UNITED NATIONS E

ECONOMIC AND SOCIAL COUNCIL

Distr.
LIMITED
E/ESCWA/CR.5/2018/CRP.1
10 October 2018
ENGLISH
ORIGINAL: ARABIC

Economic and Social Commission for Western Asia (ESCWA)

Committee on Transport and Logistics
Nineteenth session
Beirut, 26-28 November 2018

Item 8 of the provisional agenda

The technological revolution and its impact on the future of the transport sector in the Arab region
(Round-table discussion)

Summary

The present document was drafted by the Economic and Social Commission for Western Asia (ESCWA) within the framework of preparatory studies to develop a common strategic vision on the development of multimodal transport to promote economic and social integration in the Arab region, so as to strengthen stability and growth and achieve inclusive and sustainable development. It draws from the conceptual framework of the systems approach to analyse the expected applications of the technological and digital revolution in the transport sector, and reviews key features of expected future transformations, including hyperloop trains, solar-powered electric cars, driverless vehicles, developments in shared transport, the redundancy of intermediary professions, and open governance of the transport sector.

The present document stresses the need to prepare for expected technological and digital developments in the transport sector in the Arab region, by improving infrastructure, preparing trained and experienced human resources, developing regulatory frameworks, and adopting a participatory approach to those ends. It concludes with a set of recommendations on facing future challenges posed by expected transformations at the regional level. Representatives of member States are invited to take note of the information in the present document and comment thereon to advance the secretariat's work in this area.

Note: Mention of commercial names and products does not imply the endorsement of the United Nations.

CONTENTS

Introduction

1. The transport sector is characterized by long periods of slow growth, punctuated with rapid and profound transformations in the form of singularities or revolutions in the development process, as a result of a combination of various factors known in some literature as "drivers of change in the transport sector" in comprehensive and widespread references.[1]

2. Given the significant importance of infrastructure investments in the transport sector and their high cost, and the sector's strong impact on people's lifestyles and social and economic activities, it is vital that decision makers and those responsible for planning and managing the sector anticipate expected future trends to incorporate them into planning scenarios for the sector's future development to effectively meet changing needs in a timely manner.

3. The Economic and Social Commission for Western Asia (ESCWA) is undertaking a project on formulating a strategic vision to develop a multimodal transport system in the Arab region, in collaboration with member States and in coordination with international and regional development bodies. The project focuses on revealing global transport megatrends and their potential implications for the Arab region, so as to strengthen cooperation to handle those trends and tackle their challenges. The project was presented at the eighteenth session of the Committee on Transport and Logistics, which was held in Beirut on 20 and 21 December 2018. Committee member recommended starting its implementation and approaching regional and international financing institutions to mobilize the necessary resources.

4. As part of the preparatory studies for the project, the ESCWA secretariat set out a detailed explanation on the relationship between transport and the Sustainable Development Goals (SDGs), which it presented to the Committee on Transport and Logistics at its seventeenth session, held in Cairo on 23 and 24 January 2017.[2] The secretariat also drafted a concept note on megatrends in the transport sector and their impact on the Arab region,[3] which was presented at the thirtieth ESCWA ministerial session held in Beirut, from 25 to 28 June 2018. Member State representatives recommended adding an information and communications technology (ICT) component to the concept note. The session's outcome document, entitled Beirut Consensus on Technology for Sustainable Development in the Arab Region, also focused on the importance of technology and innovation in advancing sustainable development and driving structural transformations in various fields, including transport; it recommended building capacity to innovate, and adapt and protect technological breakthroughs.

5. The present document on the technological revolution and its impact on the future of the transport sector in the Arab region was prepared pursuant to the recommendations made at the above-mentioned meetings. It reviews the advantages of the systems approach in understanding transport system evolution mechanisms and underlines technology's role as the main driver of change in the sector. The document will serve as a basis for discussion at the nineteenth session of the Committee on Transport and Logistics, and will also be discussed at a later date at an expert group meeting on the subject.

