Smart Transportation Alliance

Road maintenance in Spain, United Kingdom, Germany, France and Italy: a comparative study

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1. Introduction

Road infrastructure plays a vital role in the development of socio-economic activities, constituting a fundamental element for societal progress. A road network that allows an efficient movement of people and goods paves the way for an efficient exploitation of a country's economic and human resources, as well as its growth and sustainability over the years.

The road sector, however, faces enormous challenges. The growing demand for transport requires adequate maintenance and exploitation activities in order to preserve the efficiency, safety and comfort of the road network. However, road authorities must often deal with inadequate financial and budgetary resources. In addition, new techniques and approaches are needed to optimise maintenance operations with the specific objectives of combining security, financial, environmental issues and the need to minimise infrastructure downtime during maintenance.

This Technical Report summarises the key conclusions of a study commissioned by the Spanish Association of Road Maintenance and Exploitation Companies (ACEX) that investigates the existing methodologies and practices of road maintenance and exploitation, as well as the economic and budgetary approaches, in five 'target' countries: Spain, the United Kingdom, Germany, France and Italy. The study counted on the collaboration of several experts from each target country, under the overall coordination of specialist firm Etelätär Innovation and the Smart Transportation Alliance (STA)[1], and spanned from January to September 2019.

The objective of the study was to develop a solid comparison of existing maintenance and exploitation practices in a number of reference countries in Europe, systematically addressing the following topics:

- Legal and institutional framework,
- Scope of maintenance and exploitation activities,
- Bidding and contracting processes,
- Financing, and
- Specific characteristics of the sector.

The objective sought was to provide the reader with a complete overview of road maintenance and exploitation activities in the selected countries, in order to outline aspects and practices that could constitute criticism, or alternately a promising best-practice approach.

[1] The full study can be downloaded (only in Spanish language) from http://www.acex.eu.

Detailed information on the subject at hand is scarce. In fact, data collection and notification systems in different countries are not standardised, which means that the information provided is not homogeneous. In addition, the different road authorities often lack a dissemination procedure and/or keep the information confidential. This is especially true for financial and budgetary figures. At the same time, the local administrative layer is particularly challenging, as the information is distributed amongst a large number of entities dealing with road networks.

2. Terminology

There are also important differences in the terminologies used in different countries when referring to road maintenance and exploitation practices, which makes direct comparison difficult. To understand this, it is necessary to first establish a clarification on the terminology to be used in the operation, maintenance and maintenance of infrastructures.

For instance, in Spain the terms '*explotación', 'conservación'* and '*mantenimiento'* are used to define different types or road maintenance works and activities.

'Explotación' (exploitation) activities are those focused on keeping the infrastructure permanently on service, in the best possible conditions, ensuring a safe, fluid, comfortable driving on existing roads and at the lowest overall cost for society, while preserving road value.

'Conservación' (structural maintenance) activities ensure that road elements fulfil the function for which they were designed and built, delaying the process of degradation of functional or structural characteristics, including replacement of repair of elements, repairs, rehabilitations or improvements.

'Mantenimiento' (routine maintenance) activities ensure that the road works permanently, paying attention to incidents, surveillance, cleaning (pavement, drainage, etc ...), environmental actions, winter conditions, etc.

In the case of the United Kingdom, the UK's Department of Transportation uses the terms *structural maintenance* and *routine maintenance* to describe maintenance activities. We observe here important differences, as routine maintenance tasks include reactive actions such as pothole repairs, cuddling, etc. which are considered structural maintenance in other countries. Therefore, the activities included in the two aforementioned categories also do not exactly match, for example, with what seemed similar categories in Spain.

In France, the *Direction Générale d'Infrastructures* uses the term '*entretien*' (maintenance) or '*preservation'* (preservation) to refer to the activities of repair or rehabilitation of pavements, while cleaning or winter maintenance are not considered as '*entretien*' tasks. These tasks are usually described under the '*viabilité*' (serviceability) term.

In Germany, the term '*erhaltung*' (conservation) is used to refer to maintenance tasks, although the literature does not specify which specific activities are included or not.

The limitations mentioned above do not affect in any case the overall value of the systematic comparative analysis performed.

3. Comparison between countries

Due to the heterogeneity of the available data, and even the lack of these in many cases, it has been a challenge to make a direct comparison between the analysed countries. For this reason, the comparison has been limited to road networks managed by the central state, either directly or delegated to agencies or public companies exclusively responsible for this function.

