OPTIMAL TOOLS FOR THE DEVELOPMENT OF SUSTAINABLE ROAD INFRASTRUCTURE WITHIN THE EUROPEAN UNION

GRAȚIELA BRÂNZĂ [*]

ABSTRACT: *Sustainable development is a desideratum for any society. But it cannot be achieved without respect for the right of future generations to enjoy all the resources, in the conditions of a cleaner environment. Transport, without which no society can develop, must meet a number of economic, social and environmental conditions in order to be sustainable. Sustainable transport systems cannot exist without sustainable infrastructure. This paper addresses several aspects of this topic in the field of road transport at the European Union level, as it has the highest share of transport activity, although the Union has been promoting multimodal transport over the last decades. Here are some definitions of sustainable roads, the importance of road transport infrastructure in the European Union and the role of certificates for achieving sustainable road performance.*

KEY WORDS: *sustainable road, road infrastructure, environment, sustainability, road transport, cost.*

JEL CLASSIFICATIONS: *R41, R42, Q56.*

1. INTRODUCTION

Road infrastructure is an essential element of the global mobility and the road transport is constantly striving to provide citizens with the accessible, efficient and safe mobility they deserve.

In general, transport is an important factor in socio-economic development, but if it is not developed sustainably, it imposes high costs for society, especially on environmental and health impacts. Sustainable transport systems increase social

[*] *Lecturer, Ph.D., Constanta Maritime University, Romania, gratielabranza@gmail.com*

cohesion, reduce environmental issues, help create a more efficient economy and increase quality of life.

Road freight transport has grown massively over the last decades, with a larger volume than any other mode of transportation, being prosperous for industry, but with negative social, economic, environmental and environmental impacts: increased emissions of pollutants and greenhouse gases, noise pollution, increased number of accidents and their victims, higher costs for maintenance and repair of road infrastructure caused by trucks, which pay only some of the damages they cause.

Road accidents issue requires commune efforts from all implied parties from every state member. Overall, at European Union's level, in the period 1990-2015 has been recorded a decrease of 27,4% of road accidents (411,8 thousand), but there are member countries which recorded increased values in the analysed period: Italy with 7,85% and Romania with 198%. The huge value of road accidents reflects the real status of road infrastructure in Romania.

Table 1. Road accidents involving personal injury by country in European Union in the period 1990-2015 (thousand)

Country	1990	1995	2000	2005	2010	2015
Austria	46.3	39.0	42.1	40.9	35.3	38.0
Belgium	62.4	50.7	49.1	49.3	42.1	40.3
Bulgaria	6.5	7.4	6.9	8.2	6.6	7.2
Croatia	14.5	12.7	14.4	15.7	13.3	11.0
Czech Rep	21.9	28.8	25.4	25.2	19.7	21.6
Cyprus	3.2	3.1	2.4	1.4	1.2	0.7
Denmark	9.2	8.4	7.3	5.4	3.5	2.9
Germany	389.4	388.0	382.9	336.6	288.3	305.7
Estonia	2.1	1.6	1.5	2.3	1.3	1.4
Finland	10.2	7.8	6.6	7.0	6.1	5.2
France	162.6	133.0	121.2	84.5	67.3	56.6
Hungary	27.8	19.8	17.5	20.8	16.3	16.3
Ireland	6.1	8.1	7.7	6.5	5.8	5.5
Italy	161.8	182.8	256.5	240.0	211.4	174.5
Latvia	4.3	4.1	4.5	9.3	3.2	3.7
Lithuania	5.1	4.1	5.8	6.8	3.5	3.2
Luxembourg	1.2	1.2	0.9	0.8	0.8	1.0
Malta	0.2	1.0	1.3	0.8	0.6	1.4
Netherlands	44.9	42.6	42.3	27.0	12.5	18.5
Poland	50.5	56.9	57.3	48.1	38.8	33.0
Portugal	45.1	48.3	44.5	37.1	35.4	32.0
Romania	9.7	9.1	7.9	19.8	26.0	28.9
Slovakia	8.2	8.7	7.9	7.9	8.1	5.2
Slovenia	5.2	6.6	9.0	10.5	7.7	6.6
Sweden	17.0	15.6	15.8	18.1	16.5	14.7
United Kingdom	265.6	237.3	242.1	203.7	160.1	146.2
EU 28	1502.1	1433.0	1505.7	1342.0	1130.4	1090.3

Source: ERF, Road statistics, 2017, p.58

2. LITERATURE REVIEW REGARDING SUSTAINABLE ROADS

European Union Road Federation defined "sustainable roads" as "those roads effectively and efficiently planned, designed, built, operated, upgraded and preserved, by means of integrated policies respecting the environment and still providing the expected socio-economic services in terms of mobility and safety".