I. CONCEPTUAL FRAMEWORK AND LESSONS OF HISTORY

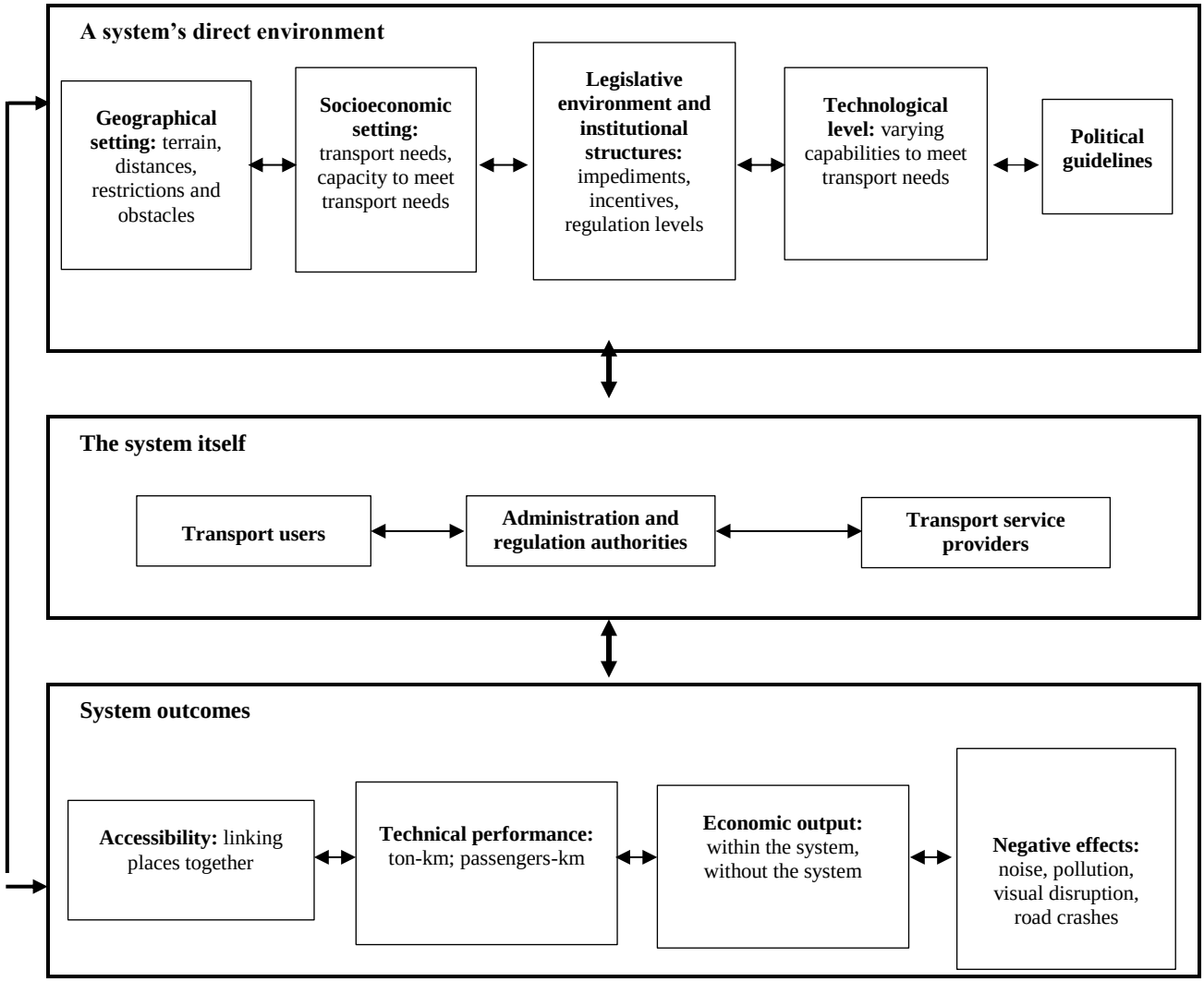
6. Transport, with its various aspects and economic, social and environmental dimensions, is considered a multidisciplinary scientific sector with various perspectives on how to study and solve challenges. The general systems approach is the most appropriate and integrated conceptual framework to explain the reciprocal influences between transport-related activities.

[1] Jean-Paul Rodrigue, Claude Comtois and Brian Slack, *The Geography of Transport Systems*, 4th ed. (New York, Routledge, 2017).

[2] E/ESCWA/EDID/2016/IG.1/5(Part I).

[3] E/ESCWA/30/4.

Figure 1. Schematic representation of the transport system



Source: S. Reichman, *Les transports : servitude ou liberté ?* (Paris, Presses universitaires de France, 1983).

7. The main elements of Reichman's approach can be summarized as follows:[4]

(a) To understand transport issues, it is necessary to analyse the reciprocal relationships and influences between the system's various components, its environment and its outcomes;

(b) Evolution in the transport sector is not always linear: the sector might temporarily stabilize in a given state because of the balance between different forces expressing conflicting interests. When this balance is upset, the system might move from a stable state to an unstable state or vice versa;

(c) Evolution in the transport sector occurs over the long term through significant structural transformations that generally accompany major changes in the system's environment, especially but not exclusively changes related to technological revolutions and their profound impact on the economy, society and people's way of living.

8. Throughout history, there are several examples of technology's role in effecting revolutionary changes in transport modes, resulting in qualitative improvements for humankind. The invention of the wheel

[4] S. Reichman, *Les transports : servitude ou liberté ?*

7,000 years ago continues to underpin all forms of road transport to this very day. Sails, rudders, astrolabes and compasses were all innovative technological creations that significantly increased the efficiency of maritime transport, thus allowing human beings to overcome natural obstacles such as rivers, lakes and seas, using them for trade in goods at a lower cost than road transport.

9. At the end of the eighteenth century, the invention of the steam engine constituted a significant leap in maritime transport, resulting in the spread of railroads at the start of the nineteenth century to transport passengers and goods. Diesel engines then assumed that role, followed by electric engines that now power hyperloop trains, keeping in mind the key role of electric engines in driving shared transport in cities, such as trolleybuses, tramways and the metro (underground, overground and elevated).

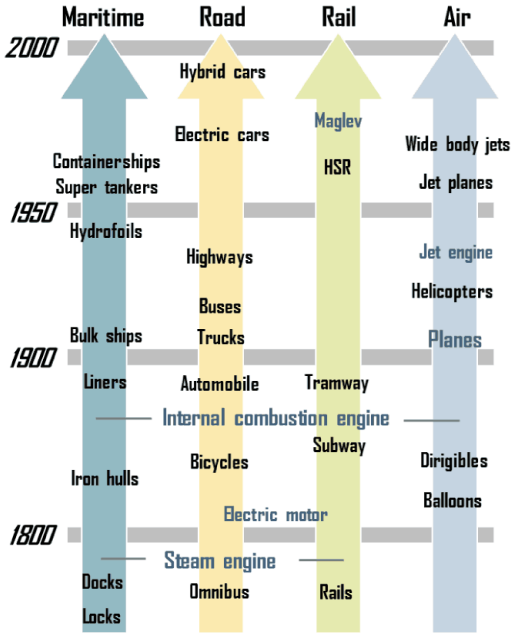
10. The internal combustion engine allowed for advancements in and the spread of various road transport modes for passengers and goods, in conjunction with significant developments in road construction technology and the resulting competitive advantages for essential door-to-door road transport for short and medium distances, from ports and railway stations to final destinations and vice versa.