First, the study compared the total investment in road maintenance for these networks. It is necessary to clarify that there are important differences between these networks and also the way in which expenditure is categorised in different countries and what activities are included in the different categories. This is primarily caused by the different definitions used in the realms of maintenance activities which were described in the previous section.

For example, routine maintenance may be included, have a separate budget, or be accounted for as an operating expenditure. It may also include (or not) maintenance of structures such as tunnels or viaducts. There are no data specific to the expenditure made according to the type of road (motorways or conventional roads) in most countries, with the exception of Germany. These data would have offered a much clearer and directly comparable image between the different networks. In order to make the comparison, the 'equivalent Km' approach was followed. The criterion basically reads 1 Km of motorway is equivalent to 2.1 Km of conventional road.

The average expenditure per kilometre obtained must be compared with cautiousness, since the different proportion between types of roads in the different networks must be considered. For example, the network managed by Highways England is exclusively composed of highways and roads classified A in a proportion of approximately 50%, while, at the other end, the Italian ANAS network is mostly composed of conventional roads, with a small proportion of approximately 5% of motorways. These figures also do not reflect other characteristics of the network, such as specificities due to geography and climate.

Table 1. Investment in road infrastructure

	Spain (2017)	United Kingdom (2017)	Germany (2017)	France (2015)	Italy (2017)
National motorway network (Km)	8,950	3,497	12,800	2,300	1,294
National motorway network (Km equivalent)	18,795	7,343	26,880	4,830	2,717
Total investment in National motorways	N/A	N/A	2,110,000,000	N/A	N/A
Average investment per Km in National motorways (€/Km)	N/A	N/A	78,497	N/A	N/A
Conventional road network (Km)	15,000	3,420	38,000	9,800	22,682
Total Investment in Conventional roads	N/A	N/A	1,084,000,000	N/A	N/A
Average Investment in Conventional roads per kilometre (€/Km)	N/A	N/A	28,526	N/A	N/A
Total National network (Motorways + conventional roads) (Km)	23,950	6,920	50,800	12,100	23,976
National network (Motorways + conventional roads) (Km equivalent)	33,795	10,763.7	64,880	14,630	25,399
Total investment in national network (Motorways + conventional roads)	760,000,000	1,164,000,000	3,194,000,000	395,000,000	1,055,000,000

Average investment in Motorways + conventional roads (€/Km)	31,732	168,208	62,874	32,644	44,002
Average investment in Motorways + conventional roads (€/Km) (Km equivalent)	**22,489**	**108,141.25**	**49,229**	**26,999**	**41,536**

3.1. Spain

The figure presented corresponds to replacement investments according to the Spanish Ministry of Public Works (*Ministerio de Fomento*). No data was found on what specific activities are included in this budget. From this figure, it has been deducted the cost of constructing, financing and maintaining the first-generation highways (1,000 km), resulting in an actual investment of 760 million Euros.

3.2. United Kingdom

Only the network managed by Highways England is analysed. The budget, calculated in Euros, corresponds to the total budget allocated to structural maintenance, (864 million Euros) and routine maintenance, (300 million Euros), as described in the report of the ORR (Office of Rail and Road) and the British Department of Transport. Highways England manages the Strategic Road Network (SRN) composed exclusively of motorways and A class roads, which makes it a particular case among those compared.

3.3. Germany

The figures correspond to the budget allocated to maintenance published by the Transport Infrastructure Financing Company (VIFG), although it is not specified which activities are included or not. The VIFG is responsible for the total budget for federal highways and roads, although there may be additional investments from the Ministry of Transportation for which no data has been found.

3.4. France

The last budget published by the General Directorate of Transportation and Sea Infrastructures (315 million Euros) dates back to 2015. That year, additional 80 million Euros were contributed by the toll concessionaires in the framework of a national plan for national motorways renewals. The figure corresponds only to maintenance budget

(preventive maintenance and renovation). In France, routine maintenance is usually considered an operating expenditure, and related data are not available.

3.5. Italy

The data included in the table above correspond to the figures published by national company ANAS, and includes expenditures divided in two categories: ordinary maintenance (635 million Euros) and extraordinary maintenance (420 million Euros). Ordinary maintenance corresponds to routine tasks and pavement maintenance, and the extraordinary includes major works and renewals. It should be noted that only a small part of the network managed by ANAS are motorways.

