Executive Summary

Report from the Technical-Scientific Committee for the Study of Improvements in the Railway Sector





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EXECUTIVE SUMMARY

Recent years have seen spectacular development in the Spanish railway sector. The introduction of the high-speed rail system, the expansion of local railway services and the development of new urban transport modes on the one hand, and the guidelines established by the European Union on transport in general and railway transport in particular on the other, have boosted the Spanish railway network in a way that would have been unimaginable only a few decades ago.

The constituent elements of the Spanish railway sector, railway companies, the supply industry, universities and all the institutions and organisations relating to the railway sector and transport in general, have been part of a changing environment that has positioned Spain as a world leader in railway technology and know-how.

The overall process undergone up to now can be considered extremely positive for society, for its transport system and for the companies operating in this sector. Even so, given the enormous changes we are continuing to see (not just in technology but also in the economic, social and political spheres at national, European and international levels), we now need the general overview and specific detail that will enable us to keep making the most appropriate decisions so the railway network can continue to evolve and adapt to new times and circumstances.

A Ministerial Order issued by the Ministry of Public Works and Transport on 2 August 2013 created a technical-scientific committee for the study of improvements in the Spanish railway sector. It was made up of a small group of professionals from several specialist fields relating to the railway sector and was tasked with presenting a study within a six-month deadline that would summarise its findings.

Now that the deadline has passed, a report has been submitted to the Ministry containing the most relevant aspects of the current and future situation of the Spanish railway sector. This report aims to present those elements from the professional, technical and scientific points of view. Economic, social and political variables will have to complete the decision-making process shaping the Spanish railway sector over the next few decades.

The term "Railway sector" refers not just to the railway network and railway services, but also to every aspect that falls within the scope of the political, decision-making, industrial, educational, research and other spheres relating to that sector.

While the Committee focused mainly on the national rail network, it also took some account of the urban, suburban, metropolitan and industrial railways, tramlines, etc., making up Spain's railway sector, even though no specific recommendations were made for railway systems outside the responsibility of the Ministry of Public Works and Transport.

The first part of this executive summary presents a series of specific proposals which may prove useful, given their strategic value, to the decision-making process as it concerns railways in Spain. These are the decisions that will shape the railway sector, and the transport system in general, that will be used by future generations of Spanish and European citizens.

1. The Spanish railway sector in figures

The Spanish railway sector is technologically powerful and one of the most important in the world.

The turnover of the rail transport and supply industry in Spain is approximately 2.15 billion euros and 4.35 billion euros a year respectively; of the latter figure, 1.85 billion euros are spent in Spain and the other 2.5 billion euros correspond to exports.

Leaving aside training, research, legislation etc., the railway sector represents approximately 6.5 billion euros per year.

The rail supply industry consists of 600 companies and represents the main activity for 220 of these, 75% of which are small and medium-sized enterprises.

Employment in the sector represents a total of just over 145,000 jobs, of which 45,000 correspond to railway companies and the rest (some 100,000 jobs) to the supply industry, plus the corresponding figures for the civil engineering sector.

2. Essential principles of the railway

Before we go into the detail of these recommendations, we need to mention briefly the importance of an understanding of the main features of railways as a mode of transport. Knowledge of these features is essential for ensuring the efficiency and competitiveness of railways and their capacity to provide service to society.

These essential features can be divided into 3:

- The term "railway" is not synonymous with "progress", but with "capacity". In fact, the railway
 is not the best method for all situations, as it was many decades ago, but it needs to be used
 where it can truly and effectively compete with other modes of transport. It is vital for society to
 be aware of this condition when carrying out any future planning relating to transport.
- Railways are a complex system made up of many elements which have to be compatible with
 one another and with the features of the required services and which all function together
 satisfactorily and reliably. Therefore, when it comes to discussing the suitability of a specific
 railway and the possibility of making decisions about it, we need to talk about railway services
 rather than railway lines or trains. The building or regeneration of a line must never be an end
 in itself, but the result of a decision taken with a view to providing a specific transport service.
 The railway network must be compatible with the other modes that make up the transport system,
 which in its turn is part of another complex system.
- The service life of most of the elements that make up a railway network is usually very long (it
 is normally measured in decades) and so decisions made regarding railways usually have
 long-term and extremely long-term implications. Therefore when we make such decisions, as
 well as the normal precautions, we need to consider the foreseeable development of each
 element, the services required, the requirements posed by demand, etc.

Now that these principles have been established, we offer a series of recommendations below which may prove useful for improving the conditions and features of the Spanish railway sector.

3. Legal mechanism enabling the separation of rail-transport planning and decision-making from political cycles

State decisions can have a long-term impact and these should be consensual rather than personal or associated with a particular time or a political situation.

The resulting procedure could equally well apply not just to decisions relating to the railway but also to other areas requiring significant public investment or with a considerable territorial impact.

With railways, this procedure would affect decisions relating to infrastructure as well as the purchase of railway rolling stock, facilities, equipment, etc.

As an example, leaving aside the suitability of the Spanish model, the French DUP (Debate and subsequent Declaration of Public Utility) system could provide a model for such procedures.

4. Multidisciplinary analysis of the experience of the railway sector in Spain since 2005. Recommendations

Now that the Railway Sector Act has come into force and several years have passed since the introduction of significant structural changes to the Spanish railway network, calm reflection and a thorough analysis of the experience in Spain would be advisable. It is essential to identify the positive and negative aspects, analyse the cost/benefit of the initiatives embarked upon in the context of the sector's reorganisation, study in depth the effectiveness and efficiency of the new organisational structure, and propose complementary and alternative solutions to correct any flaws detected.

For this reason, the Ministry of Public Works and Transport is recommended to carry out the drafting of a multidisciplinary report which includes such an analysis and, where appropriate, establishes any recommendations deemed appropriate.