11. The invention of airplanes, which were powered by piston internal combustion engines in the early twentieth century then by jet engines mid-century, caused a fundamental transformation in the transport of passengers and goods between countries and continents at unprecedented speeds, especially when compared with other widespread transport modes.

12. Containers are an important innovation that transformed maritime transport in the second half of the twentieth century, by facilitating and expediting cargo loading and unloading from ships, and the resulting savings in time and transport costs. Container transport accounts for 60 per cent of the maritime transport of goods worldwide.[5]

13. Figure 2 provides a comprehensive aggregate representation of developments in transport technology in all modes over the period 1750-2000.

Figure 2. Developments in transport technology, 1750-2000



Source: Rodrigue, Comtois and Slack, *The Geography of Transport Systems*.

[5] E/ESCWA/EDID/2016/IG.1/4(Part II).

II. GLOBAL STUDIES ON TECHNOLOGICAL AND DIGITAL DEVELOMENTS IN TRANSPORT

14. Several studies address expected transformations in all technology fields and their potential fundamental impact on transport modes. In the above-mentioned study, Rodrigue, Comtois and Slack tackle those impending transformations and categorize them under the following two main fields, which will greatly affect transport modes in the future:[6]

- Automation and information technology: involve ICT applications to increase transport speed, efficiency, safety and reliability, and to fully or partially automate vehicles and transport terminals. This change will also impact on-demand transport services, driverless cars and trucks, automated ticketing and self-check-in at airports;

- Alternative transport modes and fuel alternatives: involve maglev trains that use magnets to reduce friction and increase operating speeds to 500-600 kilometres per hour, hyperloop trains that can reach speeds of 1,000 kilometres per hour, hybrid vehicles powered by electricity and fuel, electric cars, fuel cell engines that generate electricity by fusing hydrogen with oxygen, and new generations of airships for cargo transport.

15. Following a request by the National Cooperative Highway Research Programme in the United States of America, a study was prepared in 2008 on long-term strategic issues affecting the transport industry.[7] The study was drafted from a systems-approach perspective to identify a general framework for priority research projects aimed at tackling expected challenges in road transport in the United States over the next 30 to 40 years.

16. The study identifies the following key areas that require focused research:

- Transport demand and changing behaviour patterns;
- Operation and performance of advanced transport systems;
- Sustainable transport;
- Transport financing;
- Transport service provision.

17. The study highlights the importance of recognizing the impact of external factors on all those areas, namely population and social factors, environmental and energy factors, technology, economy, governance and regulation.

18. The study presents key expected impacts resulting from technological developments in the transport sector, as follows:[8]

- Technology may render some movements redundant, replacing them with telecommuting and online shopping, for example;

- The use of global positioning systems (GPS) and other similar technologies;

- Stronger transport capacity and accessibility by improving access to information on demand, and controlling transport supply in line with changing demand, such as increasing the number of buses on a route and redirecting traffic to less congested roads using electronic variable-message signs;

[6] Rodrigue, Comtois and Slack, *The Geography of Transport Systems*.

[7] ICF International, "Long range strategic issues facing the transportation industry: final research plan framework", paper prepared for National Cooperative Highway Research Program Project 20-80, Task 2 (Fairfax, 2008).

[8] Ibid.

- Emergence of new technologies to improve safety and reliability;
- Establishing new mechanisms for transport pricing.

19. In 2015, a study was prepared for the Joint Research Centre of the European Commissions on the future of the transport industry.[9] The study compiles around 400 technological innovations that could potentially impact the future of transport worldwide by 2030 and beyond. It also contains a table that sets out key outcomes, classified by major fields of innovation and development in transport, thus directing future research towards priority fields for the European Union.

TECHNOLOGICAL AND DIGITAL DEVELOPMENTS IN THE TRANSPORT SECTOR

Field	Technology or innovation
Automation of road transport	Advanced driver-assistance systems
	Full autonomous driving
	Intelligent transport communication systems (inter-vehicle communication, vehicle-infrastructure communication, intelligent signalling)
Fuels and propulsion technologies	Battery electric vehicles
	Hybrid technology (allowing pure electric drive for a certain distance)
	Fuel-cell electric vehicles
	Second-generation biofuels
	Improvements in conventional internal combustion engines (e.g. downsizing)
	Liquid gas for shipping
Improving the means of transport	Lightweight materials (e.g. carbon fibres)
	Improved aerodynamics
Intelligent transportation systems	Ubiquitous (Internet) access to harmonized traveller information (passengers) and tracking information (freight)
	Personal rapid transport (small automated vehicles operating on a network of specially built guideways)
	Radio frequency identification/near field communication for seamless user interfaces
	Autonomous supply chain management for more efficient use of logistics services
Services/organizational innovations	Innovative sharing services (car-sharing, bike-sharing, etc.)
	Teleworking, video conferencing and holographic conferencing
	Smart ticketing schemes
Infrastructure	Innovative new types of transport infrastructure (e.g. cargotube, hyperloop)
	Innovative transhipment technologies for seamless intermodal freight transport
	Inductive charging infrastructure for electric vehicles

Source: Centre for Research and Technology Hellas and Hellenic Institute of Transport, *Future Prospects on Transport Evolution and Innovation Challenges for the Competitiveness of Europe (FUTRE) Newsletter Issue 2* (December 2013). Available at http://www.futre.eu/Publications/Newsletters.aspx.

