New Economic Regulation for Transport in Case of Emergency Events

Outcome 2 – Procedures and technologies for monitoring the infrastructures status and transport flows

Output 4 –Institutional, regulatory and operational framework for emergency interventions

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1 Introduction

The present report represents Deliverable number 4 of the research project "New Economic Regulation for Transport in Case of Emergency Events", an Action under the Structural Reform Support Programme of the DG Reform.

This deliverable describes activities made under the output 4 of the Grant Agreement signed by the Università degli Studi di Genova (UNIGE) – Centro Italiano di Eccellenza sulla Logistica, i Trasporti e le Infrastrutture (CIELI).

Briefly, the scope of the Output 4 is to synthetize how transport infrastructure are managed in Italy, which duties are in charge of the infrastructure managers; how the regulation of the sector is made at the different geographical scales; which data sources are currently available for the regulators.

The planning of the Actions is as follows:

- Review of the actors involved in the management of transport infrastructure, with identification of roles and responsibilities
- Analysis of the policies and regulatory measures/arrangements currently in place at local, regional and national levels
- Identification of the information sources for the description of the transport network and flows

The results of these actions allow to derive useful information for the writing of the handbook (that represents the conclusive report of this project) regarding the implementation of tools - models and actions - for managing emergency events as well as the subjects in possession of the necessary information for the predisposition of models of static and dynamic analysis of the transport network.

2. Review of the actors involved in the management of transport infrastructure

2.1. Introduction

Transport infrastructures are essential facilities for the production and the consumption function of the economic agents. They positively impact on the economic system raising the productivity of private inputs, reducing the cost of production, and raising the rate of total factor productivity growth (Ferrari et al., 2019).

Hence, the transport systems is the backbone of the global economy (Schuckmann, Gnatzy, Darkow, & von der Gracht, 2012), and its infrastructural component contributed under specific conditions to the economic growth (Banister and Berechman, 2001).

Transport infrastructures represent the fixed component of the transport system (Button, 1982) and determine a wide range of scale and scope economies; therefore, as underlined by Rietveld (1994), they are usually supplied as a collective input into production. It is quite common that transport infrastructures serve a multiplicity of users; Rietveld and Bruinsma (1998) use the term "polyvalence" to refer to this characteristic of transport infrastructures. For such reason and in order to guarantee equal access to infrastructure and foster their impact on the economic growth, in the early XX century railways were then subjected to a process of nationalization.

In general, transport infrastructures are natural monopolies – due to the large relevance of scale and scope economies that makes the average cost curve subadditive – and therefore they are subject to a public regulation aiming at "simulating" the pressure for efficiency that in other contexts is naturally made by the market forces (Beria and Ponti, 2009). This is the so-called competition *for* the market that replaces the (more usual) competition *in* the market.

In the present deliverable, the attention is focused on railways and highways – and land infrastructure, more in general – that are the transport modes mainly interested by the project. These two transport modes are differently regulated as shown in Table 1.

Table 1 – Separation of infrastructure managers and service operators in land transport mode

Transport mode	Industrial structure	Infrastructure manager(s)
Railways	Unbundling (vertical separation)	RFI – Rete Ferroviaria Italiana
Highways	Unbundling (vertical and horizontal separation)	Several private and public concessionaires
Local public transport	Vertical integration on a municipal base	Private and public operators

Source: Own elaboration

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2.2. The current management structure of transport infrastructure