The Federal Highway Administration of U.S. Department of Transportation stated that "a sustainable highway should satisfy lifecycle functional requirements of societal development and economic growth while reducing negative impacts to the environment and consumption of natural resources". Safety, mobility, environmental protection, asset management, development of programs and technologies to reduce the number of fatalities and injuries and other objectives have an essential role for the accomplishment of european sustainable roadways.

Many authors and specialists talk about the concept of "green roads". A green road is defined as "a roadway project that has been designed and constructed to a level of sustainability that is substantially higher than current common practice" (Stevenson, A.). Sustainability has to begin with road design and construction and according to Stevenson there are measures that can be taken, as:

-"reduced emissions and other air pollutants,
- reduced water usage,
- reduced energy consumption,
- reduced use of virgin material in construction and increased use of recycled materials,
- reduced construction and operational impact on the environment,
- creating low impact development,
- creating safer and more integrated roadways,
- promotion of sustainable transport,
- enhanced community awareness of sustainability,
- enhanced community involvement,
- promotion of innovative solutions".

Finally, green roads can be defined as "road projects that have superior performance in economic, social and environmental sustainability. The sustainability features in green roads mainly include environmental sustainability, social sustainability, economic sustainability, quality, pavement technology and innovation" (Wu P., et al., 2015).

3. CONSIDERATIONS ABOUT ROAD INFRASTRUCTURE AND ITS IMPORTANCE FOR TRANSPORT IN EUROPEAN UNION

Road infrastructure is a vital asset for Europe, allowing access to services, promoting trade, facilitating accessibility, ensuring prosperity and better regional cohesion. According to European Commission statistics, roads are the most popular mode of transport for both passenger (82.3% of passenger journeys in 2013) and inland freight transport (71.9% in 2013) (ERF, 2017).

Also, roads provide jobs for more than 14 million people in Europe and contribute by 11% of the European Gross National Product. As it can be seen in the

table below, road freight transport and road passenger transport account 46,8% of total employment by mode of transport in European Union.

Table 2. Employment by mode of transport in European Union in 2013

Mode of transport	Share of total employment (%)
Warehousing and support activities	25.1
Postal and courier activities	17.2
Road freight transport	27.9
Road passenger transport	18.9
Railways	5.3
Pipelines	0.3
Inland water transport	0.4
Sea transport	1.6
Air transport	3.3

Source: ERF, Road statistics, 2017, p.17

Although European Union encourages and promotes multimodal transport, the share of road transport has remained the highest, being the dominant mode of transport. To obtain sustainability, it is needed a reconciliation between road transport growth and the accomplishment of the objective "cleaner, safer and more efficient mobility". Transport sector accounts for more than 20% of greenhouse gas emissions generated in European Union and a high level of noise nuisance (ERF, 2017).

Having in view that 90% of the road works consist in maintenance and reconstruction and 10% of building new infrastructure, minimising the environmental impact of the first two operations represents the main challenge in the future (ERF, 2017). At the European Union level maintenance expenditures in road infrastructure have decreased in the period 2010-2014 with 982 million euros. Statistical data from table 3 show that the highest maintenance expenditures are in Italy (9564 million euros in 2014) and the lowest ones are in Malta (17 million euros in 2014).