[9] A. Aggelakis and others, "The Future of the Transport Industry", Joint Research Center Technical Reports, JRC93544 - EUR 27085 EN (Luxembourg, European Commission, 2015).

20. In January 2018, the World Bank, in collaboration with World Resources Institute, held an international forum on the theme "Transforming transportation: realizing sustainable mobility for all in the digital era". It covered various issues related to technology and digitization. Participants discussed societies' preparedness for driverless cars, and reviewed the digital revolution's role in achieving sustainable transport and employing clean technologies in urban transport. The forum stressed the need for transport to move beyond its traditional role as an enabler of the digital economy, limited to delivering e-commerce goods, so as to achieve further openness and advancement by harnessing powerful technological achievements.[10]

III. TRENDS IN TRANSPORT-RELATED TECHNOLOGY AND DIGITIZATION

21. The present section sets out the major expected effects of technological and digital developments in the transport sector:

- Hyperloop trains;
- Solar-powered electric cars;
- Driverless cars;
- Advancements in shared transport;
- Redundancy of intermediary professions;
- Open governance of the transport sector.

A. FROM HIGH-SPEED TRAINS TO HYPERLOOP TRAINS

22. Upon their expansion, railroads became the most efficient land transport mode, unparalleled by road transport modes. However, after the invention of the internal combustion engine, which is smaller than the steam engine, road vehicles such as cars, passenger buses and cargo trucks overtook rail transport, especially following the wide expansion of paved roads, which exceeded that of railroads. Simultaneously, rail services and competitiveness deteriorated to the extent that the British Government, for example, was obliged to nationalize its rail network after the Second World War to protect it from extinction.[11]

23. Railroads were reinvigorated by significant developments in train speeds, rendering them an efficient transport mode for long distances exceeding 500 kilometres. Such advancements were the result of technological improvements in electric train engines, reduction of air resistance with more aerodynamic designs, improvement of carriage stability on tracks, and strengthening of brake efficiency at high speeds.

24. There are many types of high-speed trains, but the French model, known as TGV and launched in 1981, uses regular 1,435 millimetre tracks with sections that have been modified to accommodate high speeds. It was therefore possible to integrate TGV trains into the existing railway network, travelling at high speed on modified sections of tracks and reaching all stations serviced by regular tracks. On 3 April 2007, TGV broke the railway speed record, reaching 574.8 kilometres per hour. However, in reality, TGV trains operate at 300-320 kilometres per hour, so as to not use more energy that regular trains that travel at 120 kilometres per hour.[12]

25. Hyperloop trains are expected to become operational in the near future, most likely before 2030. They are a promising innovation that will significantly impact the transport sector. They can travel at speeds of 1,000-1,200 kilometres per hour in a low-pressure tube so as to eliminate air resistance and the resulting atmospheric drag. Magnetic levitation causes the pods to float to avoid wheel friction on the tracks, and electric linear motors are used to propel the pods.

[10] http://www.transformingtransportation.org/resources.

[11] Bernard J. Smales, *Economic History: Made Simple* (London, W. H. Allen, 1975).

[12] https://www.railway-technology.com/projects/frenchtgv.

26. Hyperloop trains are being developed to link between Los Angeles and Las Vegas, thus reducing travel time to 30 minutes instead of four hours by car or two hours by high-speed train. News reports indicate that that the United Arab Emirates is interested in linking Dubai and Abu Dhabi, thus reducing travel time to 12 minutes instead of one hour and eight minutes by car or one hour by high-speed train.[13]

27. Undoubtedly, a train travelling in a tunnel or an overground tube at speeds of around 1,000 kilometres per hour poses a significant challenge for air transport in terms of safety and low energy use. A transformation towards that mode of transport is expected, especially if such trains can service city centres like regular trains and if travellers do not have to cross long distances to reach airports, which are commonly located far from cities.

28. Similar to transformations witnessed following the launch of high-speed trains in the 1980s, the introduction of hyperloop trains travelling at 1,000 kilometres per hour could result in considerable transformations in spatial and temporal connectivity. Those living in cities 500 kilometres away from the capital but serviced by hyperloop trains will become closer to the capital in practical terms than those living 30 kilometres away but commuting by conventional low-speed transport modes subject to congestion. Such developments will result in a structural transformation in city planning principles, which will be freed from traditional distance regulations when determining relationships between residential areas and workplaces.

29. Regarding hyperloop infrastructure, magnetic levitation in low-pressure tubes is a fundamental innovation when compared with conventional transport modes established since the industrial revolution. However, hyperloop trains cannot be integrated into existing transport networks, in contrast to TGV trains. This reality presents a practical choice for countries with emerging transport networks, which can prepare for the future by implementing such new transport infrastructure after ensuring its economic feasibility, without the need to invest in traditional transport infrastructure.

B. From internal combustion engines to solar-powered electric engines

30. The twentieth century witnessed the dominance of the internal combustion engine in powering most road transport vehicles, such as cars, buses and trucks, because of its small size and the freedom of movement it provides. For a long time, electric car manufacturers were unable to compete with internal combustion engines, because of their inability to produce batteries that ensured the same independence provided by fuel tanks in conventional vehicles, in terms of distances travelled before the need to recharge batteries, in addition to complex and long charging processes.