4. Legal Framework

In the following tables, other aspects of road maintenance in the different countries are compared: ownership and management of roads, execution of maintenance work, scope of contracts, service evaluation (indicators) and road taxation.

In some cases, it was not possible to locate data to justify the response; on these occasions the No Data Available (N/A) acronym has been indicated.

Table 2. Who is owner/responsible for the road network?

	Spain	United Kingdom	Germany	France	Italy
Central State/National Government	Ministry of Public Works (Ministerio de Fomento)	Department for Transport (England and Wales) but delegated to Highways England	BMVI (Federal Ministry of Transport and Digital Infrastructure)	General Directorate of Transportation and Sea Infrastructures (Direction Générale des infrastructures de transport et de la mer)	Ministry of Infrastructures and Transports
Regions/states	17 Autonomous Regions (Comunidades Autónomas)	Transport Scotland	Ministries of Transport or equivalent of the 16 Federal States (BundesLänder)	No regional roads, but 11 DIR (Directions Interdépartementales des Routes) manage the national network	20 Regions
Counties/Districts	3 Provincial Authorities, Basque Country (Diputaciones forales)	Department for Infrastructure			

	46 Provincial Authorities (Diputaciones)	118 Councils responsible for local highway maintenance – sometimes delegated to district councils and sometimes to regional consortia			
	7 Island Councils, Canary Islands (Cabildos insulares)	26 County Councils (mostly non-urban)			
	5 Island Councils, Balearic Islands (Consejos)	55+1 Unitary authorities (mostly urban areas)			
Local Authorities	8,131 City Councils (municipios)	36 Metropolitan Boroughs (division of major metropolitan areas)	Districts (LandKreise)	Districts (Départaments)	Municipalities
		Greater London divided into 32+1 Boroughs. Boroughs and Greater London share responsibility for highways	Municipalities	Municipalities (communes)	

5. Bidding and contracting procedures

This study includes an exhaustive analysis of the different contracting models that are used by the analysed countries. There is no single or generic model, observing a term of duration for multi-year contracts. This is clearly necessary for this type of contracts. On the duration of these contracts there is no convergence or unanimity, but the need to cover the heavy investments in initial equipment, in training and training of personnel, in innovation and R&D programmes, makes us recommend contracts with a duration between 7 to 10 years.

Table 3. How are maintenance works commissioned?

	Spain	United Kingdom	Germany	France	Italy
Concession	3,303 Km	23 toll roads	Selected 'PPP' motorway sections. Tolls for heavy vehicles.	9,000 km	Yes
Service Contracts	Per Km	Yes	Only applied at the few selected 'PPP' funded road sections	Very rare	Yes
Works Contract	Yes	Yes	Yes	Yes	Yes
Frameworks	No	Yes	For minor works, cleaning and services	Yes	No
In-House	No	Yes	Yes	Yes (routine works)	No

In order to better understand the scope of the maintenance work contracts, and due to the enormous differences between the target countries, they study resorted to a comparative table where the experts from each country answered several key questions about these contracts. These results are showed in Table 4 below.

Table 4. Scope of Maintenance Works contracts

Question	Spain	United Kingdom	Germany	France	Italy
Are they service contracts?	Yes	Yes	No	No	Yes
Are they works contracts?	No	Yes	Yes	Yes	No

Do they have fixed resources with permanent workforce (personnel and machinery)?	Yes	Yes	Yes	No	Yes
Are the materials used by these permanent staff paid?	Yes	Yes	No	Yes	Yes
Include works with specific personnel and machinery, which are only temporarily contracted?	Yes	Yes	In some cases	Yes	Yes
Construction of facilities to allocate workforce is included?	Yes	Yes	Yes	No	N/A
Is the completion of inventories of the network included?	Yes	Yes	Yes	No	Yes
Is basic inspection of bridges and structures included?	Yes	Yes	No	No	Yes
Are tunnels, bridges and structures included?	Yes	Yes	Yes	No	Yes
Is obtaining IRI (International Roughness Index) and CRT (sideways force coefficient) included?	Yes	Depends on contract	Yes	No	N/A
Is the replacement of the elements of the road included immediately?	Yes	Yes	Yes	Yes	Yes
Are environmental operations included (cleaning road margins, clearing, herbicides ...?	Yes	Yes	No	No	Yes
Is the repair of potholes and cracks included?	Yes	Yes	No	Yes	Yes
Is the cleaning of the longitudinal and transversal drainage included?	Yes	Yes	No	Yes	Yes
Is cleaning and replacement of vertical signage included?	Yes	Yes	No	Yes	Yes
Is cleaning and replacement of vehicle restraint elements included?	Yes	Yes	No	Yes	Yes
Is cleaning and replacement of beacons included?	Yes	Yes	No	Yes	Yes
Is it included the repainting of the horizontal signage and the road markings?	Yes	Yes	No	Yes	Yes
Do they include the winter service?	Yes	Yes	No	No	Yes
Do they include response to emergencies, incidents, accidents?	Yes	Yes	No	No	N/A

