

INTERRELATIONSHIPS OF TRANSPORT AND ITS EXTERNAL MILIEU WITH A FOCUS ON THE ENVIRONMENT

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Summary: Transport is significantly influenced by its external milieu, and, at the same time, it itself affects this milieu. The interaction can be observed in political, legislative, economic, social, cultural, or technological fields. The strongest impacts are connected with the environment. Climatic changes, which the transport sector contributes to, have negative retroactive effects on transport systems. In this context it is necessary to deal with transport sustainability, and search for ways how to reduce this negative interaction.

Key words: transport, transport system, environment.

INTRODUCTION

Transport became an essential part of the modern economy and society, in which a huge number of goods and people moves. Trade was always an attribute of human civilization, but it has never been as intensive as at present. Especially more opened economies, based on export and import of goods, are dependent on running transport systems. Travelling intensity is still on the increase, people need to meet each other, they commute to work or to do shopping, travel on holiday. Mobility is therefore a prerequisite of the modern society.

The transport system, of course, can not exist independently of its milieu, it is strongly influenced by it, and, at the same time, it itself affects the external milieu. It is necessary to deal with these relations, examine positive and negative interactions of transport and its external milieu, and use the acquired knowledge so that running of particular transport systems can be improved.

1. THE EXTERNAL MILIEU OF THE TRANSPORT SYSTEM

The external milieu of the transport system includes following effects:

- political and legislative,
- economic,
- social and cultural,
- technological,
- environmental.

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1.1 The political and legislative milieu

Politics and legislature influence all branches of the national economy, thus transport as well. Political stability, domestic as well as foreign, the EU membership and following regulations – these are important aspects of the external milieu.

The political and legislative milieu affects transport through antimonopoly laws, regulations in the sphere of foreign trade, tax policy and price policy, environment protection laws, consumer protection laws, but also labour law or labour protection regulations.

1.2 The economic milieu

The economic milieu of the transport system is represented by the influence of business cycles and related trends of GDP, inflation, unemployment or purchasing power. It is necessary to take into account also tax burden, trends of energy prices, exchange rates, interest rates, average wages, etc.

On the other hand, transport strongly affects the economic milieu. It contributes considerably to GDP creation, it is an important employer. The automobile industry is one of the most significant branches of the world economy, and the aircraft industry is regarded as vital for economic competitiveness in the global economy. Low-cost airlines enabled general public to travel by plane, and then the number of passengers increased significantly. That forwarded the economic development of many holiday destinations.

1.3 The social and cultural milieu

The social and cultural milieu is represented, for example, by demographic development of the population, data concerning labour force, level of education, approach to work and leisure time. This is connected with life style changes, from which also demands on mobility or accessibility of particular places arise.

Mobility is perceived as a self-evident attribute of today's society. Ability to travel, move from one place to another, is connected with certain liberation of man, whose living space is not limited any more. Mobility contributes to personal satisfaction, but, in a broader context, to international understanding as well. On the other hand, it is necessary to mention that contemporary information technologies enable communication independent on travelling, which can reduce demands on mobility.

An important factor in decision-making about transport is time. Transport infrastructure building is often justified by time saving during travelling, and then by an increase in economic effectiveness. One of the reasons why people prefer travelling by car to more sustainable modes of transport such as walking, bicycling or public transport is just time saving. Travelling by public transport is often associated with long travel time, and so some people even don't try it. Time saving during travelling for one interest group, however, can mean travel time lengthening for somebody else. This can be illustrated by the fact that storehouses, hypermarkets and big business centres are usually built in peripheries so that trucks can get there easily, and it would be possible to supply them smoothly, which causes

worse accessibility for example by walking, though. So, time saving during supplying those facilities means increased time demands on customers.

Accessibility is another aspect of transport. People solve the question how easy or difficult is for them to reach a certain destination. With motor transport expansion, people who don't drive seem to be handicapped. Cars enable flexibility that public transport can not compete with. Daily life is limited to a certain extent for people without a car, because one important freedom is limited – the possibility to travel from one place to another. It is not possible, of course, for all people to have the same access to all kinds of transport. But, it is necessary for public transport to enable people without cars mobility, too, and offer an alternative of more sustainable travelling even to car owners.

1.4 The technological milieu

The technological milieu includes government support of research and development, general state of technologies, rate of their obsolescence, but also changes in technologies, new discoveries, etc.

