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PRESIDENT

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FUTURE

TECHNICAL ARTICLE

RAILWAY:
ESSENTIAL
INFRASTRUCTURE
FOR DEVELOPMENT

IT'S HAPPENING

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RAILWAY: ESSENTIAL INFRASTRUCTURE FOR DEVELOPMENT



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HYBRID APPROACHES IN RAILWAY ENTERPRISES WITH SEMI-INTEGRATED EXECUTION

Wellington Berganton
President of
AEEFSJ



A great driving force for the Economy, this year we celebrate the 170th anniversary of the first railway built on Brazilian territory. The Mauá Railway, as it is known today, was a pioneering project by businessman Irineu Evangelista de Souza, the famous Mauá Baron. Opened on April 30, 1854, the small railway of just over 14 km connected the Mauá Port to Fragoso, in Rio de Janeiro. Not by chance, this date also became the Railway Day.

And, 170 years later, in this historic edition, we show that the railway is indeed an essential infrastructure for national socioeconomic progress. It is enough to analyze the major economies around the world to see the fundamental role it plays in both the passenger and logistics sectors. It is impossible to dissociate the prosperity and wealth of a nation from its railway system, when it is strengthened and thriving.

Stimulating the national railway industry requires bold actions, which reduce taxes and expand tax incentives, as this involves environmental gains for the population. Railways are sustainable and, by avoiding the emission of greenhouse gases, they reduce atmospheric pollution, contributing to the preservation of the environment and the quality of life on the planet.

Rails are essential for loading products, especially agricultural production and manufactured goods, with numerous advantages in the flow of large loads, producing and generating wealth for the entire society.

The São Paulo metropolitan train

operator is a great case. Dependent on Government resources, it uses money creatively by investing in innovation, technology and maker culture, which works with the “Do It Yourself” logic and, thus, avoids waste of materials, with intelligent use and sustainable, following the premises of enterprise management. And there are plenty of examples.

In São Paulo, the project called “Inovagão” was implemented, in 2021, an old, decommissioned wagon was transformed into an innovation laboratory, which functions as a room for training, studies, experiments, development and testing of projects and products.

The following year, it was the turn of “FerroLab”, a digital space equipped with a 3D printer and scanner, vinyl and laser cutters, plotters and milling machines. On site it is possible to create rapid functional prototypes to test railway concepts, identify flaws and improve them before investing resources for large-scale production.

Furthermore, it encourages interdisciplinarity by bringing together people from different areas, such as engineers, technicians and designers, integrating knowledge and skills, which result in creative and innovative solutions.

Ultimately, protagonism, knowledge and motivation is part of the DNA of the railway sector and to multiply this know-how it is necessary to respect and consider the manager's role as multidisciplinary and systemic, supported by supervisory institutions such as regulatory agencies, so

necessary to, above all, improve the lives of passengers.

The seed was sown in the 18th century by the Mauá Baron. A visionary, in 1867, he teamed up with the British engineer, James Brunlees, to build the São Paulo Railway, connecting Jundiaí to the Santos Port. First railway in São Paulo, SPR overcame the challenges of Serra do Mar to take the coffee produced in the interior of São Paulo to ships anchored in the port, which would disseminate it throughout the world.

As an example of success and perseverance, the AEEFSJ – Association of Engineers of the Santos to Jundiaí Railway was founded on May 18th, 1954, which has undergone many transformations and, in these seven decades, has always acted inspired by the lessons of great Mauá Baron, by seeking innovation and acting with a focus on defense, training and qualification of railway workers. With this pluralistic vision, AEEFSJ incorporated among its members not only professionals from Engineering and Architecture, but also from Administration, Law, Communication, Accounting Sciences, Mathematics, Social Studies, History, Geography, Environment, Technologies and even the Military.

With this group of experts, our Association maintains railway qualifications in different fields of human knowledge, which are essential for companies or concessionaires entering this sector and will need this expertise to maintain the standard of excellence in the services offered. and safety in railway operations.

PASSENGER SATISFACTION IN NUMBERS: THE RESULT OF HARD AND RESPONSIBLE WORK

Suppose a football team scores 86 goals for every 100 shots. Now imagine the joy of an entire team upon learning this and remembering all their efforts to achieve this brilliant index. This good feeling is what CPTM's more than 6 thousand employees, including me, feel when we see the results of our satisfaction survey.

Between December 19th and 29th, 2023, 17 researchers and 4 supervisors went into the field at the 57 CPTM stations, which cover 18 municipalities. 3,010 questionnaires were administered with samples proportional to the flow of passengers by peak and off-peak time intervals. Everything was carefully studied so that the result was as close to reality as possible (the research confidence level is 95%, with a margin of error of 3.6% in the lines and 1.8% for the entire network).

The data obtained filled us with pride:

the CPTM Passenger Satisfaction Index obtained 86.74% approval in 2023, the highest percentage in the last five years, the result of strategic planning focused on improving the quality-of-service provision of more than 1.6 million people use the company's five lines every day. We won a championship!

For the company's passengers, who, for the most part, use the trains at least three times a week, the quality of service improved on the five lines compared to previous years for 54.68% of them. Furthermore, 68.94% of these people believe that quality should improve even further in the coming years.

But what makes these passengers, like us, the victorious team, optimistic about the future?

I believe this is the result of several combinations. These people, for example, they see every day that we are working

for their benefit. The works that often bother passengers at the end of the week, with an increase in the average interval between trains, turn into faster trips when they go to work during the week. And this characteristic makes CPTM the only short-distance passenger rail transport company in the world that operates with subway intervals.

They also see improvements at stations, with modernization and accessibility adaptation works, in addition to works on signaling, energy and rail track systems, which allow for faster and safer travel.

They also see them boarding modern, clean trains, with air conditioning adjusted correctly on hot days.

According to the opinion of 34.30% of those interviewed, the biggest change in the service provided was in relation to the quality of the trains, while another 31.65% noticed a reduction in waiting time on platforms.

This same passenger sees the effort made by employees to help, to treat them with respect, always offering the best service to make your day better. He notes the increase in services within our stations and our speed in responding to your questions, whether via social media, WhatsApp or 0800. He follows, every day, the gears moving so that he can achieve reach your destination. We respect those who support CPTM.

All positive results are related to the



Metal walkway
São Caetano Station



Station Elevator
São Caetano



Aerial Network Maintenance Vehicle

investments and operational strategies adopted by the company to improve regularity and reduce intervals between trains on all lines. But we see in our service. This is another part of the return on such a good satisfaction index.

As I said above, the passenger contacts CPTM and knows that its response will be quick and effective. We have a modern and with broad support capacity. Our social networks provide basic information about our services, events and occurrences that may affect your trip on that particular occasion.

We treat our followers with respect, but also with great humor – by smiling, the passenger begins to understand what rolling stock is, AMV and what our famous “loop” is – and how this is beneficial for them.

The service at our stations also helped us achieve this satisfaction index – the objective of which is to overcome 90% as quickly as possible. So much so that, starting this year, CPTM created the “Customer Champion Service” program, an initiative that recognizes the unique value of each employee in creating a

remarkable customer service, which provides an exceptional experience to our customers and reinforces the commitment to each team member to deliver an experience that not only meets, but exceeds the expectations of those who use our stations.

Knowing our passengers helps us understand their needs and, most importantly, meet them. We know, for example, that, in 2023, the number of male people using CPTM corresponded to 54.45% and 45.55% of females, and that people aged 25 to 34 represent the most significant percentage of the five lines, totaling 27.74% of the total. A pesquisa também quis saber se os entrevistados trocariam a utilização do trem por ônibus e 87,28% responderam que não mudariam o uso do modal – não se mexe em time que está ganhando. Furthermore, 75.22% of passengers reported that they chose CPTM more than five years ago – following the growth of our own satisfaction survey.

The survey also wanted to know whether respondents would change their use of the train for buses and 87.28% responded that they would not change their use of the mode – you don't change the team that is winning.

In these five years in which we started the satisfaction survey with 79.35% approval – an already high rate, we know, but we always wanted more, we reached more than 80% in 2020 and we continue like this, always keeping an eye on the needs of our customers. passengers and in search of innovative and effective answers to their demands



Early morning maintenance on permanent road



Pedro Moro
President of CPTM since
2019

TROLLEY CONTACT WIRE PERFORMANCE AND TEMPERATURE INCREASE

This article is an integral part of the Railway Electrification Manual prepared by JICA – Japan International Cooperation Agency for the Steel Railway electrification course in cooperation with RFFSA-ENGEFER.

In Revista Ferrovia (issue 183/2023), we dealt with considerations about the contact wire, trolley type, in the constitution of the overhead traction network. In this article, we will discuss other factors that also contribute to changing the behavior of this catenary component, which are the following:

CATENARY VIBRATION

During current collection by the pantograph, catenary vibrations may occur in the area around the critical point due to the variation in the superelevation of the permanent track.

As a result, there will be repetitive torsional force due to the vibration of the catenary, which will be large at these points and will increase with the speed of the operation, which may cause the trolley wire to break in the vicinity of that point, caused by the fatigue of the catenary. Therefore, efforts should be made to reduce critical points and, where this is not possible, more resistant materials should be used.

TROLLEY WIRE TEMPERATURE RISE

The rise in temperature depends on the incidence of sunlight and the ambient temperature, in addition to the loss of the wire's own resistance and the loss of contact resistance between the pantograph and the trolley wire. On railways electrified by alternating current, voltages are high with low current and the

increase in the temperature of the trolley wire hardly causes any problems, which does not occur with railways electrified in direct current, with low voltages and high currents.

INCREASE IN TEMPERATURE IN RELATION TO AMBIENT TEMPERATURE AND WITH THE INCIDENCE OF SUNLIGHT

Normally, the ambient temperature and the temperature of the sun's rays are adopted, with this difference being between 40° Celsius between the minimum and maximum. The rise in temperature due to the Joule effect, resulting from the incidence of solar rays, must also be considered.

TEMPERATURE RISE DUE TO LOSS OF RESISTANCE IN THE TROLLEY WIRE

There is a basic temperature rise due to the current coming from the trolley wire and an increase in temperature at the derivation locations. The incoming current of the trolley wire at these points depends on the time- distance from the catenary, with an increase in temperature with the entry and exit of the electrical current.

With the increase in the power of the electric train and the decrease in the interval between them, there will be an increase in the local temperature and a consequent increase in the basic temperature, resulting in corrosion of the trolley wire because of the increase in temperature of this wire.

TEMPERATURE RISE DUE TO CONTACT RESISTANCE

The rise in temperature due to the contact resistance between the pantograph and the trolley wire is caused

by the increase in the capture resistance, increasing the current required to move the train.

PROTECTION MEASURES AGAINST TEMPERATURE RISE

Some measures may be taken to minimize this effect, such as:

- a - Install more power cables;
- b - Increase the cross section of the contact wire;
- c - Use single and double catenaries to support high current collection; and
- d - Use material with low contact resistance between the pantograph and the trolley wire.

João Dini Pivoto

Electrical and electrical engineer Workplace safety; Post-Graduate in Management- Emphasis in Business; Specialization in Railway Signaling - Japan; Specialization in Electric Traction – Argentina; Former Regional Councilor of CREASP by AEEFSJ



RAILWAY: ESSENTIAL INFRASTRUCTURE FOR ECONOMIC DEVELOPMENT



HISTORICAL ROLE IN ECONOMIC DEVELOPMENT

Since their invention in the early 19th century, railway tracks have revolutionized the way people and goods are transported. Today, railway tracks are used all over the world, offering an efficient alternative in terms of cost and energy compared to other transport options, being in many countries the main mode in the transportation system.

At the time of Colonial Brazil and the beginning of the Empire, transport was carried out basically through animal traction, the cost of which was extremely

high and, consequently, restricted the country's growth. Brazil was characterized by several isolated economies that did not trade with each other. With the construction of railways from the 19th century onwards, there was a reduction in these transport costs and the number of resources saved was directed to other areas of the economy, such as the banking sector and industries.

The construction of railways was also responsible for urban expansion. To the Cities that were served by railway lines became important connection points, attracting investments and migrants

in search of job opportunities. New neighborhoods and suburbs emerged around train stations, driving population growth and urbanization in these locations.

THE CURRENT ROLE OF THE RAILWAY STRUCTURE

Railway tracks play a fundamental role in the economy of many countries, as they are the mode of transport in which large quantities of goods are transported long distances in a single trip. This is especially relevant for the agricultural, mining and energy industries, where in many cases goods are large or bulky.

Rail transport also facilitates international trade, allowing products to be transported over long distances efficiently and at a low cost per kilometer, when compared to other modes of transport. This helps to open new markets for companies, enabling them to sell their products around the world, as the railway is one of the main means of connecting goods with ports.