5. Track gauge

The current situation of the railway-track gauge in Spain is the result of many decisions made during the past 200 years (even before the first railway line was established), which can be summarised, on a national level, as the existence of three superimposed systems with three different track gauges and various features in terms of capacity, services and geographical scope.

Without any wish to judge past actions in hindsight, and before committing to any new decisions or initiatives, it would now be reasonable to consider and discuss the most appropriate options for each of the systems in the future.

This action should define not only the track gauges for each section, but also the features and functionalities (particularly those relating to capacity) of each section of those systems, and the rail hubs and respective intermodal conditions for the transport of passengers (in the various high speed, conventional long distance, regional or local modes) and of goods, all within an Iberian and European context. This action is essential for defining the role of railways in society now and in the future, taking into account their possibilities and the external costs of each transport mode.

All players with a potential interest in this crucial matter for passenger and, above all, goods transport in Spain and in Europe must take part in this debate: central government, regional governments, railway operators, managers and companies relating to infrastructure, the supply industry, social partners, etc.

The result of this debate should lay the foundations for consensus-based and committed long-term planning of the future track gauge of each section of the Spanish railway network, with implications for infrastructure and facilities, rolling stock, possible transitory situations, safety conditions, etc.

Likewise, the conclusions of this debate could feed into forthcoming decisions with a potential impact on the future evolution of the various systems and railway operations in the meantime.

Regarding this matter, the use of the following terminology is recommended for designating the various track gauges:

- "Metre gauge" refers to a separation of 1000mm between the rails (not "narrow gauge", which has a pejorative connotation).
- "Standard gauge" refers to a separation of 1435mm between the rails (not "UIC gauge", as the technical guidelines of the International Union of Railways, UIC, allow for all possible track gauges, meaning therefore that all track gauges are "UIC gauges"; neither should "international gauge" be used, as the other track gauges are also international gauges).
- "Iberian gauge" refers to a separation of 1668 mm between the rails (not "Spanish gauge" or "RENFE gauge", which does not actually correspond with that measurement).

6. Spain in the European Union

Within the framework of the railway transformation process promoted by the European Union, the content of the "Fourth Railway Package" is one of the most critical aspects which have not yet been fully defined. The technical aspects seem more or less clear, but this is not the case for what could be termed the structural aspects, which have a strong political component and extremely important consequences for both domestic and continental railway networks.

These aspects predominantly concern the possibility of allowing – or not – publiclyowned organisations (in principle based on the public "holding" company format) which manage infrastructure at national level and also provide the services of an operator. The second concern is the date and conditions for the mandatory liberalisation of domestic passenger services, the only segment still currently awaiting the complete liberalisation of European railway space.

Spain, whose vote contributes to the drafting of this legislative framework via the fourth railway package, must do all it can to ensure that this framework is favourable to Spanish interests. This framework must promote the co-existence of those states where infrastructure managers are totally independent of railway operators and those where infrastructure managers are part of a structure that is integrated with the railway operator.

As a member of the European Union, Spain wields a certain amount of influence and power in community bodies and must exercise it fully in the decisions those bodies make. This influence must be exerted in favour of previously defined and identified national interests.

For this reason, it is very important to define a strategy for positioning Spanish railways with respect to the processes ongoing in Europe, and in particular, the process of liberalising the railway sector.

In addition to defining and assuming that strategy, it will be necessary to ensure a representative apparatus that is able to transmit the ideas of the Spanish state and assert them in the face of potential adversities during the European debate process.

That participation and capacity to wield influence at European level should not be limited to political and strategic aspects. From the more technical and operational standpoint, there are still important steps to be taken regarding interoperability, standardisation and simplification of the technological and operational diversity that currently exists in Europe.

Such processes, which will eventually lead to a much more efficient and much less costly railway, must be developed as a consequence of the power and authority exercised by the European Union, a percentage of which is represented by Spain. For that reason, it is of vital importance to ensure Spain has the appropriate channels of representation.

7. Organisation and functional structure of the domestic railway network. Position regarding the liberalisation of passenger services

At the domestic level, in 2005 Spain adopted a structure comprising a national railway infrastructure manager (ADIF) and a national operator (RENFE¬Operadora), both of which were completely independent. In addition, there are other regional or private infrastructure managers and operators.

Regardless of the functional structure of the national railway network, a series of institutions or organisations are required for regulating certain essential activities: supervision of safety and interoperability (State Railway Safety Agency), supervision of safety in awarding capacity and other similar functions (Regulator), Railway Accident Investigation Committee (CIAF), standardisation bodies, inter-ministerial institutions, etc.

In the case of the State Railway Safety Agency, it would be desirable for the "railway safety" part of its remit not to restrict its functions to those exclusively relating to safety, in order to allow it to act as a real railway agency (in accordance with the most recent legal provisions, it appears that this is the path that is to be followed).

In the case of the Regulator, it would be desirable for it to come under the Ministry of Public Works and Transport rather than the Ministry of the Economy and Competitiveness, given that the issues it will have to act on, for all their possible economic impact, have more to do with railway operations.

Until all these organisations or bodies have been defined and structured and operate correctly, and until we have much more consistent feedback from experience, we will have to make a cautious analysis of the possible implications if we are to make progress in liberalising Spain's passenger transport above and beyond what is eventually required by the European Union.

To date, there have been very few successful liberalising experiences in the long-distance passenger rail sector (the experience of Great Britain does not apply here), and so it would be prudent to undergo a gradual transformation process. In fact, the management performed by RENFE-Operadora, though it has room for improvement in certain aspects relating to operating costs, has shown good results from the utilisation standpoint, mainly in high speed services, which have witnessed a very significant increase in demand over the past two years. This increase in demand means an increase in the use of high-speed lines, allowing the optimised use of the infrastructure. In addition, the profits made in this market segment (high speed) have offset a large share of those commercially loss-making services which, while not economically profitable, are positive from the point of view of society and of territorial cohesion.