2.2.1. Railways

Railways were initially the result of private enterprises and were managed in the first decades of their existence in order to maximise the profits of their owners. Soon afterwards, as they revealed all the potential positive spillover effects in case of their common usage, railways were interested, by a process of interconnection of the existing lines and at the end of the XIX century, by a process of nationalization that took place approximately all over the world. In Italy, the nationalization of railways took place in 1905. Then, the railways were managed – bundling infrastructure with the service production - by a public enterprise "Ferrovie dello Stato" (FS) until 2000 and 2001 when, following the adoption of the European Directive 91/440/EEC, unbundling took place and the former rail enterprise was split into 4 different companies, even if all controlled by the FS Group[1]. Rete Ferroviaria Italiana (RFI) was given the management of the infrastructure while Trenitalia provided the transport service. This represented a preliminary step in order to prepare the Italian railways to the adoption of the European Directives that progressively introduced the so-called on-track competition in the sector (Bergantino, et al. 2013). The first years after the introduction of the "on track competition" principle saw the entering into the market of new (private) cargo operators. Only in 2012 a new operator, Italo, entered the high-speed service market competing with the incumbent (Trenitalia) for the most profitable market segment. At present, railway undertakings legitimated to carry out rail transport services by virtue of a licence issued by the Ministry are: 14 for freight services only, 8 for only passenger services and 10 for passengers and freight services. The total production realized in 2018 on the rail network managed by RFI was approximately 364 million train-km.

The railways infrastructure remains under the state control; it is managed by RFI that in accordance with the Italian and EU regulations must ensure free access to all operators. Only in case of a saturation of the rail capacity, RFI must define a priority order to decide to whom to give access to the infrastructure. The priority order takes into consideration the different values of trains, nevertheless the rail capacity is not allocated on an economics base (Beria and Ponti, 2009), for instance through an auction system.

RFI manages over 16,700 Km of standard gauge tracks[2]. In order to calculate the fee for the use of the railway network, the rail lines are classified by the Ministerial Decree n.43/T of March 21, 2000 into:

- fundamental lines (6,400 Km): characterized by high traffic density and high infrastructure quality, they include the international routes and the connection axes between the main Italian cities;

[1] The holding company is controlled by the Ministry of Economy and Finance. As reported in the last annual report published by Ministry of Infrastructure and Sustainable Mobility, in 2018, the FS Group included, in addition to the holding, 40 directly controlled companies in Italy and 39 abroad, 2 joint ventures in Italy and 11 abroad (Conto Nazionale delle Infrastrutture e dei Trasporti, 2018-19).
[2] In addition, in Italy there are few narrow-gauge railways lines that are not managed by RFI.

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- complementary lines, subdivided into secondary lines, lines with low traffic, shuttle lines (9,300 Km): with lower levels of traffic density. They constitute the connection network within the regional basins and connect the main routes;

- junction lines (950 Km): they are developed within large areas of exchange and connection between fundamental and complementary lines.

2.2.2. Highways and National roads

The construction of a toll highways network in Italy dates back to the '50s when the first agreement was drawn up between ANAS (the grantor) and "Autostrade", a public company set up specifically by IRI (Institute for the Industrial Reconstruction) for the building of the Milan-Rome-Naples highways. In 1968 the law 385/68 entrusted the construction of a further 664 kilometres of highways and extended the duration of the concession until 2003. In 1976 and 1983 with legislative interventions, the monetary revaluation of the assets increased net equity on the balance to 1,658 billion liras.

In 1986 the Government decided to sell about 13% of the company.

In 1999 Autostrade was privatized: the holding Schemaventotto acquired from IRI a 30% share of the company with an investment of about 5,000 billion liras. In 2003 another 56% of the company was placed on the stock market. In the same year, the company "Autostrade per l'Italia" was created in order to separate the concession assets from the rest of the holding's activities. The concession system that entrusts the management of the network to Autostrade is regulated by the Convention signed in 1997 (4th Additional Act). The same act introduced the price-cap as a tool for regulating tolls.

Then the duration of the highways concessions was extended in 2006 and 2018 against investment plans for network improvement.

In the meantime, in 2011, the Ministry of Transport replaced ANAS as the awarding body of the highway sections.

In the same year the Transport Regulatory Authority (Autorità di Regolazione dei Trasporti - ART) was established with competencies in transportation and infrastructure access. In particular, ART became responsible for the new highway concessions (but not for renewals). From 2018 on, all concession agreements are under ART's control.

