

Megatrends – a Way to Identify the Future Transport Challenges

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Abstract. In the last ten years, huge advances in detecting trends methodology have been spotted in particular in Europe. Trend represents a fundamental change over an extended period, i.e. associations that are defined by crossing contextual borders. They are phenomena that are always complex and whose lifespans can only be measured inaccurately. Trends, whose implications are reflected on the whole or almost entire society, are called megatrends. The objective of this paper is to define the key megatrends affecting the future passenger and freight transportation system through review and analysis of the transport reports and studies on the global level. Megatrends commonly elaborated in the majority of literature sources will be identified. It indicates a convergence to those that are most important for the future development of transportation processes.

Keywords: Key megatrends, Passenger and Freight Transportation, Reaching Consensus.

1 Introduction

Based on the existing knowledge and understanding, it is obvious that megatrends lead to serious challenges for the transportation systems. Therefore, there is a need for the transportation practice to adjust its developing routine to the current and future megatrends. However, different economic, social and environmental characteristics of various regions all over Europe cause different impacts of these megatrends on corresponding transportation systems.

The process of identifying megatrends affecting the future transport system will be based on the review of existing literature dealing with the megatrends and their implications on transport. Therefore, our goal is to reach consensus on the key megatrends for both passenger and freight transportation systems.

This paper presents initial results of the H2020 project INTEND - Identify future Transport Research Needs (grant agreement No 769638). The overall objective of the INTEND project is to deliver an elaborated study of the research needs and priorities in the transport sector utilising a systematic data collection method. INTEND will

develop a transport agenda that would pave the way to an innovative and competitive European Transport sector.

Rest of the paper is organized as follows. Section 2 elaborates concepts of trends and megatrends. Analyzed literature sources for both passenger and freight transportation are listed in the section 3 of this paper. Section 4 defines the criteria for reaching consensus on the most important megatrends for each transport sector and identifies them. Section 5 concludes the paper.

2 Weak signals, trends and megatrends

Trend management, as a research discipline, arose from the concept of weak signals, introduced by [3] and [4]. According to [4], weak signals are “*warnings (external or internal), events and developments that are still too incomplete to permit an accurate estimation of their impact and/or to determine their full-fledged responses.*” Over the years, Ansoff’s concept of weak signals has been accepted for what is now called a trend ([38]). Studying trends implies research of something new, with the aim of understanding them and correctly perceiving the possible consequences in certain areas ([38]). Liebl and Schwartz, 2010 [22], point out that innovation and diffusion are two perspectives from which trends should be observed in order to understand them. Innovation clearly points out the need for something new in every trend, while diffusion enables us to see to what level a certain trend influences the development of different areas, such as transport.

If the importance of certain transformation processes is to be emphasized, such changes are often called megatrends. Therefore, megatrends are one of the research disciplines in trend management. Vejlggaard, 2008 [37], points out two the most significant characteristics of megatrends:

- megatrends represent cultural, economic, political and technological changes that have not yet happened;
- the effects or implications of megatrends are reflected on the whole or almost entire society.

The same author indicates the following differences between trends and megatrends:

- Megatrends last longer;
- Megatrends have a more pronounced impact on many areas;
- It is significantly easier to predict development patterns of certain trends in comparison with the prediction of future development of megatrends.

It is known that many internal and external factors influence both freight and passenger transportation system. This paper deals with general external factors or megatrends i.e. “*those variables, which are not specific to the transport system, but have impacts on it and contribute to shape its development*” [5]. These external factors or megatrends interact with policy actions within both freight and passenger transportation processes. It means that any policy action affects not just transportation systems but also development patterns of the megatrends.

3 Reviewed literature

The aim of this paper is to identify megatrends that may affect both passenger (PT) and freight transportation (FT). The applied approach is based on a literature review of transport studies, projects and papers. We took into account relevant studies that consider megatrends with time perspective of up to 2050. The analysis of studies was performed particularly for passenger and particularly for freight transport. Passenger and freight transport related studies that we reviewed for the purpose of identification of relevant megatrends are given in Table 1.

Table 1. Reviewed passenger and freight transport related studies.