Connectivity between the most populous cities and urban centers is another very common use of railway infrastructure. Its use encourages regional development, helping to connect these locations with travel times that are in many cases faster than road mode. This gives people and companies access to new markets, helping to promote economic advancement in less developed areas and away from large economic centers. Furthermore, rail transport can help connect people to essential services, such as health and education, improving their quality of life.

Rail transport can help reduce congestion on the roads, as it has a high capacity to transport people and goods, removing trucks, buses and cars from circulation. As secondary effects, it improves traffic conditions and reduces air pollution, as rail transport is more efficient in terms of fuel consumption and reduces pollutant gas emissions, which helps to preserve the environment. environment and lower operating costs.

TECHNOLOGY AND INNOVATION

In addition to all the positive impact that railway infrastructure brings to logistics and regional development, research, technology development and innovation in the railway sector have presented major advances in recent years, with greater focus on the interaction between people and machines, customer immersion and experience and hyperautomation.

The massive monitoring of components and the ability to analyze large volumes of data (“big data”) allow optimizing predictive maintenance

processes, increasing the safety of cargo and passengers, reducing operational service costs, avoiding delays in schedules and increasing service reliability and end customer satisfaction.

Inspection drones and intelligent traction systems are also some of the technologies focused on the construction of Smart Rail Automation, as well as robotic RPA systems derived from industrial automation, resulting in multiple applications for the cleaning and maintenance of rail tracks. and other infrastructure systems.

In passenger rail transport, automatic ticketing systems, image and suspicious behavior surveillance, boarding optimization of passengers, public information, on-board entertainment and education and facial and biometric identification are some of the possibilities opened by new technologies.

As an example, train stations with a high volume of passengers can be transformed into shopping centers. Big companies are interested in seeing their brands in these seasons. And, with the technologies mentioned above, it is possible to provide a specific experience for each passenger using their smartphone, being able to

inform them that “at this station there is store “X”, which is on the second floor”. With a simple query via 4G internet, a connection is created for consumption within a station.

Finally, autonomous train technology is a new reality that has been developed and improved over the years. This type of rolling stock can move without human intervention, its main objective being to increase the efficiency of the railway system and reduce the risks and errors associated with human activities.

THE CHALLENGE OF EXPANSION AND INVESTMENTS

So that the railway modal has role in the transport infrastructure of any country, investments in this infrastructure, both in maintenance and expansion, must be continuous over the years. And Brazil's challenges begin there.

Large infrastructure works transcend mandates, being subject to changes in management and partisan political aspects. Therefore, a non-partisan State plan for this infrastructure becomes fundamental, which unfortunately has not occurred in Brazil for decades.



Without a State plan, qualified and viable projects for expanding the railway network end up not being developed, preventing the mode from expanding. The immediate reflection of this problem is the stagnation in the size of the Brazilian network, currently on the order of 30,000 km, with only 12,000 km in operational conditions, very little for a country of continental dimensions like Brazil.

This stagnation means that the Brazilian transport matrix continues to be “road-based”, with more than 60% of it based on highways, affecting Brazil’s competitiveness in world trade and causing population movements in large numbers. Distances are necessarily by road (more time-consuming) or air (more expensive), when compared to rail transport.

Reversing this scenario is not simple. An investment of more than 2.5% of GDP, for more than a decade, would be necessary for a significant expansion of the Brazilian railway network, also counting on the recovery of the current non-operational network and modernization of the one currently used. Historically, Brazil’s investment in transport infrastructure (speaking of all modes) has never exceeded 1% of GDP.

INTERNATIONAL EXPERIENCES IN RAILWAY PLANS

National plans aimed at development, modernization or expansion of their railway networks exist in several countries around the world. As examples, we can mention:

- China, with its ambitious railway plan initiated in the 2000s, which continues with the construction of long-distance high-speed lines, significantly expanding its railway network;
- India, with the “Vision 2030” plan for the development and modernization of its railway network, focusing on improving existing infrastructure and introducing new technologies;

- The United States, which, even with the use of automobiles being part of its culture, has initiatives at state and federal level to expand the railway system, such as, for example, Brightline, connecting Orlando to South Florida;
- Germany, with its strategy called “Schienenpakt”, which aims to modernize and expand its railway network, prioritizing quality, sustainability and connectivity.
- The United Kingdom, always a reference in the use of rail, has significant investment plans in its rail network, focusing on modernizing existing infrastructure, introducing faster trains and improving current services.

These are some examples that could serve as a basis, making the necessary adjustments to the Brazilian reality, for the construction of a robust long-term plan for the resumption of railway expansion in Brazil.

CONCLUSION

The historical role that the railway had in the growth of nations is undeniable, being in many cases the backbone of infrastructure, economic development and national integration of many countries. Even with the development and creation of new modes of transport after its creation, the railway “continued current”, with a central function both in the transport of goods and in the circulation of people and services.

Its competitiveness, strong environmental appeal and prominent role in research, technology and innovation mean that several countries around the world have specific plans for their modernization and expansion, which demands the creation of plans of long-term transport infrastructure, with the commitment to be put into practice.

In Brazil, the great challenge is to make up for lost time in the maintenance and expansion of the railway network, aiming not only at its historical recovery,

but also for the railway to increase Brazilian competitiveness in world trade and create regional integrations that are so important in a country with Brazilian dimensions.

If governments do not become aware that this is a State program and not a political party and there is no heavy, long-term financial investment, with the development of robust studies and projects for recovery, modernization and expansion network, the country runs a serious risk of further reducing its relevance on the international scene, with its current transport infrastructure potentially collapsing in the short term.



Rodrigo Sartoratto de Alencar
Executive Advisor at CPTM Presidency

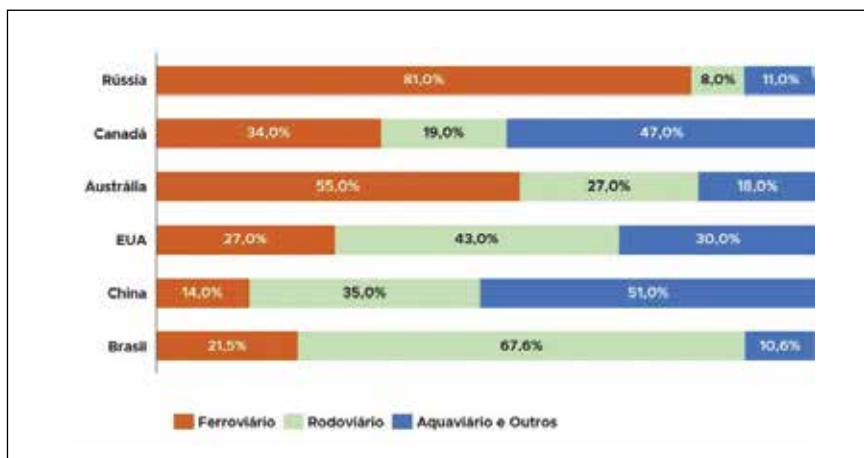
ASPECTS OF BRAZILIAN RAILWAY INFRASTRUCTURE

The railway is present in our imagination as responsible for the integration between distant regions, inducing progress and promoting cities. The sight of a passing train, with its carriages and peculiar sounds, awakens nostalgic feelings and takes us back to a time when its value was recognized by everyone. However, it is still crucial today for the matrix of a country's future, especially those with continental dimensions like Brazil.

This principle is accepted by countries such as the United States, Russia, Canada and Australia, and more. They have extensive railway networks that are responsible for an important part of the transport system. Graph 1, taken from the website from ANTF – Associação Nacional dos Transportadores Ferroviários (National Association of Railway Transporters), shows us what railway participation is like in these countries. It was prepared based on information from the Plano Nacional de Logística (National Logistics Plan) – PNL 2035 of the Federal Government and with a database from 2022¹.

Brazil is a country with low railway density compared to the previously mentioned countries. It is the result of the stagnation of its network and caused by historical, economic and political factors. We will highlight some of them that negatively impacted the evolution of the Brazilian railway network.

Firstly, and perhaps the most important, was the prioritization of road transport that occurred in the 1950s and 1960s. The automobile became a symbol of modernity and mobility and participated, throughout the world, in the reconstruction of economies of countries that had been



Graph 1 – Participation in the rail transport matrix

affected by the economic crisis generated by Second World War. Furthermore, due to the improvement in people's purchasing power, the automobile became an object of consumer desire, as it provided a degree of freedom in travel never seen before in traditional railway and animal-drawn modes. Road technological developments expanded rapidly with the reduction in vehicle prices, the creation of efficient production lines and the establishment of comprehensive road infrastructure. This road development was in line with the desire for individual freedom, expansion of private property and free enterprise, as well as the reduction of State interference in people's lives. These were cherished values of modernity and liberal philosophy. Thus, private and State financial resources allocated to the railways were drastically reduced.

Another contribution to the low Brazilian railway density is the continental dimension of Brazil. It adds economic and

logistical difficulties to the installation of new railways. The complexity of the projects and the social and environmental impacts require long implementation times and high investment costs for railway systems. Furthermore, the lack of in-depth studies of economic and social cost-benefit and intermodal integration discouraged the growth of the rail network. Finally, there is a lack of investment in maintenance and expansion of the existing railway network, which causes stagnation and low productivity in the sector.

Graph 2 shows us the comparison of rail modal density between different countries. The density indicator is obtained by dividing the railway length by the total national area. Note that Brazil has the lowest density among the countries listed. The information is from 2022 and obtained from the ANTF website².

Knowing the evolution of the legal regulation of the national railway system is important to understand the reasons

¹ ANTF website – National Association of Railway Transporters. Data referring to the year 2022. Available at <https://www.antf.org.br/>. Accessed in February/2024.

² Ibid. ANTF

	ÁREA (MILHÕES KM ²)	FERROVIA (MIL KM)	FERROVIAS/ÁREA (KM/1000KM ²)
ÍNDIA	3,29	108,71	33,04
EUA	9,83	293,56	29,86
ÁFRICA DO SUL	1,22	24,28	19,90
CHINA	9,6	141,40	14,73
MÉXICO	1,96	26,91	13,73
CANADÁ	9,98	77,93	7,81
ARGENTINA	2,78	18,00	6,47
RÚSSIA	17,1	86,00	5,03
AUSTRÁLIA	7,74	33,34	4,31
BRASIL	8,52	30,81	3,62

Graph 2 – Density of railway networks

for its situation in the transport matrix and foresee what will happen in the future. All regulation is influenced by political and economic contexts that characterize a phase in our history. So, let's check which legal frameworks influenced the implementation of our railways.

Brazil opened its first railway in 1854, the result of a concession from the then Province of Rio de Janeiro to businessman Irineu Evangelista de Souza. The undertaking was carried out based on the Imperial Interest Guarantee Law, decree 641 of June 26th, 1852. The construction and operation of the railway for up to 90 years and a series of benefits were part of this license. Among them, we can highlight the guaranteed business return of up to 5% on the capital allocated to its construction and the exemption from import taxes for rails and other inputs. It still imposed a market monopoly with a prohibition on the construction of another railway within a radius of around 30 kilometers from the implemented railway.

Between 1854 and 1889, based on the imperial railway regulatory framework that was not limited to the aforementioned “Interest Guarantee Law”, more than 9 thousand kilometers of railways were built in the country. The Brazilian government gradually became a shareholder in concessionary companies due to the lack of private financial capacity for the expansion of the railway network. It was vital to the country's commercial

progress (CNT, 2013). These railways were concentrated, especially, in the Southeast and South regions.

At the beginning of the 20th century, there was a major Brazilian railway expansion, following the global trend and motivated by international trade in agricultural products, especially coffee. At the end of the 1930s, Brazil had around 29 thousand kilometers of railways, which greatly contributed to the nation's advancement.

Until 1941, state control of railways was the responsibility of the Federal Road Inspectorate – IFE, a body linked to the Ministry of Transport and Public Works. However, with Decree-Law no. 3.163, of March 31, 1941, it was replaced by the National Department of Railways – DNEF. In 1950, the General Railway Refurbishment Plan was established, which, together with the National Railway Fund, aimed to finance the railways. Due to the negative effects on the economy caused by the Second World War, a process of nationalization of railways was observed. Private resources migrated to the reconstruction of national industries and to promote international trade. This effect culminated, in 1957, with the creation of the *Rede Ferroviária Federal Sociedade Anônima* – RFFSA, through Law No. 3.115. The company unified the railroads belonging to the federal government, totaling 39 thousand kilometers of tracks (THIESSSEN, 2023).

Later, in 1971, the Government of the State of São Paulo unified the São Paulo railways with Ferrovia Paulista S/A – Fepasa. This company was incorporated by RFFSA in 1998.

