

Review of Researches Tendency in the Future of the Road Transport

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Abstract

The economic growth in the last years lead land vehicles to become an irreplaceable meaning of cargo transportation and people's travel. The massive increase in using personal vehicles and increasing the number of cargo transportation vehicles led to raising the different research needs in driving towards better vehicle structures and road transport systems. The aim of the current review research is to analyse, according to the world's scientific activities, the possible evolution of the road transport sector and personal mobility in the few future decades. The research includes a detailed review of developed and planning for implementation technologies and methods in the transport sector from energy use and emissions direction to safety and automation in transport. The reviewed trends in the research describe the effect of the part of the overall transport system linked to road urban area transport. In the final review analyses were founded four major directions for a new research tendency in the transport sector future: decarbonisation; automation; connectivity, and sharing. The research established the essential to address the road transport externalities in order to reach an efficient, safe, sustainable and inclusive multimodal transport system in the future.

KEY WORDS: *transport; research tendency; infrastructure; road; vehicle*

1. Introduction

Personal mobility, as well as cargo transportation each year, plays more and more important roles in society's life. The economic growth in the last years lead for land vehicles to become an irreplaceable meaning of cargo transportation and peoples travel. The massive increasing of using personal vehicles and increasing a number of cargo transportation vehicles led to raising the different research needs in driving towards better vehicle structures and road transport systems. The transport sector is – and will continue to be – increasingly driven by technology. According to [1], the main current research in the transport sector is directed in order to reach an efficient, safe, sustainable and inclusive multimodal transport system in the future.

To indicate the present and future challenges for research, firstly, should be provided actuality. Sustainable and universal mobility – is always at the centre of European Union (EU) transport policy, since it plays a vital role in the competitiveness of EU industry and services to meet citizens' needs. From 2005 to 2017, the total number of passenger kilometers (pkm) increased by 23.8%, according to information provided by European Commission [2], the vast majority of which were covered by passenger cars (Fig. 1). At the same time, expected that EU transport sector activity will grow, even more, in the coming decades, with road transport maintaining its dominant role, according to [3]. Specifically, growth is visible for two-wheels and private (passenger and cargo) transport and estimated at 16 % during 2010-2030 and at 30% for 2010-2050 (Fig. 1). From another side, for indicate especial trends in transport sector, additional researches is investigated age and urbanization factors in people mobility. This can be achieved during a detail review of [4], where is displayed that public transport is more pronounced for using in urban and in non-urban areas its prefer to use the private transport (Fig. 2), additional presented a preferences by age factor. This statistics make insure that researchers is plan to active in a trend transport direction for their research. Additional, just with information presented above, exist a limitation. That's why in current review also provided a main challenges facing to road transport sector: safety; urbanization, commuting times and congestion; environment influence; demography.

According to United National Economic Commission statistics [5] – the trends in road traffic accidents and fatalities' in period 2009-2019 years is slowly decrease. Between 2009 and 2019, the total number of fatalities in road traffic accidents decreased by ~20% in the EU region. At the same time, World Health Organization [6] statistic shown that the road traffic accidents is on the leading place of deaths for a children and young people up to 29 years old. According to [7] research, between the 2015 and 2030 years expected an up to \$1.8 trillion losses costs (hospitalization, combined societal losses of labour etc.) due to collisions from road traffic accidents. This all make a relevant a first challenges for a transport sector – safety.

United Nations (UN) each five years presented statistics about urbanization processes in the World, which also important challenge for a transport sector. According to [8], in 2019, globally more than 50% of people is live in urban areas, for Europe it's even more charactering up to 75%. At the same time, by UN prognoses [9] the urbanisation will continue to grow and will reaching 84% in Europe and 68% globally by 2050. Generally, the growing urban population, already mean, that the global challenge faced to mobility and transport more and more intensified. The more activities

challenges connected with urbanisation for transport sector, from one side consist by commuting times (daily in/out city traveling for a working people), from another side, in larger cities, private car ownership tends to be lower and lower, since people in cities prefer alternative variation of transport (public, cycling, scooters etc.), according to [10] information. All mention above, lead to large amount of congestion in the urban areas. According to INRIX report [11], the productivity losses, achieved by different vehicle traffic congestion, around 2% from all gross domestic product in the EU country. In final, it can be pointed that urbanisation and congestion make a relevant a second challenges for a transport sector.

