety indicators, methods and targets, that must be followed by interregional railroads or interoperable ones, as described in the topic 5.4.

Thus, without specific knowledge of the requirements that will be considered by the new legislation, it is impossible to define the costs for the adaptation of the current operators. However, it can be assumed that, if the legislation project would be approved and applicable, the operators already on the market would have few financial costs to attend the minimum safety parameters as they already have internal safety procedures that, probably, are even higher than the future ones present on the new legislation. However, it should be in mind that, over time, these costs may rise as a result of an eventual disorderly growth of the market, which will make harmonization based on legal requirements have a greater financial impact in the future.

On the other hand, future passengers' operators interested on passenger lines would already consider these minimum safety parameters presented on the law on its costs and implementation plans.

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