The toll highways network under concession from the Ministry is currently operated by 22 companies under 25 concession agreements. It extends over 5,886.6 km.

As result of the privatisation process that began in the 1990s, the majority of concessionaire companies are currently owned by private operators, belonging to corporate groups. The only exceptions are the highways sections located in the north-east of Italy (Veneto - Trentino) and in Lombardy, which are instead owned by local authorities.

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The concessions managed by the Ministry also include the international tunnels (SITRASB, SITMB and SITAF), whose Conventions are ruled by international treaties and managed by Intergovernmental Committees (IGC)[3].

The non-toll highways network is managed by ANAS and extends for 939.3 km (most of them located in Southern Italy).

At present, the Ministry of Sustainable Infrastructure and Mobility (the new name of the Ministry of Transport) is responsible for the awarding of concessions and ART performs the functions of toll controller and AGCOM (the competition Authority) those of competition.

Tables 2 and 3 list the highways sections under concession and those managed by ANAS, respectively.

It is clear from the tables that the size in kilometres of the highways granted does not seem to be attributable to the search for an optimal size due to possible economies of scale[4].

Table 2 – Private concessionaires

Sections under concession	Km
1 ATIVA SpA	155.8
2 Autostrade per l'Italia SpA	2857.5
3 Autostrada del Brennero	314.0
4 Autostrada Brescia – Verona – Vicenza – Padova SpA	235.6
5 Autovia Padana SpA	105.5
6 SALT SpA – tronco Autocisa	101.0
7 Autostrada dei Fiori SpA – tronco A10	113.3
8 CAS – Consorzio per le Autostrade Siciliane	298.4
9 Autovie Venete SpA	210.2
10 Milano Serravalle – Milano Tangenziali SpA	179.1
11 Tangenziale di Napoli SpA	20.2
12 RAV – Raccordo Autostradale Valle d'Aosta SpA	32.4
13 SALT SpA – tronco Ligure Toscano	154.9
14 SAT – Società Autostrada Tirrenica SpA	54.6
15 SAM – Società Autostrade Meridionali SpA	51.6
16 SATAP A4 Torino – Milano	127.0
17 SATAP A21 Torino – Piacenza	164.9
18 SAV –Società Autostrade Valdostane SpA	67.4
19 SITAF – Società Traforo Autostradale del Frejus SpA	82.5
20 Autostrada dei Fiori SpA – tronco A6	130.9

[3] Some concessions held by private operators were subject to merger operations in 2019.
[4] Benfratello et al. (2009) finds that the optimal size of highways network is about 300 km; exceeded that size, no further reduction in average cost is recorded.

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21 SITMB – Società Italiana Traforo del Monte Bianco SpA	5.8
22 SITRASB – Società Italiana Traforo Gran San Bernardo SpA	12.8
23 Strada dei Parchi SpA	281.4
24 Società Autostrada Asti – Cuneo SpA	55.7
25 CAV – Concessioni Autostradali Venete SpA	74.1
TOTAL	**5,886.6**

Source: Ministry of Sustainable Infrastructure and Mobility.

Table 3 – Highways sections managed by ANAS

Sections	Km
1 A2 Autostrada del Mediterraneo	432.2
2 A2 Diramazione per Napoli	2.3
3 A2 Diramazione per Reggio Calabria	9
4 A18 Diramazione per Catania	3.7
5 A19 Palermo - Catania	191.7
6 A19 Diramazione per Via Giafar	5.2
7 A29 Palermo – Mazara del Vallo	114.8
8 A29 Alcamo – Trapani	36.9
9 A29 Diramazione per Birgi	13.1
10 A29 Diramazione per Punta Raisi	4
11 A29 Diramazione per Via Belgio	5.6
12 A90 Grande Raccordo Anulare di Roma (GRA)	68.2
13 A91 Roma – Aeroporto di Fiumicino	17.4
14 Catania - Siracusa	25.1
15 Sistiana – Rabuiese (svincolo di Padriciano – svincolo di Cattinara)	5.5
16 Sistiana – Rabuiese (Lacotisce – Valico di Rabuiese)	4.6
TOTAL	**939.3**

Source: Ministry of Sustainable Infrastructure and Mobility.

