TRANSFORMING TRANSPORT AND MOBILITY – THE ROLE OF TEACHING-RESEARCH NEXUS IN THE FIELD OF TRANSPORT ECONOMICS

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Abstract Economic and social challenges of the modern world force the implementation of innovative solutions in all sectors of the economy. The relationship between knowledge, innovation and economic development is increasingly obvious and measurable. The European transport sector is currently facing new challenges, mostly regarding the negative externalities of transport activity. Sustainable transport policy goals call for a greater involvement of research activities and broadly understood innovations in various segments of the transport market. It means that new challenges induce the need for innovative solutions, comprising not only new technologies but also organisational improvements. The paper aims at identifying the main areas for the implementation of the results of transport economics research in the process of technological and organisational change of transport system as well as at discussing the role of research in university teaching in the field of transport economics.

Keywords: innovation, transport, teaching, research, mobility.

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Introduction

Transport is the foundation of a well-functioning economy. The transport sector plays a significant role in the economic development of the European Union (EU). Overall, the entities related to transport sector (in services, manufacturing, maintenance and construction) account for more than 9% of EU gross value added and employ more than 9% of total EU workforce. Despite the fact that transport is a key enabler of economic and social activity, it is also a source of environmental concerns and generates negative effects (accidents, air pollution, noise, greenhouse gas emissions, etc.). The external transport costs are valued at the equivalent of approximately 4% of EU GDP (European Commission, 2017a).

The upcoming decades are the time of intense changes in the transport sector, which will be forced by the decreasing oil resources in the world, the accelerating climate changes and the increasing problems resulting from the deteriorating quality of life in the cities. The challenges faced by the transport sector force a higher involvement of research activity and implementation of broadly understood innovations in various transport market sectors.

The paper aims at identifying the main potential areas for the implementation of the results of transport economics research required in the process of technological and organisational change of transport systems that has to be faced. Moreover, the aim of the paper in this context is to discuss the role of scientific research in the process of teaching and training staff for the transport sector.

Transport and mobility – potential areas for innovative solutions

Striving for a competitive and resource-efficient system

The main strategic challenges in the field of transport and mobility that the EU Member States have to face during the next decade contribute to the objectives set in *White Paper on transport. Roadmap to a Single European Transport Area – Towards a competitive and resource-efficient transport system*. The White Paper of 2011 sets out an ambitious strategy for transport development in the EU community by 2050, giving priority to sustainable transport development. This document formulates 10 goals towards the establishment of a competitive and resource-efficient transport system,

thanks to which it will be possible to reduce greenhouse gas emission by 60% (European Commission, 2011):

I. *Goals related to the development and use of alternative fuels and propulsions*
   1. Reduce the number of conventionally-fuelled vehicles (combustion engines) by half in urban transport by 2030, and consequently eliminate them from the cities by 2050. Achieve CO_2-free logistics in major urban centres by 2030.
   2. Achieve the level of 40% of low-carbon fuels in aviation and reduce by 40% emissions from maritime bunker fuels by 2050.

II. *Goals related to optimising the operation of multimodal logistic chains*
   3. Shift 30% of road freight transport over 300 km to energy efficient modes of transport, i.e. rail or water transport by 2030 (over 50% by 2050).
   4. Triple the length of the existing high-speed rail network in the EU by 2030 and complete its construction by 2050. Shift a significant part of medium distance passenger transport to rail transport by 2050.
   5. Create a fully functional European multimodal network TEN-T by 2050.
   6. Connect all core network airports to the rail network, preferably with the high-speed rail network, as well as connect seaports with the rail network and, if possible, with the inland waterway system by 2050.

III. *Goals related to increasing the efficient use of transport and infrastructure thanks to information and communication technologies (ICT) and market incentives*
   7. Implement modernised air traffic management infrastructure (SESAR) in the EU, complete work on the European Common Aviation Area and implement intelligent systems for management of other modes of transport (e.g. ERTMS in rail transport) by 2020.
   8. Establish the framework for the European information, management and payment system with respect to multimodal transport by 2020.
   9. Reduce by half the number of road accident victims by 2020 and reach the near-zero number of road transport fatalities by 2050.
   10. Fully apply the rules 'user pays' and 'polluter pays', as well as involve the private sector in order to eliminate market distortions and ensure the funding of future transport investments.

The vision of competitive and resource-efficient transport system outlined in the White Paper on transport of 2011 is mainly a response to the need to reduce external transport costs. The dynamic growth of road transport, including especially passenger car traffic in the European Union, is one of the main sources of natural environment and noise pollution as well as one of the main reasons for the consumption of non-renewable resources. In urban areas, the problems connected with congestion and the deteriorating quality of life for cities inhabitants are increasing. Another major issue is accidents.

