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Traffic Safety and Ecology
Review
U. D. C.: 656.2:504.06
Accepted: Jul. 2, 2000
Approved: Jun. 5, 2002

RAILWAY DEVELOPMENT FROM THE ASPECT OF ENVIRONMENTAL PROTECTION

ABSTRACT

General development of civilisation and constant growth of population have inevitably resulted in an increased volume of traffic and energy consumption. One of the consequences is also the adverse effect on the environment, i.e. people, climate and nature. Comparing individual forms of transport, it may be noted that railway, as mass carrier in passenger and freight traffic plays a significant role and has great responsibility. Since railway represents a very convenient form of transport regarding both power and ecology, it has to provide significant contribution to the passenger and freight transport in the future, in a way which is friendlier to the environment than most other forms of transport.

This work analyses the current and future role of railway in the transportation of people and goods. It mentions the most important strategic orientations in the railway development, that would render it competitive and attractive compared to road and air traffic. Special emphasis is put on economic efficiency, ecological sustainability and social justice. The possibilities of reducing energy consumption, i.e. CO_2 emissions, as well as reducing harmful exhaust gases of Diesel railway traction vehicles are given special consideration.

KEY WORDS

railway traffic, ecological sustainability, social justice, competitiveness, development

1. INTRODUCTION

The development of civilisation inevitably requires increased passenger and commercial transport. Since this results in greater pollution of the environment, the issue of balancing these two basically opposed requirements will represent a great challenge in the future.

By 2005, compared to the year 1988, road traffic is expected to have increased in passenger transport by 25% and over 90% in cargo transport. Although motor vehicle manufacturers manage to gradually reduce the specific consumption of fuel by various measures, the forecasts say that emissions of CO_2 will increase over the given period by more than 40%. Considering the adverse impact of CO_2 on the environment, creating greenhouse effect, and the international efforts in reducing CO_2 emissions, their constant increase over long-term is reason enough for worry.

Every country which is environmentally conscious and responsible, or a signatory party of adequate international agreements on environmental protection, has to implement an active policy of protecting the environment.

Here, railway, as an energy efficient transport mode can and must contribute significantly. Based on physical and technological advantages, compared to road and air traffic, the wheel-track system guarantees such environmentally friendly mobility of passengers and cargo that it may be compared only with an inland navigation ship.

Regarding energy consumption and CO_2 emissions, comparisons result in the following relations:

- With every tonne of transport goods that would be transported by rail instead of road, the CO_2 emission would be reduced by about 8.1 kg per 100 km travelled;
- With every passenger who would use railway instead of an automobile, the CO_2 emission would be reduced by 10.4 kg per 100 km travelled.

In conditions of West-European countries this means CO_2 emission reduction by 75% in cargo transport and 74% in passenger transport. The comparison of specific CO_2 emission for certain branches of transport in passenger traffic is presented in Figure 1, and in cargo transport in Figure 2 [1].

Such changes may be achieved by adequate measures on a very short-term basis. In transportation sector, a great chance for reducing energy consumption and CO_2 emission lies in greater conversion from road to rail traffic. This would result in additional favourable effects for the environment.

Strategically, in the future, railway should represent a permanently suitable means of transportation system. In order to achieve such orientation, a wide action is necessary as well as acceptance of the idea itself. One of the steps in that direction is the Railway Agenda 21, which determines the main tasks and goals of railway in the 21st century.