31. Moreover, for a long time, electric vehicles were associated with golf carts and vehicles used in airports to transport passengers with reduced mobility.

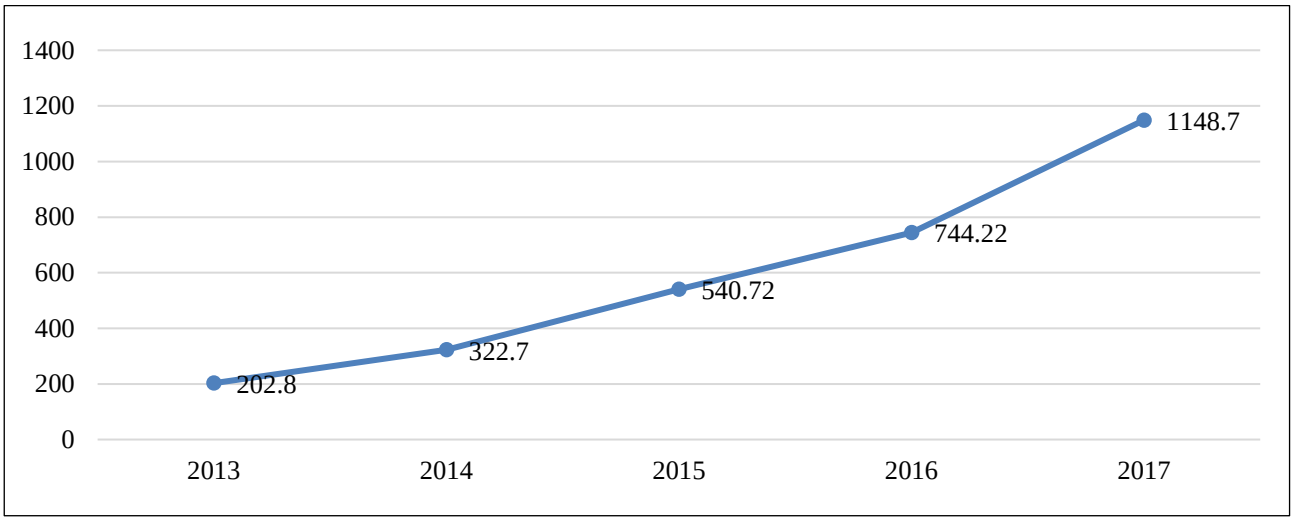
32. The 2010s witnessed prominent developments in electric engines, including increased speeds equivalent to those reached by internal combustion engines, advances in car batteries and charging methods, and reduced prices of electric cars and their parts. Tesla made critical advances in this area by producing a highly efficient electric car with a battery life of 220 miles (around 350 kilometres), at prices matching those of similar cars powered by traditional engines.[14]

33. Sales of electric cars are on the rise worldwide, with the number of new electric cars increasing five-fold between 2013 and 2017 (figure 3).

[13] https://hyperloop-one.com/.

[14] https://www.tesla.com/en_GB/model3.

Figure 3. Global sales of new electric cars, 2013-2017
(*Thousands*)



Source: International Energy Agency, *Global EV Outlook 2018: Towards A Cross-model Electrification*. Available at https://www.iea.org/gevo2018.

34. A key feature of electric cars compared with internal combustion engines is that the former are almost completely non-polluting and are mechanically less complicated given the absence of combustors or transmission equipment. They also break down less than traditional cars, whose engines cost half as much as their maintenance.[15]

35. With many promoting features, such as efficient batteries, independence of movement and lower costs and pollution levels, electric cars will undoubtedly become widespread in the near future; however, this might be impeded by restrictions on increased electricity consumption. It is vital to meet increased demand for electricity without causing more pollution from power stations that use fossil fuels. Proposed solutions include charging batteries at night when electricity demand is low and increasing the use of renewable energy sources in electricity generation, especially solar power.

36. The sun is the original source of energy for life on Earth. Other than nuclear power and thermal energy from within the Earth, all other types of energy used by human beings are derived directly or indirectly from solar energy. This applies to most energy used since the spread of internal combustion engines in the second half of the nineteenth century; in other words, the energy created by burning fossil fuels, such as coal, gas and petroleum derivatives. Such resources are created through geological pressure over millions of years on layers of plankton, which would not have existed in the first place without solar energy.

37. The direct use of solar energy to generate electricity to operate machinery used daily in industry and transport appears more efficient and logical than waiting several million years for the creation of more fossil fuels.

38. The transformation from fossil fuel-reliant internal combustion engines to sustainable electricity from solar energy is not the result of fears that fossil fuels are becoming depleted, but rather aims to achieve energy efficiency. Similarly, the transformation from the Stone Age to the Bronze Age was not caused by the depletion of stones, but because of the discovery of a more efficient material for making better tools that helped human beings advance, which they used for agriculture, hunting, protection, construction and maintenance in their daily lives.

[15] Rodrigue, Comtois and Slack, *The Geography of Transport Systems*.