The legislative provisions adopted in Spain, which establish a timescale that is not closed but fairly indicative, as well as the expectations created among potential candidates, make it advisable to proceed with caution and with concession terms that are not too long, in order to allow miscalculations and errors to be corrected and undesirable situations to be rectified in the short term.

Lastly, attention should be drawn to the fact that a totally open liberalisation process may lead to a series of economic problems, given the small size of the existing railway market, and a lack of profitability for provider companies. This, in the short term, may give rise to a real deterioration in services and also damage the image of the railway in a segment such as high speed rail, where an extremely positive commercial image has been created. In this respect, it appears that both the Government and the sector are aware of the limited expectations of profitability on commercial services run by competitors, and for this reason it may be logical to open up the market to competitors gradually and in a controlled way, which will also be easier for the sector to cope with.

It would be advisable, when issuing invitations to tender for Local-Commuter and Regional lines, to try to form lots, so as to avoid only contracting-out the most profitable or least loss-making services, since otherwise only lines with zero financial viability would potentially end up in the hands of the State. A controlled and gradual liberalisation process should be embarked upon for these railway passenger services, based on what could be termed "controlled competition".

In addition, as has already occurred in some countries, and as the Fourth Railway Package seems to imply, the possibility of grouping the national operator and infrastructure manager under a "holding" format for the purposes of reducing structural and operating costs cannot be ruled out.

8. Improved university education for future railway professionals

One of the essential aims of the education system which will train the future professionals who will one day be responsible for designing and managing the railway of the future is to identify educational needs.

In recent years, after observing the railway sector as a whole, along with the new technological developments that have been incorporated into railway networks, there has been a fragmentation of knowledge which has led to the appearance of experts who are highly specialised in certain fields but have no connection with the system's other elements and so lack a comprehensive overview of the very different technologies applied.

One essential aim would be to achieve a holistic vision and an integrated understanding of all that knowledge, in order to achieve excellence in the railway network and in the transport system in general.

The education of future engineers and technical staff, managers, etc., must be considered in such a way that, alongside the specific and probably highly specialised training they acquire, they have a global vision that allows them to be aware of how their speciality and their work fits into the overall context of the railway transport sector, in order to bring about greater and better interaction with other specialists from their area of knowledge.

Spain now has considerable technological expertise on railways and this must be maintained and increased. To that end, well-structured railway training curricula will have to be established in official bachelor's- and master's-degree programmes, based on current knowledge, attractive to students and that help strengthen the high technological level of the Spanish rail industry, connecting the content of the syllabuses to the demands of the sector and introducing a more global vision in terms of contents and teaching methods, in a quest for greater internationalisation of future railway professionals.

The external projection of this sector, as in other engineering fields operating outside Spain, faces problems relating to legal and administrative recognition of the qualifications of Spanish engineers, despite these being highly valued from the technical standpoint. This problem has become more critical since the introduction of the European Higher Education Area (EHEA). There is an urgent need for the Spanish Government to define and identify current engineering qualifications corresponding to level 7 of the European Qualifications Framework (EQF) and consequently the master's-degree courses belonging to that level.

To avoid the loss of human resources, given the high average ages of current professionals, e.g. due to retirement or early retirement, a policy for conserving accumulated railway experience and knowledge must be promoted and implemented. It would be advisable, for these purposes, to promote the institutional development of foundations to ensure this essential function, with the support of the supply industry and railway companies.

Last of all, special attention must be paid to training in human factors for all railway professions associated with safety, human factors having become the scientific discipline that applies systematic methods and knowledge about people for the purpose of assessing and improving interaction between individuals, technology and organisations, with a view to contributing to the efficacy and safety of operations.

9. Pooling Spanish know-how to promote Spanish expertise and industries abroad

Spain's railway sector has significant export potential and its image abroad is generally quite positive.

This potential has been consolidated in recent years, particularly with respect to high-speed rail, as the result of significant technological development at several levels and accumulated experience in railway operation in Spain.

However, to maintain and improve that export capacity, we need to offer an overview of the railway systems and the integration of each and every one of their elements. That is why this knowledge need to be pooled, so that the necessary overview and experiences of the system which "Brand Spain" can contribute are efficient and competitive.

One way of bringing about this proposal would be to create a network of contacts (seminars, associations, etc.,) between railway experts and railway companies and export institutions.

10. Railway research

Today, research, development and innovation are extremely important concepts in any activity or field of technology and knowledge in general. However, these concepts are particularly critical for the railway sector and its survival in the forthcoming decades.

This is critical above all in relation to high speed rail (but also in urban and local railway services), since it is in this field that the technological development/competition binomial becomes especially relevant.

It is impossible to ignore the example of how high-speed railways were developed during the 1960s in France and Germany, along with other modern railway networks or subsystems; while in Great Britain, due to the public finance restrictions on the railway promoted by the Prime Minister in office at that time, the railway, although remaining at a high technological level, soon ceased to be at the forefront of technological advances as it had been until then. When, years later, it was decided to implement the high-speed rail system, it had to be imported from France.

Railway research exists at several levels and is conducted by several players.

The Spanish Technological Platform, co-ordinated by the Spanish Railway Foundation and financed by the General State Administration, focuses its strategic research agenda on improving scientific and technological advances that will foster competition and sustainability in the Spanish railway sector.

Nonetheless, special attention must be paid to the fact that the current configuration of the European railway network does not promote research at the levels which gave rise to the emergence of the high speed rail system, for instance.

With the separation of national railway networks into infrastructure managers and railway operators, the aims of each of these have often focused more on achieving current goals (transport and correct infrastructure management) than on providing for future needs.

As occurs with airline companies, a railway operator is not interested in designing new rolling stock, but only in operating it and sometimes not even in maintaining it.

For this reason, any initiative aimed at promoting railway research as a whole and stimulating and co-ordinating it through state institutions is to be welcomed.