Table 3. Maintenance expenditures in road infrastructure in European Union countries in the period 2010-2014 (million euros)

Country	2010	2011	2012	2013	2014
Austria	559	494	517	559	667
Belgium	184	156	145	147	206
Bulgaria	100	71	103	96	93
Croatia	195	212	187	209	257
Czech Rep	670	570	571	513	587
Denmark	1058	881	945	920	796
Estonia	38	39	44	47	45
Finland	667	658	574	585	506
France	2431	2746	2851	2904	2760
Hungary	328	256	296	412	357
Ireland	164	161	139	128	85
Italy	6437	6220	7195	9134	9564

Latvia	85	90	93	100	154
Lithuania	160	153	123	127	143
Luxembourg	34	37	34	41	41
Malta	25	27	24	25	17
Netherlands	1209	323	-	-	-
Poland	2636	2678	428	438	383
Portugal	102	-	165	174	-
Romania	-	-	-	-	-
Slovakia	175	160	193	204	181
Slovenia	137	122	120	123	118
Sweden	875	856	959	1044	1017
United Kingdom	3919	3552	3591	3346	3229,13
TOTAL EU	22188	20462	19295	21276	21206

Source: ERF, Road statistics, 2017, p.36

In this framework, the road infrastructure industry has developed new solutions that permit the use of existing materials through recycling, new technologies for construction in order to extend the road network durability and to reduce the use of virgin materials. This generates benefits in terms of energy savings, noise reduction, CO_2 emissions. Positive effects are highlighted through statistical data in the tabel below, regarding the average CO_2 emissions per km from new passenger cars in European Union in 2014 and in 2015. From one year to another the level of this indicator is lower. Compared with EU 28 level, the smallest values of the average CO_2 emissions per km are recorded in The Netherlands, Portugal and Denmark.

Table 4. Average CO_2 emissions per km from new passenger cars in European Union countries in the period 2014-2015

Country	**2014**	**2015**
Austria	128.5	123.7
Belgium	121.3	117.9
Bulgaria	135.9	130.3
Croatia	115.8	112.8
Czech Republic	131.6	126.3
Cyprus	129.8	125.7
Denmark	110.2	106.2
Germany	132.5	128.3
Estonia	140.9	137.2
Finland	127.4	123.0
France	114.2	111.0
Hungary	133.0	129.6
Ireland	117.1	114.1
Italy	118.1	115.2
Latvia	140.4	137.1
Lithuania	135.8	130.0
Luxembourg	129.9	127.5

Malta	115.3	113.3
The Netherlands	107.3	101.2
Poland	132.9	129.3
Portugal	108.8	105.7
Romania	128.2	125.0
Slovakia	131.7	127.6
Slovenia	121.3	119.2
Spain	118.6	115.3
Sweden	131.0	126.3
United Kingdom	124.6	121.3
EU 28	124.7	120.9

Source: ERF, Road statistics, 2017, p. 81

According to data from the International Transport Forum, European Union member states spent almost 80 billion euro on roads in 2013 (ERF, 2017). It is essential that every euro spent on road infrastructure generates the maximum possible socio-economic return. The most important actors in this regard are the public authorities, which can provide appropriate incentives for industry stakeholders to develop more durable solution. The majority of public tenders for road related services have been based on the principle of "the cheapest initial price". So, in order to promote sustainable roads, the new European Union legislation package for public procurement in force since April 2016 aimed at supporting the uptake of greener and more innovative solutions. This encourages the evaluations of tenders based on cost-effectiveness approach on the basis of life-cycle costing (ERF, 2017).

In 2014, European Union adopted a set of rules in Directive 2014/24/EC, which will facilitate governments to purchase greener and more innovative products and services and to address new challenges (climate change, globalization and others). This legal framework for public procurement will be efficient for the entire society by optimising public resources and delivering to citizens better and more durable roads. The new Directive is better than the previous one, because it uses in article 67 "the MEAT principle" that identifies the "most economically advantageous tender by using a life-cycle costing approach to ensure the best-value for money invested" (ERF,2017).

The European Union Road Federation supports the MEAT principle as a tool to improve performance of materials and services provided by the road industry. Future tendering processes can help ensure that the best performance proposal is selected according to qualitative, technical and social sustainable elements.