In addition to the above-mentioned sections, ANAS also manages 13 highways junctions, for a total of 355.1 kilometres.

It is worth noting that in 2017 ANAS entered the FS group through an increase in the capital of Ferrovie dello Stato carried out by the Government with the contribution of ANAS. As a result of this operation, two of Italy's main transport networks came under the control of the FS Group, while retaining their own business autonomy.

3. Analysis of the policies and regulatory measures/arrangements currently in place at local, regional and national levels

3.1. The Transport Regulatory Authority (Autorità di Regolazione dei Trasporti - ART)

ART is an national agency created in 2011. It is responsible for the transport sector and the access to the relevant infrastructure. Its tasks also include the definition of the minimum quality conditions for transport services and the minimum content of users' rights in respect of the operators of transport services and infrastructures.

According to the decree-law that established ART, it has been assigned several duties, as:

- to guarantee, adopting methodologies that encourage competition, the productive efficiency of management and the containing of costs for users, businesses and consumers, conditions of fair and non-discriminatory access to the railway, port, airport and highways networks;
- to contribute to the definition of the criteria for setting tariffs, fees and tolls. Moreover, it has to check their correct application, by the parties involved;
- to determine the minimum quality conditions for national and local transport services with public service obligations, identified according to territorial characteristics of demand and supply;
- to define the outline of the invitations to tender for the assignment of exclusive transport services and of the agreements, to be included in the specifications of the same invitations to tender, and establishing the criteria for the appointment of the awarding committees;
- to check that the calls for tenders for regional rail transport do not include discriminatory conditions or conditions that prevent access to potential competitors, with particular reference to the requirement about rolling stock;
- acting as a regulatory body for access to the railway infrastructure, defining the criteria for determining tolls and allocating train paths and capacity, and monitoring their correct application;
- approving the charging systems in the airport sector and the amount of airport fees;
- monitoring and checking the correspondence of the levels of service of the cab sector.

ART also intervenes in the regulation of the linear infrastructures covered by the project. In the railway sector it defines, in accordance with the Ministry of Infrastructure and Transport, the regions and the local authorities concerned, the scope of the public service on the railways routes as well as the methods of funding. It is also in charge of analyzing the efficiency of the different degrees of separation between the company managing the infrastructure and the railway

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company in order to protect the rights of commuters, also in relation to the experiences of the other EU member states.

In the highway sector, ART is in charge of defining the tolling systems based on the price cap method, with determination of the productivity indicator ("X") every five years for each concession. It defines the concession schemes to be included in the calls for tenders relating to operation or construction as well as the outline of the calls for tenders.

3.2. The role of ANSFISA

In 2020, in accordance with Article 12 of Decree-Law No. 109/2018, converted with amendments by Law No. 130 of 16 November 2018, the National Agency for the Safety of Railways and Road and Motorway Infrastructures (ANSFISA) was created. It replaces the abolished ANSF (National Agency for the Safety of Railways).

The agency carries out technical and operational activities of national and European interest and, without prejudice to the tasks, obligations and responsibilities of the infrastructure owners and managers in terms of safety, it promotes and ensures supervision of the safety conditions of the national railway system and road and motorway infrastructures.

In accordance with the provisions of Art. 19 of Legislative Decree no. 50/2019, ANSFISA publishes annually and transmits to the Ministry of Infrastructure and Transport (and the European Union Railway Agency) a detailed report on the activities carried out in the previous year. Such reports – those published so far refer only to the railways sector – focus on the direct impacts and technical management of rail incidents.