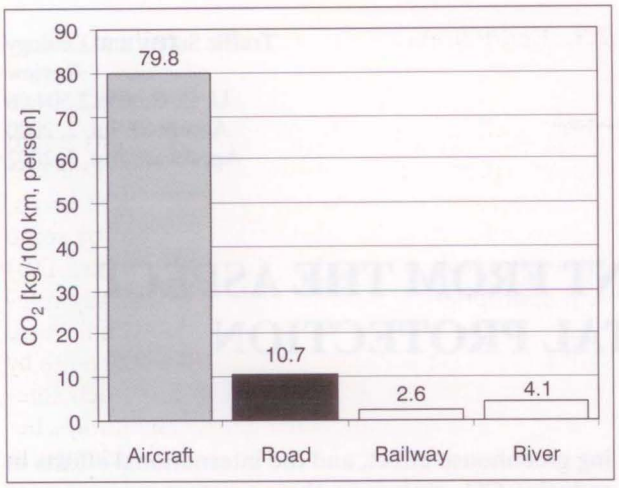

Figure 2 - Specific CO_2 emission of individual branches in cargo transport

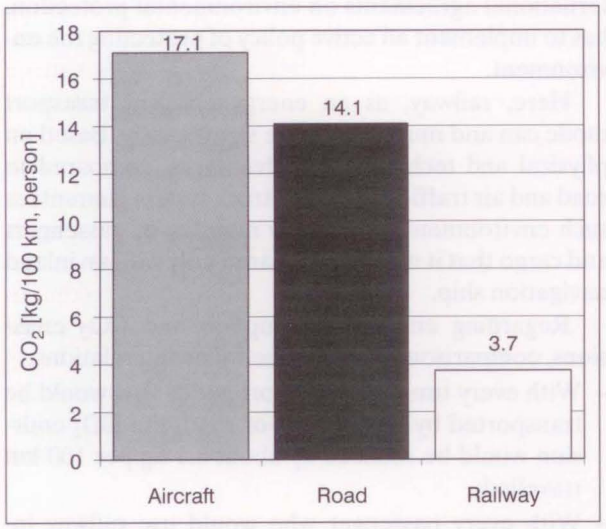

Figure 1 - Specific CO_2 emission of individual branches in passenger transport

2. STRATEGIC GOALS OF RAILWAY AGENDA 21

In order to create the Railway Agenda 21, it was necessary to define the following issues:

- What strategic fields does the railway have to focus on in order to meet the ecological, economic and social challenges over the next 10 to 30 years, at the same time insuring its own entrepreneurial success?
- What projects, programs, and measures will help in realising this task?
- How to organise the discussion process at companies, so as to include all the associates, thus integrating both the creativity and improvement potential of all the employees?

The process of discussion brought to the surface seven characteristic issues. They should be present as the basic tasks in every railway management that makes long-term plans for high-quality development of railway.

1. create prerequisites for further shift from road and air to railway traffic,
2. reduce harmful emissions as contribution to reducing regional load and protecting of climate,
3. noise reduction of rail transportation,
4. protection of nature and landscape,
5. strengthening the role of railway in urban and regional development,
6. increase of efficiency in investments and service,
7. building of environment management system.

The 1992 Rio de Janeiro Railway Agenda 21, starts from three basic aims of equivalent value:

- economic efficiency,
- ecological friendliness and
- social justice.

These basic aims form the foundation of the Railway Agenda 21 on which all the future entrepreneurial measures are to be based. This means planning, developing and introducing programs, projects and measures directed in such a way as to permanently insure entrepreneurial development of railway.

2.1. Greater shift of traffic from road and air to railway

In order to transfer greater traffic volume from road and air traffic to railway, it is necessary to work hard on increasing the technical and power potential of railway, building up wide coverage of mobile and transportation supply as well as providing greater attractiveness. Several measures may be mentioned as example:

- Separation of traffic on high speed tracks for passenger transport from combined transport tracks, speed harmonisation at certain network sections, further development of guidance and safety techniques in order to increase capacities on the existing network and to achieve significant increase in throughput capacity;
- Introduction of "rendezvous method" both in passenger and cargo transport, i.e. introduction of smaller flexible trains that could be coupled to trains of various sizes in the shortest of times, thus individually adapting the supply both regarding space and time to demand and significantly increasing the utilisation;
- Intelligent networking of traffic carriers and building of continuous supply of "door-to-door" mobility for passengers and luggage may substantially increase the services and attractiveness of railway for the users. This supply may be further supplemented and new potentials for the users realised by traffic coverage of mobile counselling as well as by transfer ticket sales.

2.2. Reduction of harmful emissions

To reduce harmful emissions further improvements are possible on vehicles and devices. Accepting adequate regulations both for the new and for the existing diesel traction vehicles should result in further reduction of harmful emissions. Further possibilities lie in better utilisation of vehicles through technically and organisationally optimised propulsion method, as well as in introduction of new vehicles with lower harmful emissions, and vehicles using regenerative sources of energy.

For the railway vehicles to contribute to further reductions in energy consumption and harmful emissions, and make them generally environmentally friendlier, improvements are possible through the following measures:

- reduction of vehicle weight by light design,
- measures intended to reduce energy consumption:
  - energy optimisation of the power unit (motor and power transmission),
  - reduction of energy transmission losses between contact wire and pantograph,
  - on-board control of energy network in order to reduce peak loads,
  - recovering of energy in electrical braking,
- measures intended to reduce emissions:
  - avoiding losses of liquefied and gaseous propelling fuel,
  - reduction of noise at the source,
  - reduction of oscillations at wheel-tracks contact,
  - reduction of electromagnetic emission.