Research in transport economics – the essential element of technological change

The implementation of this vision and the achievement of the outlined objectives not only require the development of new technologies but also organisational innovations. Within the framework of Strategic Transport Research and Innovation Agenda (STRIA), which is a part of the 'Europe on the Move' policy package, European Commission has specified 7 main transport research and innovation (R&I) areas and priorities, which can be characterised as follows (European Commission 2017b; Grosso et al., 2018; SINTRAS Consortium, 2017):

1. *Cooperative, connected and automated transport* – focus areas for R&I include, for example, parallel existence of automated and non-automated systems, user needs, social acceptance of new solutions, as well as the impact of these technologies on behaviours. The area related to connected driving and automation of transport will not only require the development of new technologies but also regulatory and legal changes. There is a lack of research results concerning the impact of these technologies on the existing infrastructure, economy, society and environment. The economic, legal and ethical issues related to the automated vehicles technology still remain unresolved.
2. *Transport electrification* – research area connected with decarbonisation of transport (all modes) as well as the application of new materials, production systems, ICT technologies and innovative energy storage systems.
3. *Vehicle design and manufacturing* – research area on technologies that allow the minimisation of the lifecycle impact on the environment and energy use while

simultaneously maintaining or raising standards related to safety, comfort and affordability.

4. *Low-emission alternative energy for transport* – the area of innovative solutions with respect to technology, production, processes and organisational innovations, mainly in the field of alternative fuels, such as advanced biofuels or hydrogen, including fuel cells and new highly efficient and low-pollution combustion engines. The production costs of alternative fuels are still very high, while the level of social acceptance of these solutions is low. In this field, a particularly important role is played by the long-term strategy coherent for all Member States which is based on the incentive systems, smart regulations and targeting of R&I funding.
5. *Network and traffic management systems* – the main focus area is digitisation, which will allow for better traffic management (in real-time) and the optimisation of transport network (Intelligent Transport Systems, ITS).
6. *Smart mobility and services* – Mobility as a Service (MaaS), Multi-Modal Information and Ticketing Systems, Smart City Logistics, synchromodality and e-freight. Smart mobility services are based on the exchange and analysis of big data. Currently, the main issue to be resolved in this respect is the systems enabling data exchange, a lack of proper cooperation models between various entities as well as proper quality, data standard and data availability. The main goal of implementing solutions in this field is the improvement of the quality of life in the cities resulting from, for example, the reduction of congestion as well as increase of attractiveness and competitiveness of more sustainable modes of transports.
7. *Infrastructure* – investments in infrastructure are capital-intensive and time-consuming. Infrastructural investments are mainly financed with public funds; therefore, new infrastructural technologies are implemented slowly and do not keep up with the changes in other areas. For this reason, there is a high demand for organisational innovations in this area, especially in the field of innovative cooperation models, innovations in governance, charging, interoperability and better targeting of R&D funding.

Despite the fact that technological research and innovations are at the forefront of the identified areas, the research conducted by SINTRAS consortium shows that the biggest needs regarding innovative solutions currently do not concern technology. Technology is no longer an issue in itself. The barriers for the implementation of

new technologies, which mainly comprise economic, political and social factors (SINTRAS Consortium, 2017) are a much more significant problem. This is due to factors such as conflicting interests of stakeholders, including political entities. Therefore, the key role is played by research in social sciences, including transport economics, which focuses on the economic and organisational aspects of transport processes.

According to SINTRAS Consortium, pricing is one of the main areas where the conducted research needs to be intensified. It is necessary to develop new models of charging for new services enabled by new technology, which will be attractive for the users while ensuring the appropriate level of profits for the investors at the same time. Moreover, the effective implementation of new technologies in many cases depends on a good understanding of passenger travel patterns and preferences.

The full use of the potential resulting from the exchange and analysis of big data does not only depend on technological factors, e.g. in the form of coherent standards or interoperable data exchange systems, but it will mainly require an increase in the cooperation between the science sector and researchers on the one hand and business practice, in particular transport authorities in the cities, on the other. In the past, the main problem for the analyses of mobility and transport behaviours was how to obtain data. Nowadays, due to a huge amount and variety of received data, the problem is how to categorise and analyse them in order to make them useful in the decision-making process. As a consequence, one may suppose that it will also force certain organisational changes as well as changes in the operating model of many private and public entities (Urbanek, 2019).

Moreover, new big data sharing models require significant caution with respect to privacy protection and personal data security. Therefore, one of the biggest challenges faced by policy makers, the science sector and private sector is to effectively create and implement not only the harmonisation of rules for the collected data, but mostly to set up common platforms for their exchange so that they could be freely used by various entities, not only locally or regionally, but also on the international level (Steenberghen et al., 2013; Urbanek, 2019).