Brazilian railways, despite being drivers of the country's economic development, represented 90% of the public budget deficit in the middle of the 20th century, making its state management model unsustainable (CNT, 2013). Thus, in 1992, by Decree no. 473/92, RFFSA was included in the National Privatization Plan – PND, which was supported by articles 21 and 175 of the 1988 Federal Constitution. Article 21 defines the forms of granting for the exploitation of public services applied to the railway sector, that is, concession, permission and authorization. Article 175 establishes that concession or permission regimes must always be carried out through bidding, respecting user rights, tariff policy and the adequacy of the service provided. Although the type of permission is not explicitly addressed in article 175, there is a legal understanding that there is no conflict between the two articles cited (THIESSSEN, 2023).

Railway concessions, during this period, were made in accordance with two laws: Law no. 8.987, of February 13, 1995, which provided for the concession and permission regime for the provision of public services, and Law no. 9.074, of July 7th, 1995, which authorized the concession of federal roads. RFFSA's railway network, covering around 25,600 kilometers, was awarded and divided into seven contracts. In addition, the two railways operated by Companhia Vale do Rio Doce, the Carajás Railway and the Vitória a Minas Railway, were also included in the concession package.

Despite private administration, these railways, to this day, operate with low productivity and are concentrated in the transport of bulk materials, such as ores, with around 70%; agricultural production, with 18.5%; and steel products with 6.8% (QUEIROZ, 2023). The causes of low productivity are related to insufficient

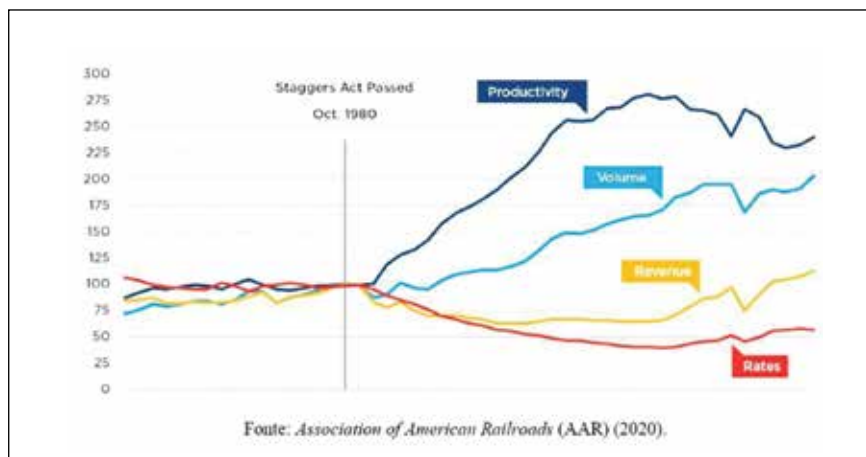
investment problems in maintenance and expansion of the network, low average train speeds, large number of level crossings in more populated centers and interference and invasions in railway right-of-way.

This low productivity, caused by structural problems and the low national railway density, refers to the comparison of performance between Brazilian railways and similar railways in the rest of the world and does not mean that there was no significant increase in the production efficiency of the rail freight transport after its privatization. Between 1997 and 2012, the TKU (ton per useful kilometer) of concession railways increased from 137.2 billion to 320.0 billion, which represented a significant increase of 133% (CNT, 2013).

Although the auctions for the concession of freight railways took place between 1996 and 1998, it was only in 2001 that the regulatory body for the sector, the *Agência Nacional de Transportes Terrestres* (National Land Transport Agency) – ANTT, was created, through Law No. 10.233. It is responsible for regulating the penalties and rights and duties provided for in the concession contracts and for monitoring compliance with its contractual clauses. In addition to the rail freight system, ANTT also regulates and supervises the service provided by third parties on the interstate road system for both passengers and freight.

The concession model adopted in Brazil relieved the State of the expenses necessary to maintain almost the entire national railway network, concentrating public investments in new projects, the main one being the North-South Railway. However, as determined by the *Confederação Nacional do Transporte* (National Transport Confederation) – CNT –, in its article “The Brazilian Railway System”, between 1997 and 2012, state investment represented 23% of private investment. While the private entity invested around R\$34 billion, the public invested only R\$ 10 billion (CNT, 2013).

The complexity of Brazilian regulation,



Graph 3 – Performance indicators after Staggers Rail Act

linked to the concession model are, did not favor the emergence of new investors in the railway sector. Seeking to overcome this difficulty, in 2018 Senate Bill No. 261/2018 proposed significant changes to the regulatory framework for Brazilian railways. The main one was the possibility of using the authorization grant mechanism, provided for in the Federal Constitution, creating railways under private law. This model was already used in airport and port systems.

The inspiration for the proposition of PL 261/2018 was American legislation from the 1980s, called Staggers Rail ACT, which promoted the deregulation of the railway sector in that country, enabling free negotiation of prices and contracts between companies and their customers. The evolution of the efficiency of North American railways was considerable, with an increase in productivity and transported volume. Graph 3, produced by the Association of American Railroads – AAR, illustrates this gain (QUEIROZ, 2023).

After intense processing, the Law in 14,273, also called the Railway Law, was enacted on December 23, 2021. It brings a series of innovations to the national railway regulatory framework. Firstly, it creates the institute of granting by authorization, which was not used in the sector. This mechanism is simpler and

less bureaucratic than the concession, allowing it to be obtained by the interested party, through a request or a call from the public authorities. In this case, there is no bidding process and there is no provision for reversibility of the assets to the Union. The financial, environmental and operational risks are the responsibility of the private interested party. The Law also establishes rules for adapting concessions to authorization and creates the institute of railway self-regulation. The grant takes place through an administrative act and not through a contract.

The market reacted with great expectations to the new legal framework for railways, filing many projects for Government approval. In an estimate made by the company INFRA S/A in 2022, 99 requests were registered, from 28 different investors, totaling 25 thousand kilometers of new railways and investments of around R\$256 billion. This proposed private investment is quite significant, considering, as previously mentioned, that the total investment made after the concessions until 2012 was around R\$40 billion.

INFRA is a federal public company, linked to the Ministry of Transport and whose objective is to provide planning, project structuring, engineering and innovation services for the transport sector. The company was created in September

2022, as a result of the incorporation of the Planning Company and Logistics – EPL and VALEC Engenharia, Construções e Ferrovias S/A. It covers road, rail, port, airport and waterway modes³.

Brazil needs both private and state investments to improve its transport logistics structure and become increasingly competitive in the world market. Recently, in an article for the newspaper O Estado de S. Paulo, on January 25, 2024, José Serra, author of the bill that gave rise to the Railway Law, tells us “the commitment of several countries to invest resources from the public budget on railways”. He cites, as an example, the announcement of public investments of US\$66 billion from the United States and US\$30 billion from India. It also reveals to us that Brazil invests very little in infrastructure, being one of the worst in Latin America. National investment in infrastructure between 2008 and 2019 was “around 0.7% of GDP per year, on average, while other countries reached more than 3% of GDP”. The amount invested is below what is necessary, which is estimated at between 4% and 5% of GDP (SERRA, 2024).

Finally, we believe that a comprehensive railway structure meets society's desires for connection and integration with efficient and equitable access. This is a fundamental condition for social equality and collective development. The construction of railways reduces regional disparities, enabling the movement of goods and people in an accessible and safe manner. It reduces the Brazil Cost and makes us more competitive in world markets. Furthermore, as we know, rail transport contributes to environmental preservation as it is one of the least polluting means of transport.

We, railway workers, believe that Brazilian economic and social progress passes through rail tracks, and we are always ready to contribute with dedication, knowledge and experience. We can only trust that public men recognize this importance for the well-being of the population and the future of our nation.



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³ INFRA – website www.infrasa.gov.br

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CPTM — CONTRIBUTING TO THE DEVELOPMENT OF THE MUNICIPALITIES IT SERVES

As a mobility company with a high flow of passengers, more than 1.6 million passengers per day, on average, CPTM today has 196 km of lines and 57 operational stations, serves 18 municipalities and is considered the best alternative to alleviate the mobility problem in the Metropolitan Region of São Paulo. This greatly contributes to the progress of these municipalities, in addition to helping adjacent municipalities benefit from favorable conditions and reap the benefits of development. CPTM also continuously promotes improvement and modernization works on the railway system it manages.

CPTM — INFRASTRUCTURE IN CONSTANT TRANSFORMATION

So, what has been done in these mobility infrastructures? How can they leverage the movement of people around cities, ensuring urban development?

One of the things that caught my attention the most when I arrived at CPTM was the quality of the floors in the Stations. Rubber floors, especially currency floors, became popular in the 1980s due to their practical installation, resistance and anti-slip properties. At that time, this type of material was widely used in subway stations.

Over time, it was realized that, despite the low initial cost for its implementation, it did not meet the precepts of sustainability, a priority in society current.

Its color makes it necessary to have greater lighting to guarantee lighting comfort, its washing requires specific machines and products to guarantee hygienic conditions, and repairs have become increasingly frequent.

In response to these challenges, the CPTM's Operations and Maintenance Directorate initiated a study to replace this type of flooring in its stations with a material that would meet sustainability criteria throughout its entire life cycle, from its initial installation phase to its useful life. The chosen option was granite flooring due to its resistance, hardness, low absorption, porosity, and diversity of colors and textures.

The floor was chosen in 50 x 50 cm slabs, in swallow gray color, with a levigated surface that brings a texture to the floor, guaranteeing friction and providing anti-slip characteristics. After installation, the floor was treated with a specific resin that guarantees even more beauty and makes it easier to maintain clean conditions.

Replacement services have started took place in the second half of 2021 and lasted for 2 (two) years, with granite being installed at the Palmeiras-Barra Funda, Brás and Guaianases Stations, totaling more than 41,200 m² of flooring.

PALMEIRAS-BARRA FUNDA STATION

This Station was the pioneer, combining track modernization works and systems for the extension of Line 13

– Jade (in operation – Airport Express) and the extension of Line 11 – Coral (under implementation). Consisting of 10 platforms, mezzanine and operational areas, in these locations the entire rubber floor was demolished, the subfloor was redone, the new granite floor was installed, tactile routes and treatment resin were applied. The services were carried out from June 2021 to October 2022, covering more than 19,000 m² of granite flooring and 3,700 m² of tactile flooring.

All revitalization activities were carried out with the station in operation. With the premise of causing as little damage as possible to the more than 550,000 passengers that travel through the location, several strategies were adopted, including changes to stops, changes to platforms and activities at night and at different times, to make the renovation viable, guaranteeing the provision of the service without interruption of circulation.

BRÁS STATION

It covers lines 7-Ruby, 10-Turquoise, 11-Coral, 12-Sapphire and the CPTM Airport Express. The rubber floor was completely replaced between June 2022 and August 2023. The work was carried out in the 2 access lobbies, 8 platforms and the mezzanine. In these locations, more than 16,600 m² of granite flooring, 2,100 m of baseboards and 5,000 m² of tactile flooring were demolished and installed.

In addition to the floor, almost 2,000 meters of white non-slip strips were replaced on the edges of the platforms, to provide even greater safety for passengers.

The replacement of floors included interventions including in the listed area, relating to the former Brás Station of the São Paulo Railway (current access from Rua Domingos Paiva), through negotiations in which we were supported by the Engineering, Works and Environment Directorate.

A very notable fact about Brás Station

Qualidade do Serviço



Fonte: Pesquisa de Satisfação com os passageiros CPTM - 31.01.2024

is the flow of passengers in the months of November and December to access one of the most important shopping centers in the city, therefore in these months. The works also had to adapt to this peculiarity.

GUAIANASES STATION

It serves Line 11-Coral and had its rubber flooring completely replaced between June 2022 and September 2023. The work was carried out in the access lobbies, 4 platforms and lower mezzanine. In these locations, more than 5,400 m² of granite flooring, 1,600 m of skirting boards and 500 m² of tactile flooring were demolished and installed.

Almost 1,000 m of white non-slip strips were replaced on the edges of platforms, stair steps and ramps, to provide even greater safety for passengers. For the same purpose, the floor of the SSO – Operational Supervision Room – was replaced.

It is an important intermodal terminal integrating the east zone of the city of São Paulo with the center and neighboring cities. Thus, all re-vitalization activities were carried out alongside the operation. In order to cause as little damage as possible to the more than 140,000 passengers traveling through the location, several strategies were adopted, including changes to stops, changes to platforms and activities at night and at

different times, to make the renovation possible, guaranteeing the provision of the service.