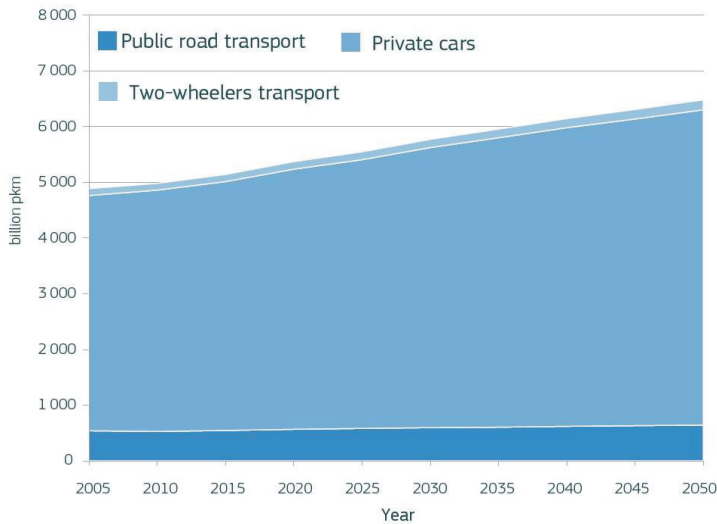


Fig. 1 Road passenger transport activity evolution since 2005 and up to 2050 (in pkm) by [2]

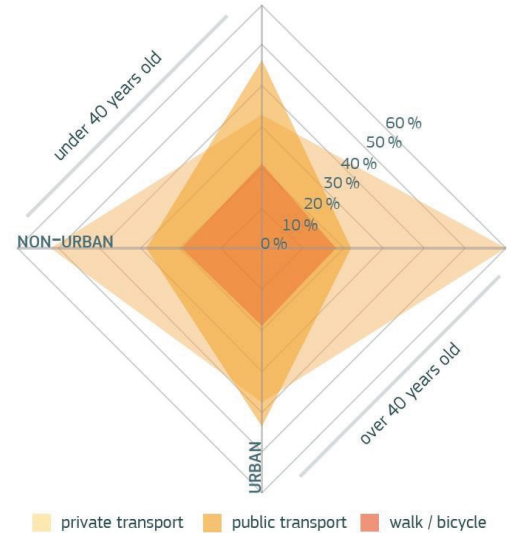


Fig. 2 Scheme of preference to use transport by different person categories, according to [4]

Transport sector it is also one of the major and growing contributor for air pollution. According to EU Commission report [2], in EU was emitted by different variety of vehicle 852 mln. Tonnes of CO₂. Particular was estimated that transport sector is responsible for ~30% of small particulate matter emissions, what automatically make it like a main cause of air pollution related deaths and illnesses, globally, by [12]. This all make a relevant a third challenges for a transport road sector – environmental problem.

The governments with each year pointed that settlements required to accommodate a growing elderly population of citizens. According to statistics and prognoses by UN [13], globally the number of people aged 60 years and over will be more than double until 2050. The governments started already facilitate for researchers work in direction connected with requiring transport mobility systems that can be adapted to become more inclusive and accessible to older population. From this information, obtained a forth challenges for a transport sector – demography.

In final, by review of statistics and reports provided by international organisation and researches can be pointed that in future the transport sector will be affected by different factors, which lead to a main challenges facing to road transport sector: safety; urbanization, commuting times and congestion; environment influence; demography. The pointed challenges is required a wide range of different solution (technical and services) exactly this solutions will make a trend and tendency in in the future of the road transport.

2. Technology Outlook in Road Transport

Four most fast-moving trends in the road transport sector can be observed during a detail review of research direction connected with a road transport. These trends can help to solve faced challenges and transform all road transport sector, as we know it now. The technology outlook in the road transport will help to create a methodology diagram for finding optimal trend and tendency of each challenge.