One interesting initiative, founded on existing research centres, could be to set up a National Railway Research Institute which could successfully unite and integrate the efforts of the various players in the sector and could concentrate the necessary resources to conduct research and development activities without actually implementing them, given the separation of the railway sector actors. Several international examples could serve as a model, among them, the Japanese RTRI (Railway Technical Research Institute, in which all the railway companies in the country participate), the Korean KRRI (Korean Railway Research Institute) or the TTCI (Technical Transport Research Institute) of Pueblo, Colorado, US, which reports to the American Association of Railways.

Within that possible framework or outside it, the building of the Antequera Test Ring or similar facilities could be important factors in that development, provided they are executed with the necessary rigour and in the case of the Antequera Test Ring, with a well-defined operating plan, at the service of the international community.

It is vitally important to be present in and aligned with European projects. Participation by Spanish railway companies and research centres in European R&D programmes is crucial and for that reason it is essential to consolidate the participation of Spanish railway R&D in Europe. Spain must try to make the most of the high European technological level, to keep pace with it and not remain isolated as it has been for so long, with such negative results.

11. Communication – Improving the perception of the railway in Spain

The railway network is extremely complex and it is neither universal nor valid for all types of transport or circumstances and its application in each country requires specific adaptations.

However, public opinion usually has a distorted image of the railway due to concepts or ideas about what it was and represented in the past, which are sometimes no more than traditional beliefs.

One widespread perception about the railway as a mode of transport leads to the conclusion that the railway is synonymous with progress, when in actual fact it is or should be synonymous with competitive and sustainable capacity and is only synonymous with progress when it is correctly applied.

For the purposes of eliminating certain mistaken ideas, promoting concepts in keeping with the current reality of the railway and improving certain aspects of the image of the railway in society, it would be useful to prepare an institutional communication and dissemination plan.

This plan would include actions at several levels to improve society's understanding of the railway, now and in the future, what is it, what it should not be, what it can offer, what it should not do and, above all, what it costs.

12. The cost of safety

Although certain incidents and accidents may sometimes have a significant impact on society and the media, statistics show that the railway is a safe method of transport.

In recent years, the "total safety" concept has been developed on an international scale, which encompasses the different modes of technical protection against deliberate acts (security) and in relation to civil and natural risks which could affect the various interests of the railway, in the first place people (customers, workers, third parties) and also property and installations.

This "total safety" system in the railway must (and does) prevent thousands of accidents and incidents every day on all railway lines and in all railway installations, even though we are not aware of it.

However, although it is true that safety must prevail over all other arguments, technological and technical elements must be implemented in keeping with the conditions and features of each line, and it does not seem logical to equip railway lines with different levels of traffic and services with the same type of equipment in terms of civil safety and protection.

The cost of safety and its impact on the system's functionality – as opposed to the limitations imposed by certain safety requirements – are two concepts which are of great relevance to all railway networks and which affect their operation, given that zero risk is impossible in any case. No matter how perfect a system may be, there is always a possibility (and therefore a probability) of failure, even though this may be remote.

Safety always comprises human factors, material resources and procedures, all of which have a cost that must be in proportion with the traffic levels supported and the level of risk assumed.

Because of their importance, human factors and their degree of integration into safety management systems must be regulated and their implementation must be regularly audited.

This regulation and auditing must be introduced for both infrastructure managers and operating companies and it is desirable for the process to be extended not only to the RFIG (Railway of General Interest) but also to railway and metropolitan transport which is under the jurisdiction of the Autonomous Communities.

As for security, baggage inspections at security checkpoints for long-distance lines should be applied only if there is a potential risk situation, such as in the Channel Tunnel or during crisis periods.

13. Regular studies of the state of the national railway network

Regular technical audits, i.e. a study of the national railway network, must be conducted in order to evaluate any potential shortcomings or malfunctions.

It also appears advisable to perform an analysis of the methods used to regularly evaluate the state of the high-speed rail and conventional network infrastructure.

14. Definition of the Railway of General Interest, its lines and types and their features

The legislative criteria for defining the State Railway of General Interest, RFIG, should be in keeping with the functions and responsibilities of the present and future railway and in consequence it may be useful to reconsider both its length and the lines currently included in it.

To that end, it is recommended that a report on this subject should be drafted under the supervision of the Ministry of Public Works and Transport, to include approaches which focus on land use, planning, demand, transport policy, infrastructure maintenance, optimisation of the network, operation, etc., and that network classification and selection criteria be proposed along with an outline for the RFIG and the lines to be included in it, indicating their types and main features.

The possible existence of lines that the state is responsible for but which are not included in the RFIG should not be ruled out and the most appropriate methods of managing them should be determined.

The National Railway Safety Authority should draft a series of safety provisions in keeping with the functionalities of each group of lines, the uses to be made of them and the agreed form of management and operation.

15. Design of railway lines

The optimisation of public investments in infrastructure and the adaptation of the available infrastructure to meet present and future demand forecasts make it advisable to propose the budgeted investments in phases, in order to prevent a surplus of railway infrastructure and under-use of its capacity, thus considerably reducing construction and maintenance costs.

Far-reaching upstream thinking is needed as to whether or not it is necessary to open new high-speed lines due to their high construction and maintenance costs, in addition to evaluating other positive and negative aspects involved in their implementation.

With regard to potential improvements of railway connections, it seems advisable to weigh up whether a new line needs to be built, or whether the requirements of customer demand, access to the whole network, contribution to growth, etc., can be satisfied in a similar way by improving the existing Iberian-gauge network instead. If it is concluded that a new line is necessary, the following aspects should be considered:

- the capacity requirements needed to meet the expected demand,
- the technical installations that will provide the line with that capacity,
- the track gauge to be incorporated: Iberian or standard,
- the necessary outlay for the different options,
- development in phases,
- the potential incorporation into this development of single-track sections, pursuant to a reasonable and credible operating plan, which would ultimately warrant a sequence of singleor double-track sections,
- the cost/benefit comparison between this option and that of improving the conventional network, or of not building a new line.