39. To resolve problems caused by the inefficiency of solar power at night or during the winter because of clouds, a proposal was made to place solar panels on satellites orbiting the Earth at heights that are permanently exposed to sunlight, and thus not affected by nightfall or clouds. Solar power can therefore be generated on a permanent basis and transported anywhere on Earth through microwaves.[16]

40. Relinquishing oil will cause a large drop in revenue in many Arab countries, which can only be compensated through early investments in projects to generate electricity from solar energy, similar to projects announced by Egypt and Saudi Arabia. Egypt plans to produce 20 per cent of its electricity from renewable sources by 2022. In 2018, it opened a solar power station costing $2.8 billion to generate 1.8 gigawatts.[17] Saudi Arabia has announced giant investment projects totalling $200 billion to build a solar-powered power station generating 200 gigawatts by 2030.[18]

C. From smart transport systems to driverless cars

41. ICT developments at the end of the twentieth century resulted in the spread of smart transport systems, where vehicles communicate to provide continual updates on traffic congestion and bottlenecks, thus allowing drivers to make appropriate navigational decisions to achieve optimal traffic flow.

42. Advancements in digital technology have had a significant impact on road traffic. Several apparatuses were developed to assist drivers, including smart signalling, electronic variable-message signs and in-car devices, such as radar sensor technology, speed control and traction control, among other equipment for increased road safety in all conditions.

43. A key feature of the digital revolution is the spread of driverless cars that eliminate the needs for drivers. Many car manufacturers are currently working on producing driverless vehicles, which are being tested in several American and European cities. Such vehicles are expected to be ready for commercial distribution by 2020, with numerous positive and negative effects. Their positive impact includes providing individual transport services across a wider age group, especially among older persons; significantly reducing traffic congestion; increasing road safety; and freeing up large spaces reserved for parking cars, which will lead to significant improvements in infrastructure and larger recreation and pedestrian areas. Road safety is expected to dramatically increase following the widespread use of driverless cars; however, many obstacles will need to be overcome in the transition phase during which both driverless and traditional cars will be on the road.

44. The negative impact of driverless vehicles will begin in the transition stage, which will witness unprecedented challenges in road safety that will gradually be resolved. The main concern with driverless vehicles is that they will make the driving profession redundant, because both private and public vehicles will drive themselves. Special attention should be paid to the social impact of losing hundreds of thousands of jobs currently provided by the transport sector in many countries.

45. The spread of driverless vehicles is expected to drastically alter perspectives on transport, with people no longer needing to own cars to travel freely. The concept of private vehicle ownership for the masses coincided with the spike in car production after the Second World War, when private cars were promoted as the only efficient method of transport. Private cars became a widespread commodity, similar to fridges and washing machines. Today, they come in all shapes and sizes to meet the needs of those who can afford them: a classic car for city streets, a four-wheel drive for mountainous areas and sports cars, just to name a few.

---

[16] M. Kaku, *The Future of Humanity: Terraforming Mars, Interstellar Travel, Immortality, and Our Destiny Beyond Earth* (New York, Doubleday, 2018).

[17] Salma El Wardany, "Desert sun to power upper Egypt with USD 2.8 billion solar park", 14 March 2018. Available at https://energywatch.eu/EnergyNews/Cleantech/article10413550.ece.

[18] Ellen R. Wald, "Saudi Arabia to build massive solar power installation", *Forbes*, 29 Mars 2018. Available at https://www.forbes.com/sites/ellenrwald/2018/03/29/saudi-arabia-to-build-massive-solar-power-installation/#6478d8ce77a9.

46. Following the increase in driverless cars and their on-demand availability via mobile applications, car ownership will gradually deteriorate given the numerous associated financial burdens, including maintenance, insurance and parking costs. The average person uses his or her car for two or three hours per day, thus requiring a parking space for 21 or 22 hours per day.

47. The spread of driverless cars requires suitable infrastructure, including clearly delineated lanes that meet technical standards in terms of visibility and sustainability and improved roadside boards that meet international standards. The introduction of driverless cars will also require fundamental amendments to related international conventions, especially the 1968 Vienna Convention on Road Traffic which states that "every moving vehicle or combination of vehicles shall have a driver",[19] and to national legislation derived therefrom that still requires the presence of a human driver to control the vehicle at all times.

D. From private to shared transport

48. Among the large drivers of change in the field of transport, behavioural patterns play a major role in developing transport routes in line with changes in consumption. The Silk Road is the oldest example of this: silk production was well known in China, but the industry was protected for a long time. When other societies became familiar with silk yarns and woven fabric, several routes were established to transport silk from China to European countries. Controlling those routes became a major concern because of the revenue they created, resulting in conflict between neighbouring empires along those routes.

49. Another example of the impact of changing behavioural patterns on transport is the issue of spices that grew in the East Indies. The discovery of those spices by European societies in the middle ages led to significant developments in land and sea transport. The Arab region played a major role in controlling the spice trade. Competition for control of the spice trails led to the establishment of direct sea routes between Europe and the spice lands after the Portuguese sailor Vasco da Gama discovered the possibility of sailing around Africa via the Cape of Good Hope in 1498. In the sixteenth century, the Spanish were introduced to hot chocolate drink, extracted from the cacao tree, which was considered a ritualistic drink in its homeland of Mexico. The transfer of the drink to Belgium and France caused significant developments in solid chocolate and its widespread exchange globally. The same can also be said about coffee, extracted from coffee beans, which is one of the most traded goods across the world in terms of volume. In contrast, healthy consumption patterns and concurrent campaigns resulted in the gradual erosion of smoking habits worldwide, causing a drop in the trade of tobacco globally.