The role of research in university teaching in the field of transport economics

The classic 19th century concept of university created by Wilhelm von Humboldt assumes the full 'unity of research and teaching', as well as 'unity of professors and students'. According to this vision of higher education, which was innovative at that time, truth is discovered through joint participation of academic teachers and students in the research process by getting to new knowledge together (Kwiek, 2006). Nowadays, the relation between scientific research and education is a subject of numerous discussions and empirical research (Tight, 2016). There are also various concepts for integrating research and teaching activities (Kowalczuk-Walędziak, 2017). The integration of scientific research and education can be understood as the incorporation of scientific research results into student learning programmes, the involvement of students in the research conducted by academic staff, the research conducted by academic teachers and sharing research results with the students (Trowler & Warehan, 2007).

Previous studies among academic teachers and students have indicated that academic teachers who are active researchers (Marsh & Hattie, 2002):

- use the results of their research to enrich, clarify and update the material taught to students, which makes classes more interesting and students more motivated to gain knowledge and participate in classes;
- are more effective in developing the understanding rather than passive acceptance of complex facts in students; and
- are more authentic with respect to the content taught.

Moreover, the source literature also highlights the positive effect of teaching on the teacher's research activity. Sharing own research results with students may help researchers understand certain issues and clarify their research. Students' suggestions, questions or criticism may confirm the adopted research assumptions or may be a source of inspiration for new research directions or further, in-depth research (Marsh & Hattie, 2002). According to Marsh and Hattie (2002), teachers who are involved in research are more aware of international perspectives in their field and are more likely to be leaders in their discipline.

The incorporation of scientific research results in education process is particularly significant in transport economics. The essence of knowledge created within the framework of transport economics is the theory of efficient, effective and environmentally friendly distance covered by passengers and goods. Therefore, the issues raised by researchers in this respect are frequently interdisciplinary and are also the subject of research for other fields of science such as engineering, natural sciences or computer and information science. Therefore, a researcher/academic teacher is required to constantly update their knowledge with new scientific research results, to be able to have a broad view of the economic phenomena as well as to monitor changes in modern technologies that may be significant for the transport sector on an ongoing basis. Another important fact is that research in the field of transport economics, apart from its theoretical values, can frequently be applied. Research results are not only important for various levels of transport policy stakeholders but also for the companies providing transport services. In this respect, academic teachers are an important source of knowledge about current trends and potential areas of innovation, whereas, on the other hand, they may gain knowledge from students and be inspired by them. The role of students in this aspect is special because they are passengers and users of transport services in everyday life. It is precisely their needs that are the source of innovative solutions in the transport sector.

The incorporation of scientific research results in the teaching process is also of particular significance in the process of teaching staff for the development of knowledge society and knowledge-based economy. Knowledge-based economies are founded on a direct application of knowledge and information for the purpose of more effective functioning and improvement of the quality of life (OECD, 1996). The last 10-15 years in the development of global information society have shown that apart from the classic resources, i.e. soil, labour and capital, knowledge has become the basic and strategic resource of every organisation as well as one of the fundamental economic categories. Knowledge is the driving force behind the development of knowledge-based economies; it is a condition for the implementation of innovations as well as a source of competitive advantage. Therefore, the importance of research and development (R&D) in modern economies has been constantly increasing (Table 1), which has been proven by the increasing expenditure on R&D on the level of whole economies (GERD) as well as the one made by individual companies (BERD).

Table 1: Indicators of R&D expenditure in EU28 and selected countries around the world in 2000 and 2017

Indicators	**Country/Group**	**2000 [%]**	**2017 [%]**	**Change 2017/2000 [p.p.]**
GERD Gross domestic expenditure on R&D (as % of GDP)	EU 28	1.67	1.96	0.29
	USA	2.63	2.79	0.16
	Japan	2.91	3.20	0.29
	South Korea	2.18	4.55	2.37
BERD Business enterprise expenditure on R&D (as a % of GDP)	EU 28	1.06	1.29	0.23
	USA	1.95	2.04	0.09
	Japan	2.06	2.52	0.46
	South Korea	1.61	3.62	2.01
Total R&D personnel per thousand total employment	EU 28	9.37	12.91	3.54
	USA	n/a	n/a	n/a
	Japan	13.67	13.19	-0.48
	South Korea	6.53	17.75	11.22

Note: n/a – not available, p.p. – percentage points
Source: Own study based on OECD Statistics Database (2019)

Involving students in scientific research conducted by university researchers and sharing research results teaches a methodical approach to problem solving and reasoning based on reliable analyses and sources. Such approach also teaches the use of scientific output and allows for the popularisation of certain good practices that provide an opportunity for future effective cooperation between the business and science sectors. Such cooperation is of great importance in terms of the challenges in the field of transport and mobility.

The challenges regarding transport and mobility that are currently faced by the European Union require the training of staff that will understand the significance of scientific research for the transport sector. This is due to the fact that the graduates include:

- future employees of the transport and logistics sector whose knowledge and skills will be crucial for the innovativeness and competitiveness of companies operating in this sector, or
- public sector employees, including various levels of transport policy stakeholders who will affect the transport policy of cities, regions or states.