For the propulsion of diesel traction vehicles, possibilities of using alternative fuels have to be foreseen in the future, for several reasons. This will enable reduction in consumption of crude oil which is of limited reserves, i.e. prolong its usage, and reduce harmful emissions.

The mentioned reasons for applying alternative fuels force scientists and professionals working in this field to look for such possibilities. Keeping in mind their characteristics, there are two types of alternative fuels today that might be used for propulsion instead of diesel fuel. These are rape-seed oil methyl ester (RME) and natural gas. The third possible alternative fuel is hydrogen. However, for the moment, there is not much chance of using hydrogen, because of the problem of insufficient availability of hydrogen in the amounts required and the problem of accessibility, and also because of the lack of a suitable and improved engine. On long-term basis, hydrogen represents a significant alternative fuel not containing carbon, having in mind the unfavourable growing share of CO_2 in the atmosphere.

2.3. Reduction of noise caused by railway traffic

In reducing railway traffic noise emissions, cargo transport plays a special role, especially due to the fact that major part of traffic occurs during night hours, very sensitive to noise. Surveys carried out by some West-European railways (ÖBB, SBB, FS and DB) with appropriate technical solutions on railway vehicles providing the so-called "Low-Noise-Train", have shown that it is technically possible to reduce noise by more than 75%. To achieve full effect of such solutions, they need to be implemented on all railways, because of the high rate of international exchange in cargo wagons.

The UIC task group working on the project "Noise reduction in cargo wagons", equipping program obligatory for all railways is being developed, and introduction of noise reducing friction elements is being planned (inserts of braking jaws made of artificial materials). Thus railway cargo traffic noise can be reduced by half in the first phase. The control of rail wear within the regulation of "specially controlled gauge" also contributes to noise emission reduction.

Further efforts are directed towards development and study of low noise cargo wagon bogies as well as mid-term integration of various low-noise components in order to develop the quiet "future of cargo wagons" (Low-Noise-Train). These projects are being carried out within joint projects of European railways and industry. Some of the measures that may reduce noise level and volumes of these reductions are given in Table 1 [2].

Table 1 - Measures and noise emission reduction level

Ord. No.	Measure to reduce noise emission	Noise reduction level [dBA]
1.	Smooth surface of wheels rolling	10
2.	Optimised wheels for low noise level	6
3.	Wheels with rubber-coated elements	6
4.	Wheels suspension	8
5.	Wheel covering	5
6.	Disc brakes	2

2.4. Protection of nature and landscape

Nature and landscape can be protected by numerous activities that all together serve the set goal of ecologically and socially sustainable usage of land as well

as introduction of the closed circular flow of materials. This includes e.g.:

- fitting the protective foil under the rail in order to protect the soil,
- vegetation control concept and vegetation control system management,
- obligation of the manufacturer to implement newly produced vehicle designs with the recycling possibility (objective: raising the recycling quota up to 90%),
- separation of waste and waste disposal, and
- reduction in consumption of drinking water.

The set requirements and individual goals set by any railway management should insure continuous improvement of the impact on the environment.

2.5. Urban and regional development

In order to make railway more attractive it is necessary to adequately design and develop the space at the stations and near them. Therefore, every railway management in co-operation with the urban and government institutions should have projects working on design and purpose allocation of all the facilities related to railway. Thus, apart from having their purely railway purpose, railway stations should become also shopping - business centres where passengers would be able to attend to other activities as well. The space around railway stations should become attractive pulsing district providing all kinds of facilities, passenger, trade, business and residential.

2.6. Increase of efficiency in investments and operation

Railway Agenda commits railway managements to undertake activities and measures within their own projects so as to achieve harmony between ecology, economy and society. Particularly important is the control and transparency of the success of made investments and all the costs. Monitoring of all the costs in a life cycle of every subsystem in the ecologically controlled system and good analysis of these costs may result in opening of additional potential for further improvements.

Life Cycle Costs (LCC) represent the modern term for all the costs that occur during the whole lifetime of a technical means.

LCC can be divided into four typical categories:

- investment,
- operation,
- maintenance, and
- depreciation.

The cost calculation includes the time of their creation. Created costs during life cycle are taken into consideration only during the economic exploitation, which is shorter than the technical life cycle.