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4. Identification of the information sources for the description of the transport network and flows

The information relevant for characterising and measuring the land transport network can be distinguished between static and dynamic information. The former essentially concerns the description of the physical characteristics of the infrastructure network, while the latter has to do with the traffic flows that take place on the infrastructure.

4.1. Static description of land transport infrastructure

The static analysis of transport networks considers the physical and technical characteristics of linear infrastructures and nodes in order to derive a measure of the traffic capacity that can be carried out on them. Static network measurements have the advantage of being easily obtainable. Moreover, they change very slowly over time, so it is quite easy to have a constantly updated situation at least for the main measurements of the physical state of the network.

In the case of motorway transport, the physical description of the infrastructure is generally known to the public entity granting the concession, being the object of the concession itself. Moreover, the main metrics (kilometric extent, number of lanes, altimetry, etc.) are generally freely available on the websites of the concessionaires.

With regard to the railway network, the main static network measurements are published (on the web) every year by RFI in an annex to the Network Information Plan. They include the length of the various sections of line, whether the circulation is double or single track, whether the section is electrified and the type of line. Moreover, for each section of the line the same document reports the maximum hourly and daily commercial load expressed in number of trains and finally the rate of saturation (as per the scheduled trains).

4.1.1. Relevant Static Key Performance Indicators

Starting from the characteristics and measurements of the networks indicated above, it is possible to build a set of key performance indicators (KPI), reported in Table 2, that allow to have initial information about the state of the infrastructural network.

KPI	Description
Travel time	The ratio between the length of the section and the maximum theoretical speed allowed
Node degree centrality	Number of the direct connections to other nodes of the network (may be distinguished in out- and in-degree)

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Node betweenness centrality	Indicates the number of times the node is in the minimum path between two nodes
Eigenvector centrality	The centrality for a node is computed based on the centrality of its neighbours
Closeness centrality	The reciprocal of the sum of the distance of any single node from every other node in the network

The centrality measures may be computed taking into consideration specific weights that may be static (as for instance the metric distances) or dynamic (as transport flows).

Starting from the above mentioned KPI it is possible to compute other complex measures and indicators in order to study the efficiency and the robustness of the networks and the sensitivity of nodes and links to disruptive events (as reported in Deliverable 2 of the project).

Lastly, it should be pointed out that the static measures of the network define the main characteristics of the transport supply. In the case of highways, the supply corresponds to the traffic capacity, while in the case of rail transport, the static characteristics define the potential supply - expressed in number of train-hour or train-day - which will be transformed into the actual supply when the train timetable is defined.

4.2. Dynamic analysis

The dynamic analysis of the transport system is based on the ability to measure demand through the detection and monitoring over time of the traffic flows that take place on the infrastructure. This aspect is worth analyzing separately for the three networks that were considered by the project.

As far as the Local Public Transport (LPT) network is concerned, there are no systematic and repeated surveys of demand over time. The presence of a single ticket for the various services offered (road, rail and fixed installations), as well as the widespread presence of season tickets, makes it impossible to use traffic revenues to determine demand for individual services at different times of day. From time to time, ad hoc surveys are carried out based on the estimation of passengers boarding/exiting at each stop, thus managing to estimate the load factor of vehicles (which in the future will be increasingly easy to obtain, given that modern vehicles already have sensors for detecting boarding and exiting), but this does not make it possible to construct an O/D matrix useful to set up a transport model. The owners of this information are the individual companies that manage the service and the Regions that carry out the control and assign the concessions to the operators. The only available O/D matrices are built on the basis of data on communing for work and study purposes collected during population censuses, but they are usually updated every ten years. Moreover, in such way commuters aren't measured but they are the result of self-declaration made by respondents.