2.1. Automation and Connectivity

The International organization of Society of Automotive Engineers (SAE) in 2016 [14] was proposed to classified the vehicle automation driving by different levels for planned deployed of transports in the future. According to [14] and researches provided by [15 and 16], the automated driving of road transport can be classified in five distinct levels. These levels in general identify whether machine or human make change of the vehicle dynamic driving task (DDT). DDT include both: vehicle longitudinal control (braking, acceleration etc.) steering control. This level ranged from level 0 (where all DDT performed by driver) to level 5 (where DDT performed by machine, full automation) with additional monitoring of environment (road condition, traffic etc.). In the current moment, the automation of road vehicles in the beginning of the 3rd level of automation. From a technical point of view, automation of road transport still required a lot of research and just in beginning of developing 3rd level with a testing, were some several fatal

accidents was taken a place [17]. Additional, the delays in the planned targets take a place in the vehicle automation researches [18], since there are not enough time to finally test a development technology.

Significant technical challenges for fully automated vehicle driving (DDT) related to reality remain, according to [19], and include training algorithms for ensuring safe and efficient transport behaviour in any situation during driving, according to [20]. Review of different levels of road transport automation progress (Fig. 2) can lead to a conclusion that in the final level, the transport sector will obtain more safety road transport adopted for urbanization and demography problems, since with full automation the human factor will be excluded from vehicles DDT.

The mean of connectivity use to describe technologies which help to communicate vehicle with other vehicles or road infrastructure (traffic signals etc.). The connectivity has a close relation with automation, since in both cases the efficient management of vehicle ride and traffic control have a place. According to [21], in the close future the two directions of road transport researches – automation and connectivity, since they are closer interlinked, will be merged for more efficient management of traffic and safety in the roads.

2.2. Sharing

Sharing is one of the innovative transport strategies, which include various forms of transport sharing (enables to gain short-term access) from car and bike sharing to ride sharing in the mean – “Mobility as a Service” (additional, this term used to describe using digital technology’s integrated in various forms of transport service in one mobility access), according to [22]. According to [23] research, the transport sharing is more adopted in the centres of cities and more used by younger age people, which make a relevant researches in the direction of improve the popularity and comfortable using a sharing technology in non-urban area and for more older people.

The mean of shared mobility, in general, include a few relevant definitions, by [23]: vehicle sharing – a programme of individual fee pay in each time when person have a temporary access to vehicle and not include the cost and responsibilities of ownership; ride sharing – vehicle service for ride, which connect drivers (cost and responsibility of ownership) and passenger (fee pay for a ride) for providing similar origin-destination pairing ride; ride sourcing – on-demand vehicle service for ride, which connect drivers (cost and responsibility of ownership) and passenger (fee pay for a ride) for providing a ride only by passenger required destination. These services already find a place and popularity in most urban areas worldwide, according to [24], and help to solve a wide range of transport sector challenges from environment impact to commuting times and congestion etc.

2.3. Decarbonisation

In the EU with each year observed increasingly stricter regulation connected with CO₂ and air pollution with particulate matter. Additional, the EU have a restrict plan until 2050 to reduce air pollution in transport sector almost to zero [25], that why one of the ideas of “Transport 2050” by European Commission, its use renewable energies and improvement in energy efficiency with minimal emission in all kind of road transport. For archive this goal, according to [26-27], the electrification of transport will be one of the best solutions, since electrical vehicles (EVs) represent from a medium timescale and alongside of decarbonizing of road transport. Decarbonization, also, addresses to use any of alternative fuels: hydrogen, biofuels etc., but the electrification of road transport has a more perspective, since more researches and governments programs pay attention in this direction.

In the EVs research field, the most perspective for technical development direction of research connected with a power system – batteries. The prospects and trends for EVs batteries development can be divided in two stages: short-term (actual right now) and long-term (will be actual after few years in next decade). The short-term strategy include that batteries should lowering in the costs with increasing energy density with limiting the cobalt content [28]. For the long-term strategy, according to research [29], the improve the range of the EVs will be reach by replace current liquid electrolyte Li-ion batteries by solid-state electrolytes, with additional improvement not only in energy density but also in safety factors. With a mention above, can be make a conclusions that zero emission in the road transport will be reach only after reaching long-term strategy for EVs batteries developments. The vehicles electrification is widely considered as viable strategy for reducing oil dependency and environment influence from the road transport.