Do they include the legislation regarding property protection, building regulation, expropriation, etc?	Yes	Yes	No	No	Yes
Is monitoring of the contracted road network carried out?	Yes	Yes	In some cases	No	Yes
Does road safety have priority?	Yes	Yes	Yes	Yes	Yes
Are there low-cost operations in road safety?	Yes	Yes	No	NA	Yes
Is a report of all accidents with fatality made?	Yes	Depends on contract	Yes	Yes	No
Are road safety studies carried out periodically?	Yes	Depends on contract	Yes	Yes	No
Are the operations of the permanent staff scheduled?	Yes	Yes	Yes	Yes	Yes
Is there 24-hour and 365 days a year service?	Yes	Depends on contract	Yes	Yes	N/A
Is there a right to subrogation of the staff?	Yes	Yes	No	N/A	N/A
Is the renovation of the road surface included?	No	No	Yes	Yes	Yes
Is the installation of new road elements included?	No	No	Yes	No	N/A
Are emergency works that may appear included?	No	Depends on contract	No	No	N/A
Are changes of layout, modification of intersections, etc. included?	No	No	In some cases	Yes	No

6. Financing

From the analysed data, and in general in all countries, we can observe that during a road's life cycle, maintenance and upgrading budgets have not been sufficient to stop the deterioration of the network. The worsening of the condition of these infrastructures has also caused an increase in the cost of the necessary repairs, which the available budgets cannot cover. This situation leads again to an increase in the deterioration levels, in some cases beyond any possible repair and hence with a need for a complete renewal of the infrastructure.

In order to fully understand this situation, we must consider that, If we take into account the value of infrastructure (which would cost to rebuild said network), the budget allocated to its maintenance is lower than 2% of the value of that infrastructure, which is the recommended cost for proper maintenance recommended by the World Bank.

In some cases, despite the budget increase, an equivalent increase in maintenance investment does not happen, since a large part of the budget is allocated to the operating expenses of the administration itself or other activities such as the construction of new network sections. This means that the final resources allocated to maintenance do not allow keeping the road network at the optimum comfort and safety levels.

It should be noted that when ordinary maintenance is neglected for a long period of time, the need for major maintenance works increases considerably, since addressing small damage regularly is three times cheaper than undertaking major repairs later.

	ESP	RU	ALE	FR	ITA
Vehicle registration tax	Yes	Yes	Yes	Yes	Yes
Taxes to motor vehicles	Yes, municipal	Yes	Yes	Yes	Yes
Fuel taxes	Yes	Yes	Yes	Yes	Yes
Car insurance		Yes	No	No	Yes
Traffic fines	Yes		Yes	Yes	Yes
Taxes to heavy or professional vehicles	No	Yes	Yes	ND	ND
Is the revenue from these taxes allocated to road maintenance?	No		No	No	Partially
Is there any specific agency managing these taxes?	No		No	Yes (AFITF)	No
Tolls	Yes, concessions	Yes	Yes (heavy vehicles)	Yes, Concessions	Yes

7. Growing concerns about current road network conditions

A growing concern can be observed in all studied countries regarding the current condition of their road networks. These are, in some cases, old networks that currently support a traffic density much higher than that for which they were originally designed. In all studied countries there has been a reduction of maintenance investment in recent years, and this has accentuated since the 2008 crisis, placing the mobility of users and the efficiency of the transport system at risk.

In France, the French Departmental Network suffered a significant decrease in maintenance budgets at the beginning of the 2010s, to around 6,000 Euros / km, bringing the quality index of this type of network to levels which forced to impose extreme measures, such as temporary speed limits or traffic restrictions.