Should the decision be taken to build new lines, the double track may not always be the most suitable option for the terminal sections of Spanish high-speed lines. Building a single track or a combined single/double track might be more reasonable in many cases and would make it possible to reduce costs without a significant loss of performance.

In this respect, it will always be necessary to ask what type of service is the most appropriate and sufficient to respond to the current or future needs identified. Several options may exist that would meet these needs and they must all be considered. It is not a question of ruling out a certain level of performance and service simply because it is not the best possible one.

In sum, the three elements, infrastructure, superstructure/facilities, and railway management, should be considered as an interconnected whole. The decision to build a railway line must be treated as a joint project. And if it is a question of trying to provide a given capacity, this must be done considering the contribution of the track in relation to the contribution of the signals and the train control system, all within the framework of the requirements indicated by studies of demand and its future evolution.

16. Technology and design of railway infrastructure

The first important principle to be borne in mind is that railway infrastructure must be considered not as an end in itself but as a consequence.

For passenger transport, the aim must always be to provide a series of services which need infrastructure with specific features, including sufficient capacity, which must on occasions (local networks, trunk lines etc.,) be extremely high.

For goods, the aim must be to provide the national or international transport system with a specific transport capacity, for which infrastructure with certain features, including high operational reliability, is also essential.

It is important to point out that in general, the desired passenger services or freight capacity may require different types of infrastructure (if a minimum degree of competitiveness is to be achieved) and the use of the same infrastructure for two distinct purposes may severely limit its availability or capacity, which consequently may affect the quality of the services offered.

Despite the benefits and positive aspects of the new high-speed lines built in Spain in recent years, certain problems or limitations are observed in the functioning of the trains during their operation, the origin of which lies in the infrastructure.

The first of these concerns capacity. If high-speed or conventional railway infrastructure is not going to be used for a minimum number of trains per day, it is quite reasonable to build the line as a single track, with dual-track sections as needed to facilitate operation, even at high operating speeds. This will ensure that desirable performance levels are maintained in terms of travel times and comfort, while also considerably reducing construction and operating costs and greatly improving environmental costs. This criterion could be applied to the HS lines which are currently being built.

As to the procedures for awarding and executing new construction jobs, when the project and its work are jointly put out to tender, it is always advisable to divide the projects into sections that are as long as possible.

Tender procedures for infrastructure construction should guarantee the highest quality, avoiding low-cost bids that are not backed up by the necessary technical justification.

To optimise investment in infrastructure, it is recommended that the work should be completed within the shortest possible time and that it should enter service as soon the safety conditions permit, in order to obtain the expected economic and social benefits as quickly as possible.

As for civil engineering, in general high-quality earthworks are particularly difficult to achieve in Spain, due to the natural conditions of the terrain. For this reason, from the technical standpoint, no large embankments should be planned for new high-speed lines. Large embankments may give rise to serious stability problems (it is not always true that most settlement takes place in the first year after building the embankment) and significant changes to vertical track stiffness, which causes serious problems for high-speed trains.

Large railway tunnels should be designed with two gradients, whenever possible.

The vertical track stiffness of new high-speed lines should be as constant as possible, by improving the design and above all, the performance of the transition blocks.

The double-track gauge (three rails) provides operational solutions, but has technical, economic and functional limitations; and so its use should not be systematic but rather applied only in cases when it offers operational benefits or significantly reduces investment costs. This merits a more specific study in cases that involve long sections or in permanent situations.

17. The supply industry

The rail supply industry in Spain is almost completely dependent on public funding and national standards that fragment the market. So it is very important to have medium and long-term planning, with investment plans and guidelines that help stabilise the industrial system, which in turn must respond to such investment.

This stability, and independence from potential political changes, must be complemented by the establishing of guidelines and regulations that are applicable to the whole country, in order to guarantee market unification.

The Spanish supply industry must show leadership in responding to European R&D&I policies: for instance, SHIFT2RAIL and its various lines of action (rolling stock, traffic control, new infrastructure designs, innovative solutions for the transport of goods, etc.)

Export activity requires significant institutional support from the State in order to help detect opportunities in sufficient time to carry out important lobbying.

In this institutional support, the presence and backing of railway companies, especially RENFE¬Operadora, ADIF, metropolitan companies, etc., and the Government are essential for providing the Spanish rail supply industry with external support, with the aim of ensuring that most of the supplies to be used for construction work come from Spain.

Based on this standpoint, it would be recommendable to define the role of those companies in export operations, and in particular the task of RENFE-Operadora, ADIF and Ineco.

18. Infrastructure tariff mechanism

The fee or toll for infrastructure use is intended to reflect the real cost of a significant share of total infrastructure costs which are normally difficult to calculate.

Given that these fees in Spain are classified as taxes, which is exceptional in the EU, it is important to stress that the fees paid for the use of railway infrastructure, regardless of whether they are technically taxes, are established by ADIF. Regulations must be introduced as soon as possible to establish basic principles for applying discounts and incentives on fees and a general tariff framework for the railway network, which is particularly important because such a framework for passing on and assuming the costs of infrastructure use would provide important guidelines for rail transport policy. It would also be useful to promote the idea that these fees are "prices" rather than taxes as at present, in order to make it easier for them to be adapted to market conditions.

It is important to gain a better understanding of the real, fixed and variable operation and the maintenance and management costs, especially the marginal cost of running trains.

Once these costs are known, a strategy will have to be established for improving traffic and in some cases, justifying discounts (for example, the case of certain goods trains) or if not, for increasing rates.

As a general criterion, whatever the tolls amount to, the fee structure should encourage railway traffic and align the aims of the infrastructure manager and operators, thus helping mitigate the contradictions and divergent aims that separation could generate.