	[13]	[18]	[26]	[32]	[40]	[10]	[14]	[31]	[34]	[15]	[2]	[9]	[12]	[28]	[29]	[8]	[30]	[33]	[5]	[10]	[16]	[19]	[24]	[39]	[1]	[17]	[25]	[35]	[36]	[23]
PT	+	-	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+
FT	-	+	-	+	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	+	+	+	+	+	+	+	-	-	+

4 Reaching a consensus

Reaching a consensus, in this case, means defining the criteria that will allow for the identification of megatrends that have the most significant impact on the future development of passenger and freight transport. In this respect, in our approach, we have adopted and used a standard for the Delphi method. Literature usually recommends that consensus should represent 50 to 70 % agreements. Numerous exercises, performed so far, required an agreement among 70 % of the sources, experts or panelist to reach the consensus (Ashton Acton, 2013, Kleynen et al., 2014; Kelly et al., 2016). Therefore, in order to select any megatrend as the most important, it is necessary that at least 70% of the identified literature sources elaborate and describe the impact of that megatrend on passenger or freight transportation.

4.1 Matrix of megatrends over sources

In order to perform the required analysis, we prepared the matrix, shown in Tables 2 and 3, listing sources against the megatrends identified in the reviewed literature. As it can be seen, a total of 22 megatrends from all sources, which are related to both passenger and freight transportation, are separated and included in our analysis. The goal of this matrix analysis is to determine the megatrends that are processed in most of the reviewed sources, indicating a certain level of consensus or convergence to those that are most important for the future development of transportation processes. Some of the megatrends, given in Tables 2 and 3, are in the same way labeled and described in a number of sources, while in certain cases, there are differences in that respect. For this reason, the labels and descriptions of the megatrends applied in various studies, projects, papers and reports have been harmonized herewith. Similar approach for identification of key global megatrends and their implication for environmental assessment practice was applied in [27].

Table 2. Key global megatrends in passenger transportation.

	[13]	[26]	[32]	[40]	[10]	[14]	[31]	[34]	[15]	[12]	[28]	[29]	[8]	[30]	[33]	[5]	[16]	[19]	[24]	[39]	[1]	[17]	[25]	[35]	[36]	[23]	Total
population growth	-	+	-	-	-	-	-	+	-	-	+	+	-	-	-	-	-	-	-	+	-	-	-	+	+	-	7
ageing society	+	+	-	+	-	-	+	-	+	+	+	-	+	-	-	+	+	+	+	-	+	-	+	-	+	+	16
GDP, income, economy growth	-	-	+	+	+	-	-	-	-	-	-	+	-	+	-	-	-	-	-	+	+	-	+	-	-	+	9
economic pressures and crisis	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	2
increase of Inter-/Intra-national social disparities	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
urbanization and megacities	+	+	-	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	22
changing lifestyles	-	+	-	+	+	-	+	-	+	+	+	+	-	+	-	-	-	+	+	+	-	+	+	-	+	+	15
changing mobility behaviours	-	+	-	-	-	+	+	-	-	+	+	+	+	+	+	+	-	+	-	+	-	-	-	-	+	+	13
climate change	+	+	-	+	+	+	+	+	-	+	+	+	+	-	+	+	+	-	+	+	+	+	+	+	+	+	22
energy demand /sources	-	-	-	+	+	+	-	-	-	-	-	+	+	+	-	+	+	-	+	+	+	-	+	-	+	+	15
key resources scarcity	+	+	+	-	+	+	-	-	-	-	-	-	+	+	-	-	-	+	+	+	+	-	+	+	+	+	15
Globalization 2.0	-	+	-	-	+	-	-	-	+	-	-	-	+	-	+	+	+	+	+	+	-	+	-	-	-	+	11
migration and internal mobility	+	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	4
European market regulation	-	+	-	-	+	-	-	-	-	+	-	-	+	-	+	+	-	-	+	-	-	+	-	-	+	-	9
knowledge society and knowledge economy	-	+	-	-	-	+	+	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	5
trade growth	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	+	-	+	-	+	-	5
land availability	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	2
natural disasters, safety and security issues	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	+	+	+	+	-	-	+	7
increased food and water demand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	1
becoming customer-oriented	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	1
employers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
infectious disease and pandemics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
geopolitical (in)stability	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	1

Table 3. Key global megatrends in freight transportation.