RESULTS

At the end of the implementations, it was found that the stations changed their level, floor faults were eliminated, the risks of accidents on the floor were mitigated and maintenance and cleaning costs were reduced. Furthermore, the passenger's perception of the services provided improved, as the color of the floor brought a greater feeling of cleanliness and safety, and this was reflected in the passenger's behavior, which demonstrated greater zeal and care for the stations.

Another highlighted point shows that CPTM has been improving its services to the population every year, which leads to more efficient and more humane cities.

Below, data from the latest satisfaction survey that demonstrate this significant improvement in passenger perception.

Service 710

Item	Anterior	Novo
Intervalo no horário de pico	06 minutos	05 minutos e 30 segundos
Nº de viagens por dia	388 viagens	415 viagens
Equipagem (Postos de Trabalho)	55	58
Nº de trens circulando	37 trens	40 trens
Oferta (lugar/hora/sentido)	20.000 lugares	21.800 lugares

Another point to highlight is the changes in what passengers expect from CPTM today. On the 5 lines operated and maintained by CPTM, several improvements in operational strategies, contributing to the performance and quality of services and, mainly, improving the quality of life of passengers, with an increase in trips and a reduction in the average train interval, in addition to improving quality of trains and stations. In this table we can highlight how such changes brought substantial gains to CPTM passengers, from reducing intervals to increasing the number of trips and trains circulating, which culminated in a greater supply of seats.

Among the improvements highlighted, one of the most important is the reduction in travel time and intervals on CPTM Line 12-Sapphire, 39 km long, this line being one of the most relevant access roads in the east zone of São Paulo and the Alto Tietê region to the center of the São Paulo capital, having 13 stations and transporting, on average, 266 thousand passengers per business day.

The first improvement results were even awarded – the reduction in travel time from 63 minutes to 53 minutes won the Smart Cities award in 2020.

More recently, the line underwent a significant change with the implementation of the “X do Brás” which was the installation of new Track Change Devices (AMVs), forming two crossings (in the shape of an X), to facilitate arrival and the departure of trains at the terminal station, allowing greater fluidity in the circulation of trains on this line.

For this to happen, a truly highly complex strategy was developed, and

Line 11

Item	Anterior	Novo
Intervalo no horário de pico	04 minutos	03 minutos e 30 segundos
Nº de viagens por dia	503 viagens	532 viagens
Equipagem (Postos de Trabalho)	36	39
Nº de trens circulando	26 trens	29 trens
Oferta (lugar/hora/sentido)	30.000 lugares	34.285 lugares

Line 2

Item	Anterior	Novo
Intervalo no horário de pico	05 minutos e 30 segundos	05 minutos
Nº de viagens por dia	354 viagens	369 viagens
Equipagem (Postos de Trabalho)	30	33
Nº de trens circulando	19 trens	22 trens
Oferta (lugar/hora/sentido)	21.800	24.000

from December 26, 2023, the stretch between Tatuapé and Brás was completely closed to that installation work be carried out on new AMVs, as well as interventions on the aerial network and signage, which would be impossible to complete without the total stoppage of traffic on the stretch.

Within the strategy, the implementation of PAESs (Support Plan between Transport Companies in the face of Emergency Situations) by bus and railway was envisaged, in this case fully opening transfers at Tatuapé and Itaquera Stations, with the support of METRÔ-SP

After all, what improvements did this system provide?

The new AMVs formed in an “X” allowed trains on Line 12-Safira to use platforms 6 and 7 at Brás Station almost simultaneously, improving circulation on the stretch between Tatuapé and Brás. This is a solution designed and manufactured exclusively for CPTM, covering all the technical requirements necessary to promote the expected improvements for passengers.

And how was this possible?

In July 2022, CPTM carried out a series of tests that demonstrated that the implementation of new AMVs would help improve circulation on this stretch. At that time, trains only arrived and departed from platform 6.

Carrying out the tests was essential to be sure of the need for implanting the X and the benefits it would bring, mainly with the implementation of the reduction in track circuits (signaling) that had been carried out by the Engineering, Works and Environment Directorate.

These efforts, combined, will reduce the interval between trains to 4.5 minutes, increasing the transport offer and providing greater comfort to passengers.

IMPLEMENTATION OF NEW SERVICES INTEGRATING REGIONS IN LINE WITH THE DEVELOPMENT OF MUNICIPAL INFRASTRUCTURE

Another major gain implemented at CPTM refers to the redefinition of strategies for the availability of transport offerings, now no longer just through lines, but also through services, with its main service implemented on 5/4/2021, called Service 710, which brought profound improvements in the mobility of passengers on Lines 7-Ruby and 10-Turquoise, in which, following the implementation of the service, it was possible to travel between Jundiaí and Rio Grande da Serra without the need to change trains at Brás Station.

The trains that serve the lines make uninterrupted journeys between Jundiaí and Rio Grande da Serra, meeting the long-standing demands of the population

and benefiting those who live and work in ABC Paulista, as well as well as to the north of the metropolitan region of São Paulo. With this service, during all commercial operations (from 4 am to midnight), every day, including weekends and holidays, the final destination of the two lines is no longer Brás Station, which, despite its importance for the mobility of passengers throughout Greater São Paulo, it is just one of the 31 stations on the route, which runs from end to end in approximately 2 hours and 10 minutes.

Another fundamental service was the expansion of the Expresso Aeroporto which, since 12/1/2020, runs every hour, every day of the week, from 5 am until midnight, and on 9/1/2023, was extended to Palmeiras-Barra Funda Station, providing passengers with connectivity with the municipalities served by the service, as well as speed in taking passengers to the airport, with an average travel time of 35 minutes.

MONITORED INFRASTRUCTURE – SECRET IN THE AVAILABILITY OF METRO RAIL SYSTEMS

Of everything we do to keep infrastructure available, monitoring assets have become essential for this mission, whether it be Fixed Equipment (Electrical Power Systems, Permanent Track, Signaling and Civil Structures), whether in Rolling Stock, and in Rolling Stock, we have made a lot of progress and I highlight some points here.

The Continuous Monitoring of trains has the concept of generating a series of information, in addition to alarms and events designed to complement the train's diagnostic function, using specific equipment and software that performs the data communication interface.

This collected information can be sent instantly through a wireless data communication system, and this system allows you to collect, centralize and present this entire volume of information at a single point of contact control, through an online application or software installed on a computer with internet access. This

data allows you to view the status of the entire fleet on screen, providing an overview of its status, including specific faults and the geolocation of each train, connecting in real time to the desired train.

This system allows you to create parameters based on artificial intelligence using all the information, alarms and events collected, indicating when equipment on the monitored train may fail or when this equipment must be stopped to carry out preventive or predictive maintenance.

This functionality demonstrates, in a clear and visual way, the alarms, faults and status of the entire train fleet in real time, so that the control and maintenance engineering center can obtain all the necessary information to make agile and effective decisions.

This system can also be activated after an incident or failure to reproduce the event history. For corrective maintenance, the system also allows you to generate reports containing the active equipment failures and a history of the main failures that occurred between the last train

entries into the maintenance workshop. The purpose of the faults to be considered in these reports is to make it possible to detail faulty systems and complete the repair more quickly.

The conclusion is that continuous monitoring of systems, as well as comparison with several predefined parameters, allows us to obtain a model for increasing performance and a model for monitoring indicators.

CPTM – ESSENTIAL INFRASTRUCTURE FOR DEVELOPMENT – NEXT STEPS

CPTM has become, every day, a better company, being one of the best operators in Brazil, as assessed by its own passengers, building with them a positive image of quality, safety and, mainly, trust in what you deliver.

In recent years, it reached the historic mark, in the satisfaction survey, of almost **87% positive evaluation**. Considering the national scenario of operators of Brazilian metro rail systems and the transport challenges of a megalopolis, is a very expressive mark, which shows that the work that has been developed is on

the right path, whose focus will always be the passenger, our client.

I end this article with a reflection, making it clear that *“I am part of a team. So, when I win, it's not just me who wins. In a way, I finish the work of a huge group of people.”* Based on this phrase by the unforgettable Ayrton Senna, I would like to highlight my thanks to the entire Operations and Maintenance Department team, in particular to the Management Advisors, Sérgio Barbosa, Guilherme Lopes Soledade and Francis Regis Silva, who contributed greatly to all these results achieved.

Luiz Eduardo Argenton
Director of Operations and Maintenance at CPTM



SOS RIO GRANDE DO SUL

AEEFSJ expresses solidarity with the victims of the floods in Rio Grande do Sul, in particular we reinforce our support and contributions to the Railway Workers and Families of Trensurb - Empresa de Trens Urbanos de Porto Alegre. At this unprecedented time, we are confident and committed to the recovery of the state and the railway infrastructure, which is so important for the people of Rio Grande do Sul.

HONORABLE MOTION 160 OF 2024 - FOR 70 YEARS OF AEEFSJ

On May 16, 2024, the Association was honored with the important tribute from ALESP – Legislative Assembly of São Paulo, through publication in the Official Gazette of the Legislative Power, authored by State Deputy Ricardo Madalena – President of the Transport Commission of the State of São Paulo. We are honored and happy with this important and historic tribute. Thank you State Deputies of São Paulo!!



ECONOMIC SUSTAINABILITY ON TRACK



For more than 50 years, society has been improving the concept of sustainability. The word sustainable has, among its definitions, the ability to guarantee or support one or more conditions of something or someone.

In October 1987, with the publication of the Brundtland Report, a document entitled “Our Common Future”, coordinated by the Norwegian Gro Harlem Brundtland, at the time prime minister of that country, the idea of sustainable development was propagated as a process in which ecological progress must be generated with the preservation of Nature and the reduction of social inequalities in an ethical and responsible way.

The role of companies in relation to economic development and the reduction of social imbalance is increasingly imperative and is something that emerged much earlier with the idea of Corporate Social Responsibility (CSR), which began

in 1953 with the publication of the book *Social Responsibilities of the Businessman*, written by the American economist Howard R. Bowen (1908-1989). It is also worth highlighting that, in the 1920s, the idea of CSR manifested itself in the form of philanthropy through foundations established by the great fortunes of that time (Henry Ford, John D. Rockefeller and Andrew Carnegie).

This concept was improved in subsequent years, by establishing that, for a business to be socially responsible, it must have ethical management, generating quality of life for employees, relationships with stakeholders, reducing negative impacts on society and the environment caused by its actions.

However, in 2005, in the Millennium Ecosystem Report, the UN (Organization of the United Nations) highlights that the world is not evolving to promote

sustainable growth that truly achieves systemic balance. This leads us to the “2030 Agenda for Sustainable Development” with the 17 Sustainable Development Goals (SDGs), which leverage the importance of companies for environmental, social and governance issues, ESG (Environmental, Social and Governance).

When we debate ESG, the tendency is to focus heavily on issues relating to “E” (environmental) and “S” (Social) themes. However, it is important to highlight the topic of Governance. The standards and processes that regulate company management are fundamental to the management and control of an organization.

Within these items, the economic and financial sustainability of the business is fundamental to its survival and continuation in the long term. So important that the AEEFSJ (Association of Engineers of the Santos-Jundiaí Railway), throughout its 50

years of existence, has witnessed how the absence of balanced management can put companies out of business.

The aforementioned economic sustainability-financial is a challenge faced daily by managers to maintain rail passenger transport companies, with a social nature, that allow the population to travel to their professional, personal and leisure occupations.

Revenue is limited by the tariff determined by the public authorities, in order to allow access for the population. This limitation entails the need for permanent and careful management so that operational costs and expenses are within the limits imposed by cash inflows.

A receita é limitada pela tarifa determinada pelo poder público, a fim de possibilitar o acesso da população. Essa limitação acarreta a necessidade de gestão permanente e criteriosa para que os custos e despesas operacionais estejam dentro dos limites impostos pelas entradas de caixa.

To improve revenue, the company looks for ways to explore its spaces and structures, with emphasis on providing areas for advertising, ventures that can generate revenue, leasing spaces for commercial exploitation of stations, among others. These initiatives have brought considerable gains to the company's economic and financial balance.

In the field of expenses, work is being improved to control costs with the aim of creating a culture of responsibility regarding expenses and the impact they have on the balance of accounts. Controlling the company's costs and expenses is essential to analyze the correct application of resources in the core of our core activity, which is passenger transport. Highlighting here our status as a dependent public company, which entails compliance with the State's own regulations and regulations.

For management, it is a permanent challenge to maintain the balance between revenues and expenses and, consequently, sustainability. This work is carried out daily by the area responsible for collection and those responsible for carrying out activities



Rio Grande da Serra Station

that generate costs and expenses. The accompanying the monitoring of these activities, aligned with the improvement of costs, will allow the company to carry out projections and scenarios that indicate which actions are necessary for economic and financial results to be achieved with the objective of demonstrating that we are a company focused on doing more, better and for less.