Transport technologies caused great changes in the economy as well as the whole society over the last hundred years. The invention of the combustion engine at the end of the 19th century, particularly, had inestimable impacts not only on the economy or society, but also on the environment. Cars changed the world in such way as no other transport technology. The 1930s brought the invention of the jet engine, which caused that air transport became a key factor of global society by the end of the 20th century.

At present there is a quest to find new technologies that could help to reduce negative impacts of transport on the environment. For example, new, affordable “car of the future” should be not only attractive, safe, comfortable, but also recyclable, and especially much less energy-intensive than today's cars. Producers strive to develop a “super car”, whose consumption would not exceed three litres per one hundred kilometres. (1)

1.5 The environment

Transport, especially motor transport and air transport expansion, has a huge impact on the environment. It is a matter of air pollution, but also land occupancy due to transport infrastructure building, i.e. motorways, petrol stations, car parks, etc. Many cities are strongly polluted as a consequence of transport, which is being worsened even by weather conditions (e.g. inversions). Another pollutant, besides carbon dioxide, is ground-level ozone, but there is also PM10, which are microscopic particles in fuel for diesel engines.

Emissions of carbon dioxide are a cardinal problem, because most motor vehicles use oil. Moreover, oil is a limited source. Another problem is represented by increasing noise strain of the environment caused by motor vehicles. There are some ways how to reduce this strain, for example by improving road surface, but this is balanced by an increased number of vehicles. It is possible to talk about so-called visual pollution caused by motor vehicles, too. The view of endless car parks is not much pleasant, and the same it is with streets full of parked cars, which degrade the view of architecture and public grounds.

Air transport pollutes the environment even more, not only by excessive production of carbon dioxide, but it is necessary to take into account also the fact that its production in heights that airplanes fly at is even more harmful than on the ground. Emissions contribute to upper atmosphere damaging and global warming. Air transport affects the environment globally as well as locally, namely not only through air pollution, but also noise, negative impact on landscape or wildlife.

2. TRANSPORT SUSTAINABILITY

Transport sector shows rapid growth rate both on microeconomic level (individual ownership of cars, more holiday trips), and on macroeconomic level (dense international traffic among continents). However, this rapid growth of transport is not well-proportioned, and the third world countries fall behind considerably. Moreover, present development indicates that transport will be more and more intensive. A new phenomenon is also huge cities and increasing urbanization, which needs transport and logistic systems combining individual and public transport.

These trends have a great impact on transport systems as well as the environment. Transport contributes to the greenhouse effect considerably, because it produces about 20 per cent of harmful emissions (2). It is proved carbon dioxide emissions, and other greenhouse gases cause increase in earth surface temperature.

New transport technologies or the development of faster kinds of transport could help to reduce negative impacts on the environment. Nevertheless, this will be always followed by a new demand. It is evident that time savings are used for further travelling or long-distance travelling. So, faster transport will probably not contribute to sustainability.

An important question is also how to measure transport sustainability. Transport demand is a derived demand in large measure, because it follows from the demand for goods or other services. Furthermore, movement of people and goods is usually chain, it includes a whole range of transport modes, and so it is difficult to limit the analysis to one transport chain element only.

The Center for Sustainable Transportation made up a list of important transport sustainability indicators:

- energy use for transport,
- greenhouse gas emissions,
- other transport emissions,
- injuries and fatalities,
- movement of people,
- movement of freight,
- travel by cars and planes,
- personal vehicle movement,
- urban land use,
- length of paved roads,

- household spending,
- relative transit costs,
- energy intensity,
- emissions intensity. (2)

Transport system sustainability can be judged on the basis of traffic monitoring, mobility, accessibility or impacts on the environment. From this point of view, the best is such transport system that minimizes negative impacts on the environment.

3. CLIMATIC CHANGES AND TRANSPORT

Transport and climatic changes are strongly interconnected. Climate is influenced by a whole range of factors, but experts believe that the most significant are emissions of greenhouse gases. Greenhouse gases produced by transport accelerate the pace of climatic changes, which influence the ways of planning and operation of transport systems on the other hand. Climatic changes then affect transport and its infrastructure much. For that reason it is necessary not only to strive to reduce harmful impacts of transport on climate, and subsequently negative impacts of climatic changes on transport, but also to adapt to those changes to a certain needful extent.

3.1 The impact of transport on climatic changes

As stated above, transport sector contributes to total carbon dioxide emissions with about 20 per cent, and this number is still on the increase with urbanization proceeding throughout the world. It is therefore necessary to make an effort to reduce these emissions, for example through (3), (4):

- using alternative fuels,
- promoting fuel-efficient vehicles,
- reducing the number of kilometres driven,
- supporting more sustainable kinds of transport,
- integrating land use in transport planning,
- increasing the use of intelligent transport systems and telecommunications,
- coordinating transport systems,
- reducing unnecessary trips.