In Germany, for several years (i.e. 2013 to 2016), negative net investments were recorded. This, together with the age of the network and the growth in traffic demand, caused a significant increase in the deterioration of the road network.

In Italy, according to ITF / OECD data, there was a sharp fall in maintenance spending in 2008 and 2009. Despite the slight increase in subsequent years, the average road condition remains below the standard, since not enough maintenance level is achieved. And this is especially significant, on provincial and regional roads, where the average investment is only 3,500 Euros / km.

In the United Kingdom, according to available data provided by the ITF / OECD for a period of 10 years, a decreasing trend in maintenance costs in the road network can be observed. In 2017, the total investment was around 2,500 million Euros, with a reduction of approximately 55% compared to the year 2007. The decrease in highways is also significant, with a total investment around 1,500 million Euros in 2017 (- 40% compared to 2007). A recent report submitted to the British Parliament describes the current situation of local British roads: there is a growing concern about the general condition of the local road network, the increased need for repairs and the associated cost. This report suggests that about 18% of the local road network is in poor condition and that it would take 14 years, at a cost of 9,310 million pounds, for local roads to return to an acceptable condition.

Regarding Spain, we observe that insufficient resources have been allocated to routine maintenance, an issue which has even worsened throughout the period of economic crisis. This fact, together with the important diversion of investment to another type of terrestrial infrastructure (we refer to the strong investments in high speed railways) have even minimized the resources allocated to roads. Maintenance budgets, which in 2009 reached 1.3 billion Euros have been reduced to 760 million Euros in the year 2018. An even worse situation can be observed in the various autonomous communities, whose investment

capacity has been very committed to financing problems, which has led to road investments have fallen not only below the optimal level, but in some cases even beyond the reasonable. It is also worth highlighting the level of transparency that Spain has in relation to investments in the various types of networks through the Annual Statistical Handbooks of the Spanish Ministry of Public Works.

8. Conclusions

The structuring of road maintenance operations varies greatly from one country to another, with remarkable differences in their administrative and political models.

In any case, the adopted model must guarantee:

- A stable allocation of human, material and management resources for achieving an adequate maintenance, that must remain independent of the political and economic fluctuations. A national infrastructures policy should favour this situation: roads are an asset whose economic value can be measured and used to allocate the appropriate maintenance funds based on a certain percentage of the total value of the asset (ideally 2%).
- A systematic methodology for decision-making regarding maintenance operations. Technical regulations and 'best-practice guidelines' play a very valuable role, especially if harmonisation of national, regional or local best practices is achieved.
- The evaluation of the performance and quality of the service provided to the user.
- Research and innovation in this field should be promoted and receive adequate funding due to its proven contribution to more sustainable maintenance and exploitation activities (financially and environmentally speaking). Administrations should seek the balance between innovation in services and research and innovation in new materials or uses of existing ones.
- An adequate management and monitoring of the network (regular inventories and inspections), as well as the necessary activities and services to ensure serviceability and road safety.

For the above reasons, there is a general tendency towards opening to competition and to the participation of private companies in order to achieve financial stability and the systematic application of a working methodology, these two factors favouring performance evaluation and innovation.

A stable financing mechanism is vital to ensure that adequate funds are allocated for road maintenance by the road authority in question: stable criteria for allocating funds generate

better results than allocations that depend on changes or annual national, regional or local budget constraints.

Expenses in routine maintenance, given that it is a systematic and continuous investment, cannot be deferred over time and therefore cannot be financed by paying interest. This model, usual in other activities, cannot be imported into the road maintenance sector. On the contrary, addressing it through a service contract model, through public management, favours better economic control and the commitment acquired by the administration with the user.

An efficient service contract model must raise compliance with the expectations of road users and their evaluation objectively. The owner administration usually establishes its commitment through a letter of services, whose compliance is transferred to the winner of the conservation through objective indicators of compliance.

Performance indicators are a clear need and must have clear and defined objectives (KPI) directly related to the activity of the contractor. Today, neither their number nor the established prescriptions comply, in most cases, with this.

We cannot finalise these brief conclusions without reminding the close relation between road maintenance and road safety. Regular maintenance activities provide a clear assessment of the actual condition of the road network. An adequate service also allows monitoring the different situations cause by different lightning or weather conditions (sunrise, sunset, rain, wind, snow, etc). The information gathered from these continuous service contracts allows the planning and implementation of low-cost measures for the optimisation of road maintenance and user safety.

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