One of the indicators that shows that we are on the right path is Passenger Satisfaction. In 2023, the satisfaction survey showed 86.74% approval from the population regarding the services provided by CPTM, which demonstrates our ability to execute our purpose with efficiency, effectiveness and quality.

Since the 19th century, when implemented in the country, railways have shown how important they are for economic advancement. Perhaps the first railway export corridor, which provided the development of the city and the State of São Paulo, is that of the São Paulo Railway, succeeded by the Estrada de Ferro Santos-Jundiaí at the end of the concession to the English, when the AEEFSJ was born, which facilitated the flow of coffee from major producing regions to the Port of Santos and to the world.

Even today, these lines transport the people who produce and make the metropolitan regions served responsible for more than 18% of the national GDP, which reveals the importance of our work for the country's sustainable economic progress. We will continue to seek to maintain this level of approval through permanent work, in order to achieve economic-financial balance, transparency in actions, improved results and customer focus.

Finally, we would like to congratulate AEEFSJ, which celebrates its 70th anniversary this year. This milestone was only possible due to the tireless work of its associates who, throughout this period, followed the split, creation and extinction of railway companies but remained firm and promoted actions so that the railway could continue with its operations. in maintaining passenger transport in the metropolitan regions of São Paulo and Jundiaí.

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INVESTMENTS IN RAILWAY WORKS

In the panorama of economic and social development, infrastructure plays a crucial role. Among the various sectors that make up this infrastructure, the railway system stands out as a backbone that drives progress. Investments in railway works not only modernize the transport network, but also stimulate economic growth, promote sustainability and improve the quality of life of communities. In this

article, we explore the importance of these investments and their positive impact on development.

Investments in railway works aim to modernize and expand the existing infrastructure, making it more efficient and competitive. The economic benefits derived from investments in railway works are diverse. Furthermore, the creation of new lines and the modernization of existing ones generate direct and indirect

jobs, boosting economic activity in the benefited regions.

From a social point of view, railway works promote inclusion and accessibility. By offering a safe and efficient means of transport, railways connect remote communities to urban centers, facilitating access to basic services, such as health and education. Furthermore, reducing dependence on road vehicles contributes to mitigating traffic and pollution,

improving the quality of life of citizens.

Investing in railway infrastructure is also aligned with environmental sustainability objectives. Trains are a more eco-efficient transport option compared to fossil fuel-powered vehicles. By promoting the transport of cargo and passengers through railways, we contribute to reducing greenhouse gas emissions and preserving the environment.

Despite the evident benefits, investments in railway works face significant challenges, including issues of financing, planning and execution. However, with a long-term strategic vision and solid partnerships between the government, the private sector and civil society, it is possible to overcome these obstacles and reap the rewards of a modern and efficient railway infrastructure.

In the last five years as head of the CPTM Engineering, Works and Environment Directorate, with full support from the State Government, we have carried out 55 comprehensive deliveries, encompassing the implementation, reconstruction, restoration and adaptation of accessibility at stations. Furthermore,



Micronesia Highway Viaduct

we expanded railway lines, built both road and railway viaducts, and implemented and renovated substations and energy switchgear cabins. Additionally, we promote the installation of railway signaling systems, thus contributing to the modernization and efficiency of our railway infrastructure.

As we move into the future, it is crucial that governments maintain their

commitment to the development and expansion of railway infrastructure. By investing in this strategic sector, we are investing in economic growth, social inclusion and environmental preservation. Railway works are not just steel tracks; They are paths to a more prosperous and sustainable future for all citizens of the state.

Investments in railway works represent a decisive step towards sustainable and inclusive development. By modernizing and expanding rail infrastructure, we are building the foundations for a more competitive economy, a fairer society and a healthier environment. The path may be challenging, but the benefits are undeniable.



Francisco Morato Station - Line 7 - Rubi



Marcelo Machado
Engineering Director, Works
and Environment
at CPTM

THE IMPORTANCE OF NEW BUSINESS FOR THE METRO-RAIL SECTOR



In recent years, companies in the metro-rail sector, whether state-owned or private, have increasingly sought to maximize their non-fare revenues, that is, revenues that do not derive solely from the fare paid by public transport users. To this end, they have been resorting to so called ancillary revenues, which come from the company's business activities such as leasing areas, providing services, in addition to passenger transport, use of spaces, naming rights (right to name an asset, event or activity) or associated ventures.

With this measure, the aim is to minimize, in the case of state-owned companies, negative impacts on their accounts and, consequently, on the treasury.

When we talk about private

companies, we seek both to equalize the economic-financial view of your business such as maximizing the profit of your shareholders or investors.

In both cases, I understand that the legitimate interest in increasing ancillary revenues should not be dissociated, whenever possible, from improving the passenger's (customer's) journey - considering this from the moment the passenger enters contact us with information about the status of the service and make the decision to use it until your destination and your feedback on how your experience was.

Otherwise, it must be avoided, at least, harming the public transport user's journey, whether granted or not.

Thus, when spaces are leased or constructions are erected in areas that

are in the possession of companies, the need for to seek, as much as possible, to improve the passenger experience on public transport, as occurs, for example, when a diverse range of products, services and facilities are offered.

In this way, the so-called new businesses, that is, those that are not directly linked to the passenger transport activity and from which ancillary revenues result, end up qualifying the spaces present in stations or in other areas that not those directly affected by the operation and maintenance of the transport service, bringing safety and comfort to its users.

Furthermore, new businesses also meet basic needs that passengers would often spend their precious time fulfilling, such as eating food or purchasing a product.



It is also important to mention that new business can often take place through real estate developments made up of a variety of infrastructure, which will not only boost advisory revenues, but also provide for the requalification of the entire space and its surroundings, often made up of degraded or abandoned areas, bringing with them numerous and varied benefits to the region where it is located, benefiting not only users of public transport, but also residents or visitors to that location.

CPTM, for example, after detailed planning, studies and preparation work that included the involvement and dedication of several areas of the company, concluded, through public bidding, the contract granting the real right to use of area for commercial exploitation of Enterprise Associated with Brás Station, through remuneration and construction, administration and maintenance

costs, as well as charges levied on the activities carried out, which will allow the requalification of the site with private capital and will provide, not only station users and visitors to the region, a rational use of the area, improving lighting, security and the provision of services.

Don't even mention the people who will be attracted to the location, who will be able to do so via CPTM trains and which, therefore, will lead to an increase in the company's operating revenue.

Following this same line of thought, when building a new train or subway station, dedicated areas are immediately thought of for the development of new businesses.

Therefore, whether from a strictly financial point of view, the passenger experience or the social legacy, it is undeniable that the increase in ancillary revenues through new businesses not

only brings enormous benefits to the public service provider but also to the society in general, proving to be essential in any company that operates public passenger transport, in Brazil and around the world.

José Marcos Miziara Filho
 Director of Planning and New Business at São Paulo Train Company Metropolitan (CPTM)



RAILWAY: ESSENTIAL INFRASTRUCTURE FOR DEVELOPMENT

I- HISTORICAL ASPECTS

The importance of railway infrastructure for the economic and social development of any people or nation is part of the common sense of the general population.

Historical documents point to finds of railway tracks in European countries from Antiquity to the Middle Ages, which enabled the movement of small wooden wagons with human or animal traction.

However, the closest railway infrastructure configuration to the current one, especially in the Western world, began in England in the early years of the 19th century when, in 1803, engineer Richard Trevithick produced a small steam locomotive that weighed around 5 tons and moved at 5 km/h. The maiden voyage of the “Mechanical Horse” took place on February 13, 1804.

However, engineer George Stephenson is considered the true forerunner of the railway when, on July 25th, 1814, he provided the movement of a steam locomotive pulling 8 wagons weighing 30 tons between the towns of Hetton and Lilligwort, in England.

The first passenger train began running on September 27th, 1825, on the Stockton to Darlington line, also in England. It covered 51 km carrying 600 people.

Subsequently, Stephenson expanded his operations in the railway sector with the implementation of the connection between Liverpool and Manchester. It was the year 1830, which was marked as the beginning of the railway era.

Thus, it can be said that the railway began and developed in England in the first half of the 19th century.

In Brazil, institutionally, the railway environment began to be designed in 1835, when Regent Feijó issued Decree no. 101, which established the rules for railway

concessions.

In 1852, the Imperial Government of Brazil issued Decree No. 641, establishing special conditions for the concession, for up to 90 years, for the implementation of a railway from the municipality of Corte to the provinces of Minas Gerais or São Paulo.

Subsequently, due to Mr. Irineu Evangelista de Souza, Mauá Baron, the first Railway in Brazil, called “Estrada de Ferro Mauá”, was designed, implemented and inaugurated on April 30th, 1854. The railway connected the Port of Mauá in Guanabara Bay to Fragoso, a city located about 14.5 km away. The first locomotive to run on the line was the “Baronesa”, making the journey in 20 minutes.

Soon after, on February 9th, 1855, the Imperial Government of Brazil signed a contract with the British engineer Edward Price to build the first section of a railway from the city of Rio de Janeiro. Thus, the D. Pedro II Railway was organized. Work began on June 11th, 1855, and on March 29th, 1858, the first section of the railway was inaugurated, between Aclamação station and the Parish of Nossa Senhora da Conceição de Marapicu.

Thus, in Brazil, it can be said that the railway began in the first years of the second half of the 19th century, around half a century after the English.

In the State of São Paulo, it all started with the insistence of some Brazilians, including the Mauá Baron, who made the Imperial Government aware of the need to implement a railway connection between Jundiaí and Santos.

As a result of such institutional negotiations, on April 26th, 1856, Imperial Decree No. 1759 was issued which: “Authorizes the incorporation for the construction of the Railway between Santos

and Jundiaí”.

After the formation of the company “The São Paulo Railway Company Limited – SPR” and specific studies to overcome the 800-meter elevation difference in Serra do Mar, works began on March 15th, 1860, and the SPR was inaugurated on March 16th, February 1867.

After the implementation of the São Paulo Railway, several railways emerged to serve the interior of the State of São Paulo. In the second half of the 19th century, there was an imperative need to connect the regions producing agricultural commodities, especially coffee and sugar, to the Port of Santos.

Thus, in addition to the SPR, several railways were designed and implemented in the State of São Paulo, the main ones of which are highlighted below:

- Companhia Paulista de Estrada de Ferro in 1868, connecting Jundiaí with the north and northwest regions of the State, passing, among other cities, through Campinas, Americana (Piracicaba), Limeira (Araras, Leme, Pirassununga, Descalvado), Rio Claro, Itirapina, São Carlos, Araraquara, Rincão, Bebedouro, Barretos and Porto Colombia on the border of Minas (North) and Brotas, Dois Córregos, Jaú, Pederneiras, Bauru, Garça, Marília, Tupã, Adamantina, Dracena, Panorama, border with Mato Grosso do Sul (Northwest).
- Companhia Ituana de Estrada de Ferro in 1870, initially connecting Jundiaí to Itu, passing through Itupeva and Indaiatuba. Later, in 1873, leaving Itaici, he headed for Piracicaba, passing through going through Capivari and Rio das Pedras, among other cities. In 1892, Cia. Ituana merged with Cia. Sorocabana.
- Companhia Mogiana de Estradas de

Ferro in 1872. Connecting Campinas with the northern region of the State and the Triângulo Mineiro, passing, among other cities, through Jaguariúna, Mogi-Mirim (Ita-pira, Sapucaí), Aguaí (São João da Boa Vista, Poços de Caldas), Casa Branca (São José do Rio Pardo, Guaxupé, São Sebastião do Paraíso, Passos), Tambaú, Ribeirão Preto (Batatais, Franca, Pedregulho), Orlandia, São Joaquim da Barra, Ituverava, Igarapava, Uberaba, Uberlândia and Araguari.

- Sorocabana Railway in 1875, connecting São Paulo to the Port of Santos and Baixada Santista (South), passing, among other locations, through Evangelista de Souza, Samaritá, Itanhaém, Juquiá and São Paulo and the southwest region of the State, passing, among other cities, through Osasco, São Roque, Mairinque, Sorocaba, Iperó (Tatuí, Itapetininga, Itapeva, Itararé), Laranjal Paulista, Conchas, Botucatu (São Manoel, Agudos, Bauru), Avaré, Ourinhos, Assis, Presidente Prudente (Euclides da Cunha), Presidente Epitácio, on the border with Mato Grosso do Sul.
- Central Railway of Brazil, 1875, connecting São Paulo to Rio de Janeiro passing through the Paraíba Valley, including Mogi das Cruzes, Jacareí, São José dos Campos, Caçapava, Taubaté, Pindamonhangaba, Aparecida do Norte, Guaratinguetá, Lorena, Cachoeira Paulista, Cruzeiro, Queluz and Rio de Janeiro.
- Araraquara Railway, in 1896, connecting Araraquara and the northwestern region of the State passing, among others, through the cities of Matão, Taquaritinga, Santa Adélia, PINDORAMA, Catanduva, São José do Rio Preto, Mirassol, Tana-bi, Votuporanga, Fernandópolis, Estrela D'oste, Jales, Santa Fé do Sul, on the border with Mato Grosso do Sul.
- Brazilian Northwest Railway, in 1904, connecting Bauru to Corumbá, passing through do, among other cities,

Cafelândia, Lins, Penápolis, Araçatuba, Andradina (border with Mato Grosso do Sul).