50. New goods are expected to emerge in the future of international trade, following the current strong exchange in laptops and other mobile devices. Changes are also expected in the mindsets of various social groups: for over a century, the idea of owning a car has dominated consumer patterns, allowing those who can afford them to travel freely; however, projections show a decreasing desire to own cars because of the widespread ability to rent cars online and through smartphone applications, enabling people to travel at any time to any place using an appropriate type of vehicle for their travel needs. It is also very likely that people in the future will begin opting for car-sharing options rather than owning a car, especially following the spread of driverless cars that will meet all travel needs without the stress of parking: after dropping off one passenger, a driverless car can move on to pick up another who is close by.

51. A 2016 study by the Organization for Economic Cooperation and Development indicates that shared use of small (six passengers) and medium (8-16 passengers) vehicles can meet travel needs in a medium-sized European city like Lisbon by using only 3 per cent of the number of existing vehicles. The study estimates that a single shared vehicle will travel ten times farther than current vehicles, but the overall sum of kilometres travelled daily will drop by 37 per cent, even during rush hour. It also projects that 95 per cent of areas currently

[19] https://www.unece.org/fileadmin/DAM/trans/conventn/crt1968e.pdf.

reserved for parking in cities will be freed up, and that the cost of city travel will be cut by half.[20] Similar results can be expected from ride-sharing in driverless cars, thus eliminating the need to buy such vehicles if enough driverless cars are provided to transport people in cities similarly to taxi services currently available via mobile applications, with the key difference that driverless cars will have no driver and will respond to passengers' travel needs through specific algorithms for individual or shared use, which are similar, in principle, to the services provided by lifts in buildings.

52. Rifkin (2000)[21] claims that future technology will eliminate the concept of ownership and will replace it with paid services. The author foresees the end of ownership of physical goods as a driver of production and growth, which will be substituted with intangible ideas and regulation to generate wealth and prosperity. He also posits that the changes accompanying this transformation will encourage enterprises and individuals to gradually get used to renting commodities, including cars and houses, instead of buying them.

E. Direct supply of and demand for transport without intermediaries

53. The digital revolution is playing a growing role in bringing people closer together and in facilitating access to various services through smartphones, such as restaurant, cinema, hotel and travel ticket bookings, which required the assistance of a third party in the past. The services revolution has made such transactions possible via mobile devices, including electronic payments.

54. Connections provided by Uber and other companies highlight the quality of such taxi services, which will eventually make traditional taxi services obsolete. Following its success in providing taxi services, Uber is now aiming to broaden its services to include road freight through instant connections between lorry drivers and freight customers, including electronic payment following clearance, without the need for tough negotiations and haggling with brokers and transport intermediaries.[22]

55. Given the decline in the use of travel agents to book flights and hotels following the prevalence of direct electronic booking services, it is only a matter of time before intermediaries become redundant in transport contracts, starting with road transport then rail, sea and air transport. Social implications will arise from the loss of many jobs in intermediary companies.

56. Airports are increasingly requesting travellers to check themselves in without the help of a human intermediary, including registering baggage and printing boarding passes. In some cases, electronic fingerprinting is used instead of showing traditional travel documents for stamping by airport staff. Electronic gates that operate using iris scanners and facial recognition are in operation in several Arab airports, such as Dubai, Muscat and Amman.

57. In a recent study on the future of truck manufacturing worldwide, Deloitte expects a steady increase in the operating efficiency of fleets in developed countries resulting from the widespread use of digital applications to effectively link supply and demand for land freight. The study projects that annual global demand for new trucks will drop to 0.6 per cent until late 2026, and to -0.9 per cent annually between 2016 and 2021 in developed countries in Northern Europe, North America and Asia, reaching an average of -1.4 per cent annually by 2026.[23]

---

[20] International Transport Forum, *Shared Mobility: Innovation for Liveable Cities* (Paris, Organisation for Economic Cooperation and Development, 2016), p. 8.

[21] Jeremy Rifkin, *The Age of Access: The New Culture of Hypercapitalism, where All of Life is a Paid-for Experience* (New York, Putnam Publishing Group, 2000).

[22] https://freight.uber.com.

[23] Deloitte, *Global Truck Study 2016: The Truck Industry in Transition* (London, 2017).

58. Authorities responsible for regulating the transport of goods in Arab countries will benefit from pre-empting these changes by standardizing transport operations in line with country specificities, according to the nature and volume of the transported material, distances and delivery deadlines, while taking into account safety and environmental aspects. Such normative activities would benefit from partnerships between cargo regulators and digital application development companies to ensure their success.

F. Open governance and social participation in performance evaluation

59. Modern technology has caused transformations in governance and performance evaluation in various transport fields, such as gradually increasing transport beneficiaries' participation in evaluation processes in an open and transparent manner. For example, mobile taxi applications, such as Uber and Careem, enable users to rate their services and provide the cumulative outcomes of customer evaluations through star ratings between one and five, thus benefiting drivers who maintain high ratings and informing users of their prospective driver's rating before they accept the ride. All beneficiaries of transport services provided by enterprises or individuals can participate in this evaluation process, thus gradually increasing competition to improve service quality and, in turn, improving services to meet user requirements, while replacing evaluation processes by third parties with customer direct reviews.

60. It is vital to apply solutions that enable user-review analyses of transport modes and services, and to make those analyses available to decision makers to improve decisions on the management and development of transport services and facilities, so as ensure that policy decisions benefit the greatest number of users and meet their needs.

IV. PREPARING FOR TECHNOLOGICAL AND DIGITAL TRANSFORMATIONS IN THE TRANSPORT SECTOR IN THE ARAB REGION

61. The technological and digital revolution affects all aspects of the transport sector, including transport modes and the type of fuel used, increased automation trends as exemplified by driverless cars that eliminate the need for the human element which has accompanied all transport modes since the invention of the wheel, and systems that enable direct communication between users and transport modes thus removing the need for intermediaries.