Moving on to consider the rail network, it is worth distinguishing between long-distance services and LPT services, which are provided following negotiations with the Regions. For the former, useful information for defining demand can be derived from ticketing and it is available to the individual service operators. This information is rarely disclosed to the public, at least to the minimum level of detail needed to describe demand, as it is clearly of commercial interest and is therefore considered sensitive by operators. As far as the LPT rail service is concerned, the same considerations made above regarding the LPT road service can be made.

Data concerning the number of trains circulating on the railways network is easier to access and can certainly be considered a good proxy of the demand for the rail mode of transport. RFI has released a dataset containing for each train, the type (freight or passenger) and category (regional, intercity, express, etc.), the place of formation of the train, its destination and the place of transit with the relative expected and real transit time.

Finally, the share of transport demand that turns to the highways is known by individual operators because the access points to the network (toll booths) are controlled, so operators are able to compile an O/D matrix of vehicles using the network. In addition, vehicles are broken down into classes (as illustrated in Deliverable 1) and this therefore allows for a good representation of passenger and freight traffic. It should be noted that the information is about vehicles and not about the number of people or the quantities of goods (which can be estimated based on average rate of occupation of vehicles).

This information is not released to the public except in very aggregate form. For the project highways concessionaires behaved very differently, while the STM group, which controls a considerable part of the highways in the north-west of Italy, made all the requested data available (see deliverable 3), ASPI after an initial refusal - justified by the fact that it considers the information sensitive - subsequently requested the signing of an NDA and after a year from the initial request we are still waiting to receive the data.

Moving on to consider data publicly released and available, AISCAT, the association that brings together the Italian concessionaires of highways and tunnels, publishes a quarterly report in which, in addition to the physical description of the highway sections granted and the accidents that occurred, it provides traffic data, distinguishing between light and heavy traffic, in relation to:

- Actual vehicles, equal to the number of all vehicular units -cars, trucks, tractor-trailers, articulated vehicles- entered the highway, regardless of the kilometres travelled.

- Vehicle kilometres, i.e. the total kilometres travelled by vehicle units that have entered the highway.

- Theoretical vehicles, given by the ratio of vehicle-kilometres to the length of the highway.

Other traffic information released by the concessionaires to the Technical Mission Structure of the Ministry of Infrastructure and Sustainable Mobility regards vehicles entering/leaving any single toll stations, divided by vehicle class. This information is also collected by quarter, so it is too aggregated in terms of time to be used to build a transportation model.

Other useful data are come from the Viasat system devices present on some vehicles and which communicate their position and, therefore, also the route travelled, permitting near real time analysis. This information is very useful for the purposes of transport planning, but it still refers to a sample that is too small (and unbalanced from the point of view of geographical representativeness of the entire nation) to be able to derive reliable conclusions.

Lastly, other very interesting information are those deriving from mobile phones that, due to the communications released by each sim card, allow to trace the movements of the owners of such

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devices. This information is available to mobile companies (for the sim cards they own) as well as to companies that manage social networks (eg. Facebook) or search engines (eg. Google).

As part of the project, a collaboration was initiated with the TIM company in order to better understand the characteristics of these data, their current state of collection and analysis and their possible use for transport analysis. It emerged that, for privacy reasons, this information is kept for only one calendar year and traces the location of sims at 15 minutes intervals, moreover, flows with few units of movement are not released in order to guarantee anonymity. For how the information is currently used, it is not possible to define with certainty the infrastructures used for travelling, since only the location of residence of the sim, the place of origin and the place where the sim stops are detected. The geo-localization of the sim allows instead a notable precision in the identification of the place in which the device is found and therefore it also allows to know on which route it moves. At present, this kind of information is treated to define, for example, the attractiveness of specific events by identifying the increases of arrivals in a location during the event compared to previous periods allowing also to understand how this attractiveness is distributed in space.

It is easy to imagine that in the future, as the number of vehicles connected to the network and the number of vehicles communicating with infrastructures increase (V2I and I2V information flows), these will become the information mostly used for transport planning due to their ability to be updated in real time.

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