In addition to the large railways, previously mentioned, several other regional railway companies were implemented, such as Estrada de Ferro Doura-dense, Estrada de Ferro São Paulo Goiás, Estrada de Ferro São Paulo Minas, Estrada de Ferro Bragantina.

Before the middle of the 20th century, the State of São Paulo had around 8,500 km of railway lines in place, with more than 6,200 km of railways considered first category.

The SPR – São Paulo Rail-way – concession ended on September 13th, 1946, and was promptly taken over by the Federal Government. On September 27th, 1947, it was transformed into the Santos to Jundiaí Railway.

After the Second World War, the Brazilian Government began to allocate more resources to the automotive sector. Between 1948 and 1952, the country invested more in the automotive sector than in importing commodities such as oil and wheat. Due to the favorable exchange rate, many European and American vehicles were incorporated into the old fleet in use in the country.

In 1956, through Decree No. 39,412 of the Juscelino Kubitschek Government, Geia – Executive Group of the Automobile Industry – was created, with the aim of facilitating the production of cars in Brazil.

In the mid-19th century, after the coffee crisis and under the strong economic impact resulting from the Second World War, Brazilian railways in general and, particularly, railways in São Paulo was experiencing financial difficulties.

Through Federal Law No. 3,115, of March 16, 1957, RFFSA – Rede Ferroviária Federal SA was created, consolidating 18 regional railways, including 3 on São Paulo territory:

- Estrada de Ferro Santos Jundiaí;
- Central Railway of Brazil;
- Brazilian Northwest Railway.
- On May 3, 1966, Federal Decree no. 58,341 was issued, disciplining the eradication of deficit railways and

railway branches, replacing them them by highways.

- On October 28, 1971, as a result of State Decree no. 10,410, Fepasa – Ferrovia Paulista SA was established, through the Incorporation into Companhia Paulista de Estradas de Ferro, of the following companies:
- Sorocabana Railway;
- Companhia Mogiana de Estradas de Ferro;
- Araraquara Railway;
- São Paulo Minas Railway.

Fepasa was transferred to the Federal Union in 1997 and incorporated into RFFSA through Federal Decree No. 2,502, of February 18th, 1998.

The RFFSA was extinguished by Provisional Measure No. 353, of January 22nd, 2007, converted into Federal Law No. 11,483, of May 31, 2007.

II - URBAN AND SOCIAL DEVELOPMENT

Due to the size of the cities mentioned on the route of the main railways installed in São Paulo, covering around 6,000 km of railways, the direct contribution of railway infrastructure to the economic, urban and social development of municipalities and respective regions is undeniable.

The railways provided structured and reliable movement of people between these locations, in addition to enabling the transport of various goods, guaranteeing economic and social development and strengthening the political power of the municipalities served.

It is common sense that rail freight transport is more efficient and cheaper than road transport, especially for liquid and solid bulk of large volumes/weights over long distances.

Thus, the logistics for importing and exporting products through the Port of Santos was gradually linked to transport via the railway network. In addition to the passenger trains that crossed the entire territory of São Paulo, departing from the capital or from Campinas, in the case of Cia. Mogiana, there were mixed trains (passenger trains goods and luggage), which

carried small orders to all municipalities served by the railway lines. Practically every station had a room designated for “baggage and small shipments” to receive and dispatch small-sized, general merchandise, which served industries, businesses and the citizen himself.

The evolution of urban growth and economic strength in the city of São Paulo perhaps synthesizes the approach of linking economic development and social connection with railway infrastructure.

The census carried out in 1872, half a decade after the inauguration of the São Paulo Railway – SPR, indicated that the city of São Paulo had around 30,000 inhabitants, rising to 65,000 in 1890 and, at the turn of the century, it counted with 240,000 residents. At the beginning of the 1940s, it already had around 1.3 million people.

At the end of the 19th century and the beginning of the XIX, the city of São Paulo was the starting point/ end of two railways (Sorocabana on Júlio Prestes and Central

in Brás/Roosevelt), in addition to being a crossing point for the first São Paulo railway, the SPR, connecting Santos to Jundiaí, passing through ABC and Luz Station, the greatest icon of the São Paulo railway era.

Furthermore, in 1917, Canadian Light Company (The São Paulo Railway Light & Power Co.) had already laid around 200 km of tram tracks in the capital.

The following tables show the evolution of passenger transport in the State of São Paulo:

EVOLUTION IN THE PERIOD 1867-1897

Year	SP Railway	Cia. Paulista	Cia. Mogiana	Sorocabana / Ituana
1867	28,707	-	-	-
1872	76,414	33,351	-	-
1877	111,726	159,706	64,442	-
1882	127,840	166,774	92,416	-
1887	230,116	231,850	203,089	-
1892	879,760	809,040	593,242	291,682
1897	1,332,226	1,422,141	1,294,328	609,450

Source: Pinto (1977) – Master’s Dissertation Célia Regina B. Stefani

EVOLUTION IN THE PERIOD 1908-1918

Year	SP Railway	Cia, Paulista	Cia. Mogiana	Sorocabana	Araraquara	Tramway
1908	1,617,764	1,084,081	1,545,487	839,076	101,394	297,629
1910	1,750,669	1,245,752	1,828,925	994,091	185,540	286,368
1912	2,878,676	2,057,318	2,426,993	1,426,396	384,565	461,888
1914	2,907,865	2,021,234	2,465,850	1,387,869	442,756	1,313,419
1916	2,974,372	1,997,294	2,305,187	1,334,443	524,182	1,495,992
1918	2,957,753	1,976,889	1,816,757	1,485,978	-	1,730,941

Source: Statistical Yearbook of São Paulo (1908-1918) – Master’s Dissertation Célia Regina B. Stefani

EVOLUTION IN THE PERIOD 1940-1946

Ano	SP Railway	Cia. Paulista	Cia. Mogiana	Sorocabana	Cantareira
1940	16,289,917	6,449,719	2,458,199	6,261,721	4,065,463
1944	20,839,435	9,562,262	3,459,079	8,266,446	7,040,950
1946	24,020,176	11,224,152	3,170,463	10,103,074	8,663,067

Source: Statistical Yearbook of São Paulo (1940- 1946) – Master’s Dissertation Célia Regina B. Stefani

The population of the State of São Paulo in 1940 was around 7 million inhabitants and the capital of around 1.3 million. The numbers of passengers transported by the State's railways reveal the importance of companies in serving the population, whether in the more urban and local environment, mainly in the case of SPR and Cantareira, or in the more regional environment, in the case of the others.

The Rail System, due to the structuring characteristic of its infrastructure, is the greatest guide and inducer of land use and occupation.

In the middle of the 20th century, Brazil had just over 50 million inhabitants, of which approximately a third lived in urban centers.

In 1950, the city of São Paulo had 2.2 million inhabitants and around 600 km of tram tracks, in addition to the railways from

SPR, Sorocabana and Central. At the time, the State of SP had a total of 9.2 million inhabitants and more than 6,000 km of first-class trunk railways.

It is undeniable that the railway infrastructure implemented in the State of São Paulo was the driving force behind the economic and social development of São Paulo, by inducing the birth of properly structured towns, cities and regions. Furthermore, population density and economic strength guaranteed the industrialization of the State, especially after the cycle of agricultural commodities.

This development imposed on the Political Power the need to implement Higher Education equipment of a public nature that could meet society's desires and guarantee a positive spiral of development, especially within the State.

This need has materialized and

today the State has three high-level public universities, whose excellence is recognized in Brazil and abroad.

Thus, USP currently has campuses in São Paulo, São Carlos, Piracicaba, Bauru, Pirassununga, Lorena and Santos.

Unicamp has campuses in Campinas, Piracicaba and Limeira.

However, Unesp, founded in 1976 from the union of isolated Higher Education institutes, is present throughout the interior of the State, basically in cities that developed in the railway environment: Araçatuba, Araraquara, Assis, Bauru, Botucatu, Dracena, Franca, Guaratinguetá, Ilha Solteira, Itapeva, Jaboticabal, Marília, Ourinhos, Presidente Prudente, Registro, Rio Claro, Rosana, São José do Rio Preto, São José dos Campos, São Paulo, São Vicente, Sorocaba, Tupã and São João da Boa Vista.

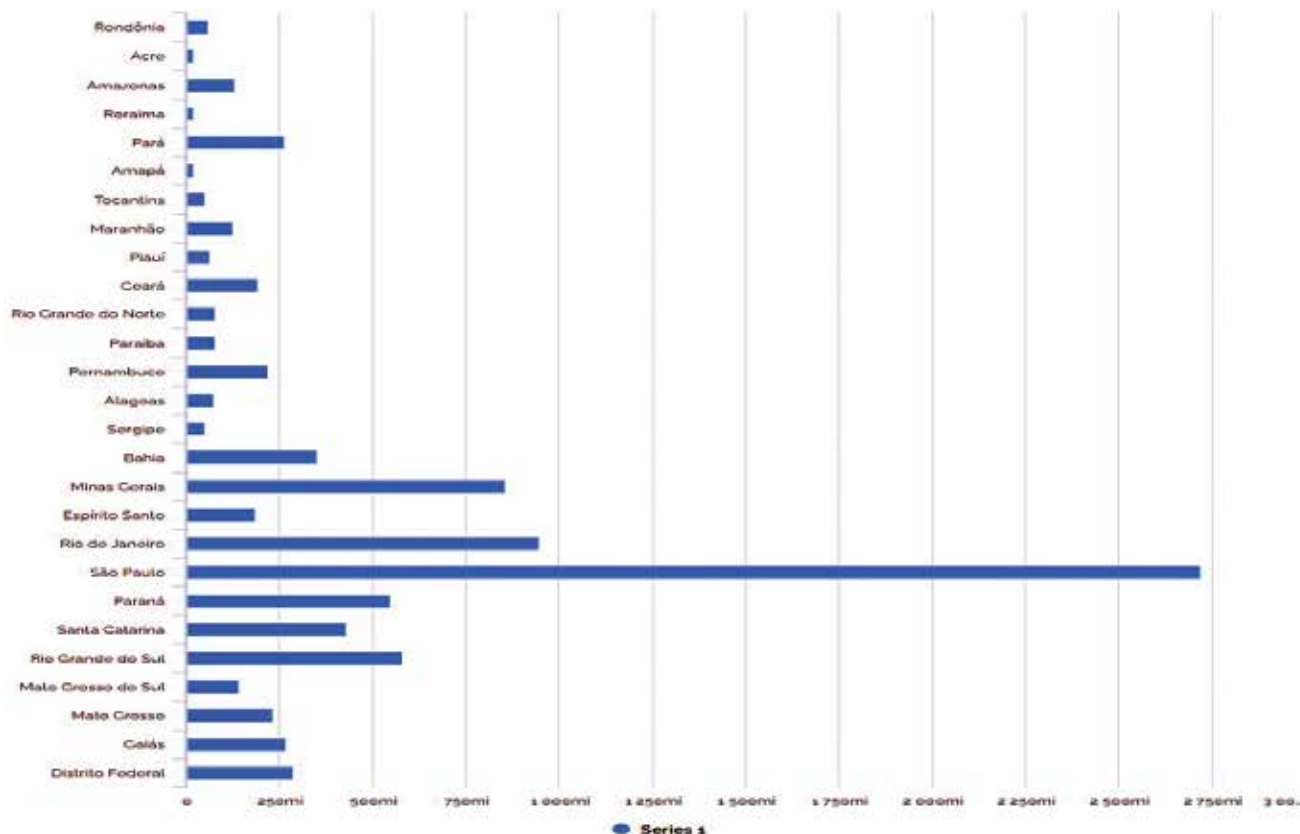
POPULATION RESIDENT IN THE COUNTRY – FEDERATION UNITS

População residente no Brasil (milhões)
Série histórica



Source: IBGE – 2022 Demographic Census

GROSS DOMESTIC PRODUCT (GDP) – FEDERATION UNITS



Source: IBGE

In addition to Higher Education Institutions, the State of São Paulo, to meet the demand for integrated logistics resulting from the development of the interior, enabled the implementation of several regional airports such as: Americana, Andradina, Araçatuba, Araraquara, Araras, Assis, Avaré, Barretos, Bauru, Botucatu, Bragança Paulista, Catanduva, Dracena, Franca, Guaratinguetá, Ilha Solteira, Itanhaém, Jundiaí, Lins, Marília, Matão, Ourinhos, Penápolis, Presidente Epitácio, Presidente Prudente, Presidente Venceslau, Registro, Ribeirão Preto, Santa Fé do Sul, São Carlos, São José dos Campos, São José do Rio Preto, São Manuel, Sorocaba, Tupã and Votuporanga.