62. Such impacts promise fundamental, rapid transformations in many areas of the transport sector, including improvements in transport conditions for passengers and goods, and increased efficiency and safety of transport processes while reducing costs. Undoubtedly, reduced costs and increased efficiency will play a key role in driving those expected transformations.

63. Countries cannot benefit from the technological and digital revolution to improve transport and logistics systems if they do not prepare in advance for the resulting challenges by providing several fundamental components, as follows.

A. Infrastructure

64. The main requirement for countries to benefit from technological and digital improvements in the transport sector is the provision of suitable infrastructure, including direct infrastructure in ports and the digital and informatic infrastructure required to benefit from digital achievements.

65. Road networks require significant improvements in all areas, including road markings and signs, prior to applying smart transport systems and introducing driverless cars.

66. Hyperloop trains will remain a pipe dream if countries cannot implement the necessary complex infrastructre for their integration, including low-pressure tubes, magnetic levitation tracks, and various other electronic and digital equipment needed to safely operate this complex system at speeds exceeding 1,000 kilometres per hour.

67. The same applies to the necessary digital and informatic infrastructure, including high-speed Internet, supercomputing equipment to handle the massive amount of data exchanged on the system, and safety procedures and additional work required to guarantee the continual flow of data in case of malfunction.

68. The starting point is to ensure the presence of an electrical grid that can continuously meet demand without cuts.

B. TRAINED AND EXPERIENCED HUMAN RESOURCES

69. To plan, design, operate, maintain and monitor smart transport networks, it is necessary to prepare national cadres to meet the requirements of increasing digital applications in the various areas of transport. Such applications cannot be sustained and exploited without a qualified human element. This responsibility falls to private and government schools and universities, which should have the capacity to ascertain and meet future needs in a timely manner.

70. Such efforts are already being made in some educational institutions involved in the transport sector and its safety in the Arab region, inculding the Arab Academy for Science, Technology and Maritime Transport that plays a major role in supplying the public and private labour markets with transport and logistics specialists, and an initiative by Saint-Joseph University in Beirut to train high-level specialists in the field on road safety.

71. Arab transport ministries and the related institutions must recognize the potential capacity of academic institutions, and support them in implementing their initiatives. In the long term, collaboration with educational institutions will be necessary to establish new specializations in line with future technological and digital needs in the transport sector. Such collaboration should include enrolling a sufficient number of students anually to gain the necessary knowledge for handling new issues, and organizing continual vocational training sessions for employees to familiarize them with technological and digital achievements and their increasing applications, so as to improve the quality and efficiency of transport services.

C. SUITABLE REGULATORY FRAMEWORKS

72. Indubitably, technological and digital applications provide technical and economic solutions to transport problems, but also simultaneously pose new, unfamiliar challenges that could cause costly and long-lasting conflicts, such as those facing companies providing on-demand transport services like Uber and Careem, in addition to legal issues that require amending international conventions and related national legislation on vehicle operation.

73. There is an urgent need to establish suitable regulatory frameworks to benefit from the technological and digital revolution in the field of transport, stimulate the dissemination of related applications by providing appropriate customs and tax benefits, and ensure the protection of all stakeholders, including users and transporters, without undermining legislative and regulatory frameworks that guarantee the intellectual property rights of innovators.

74. Regulatory frameworks must also be adequately flexible, thus allowing for their development in line with rapid technological and digital transformations and for the integration of expected dynamic changes therein.

D. PARTICIPATORY APPROACH

75. The technological and digital revolution provides many tools that strengthen and broaden participatory approaches in evaluating transport services and in determining demand for such services more accurately in all functionalities and at all times, via a large set of applications which combine technologies that monitor vehicle and user movements using smart phones, positioning systems and the Internet through supercomputing.

76. Transport service beneficiaries are thus able to improve service quality and accuracy. Managers tasked with planning and managing transport services will be required to benefit from such tools and strengthen participatory approaches with service users and providers so as to increase the efficiency, accuracy and transparency of decision-making processes, in a way that ensures the sustainable development of transport services with the highest possible specifications.

77. Achieving that objective requires a fundamental change in management mentality towards accepting the participation in decision-making of all transport service users and providers, and trusting in stakeholders' shared desire to upgrade services and achieve optimal sustainability.

V. RECOMMENDATIONS

78. Technological and digital developments are causing significant changes in the transport sector, some of which may drive the sector away from familiar transport modes that have prevailed since the industrial revolution.

79. The ESCWA secretariat will raise awareness of the technological and digital revolution, inter alia by holding a meeting of experts specializing in the field who represent relevant innovative industries, professional organizations and decision makers.

80. Countries must be well prepared so as to benefit from technological and digital achievements, especially by undertaking the following:

- Investing in improving instratructure and transport facilities in the light of expected technological and digital applications and their requirements;

- Training specialists and workers in the transport sector, and familirizing them with digital and technological applications in the various areas of transport, and with expected future trends, challenges and solutions;

- Developing regulatory and legislative frameworks for transport and its services in accordance with emerging issues and with innovative governance frameworks that are supported by technolgical and digital applications in the transport sector;

- Applying a participatory approach with all transport service stakeholders, particularly direct users, especially given that new digital applications allow for reviews and evaluations of transport services and for participation in decision-making processes.