4. CERTIFICATES FOR SUSTAINABLE ROAD INFRASTRUCTURE IN EU

In general, certificates allow a manufacturer to declare the performance of his products based on objective and verifiable criteria. As the lifespan of a road is about 30 years, public authorities use certificates for innovative and greener products to confirm the best sustainability performance over its whole life. In order to assess the life-cycle of roads, European Commission funded research projects to develop important methodologies for doing this. Also, European Commission has developed Green Public Procurement (GPP) criteria for road infrastructure.

The European Union GPP criteria for Road Design, Construction and Maintenance will have a positive influence on the determinant factors of life cycle costs of a road, reducing it. Regarding *the acquisition costs*, the selection criteria can be used to acquire skilled project managers, design teams, cost consultants and contractors, which will concentrate on reducing as much as possible the risk of innovative projects. GPP criteria gives also "early options appraisal" for cost savings or "resource efficient construction"- another criteria that promote a decrease in build costs for major construction materials (EC, 2016).

Referring to *operation, maintenance and rehabilitation costs*, GPP criteria seek to guarantee pavements' best performances, to ensure the quality of construction (drainage systems, low noise pavements, low rolling resistance pavement surfaces), to carry out a Carbon Footprint or to boost contractors to minimise long-term operating cost (routine maintenance, rehabilitation costs) (EC, 2016).

The GPP criteria are very important, having in view the reduction of external costs of road transport. There are *criteria on rolling resistance* related to the vehicle fuel consumption decrease, *criteria on congestion*, *criteria on environmental noise pollution* and *criteria on drainage systems* that contribute on the reduction of flooding risk (EC, 2016).

Road industry is constantly updated, is developing technologies, products and procedures able to reduce greenhouse emissions, energy cosumption and natural resources used for the building and maintenance of the road network in Europe. All of these couldn't be possible without the European Union's implication through its specific tools. LIFE is the European Union's financial instrument that supports environmental, nature conservation and climate action projects. The "Sustain Euro Road" LIFE projects aims to minimize the environmental impact of the road infrastructure, creating, validating and implementing an innovative software to evaluate and reduce the environmental impact of road construction and maintenance in Europe. The software has been tested in France, Germany, Hungary and Spain. The result of using this is the improvement of the sector sustainability, by reduction of 37% of energy consumption, 31% of CO_2 emissions and 70% of natural resources. This new tool is focusing on environmental performance, starting with innovations in the road industry which make road construction and maintenance greener.

"DURABROADS" is another project that aims to provide a sustainable growth through the development of cost-effective, eco-friendly, durable and resilient pavements. The main objective is to develop this kind of pavements, based on innovative nanotechnology, achieving an efficient, smarter and safer mobility, while minimising the negative impact on the environment. The purpose of mentioned objective is to build long-life, safer and greener roads.

Another important project funded by European Union is "QUIESST" (QU Ietening the Environment for a Sustainable Surface Transport). It aims to improve the knowledge of the actual acoustic performances of Noise Reducing Devices (noise barriers, claddings, covers and added devices). Sustainability of surface transport is a key objective of the White Paper on European Transport Policy; it includes vehicles, their infrastructure and the adverse effects they can have on the environment, noise being a major one. In this context, there is a high interest in reducing the number of

affected people. Noise Reducing Devices (NRDs) must be considered as an integral part of the whole transport system and their sustainability can contribute to a more sustainable road transport. QUIESST creates the framework for defining sustainability criteria for NRDs (sustainable design criteria, sustainable materials and their carbon footprint, sustainable construction technology, sustainable maintenance and others) and methods to assess their sustainability (Clairbois J-P., et al., 2010).

5. CONCLUSIONS

Sustainable development of road infrastructure is a priority and a pillar of transport policies that must take into account the relationship between economic, social and environmental aspects. This key objective can successfully contribute to the implementation of the European Union's policy for a sustainable transport system. The system in question calls for strong cooperation between industry, administration and standardization organizations.

Promoting sustainable roadways must be done through public procurement, and the EU's optimal solution is to modernize the public tender process - the MEAT principle under Directive 2014/24/EC. Certificates for green and innovative products are another important milestone for the development of sustainable roadways that will allow for environmental performance. The European Commission has also developed GPP Criteria for Road Infrastructure (design, construction and maintenance). All these and many other measures that will be initiated in the future will contribute to increasing the life quality of the European Union citizens.

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