

ENGLISH VERSION

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**RAIL TRANSPORT MODEL IN POLAND,
IN THE LIGHT OF THE IDEA OF
FOURTH INDUSTRIAL REVOLUTION**

[SUMMARY]

The Polish national economy is reflected in all the fundamental trends of change that we are seeing in the world and European economy. This is particularly true of changes in rail, passenger and freight transport. Throughout the hearing, using the term 'rail transport' or 'rail transport sector', this will always mean all rail transport, that is to say, passenger and freight transport.

The following trends, which are essential for the rail transport sector and for the national economy in general, can be mentioned here:

- the extension of the life expectancy of societies and the change in the age structure of the population in European countries, including Poland;
- an increase in the level of education of society;
- raising public awareness of the need to protect the natural environment and promote behaviour conducive to health;
- the persistence of societies' tendency to perceive social and economic phenomena in 'national' terms, which undermines the pace of the European integration process and in many cases even blocks it;
- increasing the level of wealth of societies in Europe (and some other countries of the world);

- the rise or persistence of high levels of unemployment in central European countries and the eastern Länder of Germany and the rise or persistence of fairly high levels of unemployment in Western European countries;
- the persistence in Western Europe of high social mobility and the increase in this mobility in central European countries;
- an increase in consumption in central European countries (and partly in Eastern European countries) while stabilising consumption levels in Western European countries;
- slowing down economic growth in Western European countries and maintaining a higher growth rate in central European countries than in Western European countries;
- the weakening of the pace of structural change in the industrial sector of western European countries, with the expected increase in the pace of these changes in central European countries;
- the persistence of barriers to international trade between continental and intracontinental food products.¹

In today's economy, rail transport appears to play a major role in meeting the needs of households and the sector, private and public enterprises only if rail passenger and freight service providers find rail transport attractive because it meets the following conditions for the provision of services:

- rail transport services will remain available spatially and temporarily,
- the quality of rail services will be improved,
- the costs of providing rail services will be significantly reduced,
- the value of rail services will be properly valued taking into account the external costs of the operation of all modes of transport.

These challenges faced by rail transport in Poland led me to carry out scientific research, which would result in the construction of a model of rail transport for the Polish the 21st century. This research problem clearly set out the conditions for the construction of such a model, among which, in addition to elements of the rail transport mission such as:

¹ W. Paprocki, The role of rail transport in the modern economy [in:] prof.paprocki.pl/pliki/Dzialanosc_scientific_and_didactic/Artykuly_i_referaty/The_role_of_rail_transport_in_wspolczesnej_economy.pdf (pobr 27.10.2019).

- internationalisation of economic and social processes;
- the need to promote the symbiosis of human activities with the biosphere;
- actions aimed at meeting the needs of households, companies and public and private institutions, so that social well-being in Poland continues to grow,

the rationale, ideas and technologies of the Fourth Industrial Revolution must be taken into account.

In 2011, it was announced at the Hanover Fair that the world was now moving to Industry 4.0 and thus to the Fourth Industrial Revolution. It is clear that the fundamental rationale of the Fourth Industrial Revolution was achievement:

The First Industrial Revolution (late 18th century – the first half of the 19th century), which was the era of the steam machine.

The Second Industrial Revolution (1970s), which was the era of electricity, electric and internal combustion engines and the era of mass production using division of labour both nationally and internationally, gave rise to the development of international division of labour.

iii industrial revolution (late 1960s), which began the era of automation of industry based on electronics, computers, information technology, industrial use of software controllers.²

The 4th Industrial Revolution is the era of digitization of the economy, where relationships:

man – man

man – machine

machine-to-machine relationship.

In defining terms, the Fourth Industrial Revolution is the term for describing the technologies and operating principles of economic organisations that systematically apply:

- a) cyberphysical systems and modelling

² <http://przemysl-40.pl/index.php/2017/09/12/przemysl-4-0-raporty-i-publikacje> (accessed 27.10.2019)

- b) Internet of Things and Services
- c) cloud computing capabilities
- d) The Internet of All Things and smart factories.³

The main purpose of the doctoral dissertation is to construct a model of the rail transport market in Poland, which will take into account all the premises, ideas and effects of the Fourth Industrial Revolution.

The partial objectives of this hearing will be:

- C1. Impact of the Fourth Industrial Revolution on the development of the transport system, with a particular focus on the rail transport subsystem
- C2. Integration of rail transport sub-sectors, i.e. passenger and freight transport within the framework of the European Union's transport policy and Polish
- C3. The regulatory role of the state in the design of transport policy
- C4. Application of Artificial Neural Networks (SSNs) to the construction of a neural model of demand for rail transport services and to the construction of a neural supply model for rail transport services.

In view of the implementation of the research problem put to the solution in this **doctoral dissertation, the main hypothesis of the dissertation was formulated: the premises, ideas and technologies of the Fourth Industrial Revolution induct the development of the** market for rail transport services in Poland, operating within the common transport market of the European Union.