The value of the fee must be associated with the service level and the services offered by the infrastructure, for instance, based on concepts such as speed, reliability, etc.

Consequently, the degradation of these services (e.g. unexpected speed restrictions, maintenance problems, reductions in reliability, etc.,) should lead to a reduction in fees, while an improvement in the services could justify surcharges or higher fees.

For passengers, specifically in the case of high speed lines, incentive systems (not subsidies) must be established to encourage operators to offer more seats, especially on high speed lines with little traffic. This strategy could consist of reducing the "traffic" component of the fee as total traffic on the line increases, since, as already mentioned, this fee aims to recoup the investment made.

It would be necessary to implement a "stability" criterion so that operators know how much they will have to pay in fees for their services over a longer period than at present.

In particular, in planning the total liberalisation of the European railway area, it would be advisable to establish criteria for optimising resources through tolls, options in the event of saturation, methods for establishing train contract auctions, etc.

19. Freight

The major unresolved task of rail transport (and transport in general) in Europe is the transport of goods.

Yet again, we must insist that railway is synonymous with capacity and the railway network, although similar, is different in each corner of the planet.

In general, to optimise the capacity of a railway line, of whatever type, mixed operating conditions are not the best option.

On the other hand, regarding the capacity of a single train, the train length, axle load and clearance parameters are essential.

Considering these premises and the fact that currently, the basic transport unit all over the world is the truck whereas in Europe, loading a truck onto a wagon is still a complex operation, the goods railway is facing a difficult future.

At all events, goods transport requires a much broader approach than mere rail transport. The design of an intermodal service is vital for growth in keeping with the aims of the European Union, which proposes as its aim for 2050 that the transport of goods by rail should represent 50 per cent of freight transport overall, as is the case in the United States.

This involves several critical aspects. The first of these is to reduce costs, not necessarily by competing with road transport, but by fostering intermodality.

Within this context, of the biggest states in the European Union, Spain is the one with the lowest share of goods transport by rail and also the country which has seen the most significant falls in this mode over the last decade. This share currently stands at around 4% of all t-km transported by land, as opposed to the European average of 17% (Eurostat, 2012).

From a more structural standpoint, considering the conditions of intramodal competition, it is difficult to see how a public goods transport company can compete with a private company.

According to the above, based on the criteria of the European Union (set out in Directive 91/440) and in accordance with the current potential of rail goods traffic in Spain, it will be necessary to analyse some approaches regarding the activity of RENFE-Mercancías in a competitive railway market which could, among other hypotheses, include the potential privatisation of that business.

If the privatisation option is eventually decided upon, it must be done with the aim of fostering intermodal competition (road/rail, domestic maritime/rail transport) and not just intramodal, as has been done in practically all cases (past and present competition between private operators and RENFE¬/Operadora to capture railway traffic carried out by the latter company).

Rail goods transport requires no great investment in infrastructure, unlike high speed rail or local services. The services provided by goods trains are quite different and in all cases much more modest in speed than passenger trains. The cost per kilometre of a new line for goods is considerably lower than an equivalent high speed line, since goods trains do not need high speeds, but simply not to stop.

As well as capacity, goods transport by rail (operations and operators) needs simplicity, robustness, reliability, large clearances and high axle loads, adequate train lengths, speeds "other than zero", market conditions, flexibility, intermodality and the ability to offer low transport prices.

What goods do not need, and can therefore be wholly dispensed with when representing a minimally high cost, are speed, technological sophistication and daily maintenance (necessary for passenger trains).

From a general-systems standpoint, goods require safety (for the railway network itself and for third parties) and reliability, but they must also be offered interoperability and capacity.

On the other hand, regulatory measures need to be implemented along with the management of services in terminals and investment analyses in order to improve the efficiency and competitiveness of the railway network in logistics chains, and in particular the adaptation of trunk lines for goods transport and connectivity between load-generating centres and the railway, specifically with ports, intermodal hubs and logistics platforms and factories. The Logistics Strategy policy initiated by the Ministry of Public Works and Transport should be continued.

In general, goods terminals and other logistics facilities used for goods must in principle be run by the operators themselves or by organisations which guarantee the balanced distribution of their capacities, since they are an essential part of their value chain and strategy.

To improve the transport of goods by rail, it appears necessary – and maybe sufficient – to change the management model. In many cases, travel speed is more important for image than for the market, and the time during which the goods are in motion is a small part of the time involved in transferring the goods from the supplier to the customer. Adopting a new approach in the management model does not necessary warrant the implementation of initiatives that require large investments, but rather a conceptual change and a change in the management of the trains.

A system must be established for goods trains. The types of lines that would have to be studied should at least be the following: preferential lines for goods, exclusive lines for goods, lines granted

through a concession to a private company for the exclusive operation of goods trains and the procurement of public-private contracts for the adaptation, maintenance, operation and management of a line for the transport of goods.

The options to be studied for assigning railway lines would be: lines managed by ADIF; lines given in concession by ADIF; lines owned by the State and not managed by ADIF for railway use; new lines under public-private control; or private lines such as the so-called short lines, with marginal traffic, used mostly to link other lines, which could be subject to simplified operation by private companies, ranging from small businesses to major companies, and including the affiliate companies of larger operators. In many cases these ventures would exist to feed and distribute traffic to main lines.

In short, it is very important to enact policies to increase the transport of goods by rail. In a context where the re-energising of goods transport is desired, forceful measures must be taken and approaches must be considered to organise this transport in a completely different way from passenger transport, obviously giving goods greater autonomy in the use of the network and greater independence with respect to that network, and introducing different and specific forms of management and administration of goods lines. Subsequently, the rapid implementation of legislative changes may be necessary (minor changes, in all cases) to allow the goods lines to be managed and operated in accordance with the requirements of this type of transport. Consideration also needs to be given to the possibility of granting the operation of certain lines to the private sector, following their exclusion from the RFIG; lines which should no longer be necessarily managed by ADIF but in most cases, by the concessionaire itself. These lines could encompass the various types of goods transport lines, from major lines to branch lines and short lines.