2.4. Trend and Tendency Diagram

The future of the transport sector is affected by different factors, which create the main challenges facing to road transport sector: safety; urbanization, commuting times and congestion; environment influence; demography. Apart from growth of economy, which always correlated with transport activity increasing, new technology and trends significantly can change a way of vehicle and road infrastructure developments. The pointed challenges is required a wide range of different solutions (technical and services) exactly these solutions will make a trend and tendency in the future of the road transport. The reviewed trends in the research describe the affect the part of the overall transport system linked to road transport. By review analyses was founded four major directions for a new research tendency in transport sector future: decarbonisation; automation; connectivity, and sharing, with additional providing an explanation of solving faced challenges (Fig. 3). These future main technologies categories promise to contribute to fewer negative impacts from road transport, with new mobility paradigms for a transport.

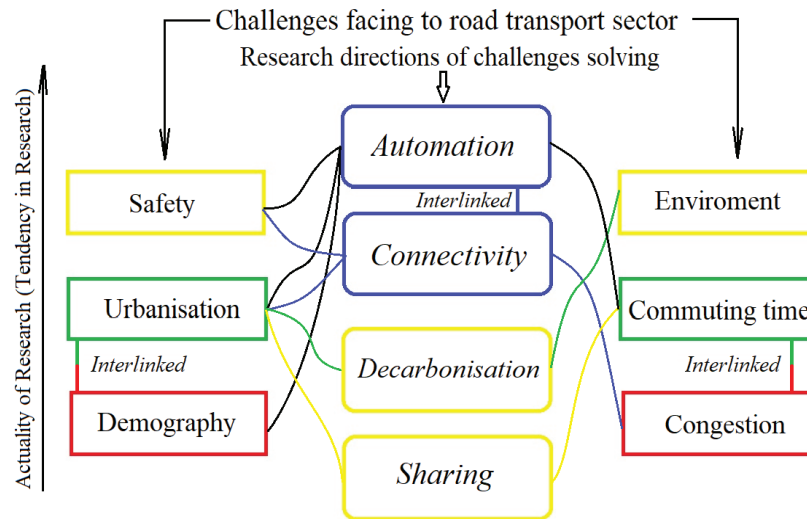


Fig. 3 Trend and tendency diagram in future research of road transport

The current diagram shows the possible evolution of the road transport sector research in the few future decades. According to the obtained diagram can be pointed four major directions for a new research tendency in the transport sector future: decarbonisation; automation; connectivity, and sharing, which help to solve the main challenges facing to road transport sector: safety; urbanization, commuting times and congestion; environment influence; demography. The research actuality line displayed that more tendency, in the current moment, go in direction of automation and less for sharing. Same time, the automation can help to solve four of six challenges facing to the road transport sector. The reviewed trends show the affect the part of the overall transport system linked to road urban area transport with establishing the essential to address the road transport externalities in order to reach an efficient, safe, sustainable and inclusive multimodal transport system in the future. These future technologies and services promise to contribute to fewer negative impacts from road transport while also generating new mobility paradigms for researchers. Researches acceptance of these trends is an important factor that will drive their research direction by pointed challenges facing to the road transport sector.

3. Conclusions

The massive increasing of using personal vehicles and increasing a number of cargo transportation vehicles lead for raising the different research needs in driving towards a better vehicle structures and road transport systems. In the current review research is analysed, according to the world scientific activities, the possible evolution of the road transport sector and personal mobility in the few future decades. Was detail reviewed in developing and planning for implementation of technologies and methods in the transport sector from energy use and emissions direction to safety and automation in a transports. The reviewing of new research in transport road sectors introduces trends from the technological and user uptake perspectives in the context of present and future mobility challenges.

By reviewing statistics and reports provided by the international organisation and research can be pointed out that the future of the road transport sector will be affected by economic and urbanisation factors, which lead to the main challenges facing to road transport sector: safety; urbanization, commuting times and congestion; environment influence; demography. To solve challenges facing to road transport sector was founded four major directions for a new research tendency in the transport sector future: decarbonisation; automation; connectivity, and sharing. The research established the essential to address the road transport externalities in order to reach an efficient, safe, sustainable and inclusive multimodal transport system in the future.

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