Moreover, in the times of information noise and the increasing use of manipulation and misinformation tools, it is also important to train staff to have the methodological background for gaining knowledge and for conducting research.

Conclusions

The economic, social and environmental challenges faced by the contemporary world force us to implement innovative solutions in all economic sectors, including the transport sector. The main strategic challenges in the field of transport and mobility that the EU Member States will have to face during the upcoming decades mainly result from the need to develop a sustainable transport system. The achievement of the goals of transport policy set by the European Union not only requires the development of new technologies but also broadly understood organisational innovations, the source of which could be research in transport economics.

The necessity to build knowledge-based economy and society requires an increasing incorporation of scientific research in university teaching. Although combining research and teaching activities is currently the subject of numerous discussions, it is the Humboldt vision of the unity in higher education that seems to gain increasing significance from the perspective of the requirements of contemporary economies and the rate of changes in the transport sector. Sharing scientific research results with students and involving them in the research process may be a source of many advantages not only for the students, but also for the research staff at the universities and for the whole society.

References

European Commission (2011). *White Paper - Roadmap to a Single European Transport Area – Towards a competitive resource efficient transport system*. COM (2011) 144 final. Brussels 28.3.2011. Retrieved

from https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:en:PDF

European Commission (2017a). *Delivering TEN-T. Facts and figures*. September 2017. DG MOVE. Retrieved from http://www.connectingeu.eu/documents/Delivering_TEN_T.pdf

European Commission (2017b). *Towards clean, competitive and connected mobility: the contribution of Transport Research and Innovation to the Mobility package*. Commission Staff Working Document. Retrieved from https://ec.europa.eu/transport/sites/ transport/files/swd20170223-transportresearchandinnovationtomobilitypackage.pdf.

Grosso, M., van Balen, M., Tsakalidis, A., Ortega Hortelano, A., Haq, G., Gkoumas, K., & Pekar, F. (2018). *Assessing innovation capacity in the European transport sector – A methodological framework for a macro-level financial and socio-economic analysis*, EUR 29415 EN. Luxembourg: Publications Office of the European Union.

Kowalczuk-Walędziak, M. (2017). Kilka uwag o (roz)łączności działalności badawczej i dydaktycznej nauczyciela akademickiego. *Parezja 2*(8), 21-33. DOI: 10.15290/parezja.2017.08.03.

Kwiek, M. (2006). *The Classical German Idea of the University Revisited, or on the Nationalization of the Modern Institution*. CPPS Working Papers Series, Vol. 1. Retrieved from http://cpp.amu.edu.pl/pdf/CPP_RPS_vol.1_Kwiek.pdf

Marsh, H. W. & Hattie, J. (2002). The relation between research productivity and teaching effectiveness: complementary, antagonistic, or independent constructs? *The Journal of Higher Education*, *73*(5), 603–641. DOI: 10.1080/00221546.2002.11777170

OECD. (1996). *The knowledge-based economy*. Paris: OECD. Retrieved from https://www.oecd.org/sti/sci-tech/1913021.pdf.

OECD Statistics Database. (2019). Retrieved from https://stats.oecd.org/.

SINTRAS Consortium. (2017). *Towards a Single and Innovative European Transport System SINTRAS. Barriers Analysis and Action Plans. Final Report*. Retrieved from https://ec.europa.eu/transport/sites/transport/files/2017-04-sintras.pdf

Steenberghen, T., Pourbaix, J., Moulin, A., Bamps, C., & Keijers, S. (2013). *Study on Harmonised Collection of European Data and Statistics in the Field of Urban Mobility*. MOVE/B4/196-2/2010, Final report 24/05/2013. SADL KU Leuven and UITP. Retrieved from https://ec.europa.eu/transport/sites/transport/files/themes/urban/studies/doc/2013-05-harmonised-collection-data-and-statistics-urban-transport.pdf

Tight, M. (2016). Examining the research/teaching nexus. *European Journal of Higher Education, 6*(4), 293–311. DOI: 10.1080/21568235.2016.1224674

Trowler, P., & Wareham, T. (2007). *Tribes, territories, research and teaching. Enhancing the 'teaching-research' nexus*. Retrieved from https://www.researchgate.net/publication/251594982_Re-conceptualising_the_'teaching-research_nexus.

Urbanek, A. (2019). Data-Driven Transport Policy in Cities: A Literature Review and Implications for Future Developments. In G. Sierpiński (Ed.), *Integration as Solution for Advanced Smart Urban Transport Systems*. TSTP 2018. Advances in Intelligent Systems and Computing, 844, pp. 61-74. Cham: Springer. DOI: 10.1007/978-3-319-99477-2_6.