20. Sustainability

In general, when considering strategic planning in the transport sector, it is accepted that an efficient transport model must be intermodal, in which each mode functions in its optimum "window of operation".

From this point of view, the railway is the transport mode that incurs the lowest external costs and for this reason, it will be necessary to promote a modal shift from other less sustainable modes, particularly road and air transport.

To do this, transport prices must internalise costs, so that they constitute an incentive to select more sustainable transport modes such as rail, which has internalised external costs insofar as electricity forms part of the CO_2 emissions trading system.

There are three great challenges which the railway sector must face in order to reduce impact and even help improve sustainability: reducing the carbon footprint by improving energy efficiency and increasing electric traction in the Spanish railway network, including electricity from renewable energy; a commitment to intermodality and the determined development of goods transport.

Other challenges identified include increased urban integration, the prioritisation of investment and an analysis of maintenance costs, the promotion of research and analysis of eco-design, the reduction of environmental impact during the entire life cycle, the analysis of adaptation to climate change and seismicity, the application of sustainable procurement criteria, the reduction of railway noise, the maintenance of railway heritage for use in territorial development, the consolidation of the Green Routes programme, the fostering of land stewardship and habitat or biodiversity banks, the strengthening of the environmental and sustainability dimension among managers and operators and the inclusion of sustainability in the Transport Observatory. There should also be a firm commitment to internationalisation, which will allow an updating of knowledge and techniques that will be to the benefit of the Spanish railway sector, not only in maintaining its leadership but also in improving its systems in this country.

21. Energy

According to the IDAE (Institute for Energy Diversification and Savings), the transport sector accounts for more than 41% of total energy consumption in Spain, the largest component, ahead of the industrial sector. 2.2% of that figure corresponds to rail transport.

The railway consumes 1.3% of total electricity in Spain and accounts for 95% of all electric energy consumed by the transport sector.

For the purposes of an eventual reduction in consumption, the energy efficiency of railway networks must be considered when planning and designing new lines and improving existing ones. For these reasons, and to ensure current and future facilities are designed appropriately, demand must be rigorously analysed.

There is very significant scope for energy improvement in rail traffic operation, particularly on metropolitan and local lines. ATO automatic train driving systems have already been installed, enabling eco-driving on most metropolitan lines, thereby improving the service quality, but most are not optimised in energy terms.

The development and implementation must be promoted of strategies and devices to use the energy generated during braking (inverters, energy storage elements, reconfiguration of supply systems), since at present a large percentage of this energy is wasted, especially in urban and local circuits.

22. Operation – General Traffic Regulation

From the operating standpoint, without doubt the main reference document is the RGC (General Traffic Regulation) and its Complementary Documents.

The RGC is not a static document, but must be adapted to the needs of each country or railway network and to their evolution over time.

However, a review and update, including the necessary supplementary documents and standardisation, is always highly advisable, at least for the most critical sections. This standardisation should be carried out at European Union level, if possible in accordance with the Technical Specifications for Interoperability on Traffic Operation and Control. In particular, in Spain it must be harmonised as much as possible with all regional railways.

The RGC establishes obligations which often have important financial and employment implications, which is why its effects on railway operation must always be assessed with caution, so that it does not end up being unworkable or having non-technical or non-operative criteria prevail over employment or economic criteria. Bearing in mind the RGC's purpose, scope of application and importance, it must be drafted by the authority responsible for railway safety (currently the Directorate General of Railways and in the near future, the National Railway Safety Agency). Its approval falls to the Council of Ministers, at the proposal of the Ministry of Public Works and Transport, through a Royal Decree.

On the other hand, it would be advisable to establish a round of contacts between the various Spanish railway players in order to establish common traffic regulations and operating criteria.

23. Operation – Drivers

One of the most important aspects of operation is the work of the drivers, including their training, documentation and conduct.

The training of staff drivers must be standardised with that of other drivers in the European Union. The process for obtaining licences and their renewal falls under European regulations, although the matter of standardisation must be studied in greater depth.

Regulated training with the State's seal of approval must ensure functionality and safety conditions that are in keeping with the operational standards which must be provided by the various types of rail services.

The most important aspect of the documents supplied to drivers is their updating and guarantee of receipt. The equipping of drivers with remote and computer resources and the respective procedures and training should provide a guarantee that all drivers are aware of temporary regulations and information well in advance.

The issuing of train documents and all the necessary information should be automated, so that the drivers can receive them on their tablets.

With respect to conduct or habits while driving, a regulation (included in the RGC) should specifically govern the use of cell phones and other similar devices (tablets, computers), whether personal or service equipment. The same specific procedure should regulate the equipment assigned to the drivers as well as their identification and handling.

It would be advisable for drivers' cabs to have a hands-free communication system to replace the use of cell phones and eliminate the risks associated with them, such as reduced attention, loss of freedom of movement for driving functions, etc.

24. Signals

The type of signals on each line must meet criteria which combine the required safety conditions with the services specified for each line, considering their technical and geographical features, type of operation, weather conditions, traffic, etc., among other parameters.

Since, for historical reasons, there may be lines that do not fulfil this requirement, a study will have to be made of each line in operation to ensure that its signalling system is in keeping with the above criteria. Infrastructure managers should carry out this mission in their respective domains. Spain must promote and collaborate in ensuring the standardisation and simplification of existing systems of conventional signals, as seen in other modes of transport, such as road and air transport in particular.

High-speed lines, and conventional lines with the type of traffic that requires it (for instance, certain local lines), should be equipped with the standard European train control system, ETCS, and if possible, follow the recommendations on conventional signalling criteria established by the European Railway Agency.