An example of share of individual costs in the life cycle of a cargo locomotive is given in Figure 3 [3]. The analysis of the mentioned shares of individual costs shows a very high share of propelling energy costs (73.8%). This means that every measure on the vehicle itself or in the exploitation method that would mean a decrease in energy consumption, would have a significant effect in total costs and a much greater effect compared to the measures that may be undertaken in the area of other life cycle costs.

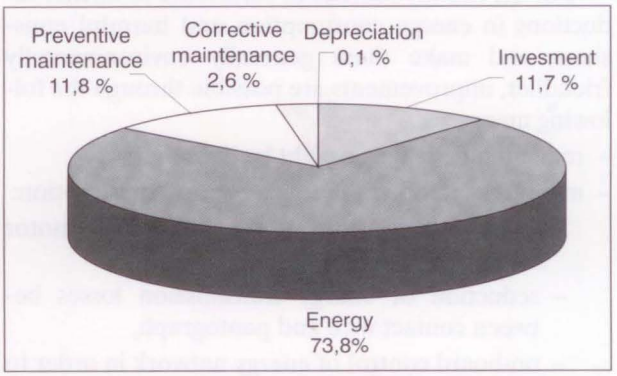

Figure 3 - Share of individual LCC of a cargo locomotive

The following example represents the construction of the permanent way which may be classical or with a "solid" base. The construction of a "solid permanent way" as a measure of new building represents a more expensive solution, but based on the lower maintenance costs it proves to be in general more suitable than the conventional permanent way.

2.7. Environment management

The requirements included in the environment management system have to be constantly present and generally valid, and they are contained in the international standard ISO 14001:

- *Policy toward the Environment*: Acknowledgement for the responsible entrepreneurship towards the environment;
- *Planning:* Planned measures to improve the environmental effect of all the relevant processes, products or services;
- *Implementation:* Organisational structures, determining and documenting responsibility, availability of personal resources;
- *Supervision and Corrective Measures:* Proof of legal uniformity towards the environment, control of the environment;
- *Highest Management Evaluation:* Periodical checking of the environmental management system.

In order to achieve efficient environment management, good information system is necessary. It provides the company management with an instrument that may offer fast insight into the actual condition and proper control of ecological and economic development.

3. CONCLUSION

Environmental protection cannot be considered any more isolated from other social problems. Every entrepreneurial activity must contain economic, ecological and social aspect in order to insure long-term harmonious development of the company and the society as well as to protect the environment. The railway plays a very significant role in this. With its main advantages reflected in lower energy consumption, reduced environmental pollution, and greater traffic safety than in other branches of transport, railway has to impose itself to all the subjects managing the transport systems and the environment.

Railway must also pay significant attention to its own development through long-term strategic projects in order to meet the ecological, economic and social challenges over the following 10 to 30 years, at the same time insuring its own entrepreneurial success. Basic trends in this development have been defined by the Railway Agenda 21 and they include economic efficiency, ecological friendliness and social justice. Every railway management has to use these goals in order to define and develop its own agenda. Greater success in establishing the projects and in their realisation will be achieved through intense discussions at all levels of a company, and with all the interested ministries and associations outside the company. The success will be supplemented by adequate financial and political support.

SAŽETAK

RAZVOJ ŽELJEZNICE S ASPEKTA ZAŠTITE OKOLIŠA

Opći civilizacijski razvoj i stalni porast stanovništva neminovno dovode do povećanja opsega prometa i potrošnje energije. To ima za posljedicu negativan utjecaj na okolinu, odnosno na ljude, klimu i prirodu. Uspoređujući pojedine oblike prometa uočava se da željeznica kao veliki prijevoznik u putničkom i teretnom prometu ima značajnu ulogu i odgovornost. S obzirom na to da je željeznica energetski i ekološki vrlo povoljan oblik prijevoza, ona mora u budućnosti dati značajan doprinos transportu putnika i tereta na način koji je pogodniji za okolinu od većine drugih oblika prijevoza.

U ovom radu se analizira sadašnja i buduća uloga željeznice u transportnom procesu ljudi i dobara. Navode se najvažniji strateški pravci razvoja željeznice koji bi željeznicu učinili konkurentnom i atraktivnom u odnosu na cestovni i zračni promet. Pritom se posebni naglasci daju na ekonomsku efikasnost, ekološku pomirljivost i socijalnu pravednost. Posebno se obrađuju mogućnosti smanjenja potrošnje energije, odnosno emisije CO_2 kao i smanjenja štetnih sastojaka ispušnih plinova dizelskih željezničkih vučnih vozila.

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