We could summarize the result of the development of the State of São Paulo by the Human Development Index – HDI of the State and its municipalities, in comparison with those of the country.

In 2021, the HDI (PNUD / IBGE) of the State of São Paulo was 0.806 while that of Brazil was 0.756.

The HDI Index classification of the first 50 municipalities in the country shows that 25 are from São Paulo served by the State's railway network, namely:

São Caetano do Sul, São Pedro, Santos, Jundiaí, Valinhos, Vinhedo, Santo André, Araraquara, Americana, São José dos Campos, Presidente Prudente, São Paulo, Assis, Campinas, São Carlos, Rio Claro, Bauru, Pirassununga, Taubaté, Ribeirão Preto, Botucatu, Marília, Sorocaba, São

João da Boa Vista and São José do Rio Preto.

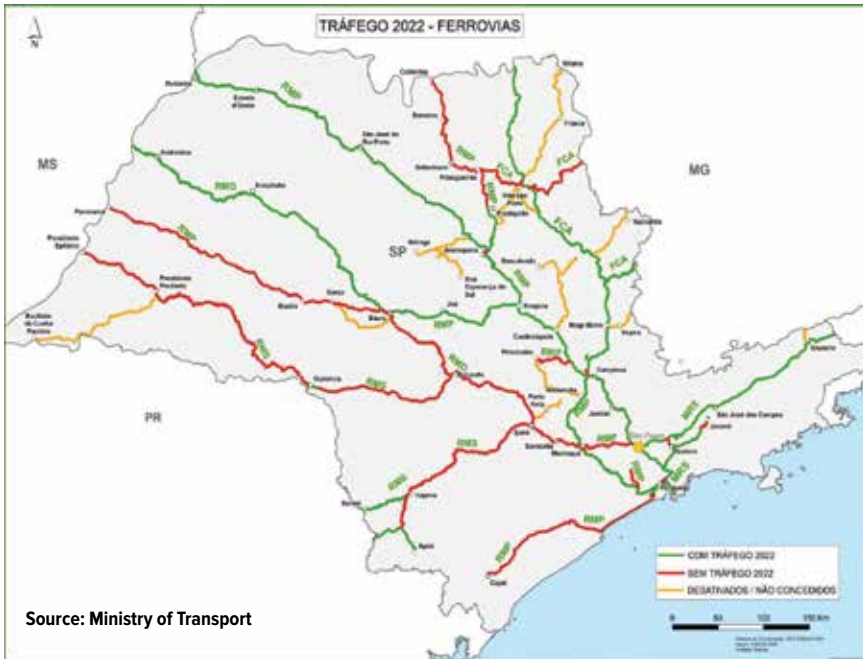
It should be remembered that the HDI is an index which summarizes long-term progress in three dimensions of human development: income, education and health.

Furthermore, the urban development resulting from the use and occupation of land imposed by the structuring infrastructure of the tracks is duly portrayed in the evolution of the population and the Bruno Domestic Product (GDP) of the State of São Paulo.

Finally, the railroad left legacies important for the State of São Paulo.

III - LEGACIES

1-) CPTM – Companhia Paulista de Trens



Metropolitanos – formed from the Federal System of CBTU/SP with the State System of FEPASA/Metropolitano, as shown in the schematic table below.

Such railway infrastructure makes it possible it transported 868 million passengers in 2019, the last year before the pandemic, with an MDU (average working day) of 2.9 million passengers

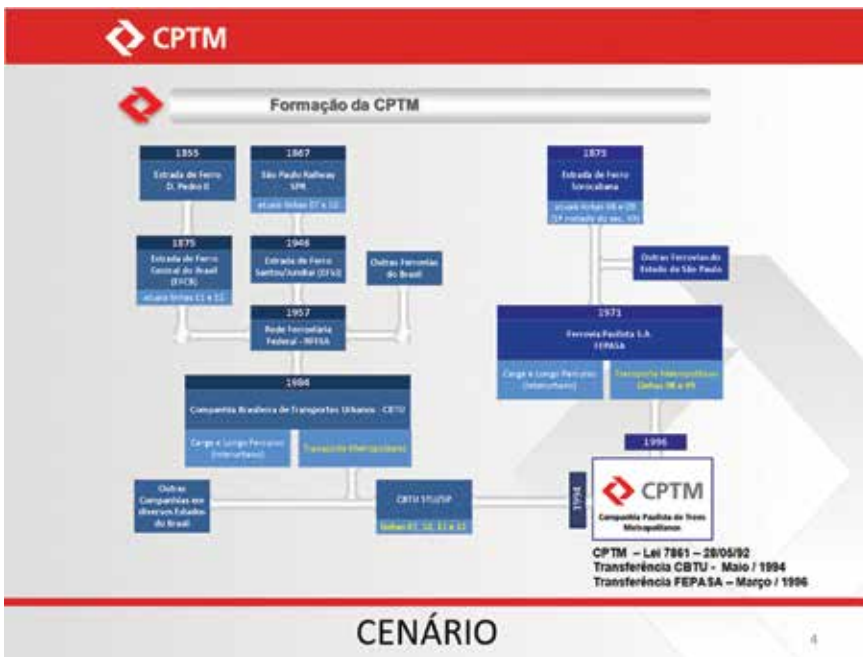
2-) The Port of Santos became the main port in the country and in Latin America.

3-) An important railway network, with rights of way still preserved in all regions of the State, as shown in the Network map shown below.

A substantial part of this railway network, in the order of 5,000 km, operated and maintained by Fepasa in the 1980s, transported approximately 22 million tu (useful tons), producing around 8.0 billion tku (tons km Useful).

Today, it contains the country's main export/ import corridor, operated by Rumo, highlighting the Estrela D'Oeste – Santos section, in addition to the metric gauge corridor, connecting Triângulo Mineiro to Santos operated by FCA/ VLI.

A significant part of the network is idle, but, considering that the right-of-way is preserved, it can be understood that there is still the possibility of rescuing the past glory of the railway in the State of São Paulo.



José Luiz Lavorente
 Advisor to the Presidency of CPTM. He was Superintendent and Technical Director of Fepasa; He was Superintendent and Director of Operation and Maintenance at CPTM.



MAINTENANCE OF SPECIAL WORKS OF ART ON THE RAILWAY

To say that the railway is an indispensable transport system for logistics and mobility is to repeat the obvious, as it is easy to see the important role it plays in society and the economy.

Would it be possible to imagine, for example, São Paulo with its demographic density without rail transport? “Chaos” would be the appropriate term for this scenario, or “unimaginable”, both words are enough to describe, in summary, this hypothesis.

Among many factors that contribute to a prosperous city, we can mention the quality of the railway network. The mode offers travel that covers long distances in a short period effectively. When compared to other systems, it allows intercity connections, a large volume of passengers transported, employability, targeting residential, commercial and industrial hubs, among other relevant aspects that contribute to the infrastructure of a metropolis like São Paulo, being an important pillar for economic and social development.

For the railway to fulfill its purpose, it is essential that the organization responsible for its administration is a synchronized body and has on its staff specialized professionals who can carry out their functions in accordance with specific characteristics of the activities they undertake. The modal demands in its particularity.

Many of these professionals have their knowledge forged within the railway, who have not only academic knowledge, but also experience, years of experience that make them references in their duties. Companies active in the system RAILS have maintenance incorporated into their activities, which can be considered one of the main foundations for sustaining the

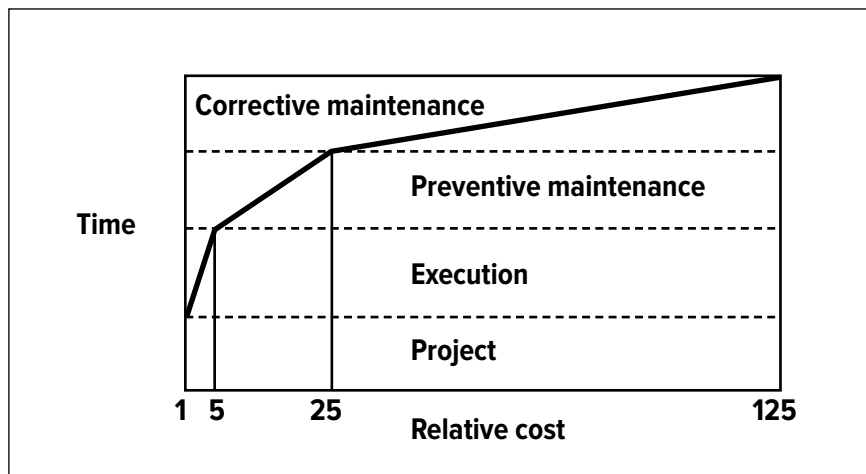


Figure 1 – Evolution of costs through the intervention phase (Sitter's Law)
Source: SITTER, 1984 apud HELENE, 1997

organization. Maintenance can be divided into two parts, one being preventive maintenance, which is, according to NBR 5462, carried out at predetermined intervals or, according to prescribed criteria, intended to reduce the probability of failure or the degradation of an item's functioning, and corrective, maintenance carried out after the occurrence of a breakdown aimed at putting an item back in a condition to perform a required function.

In addition to the issues listed, there is the economic factor, which is greatly influenced by technical measures that encompass maintenance and which reflects on financial matters. Observed in the cost evolution law (Sitter's Law), it shows that correction costs grow according to the geometric progression of ratio five.

Among the many areas that cover the railway, maintenance engineering has one of the most important actions within the sector. One of its aspects is the monitoring of special structures. These constructions receive this nomenclature because they

are unique, they are planned, designed and executed, considering the specific aspects of the location where they will be located and must meet the requested needs to overcome obstacles. For these works to reach their maximum useful life in an efficient and safe manner, periodic monitoring is necessary. The activities carried out must be followed in accordance with the specifications of standard 9452:2023 – inspection of bridges, viaducts and walkways, which serve as a guideline throughout the process. According to the FHWA (2011), special structures maintenance can be divided into three fronts: replacement, rehabilitation and maintenance (corrective/preventive).

Inspection involves collecting and analyzing construction data in a detailed and careful manner, preparing reports, evaluating and making appropriate recommendations. The types of inspection can be classified as: cadastral inspection (first carried out after construction); routine inspection (periodically every two years or



Figura 2 – Ponte Estaiada Octávio Frias de Oliveira
Fonte: Falcão Bauer, 2021.

at the manager's discretion); extraordinary inspection (this is not scheduled; it assesses exceptional damage); special inspections (carried out over a period of 5 to 8 years); intermediate inspection (monitors suspected or detected pathologies). They allow, together with the photographic report, the specialist to assign the classification of the special structures, a classification that acts according to the structural, functional and durability conditions that can vary from 5 (excellent), 4 (good), 3 (regular), 2 (bad), 1 (critical) and 0 (emergency).

The most relevant pathologies observed in special structures are in the structure, support devices, tracks, surroundings and expansion joints.

The reports prepared during of the routine inspection process are fundamental for mapping and monitoring anomalies and their corresponding recommendations

and therapies. Special inspections must present a pathology report, test results, therapy and repair project reports and complementary technical reports.

The inspection process actively contributes to maintaining the integrity and safety of, avoiding or minimizing the most diverse risks attributed to its non-completion, for example, due to the partial or total interruption of train circulation, for a specific period or no, resulting in everything from harm to thousands of people who use the system to accidents that can have more serious effects, such as the irreparable loss of life.

To provide a service that is not only efficient, but excellent, it is necessary have specialized professionals so that the system works beyond expectations. These professionals are not easily found in the job market, as the tasks to be performed require highly qualified labor.

For this reason, they must be valued and recognized, because, without them, it would be difficult for a complex mode like the railway to remain effective. After all, the combination of engineering maintenance and specialized professionals is the perfect fusion for the success.