For such a structured research task, appropriate scientific methods were selected, i.e.:

- I. A query of the literature of the subject and a critical analysis of this literature by means of comparative analysis and descriptive-historical analysis;
- II. Analysis on the modelling of the national economy, with a particular focus on the analysis of artificial neural networks (SSNs) and the design of neural models;
- III. Statistical analysis;
- IV. Inference methods: induction, deduction, reduction.

³ Ibid.

The scientific sources of the studies were:

- a) compact studies (monographs) and articles in Polish and English,
- b) government, ministerial and local government documents,
- c) statistical yearbooks of the GUS and Eurostat,
- d) European Union's 'EU Transport White Paper'.

The purpose of the work and verification of the main hypothesis was subordinated to the structure of the dissertation.

Chapter one **examines** the rationale, ideas, technologies and effects of the Fourth Industrial Revolution. This chapter highlights the importance of digitising the economy in creating:

- Smart factories
- Internet of Things and Services
- New business models
- A market development based on the concept of sharing economy and access economy.

Chapter **two**, devoted to the analysis of the definitions, dimensions and functions of the transport system as well as the diagnosis of the state of the Polish transport system. It was diagnosed here primarily:

- the availability of transport of the Polish;
- the state of the transport system infrastructure with particular regard to the rail transport subsystem;
- the market for the transport of cargo and passengers through various branches of the Polish transport system.

Chapter Three **analyses** the regulatory role of the State in shaping an optimal transport Polish. Particular attention was paid not only to practical aspects, but also to the theoretical aspects of the construction of an appropriate transport policy, including the development of rail transport in Poland.

Chapter **four** is a key chapter for this dissertation, as this chapter presents the step-by-step method, the construction of the rail transport model in Poland. It analyses the achievements of economic sciences in the modelling of the national economy and its departments, systems, industries, sectors, branches, etc. The analysis of the

different concepts of modelling of the national economy presented in this chapter allowed to choose the appropriate method of the model of rail transport in Poland.

The scientific research I carried out, presented at this hearing, made it possible to diagnose the state of the infrastructure of the rail transport sector in Poland, as well as to assess the directions of development of the market for services in this sector. In the 21st century, the development of rail transport in Poland must take into account the following conditions for its development:

firstly, the increasing globalisation and internationalisation of economic processes in the world is becoming a fundamental determinant of the development of rail transport in Poland;

secondly, the current digitalisation of the economy (digitisation) under the rationale and idea of the Fourth Industrial Revolution directly affects projections of the development of the rail transport services market;

thirdly, Poland, having been in the European Union since 1 May 2004, also co-creates the EU's Common Market in shaping and implementing the Common Rail Transport Policy throughout the Union. [full implementation of sub-objective C3 on the regulatory role of the State]

The main objective of the hearing, which was the construction of the rail transport model in Poland, was fully achieved, since:

- i. the studies carried out at the hearing make it possible to construct an effective transport policy Polish, with a particular focus on rail transport, in such a way that national transport policy is coherent with the EU's common transport policy [full achievement of sub-objectives C1 and C2 on the impact of the Fourth Industrial Revolution on the development of transport systems and the integration of the transport subsectors of the rail transport system, i.e. passenger and freight]
- ii. analysis of the modelling processes of the national economy indicated that the concepts of artificial neural networks could be used to build a rail

transport model in Poland, which allowed two neural models to be constructed:

- a) neural model of shaping demand for rail transport services in Poland [NMTK – AD] 4.0;
 - b) neural model for shaping rail transport supply [NMTK – AS] 4.0; [partial achievement of sub-objective C4]
- iii. the nature and mechanics of artificial neural networks (SSNs) allowed to create a model of rail transport in Poland, by matching (fit policy) model [NMTK – AD] 4.0 to model [NMTK – AS] 4.0 [comprehensive and full achievement of sub-goal C4]

The main hypothesis of the doctoral **dissertation: the premises, ideas and technologies of the Fourth Industrial Revolution induct the development of the market for rail transport services in Poland, operating within the common transport market of the European Union, has been positively verified.**

The scientific studies carried out at this hearing have yet to show the need for further research into:

- the development of the availability of rail transport services not only through the implementation of linear investments, but also through the construction and modernisation of railway stations throughout the country, which is not only of great economic importance but also of great social, cultural and identity importance of Polish society,
- there are at least three important pan-European corridors running through Poland, which is undoubtedly linked to the geographical location of Polish. It seems that this aspect in Polish transport and in the Polish economy as a whole is not properly appreciated, which requires specific studies and the projection of new solutions in this regard,
- investments in rail transport require EU financial support, as Poland's rail transport infrastructure needs to be modernised and developed as a result of the Fourth Industrial Revolution. Research such as these EU funds and the Polish state budget are needed to be used efficiently to meet the tasks of accessible, attractive and convenient and fast rail transport chosen by households and businesses.