Carbon dioxide emissions produced by fuel combustion in transport can be characterized with the help of the following equation:

$$G = A \cdot S_i \cdot I_i \cdot F_{ij} \quad (1)$$

G = CO₂ emissions from fuel combustion by transport, A = total transport activity, S_i = modal structure of transport activity, I_i = energy consumption of each transport mode,

F_{ij} = greenhouse gas emissions characteristics of each transport fuel (i = transport mode, j = fuel type). (4)

Reduction of greenhouse gas production in transport can be achieved by an increase in fuel efficiency, support of alternative kinds of transport with lower emissions, or reduction of transport demand.

However, even if greenhouse gas emissions didn't increase any more, their amount accumulated in the past periods would be enough to cause climatic changes, which will mean a higher frequency as well as intensity of extreme weather in the near future.

3.2 The impact of climatic changes on transport

Climatic changes are considerable, and their evaluation includes many social, economic and other aspects. As for transport sector, experts have identified five types of climatic extremes that climatic changes affect transport through (4):

- increase in the number of very hot days and heat waves,
- increase in arctic temperatures,
- rising in sea levels,
- increase in precipitation intensity,
- increase in hurricane intensity.

While the transport system as a whole is sensitive to all these influences, sensitivity of particular kinds of transport varies, and depends on infrastructure location, too. Nevertheless, all above mentioned climatic extremes can contribute to infrastructure damaging. We must add also effects induced by the demand, for example the increased use of some communications as a consequence of flooding other, etc.

It is necessary for transport experts, hydrologists as well as scientists dealing with climate to cooperate mutually. Then, the influence of climatic changes on transport is possible to estimate according to the following procedure (4):

- identification of variables connected with climate changes that are the most important for the transport system in a given region,
- determination of the time frame that particular variables will start to influence the transport system over,
- determination of geographical extent that these variables can be projected into with acceptable confidence,
- sensitivity evaluation of particular kinds of transport to the given variables,
- estimation of direct impacts of each variable on transport infrastructure by particular kinds of transport,
- estimation of indirect impacts of each variable (e.g. social effects, economic costs, increase in running and maintenance costs).

It is necessary to identify the most vulnerable transport systems in order to react to climatic changes effectively. The aim is to minimize costs connected with the disruption of

transport systems. There are several possibilities how to measure transport system vulnerability. The most frequent method is based on network accessibility evaluation:

$$A_i = \frac{\sum_j B_j f(c_{ij})}{\sum_j B_j} \quad i \neq j \quad (2)$$

A_i = accessibility of location i , B_j = attractiveness of location j , $f(c_{ij})$ = impedance function representing the separation between location i and j . (4)

The attractiveness of a certain location can be expressed by means of employment opportunities, the number of inhabitants, etc. The impedance function is an inverse function of transport costs.

It is useful to implement also a general approach together with traditional methods of transport planning, which can be done with the help of the following steps (4):

- defining performance measures, indicators, and variables that reflect the influence of climatic changes on the transport system,
- estimating system performance under different scenarios of climatic changes,
- estimating risks and economic costs of each scenario,
- drawing an adaptation plan,
- evaluating risks, economic costs, but also effectiveness and efficiency based on system performance measures of each plan.

Transport system adaptation to climatic changes is represented by the evaluation of transport system vulnerability, adaptation strategy alternatives, their evaluation by means of cost-benefit analysis, and assigning preferences to particular alternatives.

It is necessary to judge potential disruption of the transport system caused by climatic changes before adaptation strategies are used. This evaluation is useful for better understanding total damages that can occur in the system. In fact, they are the costs that can occur if no adaptation strategy is realized. Besides cost estimation also possible risks must be evaluated.

CONCLUSION

Transport and its external milieu influence each other considerably. This influence will intensify with increasing market internalization as well as with strengthening the key position of multinational firms on the world markets, which results in shifts of business activities throughout the world. We can not forget changing consumer behaviour and people life style. The phenomenon of the present is worldwide communication and mobility.

All these facts mean an increase in transport with all its negative effects. These effects show themselves mainly in the environment, contribute to climatic changes, which then affects transport systems. The solution of this problem lies partly in the necessity of reducing negative effects of transport, which is a long-term and very difficult process, though. With

respect to this fact, it is also necessary to try to reduce negative impacts of climatic changes on transport systems, and adapt these systems to those changes gradually.

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