Thais Macêdo Almeida

Operational services agent;
Engineer Civilian and
postgraduate in Concrete
Pathology



PEOPLE: THE CAPITAL THAT MOVES THE RAILWAY



Template checking during geometric correction

Raul M. dos Santos

SECURITY IS A NON-NEGOTIABLE VALUE

As essential as the railway for the transport sector are the people involved in this scenario, as they are the main driving elements of organizations.

It is the human capital that manages and commands the company, that executes the activities, controls the processes and promotes results.

And, because they are the center of the organization and given the importance of care, it is the companies' duty to create a healthy work environment, free from accidents and illnesses in which everyone can develop professionally.

The prevention of occupational accidents and illnesses are examples of this care for employees, by delivering the best quality of life at work.

Managing people and promoting safety at work go hand in hand and add value to the business. And when we talk about values, it is important that they are structured, explained, instituted and

put into practice through management policies, as they are what guide people's conduct, the definition of processes and determine the organization's culture – which the company does not give up, what is important, what is accepted and what will not be tolerated – which are reflected in everyone's attitudes and behaviors.

Therefore, it is extremely important that security is a non-negotiable value, starting with senior management that incorporates good practices into the company's culture, perpetuating it up to the operational level and, thus, building a solid identity of promoting health and valuing life.

WORK SAFETY ON THE RAILWAY

It is a fact that the concept of OSH (Occupational Health and Safety) is extremely relevant in organizations, even more so in the railway sector, in which it becomes essential, given the risks, dimension, complexity and particularity of the activities carried out daily, always

with the aim of offering a safe mode that meets the needs of the entire population, including its own professionals, passengers and other people who circulate in the surrounding areas.

CPTM, through its People Management Policy, establishes OSH guidelines and promotes actions through SESMT (Specialized Service in Occupational Safety and Medicine), which analyzes the activities carried out and the work environment, checking existing occupational risks to which employees are susceptible. Therefore, it creates action and control plans to minimize them, materialized in the GRO (Occupational Risk Management) with the adoption of technical programs such as the PGR (Risk Management Program) and the PCMSO (Program of Occupational Health Medical Control).

Such programs complement each other, while the PGR focuses on the assessment, identification, mapping and control of occupational risks, the PCMSO prevents and monitors occupational diseases at an early stage.

Periodic inspections are regularly carried out in the sectors seeking to demonstrate compliance with legal requirements. Non-conformities in these inspections and requirements resulting from audits by external bodies are dealt with through an internal management system.

As a prevention tool, DSS (Weekly Safety Dialogues) and campaigns are carried out to raise awareness about safe practices, accident risks, among other topics, cultivating an environment that promotes continuous education through awareness-raising.

This also applies to the bureaucratic part: creation of work procedures and technical verification of projects, the which demonstrate administrative risk management measures.

Annually, together with the 6 CIPAs (Internal Commission for the Prevention of Accidents and Harassment), SIPAT (Internal Week for the Prevention of Accidents at Work) is promoted. It is an opportunity to raise awareness about the prevention of accidents and illnesses, as well as everyday habits that should be encouraged to guarantee health, safety and well-being.

Periodically, simulated exercises are carried out at stations with the aim of preparing the fire brigade to trigger emergency response actions in a quick and orderly manner, in compliance with the PAE (Emergency Response Plan), establishing a set of technical and administrative guidelines that provide the necessary conditions for action in incidents.

When a work accident occurs, an investigation is opened, using a methodology, and – depending on the severity and complexity – it is conducted by a multidisciplinary team, formed by representatives of the areas involved, to extract the multicausality of the accident. event aimed at correcting deviations, in the search for learning and continuous improvement, to avoid the recurrence of the accident.

A fundamental pillar for OSH prevention is the employee training process reflected in training and development initiatives. There is a survey of training needs that includes everything from planning classes to carrying out courses, in search of the application of knowledge in convergence with the nature of railway activities.

Mandatory training is systematically carried out, also known as normative – legally required –, which, in short, are the training required by law and determined by NRs (Regulatory Standards) and are segmented according to the position/function, activities and risks linked to each function X activity X sector. Some examples of these trainings: NR 5, NR 6, NR 10, NR 12, NR 20, NR 35.

In addition to the normative part, specific operational training is provided for track access, safe driving and train

Raul M. dos Santos



Rail Grinding

maneuvers and safety guidelines when carrying out works and services.

YOU ARE PART OF THIS PROCESS!

It is expected that in companies such values guide the safe behavior of their employees so that they feel **part of the prevention process**.

On the railway, this process is a challenge for us, preventionists. Our daily work consists of the mission for the company to grow, people to work safely, society to evolve, and the country's economy to develop through the trails, always acting with intelligence and prevention.

The art and craft of “taking care of people” with a focus on OSH (Health and Safety in work) is beyond SESMT professionals.

Dear reader, in this sense, we invite you to reflect:

We are all **CAREGIVERS**.

And, in this context of 170 years of railways in Brazil, we celebrate with AEEFSJ its 70 years of history with railways, providing throughout this period the opportunity to share day by day the practical application of knowledge by through lectures, technical discussions and supporting the mission of caring for the health and preserving the lives of railway workers.

We know that the key to success is connecting people to good security practices. The culture of prevention is the commitment of leadership with the purpose of CARE and, thus, triggering extraordinary management performance. In safety there is no new path, what is new is the way of walking!

Aline Rocha dos Santos Constenla
Occupational Safety Engineer at CPTM; Civil, Environmental and Sanitary Engineer; Postgraduate in Accessibility, Diversity and Inclusion



Jeanine do C. Florença Ridelensky
Occupational Safety Engineer at CPTM; Civil Engineer and Master in Environmental Auditing; Postgraduate in SGI – Integrated Management System



VLT – LIGHT VEHICLE ON RAILS SALVADOR AND METROPOLITAN REGION



Among the good initiatives focused on improvement of urban mobility, we highlight the recent publication of a notice by CTB – Companhia de Transportes do Estado da Bahia, which is contracting civil works and energy systems for the implementation of the VLT – Light Rail Vehicle of Salvador, a system that will connect the capital of Bahia and the metropolitan region.

This important initiative aims provide residents with better conditions for their daily journeys, being part of the solutions being developed for the integration of urban road and subway modes to better serve the population of the capital of Bahia.

The VLT system under contract is part of the global and strategic planning of the State Government - Bahia, to the development of the Metropolitan

Region of Salvador and includes physical and operational interconnection with Section III of Line 1 in Águas Claras and with Line 2 in Bairro da Paz, and also integration with conventional bus lines and electrical.

The published notice provides for the contracting of supplies and implementation of the VLT – Salvador in three lots, which total.

There are approximately 37 km of electrified roads, 34 stops (stations for boarding and disembarking users), three parking lots/ workshops for maintenance services, integrations distributed along the stretch with other modes of public transport, etc.

The contracted project provides the best accessibility and comfort solutions for system users, meets all technical and environmental standards, operation and safety requirements for traffic shared with other vehicles, being a project of excellence in this modality

REFERENCE DATA FOR THE VLT PROJECT

STOPS

The VLT stops (stations) will be provided with all facilities for boarding and disembarking passengers, variable platform width between 3.50 and 4.50 meters or 10.0 meters for stops where there is integration between transport modes. different transport, complying with the accessibility standards contained in NBR 9050:2020, covered waiting areas and seats. The length of the platforms will be 70 meters, which will allow the operation of trains with a transport capacity of up to 400 passengers/users per train.

PERMANENT WAY

The permanent road meets the geometric requirements imposed by the region and the characteristics of local infrastructure, within the concepts of current standards, to support the repetitive load of vehicle traffic with a weight of 12.5 tons per axle, gauge of 1,435mm, design speed of up to 70km/hour, maximum ramp of 5.3%, vibration and noise damping system (e.g.: LVT – Low Vibration Track) and other technical solutions that enable the best safety and comfort conditions for users.

On the slab of the permanent road there is with a view to implementing banks of ducts intended for cabling

systems that will be implemented, be they: telecommunications, road signaling, medium voltage network, etc., as well as vegetation cover between rails and between roads, equipped with a system for drainage.

At level crossings between the VLT and the road, modular plates made of high-resistance rubber will be installed, suitable for level crossings, installed with a ramp with a maximum inclination of 7%. At these intersections, traffic signal systems integrated with the VLT signaling systems will be installed, which will guarantee vehicles crossing in a completely safe manner.

ELECTRIC POWER SUPPLY FOR TRACTION RAILWAY

The architecture of the electrical power system of the VLT – Light Rail Vehicle in Salvador is structured around the derivation of power from Primary Substations of COELBA – Electricity Company of the State of Bahia that supply voltage in 69/13, 8kVac (SE01 – Calçada) and 69/34.5 – 13.8kVac (SE02 – União, SE03 – Retiro and SE04 - Mussurunga), Stepping Substations fed at 34.5/13.8kVac and the redundant Distribution Network in 13.8kVac that feed the 18 Rectifier Substations with a power of 2MVA (2 x 1MVA/each), voltage of 750 Vdc and Auxiliary Substations (75kVA -13.8kVac – 0.380/0.220 kVac), to supply electrical power to the 34 VLT stops/stations.

The Power System will be covered with SCADA – Control and Data Acquisition System – standard/protocol IEC 61850, equipped with a structured internal network, with optical fiber and copper cables for acquisition and transmission of the corresponding data to commands, supervision, interlocks, measurement, control and protection of equipment/systems.

The power supply for the VLTs will be. They are 750 VDC from the Rectifier Substations, captured through pantographs installed on the roofs of

the vehicles. This power supply will be distributed by the flexible/catenary self-compensated Aerial Network System, structured by contact wire mechanically supported by consoles installed on poles or gantries distributed longitudinally to the permanent roads implemented.

The power supply for the trains is also designed to supply energy to the air-conditioning system in order to maintain a comfortable and pleasant environment for tram users, regardless of the weather conditions outside the vehicles.

The technical requirements set out in the public notice demonstrate the concern of CTB - Companhia de Transporte do Estado da Bahia - to implement a system that meets the needs of users, in terms of quality, robustness, integration facilities, comfort, etc.

It is important to highlight the high technical quality of the documentation published in the call for tenders and that there were no interruptions in the contracting process, proving that the team at CTB - Companhia de Transportes do Estado da Bahia - is doing an excellent job in preparing projects to improve urban mobility for its citizens.

Pedro Kenje Sugai
Engineer Electrician and
Technical Director of
AEEFSJ Management
2023/2025



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HYBRID APPROACHES IN RAILWAY ENTERPRISES WITH SEMI-INTEGRATED EXECUTION

Railway infrastructure projects are characterized by their technical complexity and large scale, often involving multiple engineering disciplines and continuous challenges in systems integration.

In addition to the technical obstacles that permeate from planning to execution and operation, these projects are subject to critical environmental and land restrictions that can make them unviable. Additionally, political factors influence the allocation of financial resources and priorities according to government plans. Given the scope of these projects and their significant impact on the economy and society, it is essential to adopt management approaches that ensure precision, efficiency and adaptability, capable of responding quickly to technological and regulatory changes.

In this context, about the enterprise's life cycle, a predictive approach, or waterfall model, is more appropriate, where each phase can be executed in a linear manner, without revisiting the previous steps. In the development life cycle, under the aegis of Law No. 13.303/16, a hybrid model with iterative or incremental approaches is proposed, combining adaptive methods that allow improvement adjustments as the project evolves. In addition to the approach, the quality of delivery of railway projects is a decisive issue, due to the high impact of change management during the execution phase and need for high technical-co-operational capacity of contracted companies to guarantee the scope within the estimated deadline and manage risks.

Introduced to modernize the legal status of state-owned companies, Law no. 13,303/16 imposes contracting guidelines for engineering works and services, favoring modalities such as semi-integrated contracting. This modeling enables the elaboration of the executive project in the implementation phase, including changes to the basic project, encouraging innovations as long as cost savings, quality improvements, reduction in execution times and ease of maintenance are proven. or operation, highly convergent to agile methods.

Given the complexities and challenges of railway infrastructure projects, the integration of agile methods with the guidelines of Law no13.303/16, it represents an advantageous strategy for optimizing project management. With semi-integrated contracting, railway companies can benefit from flexibility

with unprecedented advances, ensuring that each stage contributes directly to tangible results, aligning management practices and the long-term strategic objectives of state-owned companies.

At the end of this article, it is with immense joy that we recognize AEEFSJ's 70th anniversary, a period marked by significant achievements

and a legacy of excellence in the railway sector, reaffirming its commitment to innovation and engineering progress in the country. Long live AEEFSJ!

Check out this article in full on the QR Code.



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Luiz Alfredo Amorim Junior

Executive Advisor in the Engineering, Works and Environment Directorate of CPTM, Specialist in Business Management, Administrator and Mechanical Engineer from Universidade Estadual Paulista.



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