To improve effectiveness, special attention should be paid to reducing problems of compatibility between various versions of the same equipment, and for this reason, the versions to be installed and updates must be strictly supervised.

Likewise, ETCS level 2 should be extended as a priority, not overall, but on lines where it is needed to support considerable levels of traffic. On lines with less traffic, the possibility of installing a simplified ETCS level 1 should be considered.

Similarly, it would be advisable to review technical and operational specifications in order to reduce installation costs and improve quality and standardisation costs, through exhaustive operating tests performed in the laboratory.

It should not be forgotten that the initial aim of the ERTMS system was, and still is, to achieve a European railway signalling and operating management system that is interoperable, cost-effective and obviously, safe. Based on the significant experience it has gained with this type of system, Spain must participate in European developments to ensure the system progresses well and to share this acquired experience.

Lastly, satellite location is a tool that is widely used in several transport sectors and it should be developed for the precise tracking of the rolling stock of each railway operator. With current satellite location capacities, considerable added value can be provided without the need for significant investment.

25. Territorial accessibility as an essential element in passenger transport

The intrinsic benefits of transport can only be enjoyed if there is accessibility. Without accessibility, transport is an end in itself; through accessibility, transport becomes a means for development and growth, a necessary element, but one which alone is insufficient to achieve this.

Within the areas crossed by a line, accessibility is supplied depending on whether or not there is a station. If there is no station, then that area has no accessibility. If there is a station, the accessibility supplied will be directly affected by the location of the station in relation to towns and cities.

As a general principle, stations must be built into the urban fabric and their main purpose is to serve city centres. What is the use of trying to be similar to air travel in those aspects that constitute its main weakness: access to and connection with city centres, and poor connections with urban and metropolitan networks?

Therefore, it is important to value accessibility more highly than speed, since the railway relates to the territory through the accessibility it provides.

Given current timetables and travel times on Spain's high-speed services, it does not appear likely that the reason for not passing through the centre of these cities can be based purely on the purported delays of intermediate stops.

Thought must be given to the decisions regarding new high-speed lines, their plotting, the services they offer intermediate cities along their route and how they offer them. These decisions cannot be made without serious reflection, which if possible, must only consider the arguments produced by rational analysis based on diverse criteria.

It is not a question of not providing intermediate cities with railway services. On the contrary, several aspects must be assessed: for example, whether the shorter travel time by rail to the various potential locations for a station for those cities is proportionate to the total time taken to travel to those cities' centres, calibrating also the overall cost of transport and not just the price of the ticket, given the need to change trains or use other motorised transport modes to reach stations far from city centres. Several options need to be considered in terms of the demand which could be generated in the cities the line runs through depending on the route's various commercial time bands. It should be considered whether access to intermediate cities is really a deterrent to achieving attractive travel times between cities that are far apart or whether on the contrary access is an option that should be enabled in most cases.

26. Passengers – design of stations and transport hubs

The integration of local services with other urban, intercity, national, regional or metropolitan transport services should always be considered, and in this, transport hubs play an especially important role.

Transport hubs and railway stations in general must be designed based on criteria that integrate the interests of all the actors involved.

The concept of governance, which in Europe is currently defined as "who decides what", may be the key to success in the design and development of urban stations or transport hubs.

The next step after "who decides what" is "who funds what" and "who takes responsibility for what", which in turn leads to the definition of the funding for each project, operation, etc.

Among other things, a shared model of design and funding is synonymous with transparency, quality of execution and efficacy in controlling investment, i.e., the use of public funds.

The establishment of provisions regarding the governance and funding of transport terminals could facilitate the implementation of this strategy.

With respect to the operation of terminals, several models can be proposed, bearing in mind the various possibilities and experiences of existing business models.

27. Passengers – local, medium distance and urban transport

According to the liberalising philosophy promoted by the European Union, operations for this traffic segment may be carried out by concessionaires, either belonging to regional authorities or private companies which compete for the market.

However, the State must continue to own these lines and their traffic regulations and guidelines must be the same as those for the whole national network.

Proper planning of the services is needed in order to create an attractive product for passengers that will favour sustainable mobility between neighbouring cities.

In recent decades, local rail traffic has grown steadily and its evolution must be analysed and forecast, in order to plan the possible adaptation of facilities to meet future demand.

This growth must be channelled under the procedures and guidelines issued by the National Railway Safety Authority (Ministry of Public Works and Transport) and in all cases, maintaining coherence with the legislation established for the RFIG.

As is the case for the rest of the network, an analysis of the maximum theoretical capacities of each line is necessary, along with the identification of "pinch" points that limit this capacity, making it possible to eliminate them.

In urban transport, the design and operation of trams or light rail systems must be streamlined. The widespread belief that "trams are eco-friendly and modern" must be replaced by purely rational criteria for choosing the most suitable mode of transport in each case, based on expected traffic volumes.

Again, demand studies will be crucial for establishing a correct definition and successful implementation and operation, in all cases combined with other modes of transport and with the functionalities of each city area.

Conclusion

The information, data, opinions and proposals summarised in the pages above, which are explored in more depth in those that follow, are the result of an extremely complex and difficult task. Six months were necessary to collect the material, compare opinions and hold discussions and debates about the many different topics to be covered.

As a general conclusion, we can affirm that despite the economic and social circumstances currently prevailing in Spain and Europe, the Spanish railway sector enjoys a high level of technology and great prestige worldwide.

The Committee responsible for writing this report has made every effort to be objective and critical, attempting to contribute a scientific and technical viewpoint that will offer guidance about the future development of the railway in Spain through a vision of the whole. Although the points of view may be quite different and the interests of the various components of the railway sector are sometimes at cross-purposes, the result of this report and the comments and recommendations are shared by all the Committee members. We would hope that this work does not become a historical footnote; given the rapid pace of change in the railway sector, it would therefore be advisable to update its content in the near future.