	[18]	[32]	[2]	[9]	[12]	[11]	[16]	[19]	[24]	[39]	[1]	[17]	[23]	[36]	Total
population growth	-	-	-	-	-	-	-	-	-	+	-	-	-	+	2
ageing society	-	-	+	+	+	-	+	+	+	-	+	-	+	+	9
GDP, economy growth	+	-	-	-	-	-	+	-	-	+	-	+	-	+	5
urbanization/megacities	-	-	+	-	+	-	+	-	+	+	+	-	+	+	8
changing lifestyles	-	-	+	-	+	-	+	+	+	-	+	+	-	+	8
changing mobility behaviours	-	-	+	-	-	-	+	+	-	-	-	-	-	+	4
climate change	-	+	+	+	+	-	+	+	-	+	+	+	+	+	11
energy demand /sources	-	-	-	+	+	+	+	-	+	+	-	+	+	+	9
key resources scarcity	+	+	-	+	+	+	+	+	+	+	+	+	-	+	11
Globalization 2.0	-	+	-	-	+	-	+	+	+	-	+	-	-	+	7
migration and internal mobility	-	-	-	-	-	-	+	-	-	-	-	-	-	-	1
market regulation	-	+	+	-	-	-	+	-	-	-	-	+	-	+	5
trade growth	-	-	-	-	-	-	-	-	+	+	-	+	-	+	4
security issues	-	-	-	+	-	+	-	-	+	+	+	+	-	+	7
food and water demand	-	-	-	-	-	-	-	-	-	+	-	-	-	-	1
infectious disease and pandemics	-	-	-	-	-	-	-	-	-	-	-	+	-	-	1
geopolitical (in)stability	-	-	-	-	-	-	-	-	-	-	-	+	-	-	1

4.2 Key global megatrends in passenger transportation

Table 2 gives a matrix of megatrends over sources for passenger transportation. In order to select a megatrend as the key it should be elaborated in at least 19 out of 26 reviewed sources (> 70 %). Our approach has enabled us to identify the following megatrends as the most important for the development of passenger transport:

- **urbanization and megacities** (higher population densities; improvements in cities infrastructure; environmental and health risks; PPP models; more sustainable cities);
- **environmental challenges – climate change** (decrease in carbon emissions; global temperature increase; sea level arise; increased risk of flooding from melting glaciers; adaptation and mitigation policies; development of carbon markets).

4.3 Key global megatrends in freight transportation

Table 3 presents our matrix of megatrends over sources for freight transportation. In this case, consensus is reached if a megatrend is elaborated in at least 10 out of 14 identified sources (> 70 %). By applying the described approach, the following megatrends can be selected as the megatrends with the most significant influence on the future development of freight transportation:

- **environmental challenges – climate change;**
- **key resources scarcity - shortages and consumption** (more constraints on consumptions - resource management; greater demands on scarce resources – fossil fuels; development of substitute materials; global privatization of resources; changes in ecosystems use).

5 Conclusion

This paper lists the global megatrends affecting passenger and freight transportation. After thorough review of relevant and available literature, a consensus on the selection of the key global megatrends that impact on freight and passenger transport was agreed and defined across the source literature. In that context, a matrix giving megatrends over sources was prepared. By doing so, megatrends commonly elaborated in the majority of literature sources were identified suggesting some level of consensus.

As megatrends are expected to change the whole sector in a fundamental way, they should be further validated in order to estimate their impact on defining the future transport research priorities. INTEND project, in its further steps, will validate the megatrends by using the Analytical Network Process (ANP). The aim of the validation process is to determine the prioritized megatrends (as well as technological advances and political imperatives) for successful implementation and realization of key transport concepts of the future. This task will include review of non-only transport related studies i.e. general foresight studies or studies not exclusively related to the future of transportation. In order to validate the obtained results, we will also apply an approach of selection of the key megatrends based on the experts' opinions. For that purpose, we will use a lower limit of 50% agreement for selecting certain megatrends for further analysis and elaboration through the application of the ANP methodology.

In order to define streams of needed future researches in the fields of transport technologies, mobility concepts and research systems, INTEND project will also identify the gaps between technological advances in the transport sector and development prospects of the transport and mobility systems. The Gap analysis will be based on the perception of different technological advances and megatrends impacts on specific characteristics of the future transport system. Impact of megatrends on transport research needs will be visually presented by using the Transport Synopsis Tool.

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