MORE
Multimodal Optimisation of Roadspace in Europe

D3.2

Future Road Users' Needs

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Abbreviations

App.	Application downloadable by users
AV	Autonomous vehicles
EC	European Commission
EU	European Union
GDP	Gross Domestic Product
HGV	Heavy goods vehicle
ICT	Information and communications technology
ITS	Intelligent transportation system
TEN-T	Trans-European Transport Network
UN	United Nations
US	United States of America

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1 Executive summary

The MORE project addresses the issues facing major congested road corridors in European cities. These corridors are viewed as 'road ecosystems' – they may be multi-modal corridors with parallel road and rail-based modes, corridors that start at the urban fringes, perhaps linking to the TEN-T network, and corridors that finish close to the urban centre where motorised modes compete with cycling and walking for limited space. They are corridors for travellers passing through but importantly are places where communities live, work and rest, and where businesses operate. The road ecosystem is not a one-dimensional system. It is important to include sub-surface facilities – metro systems, car parks, utility cables and so on, and also the potential use of the airspace above the corridor for drone developments.

MORE is assessing road corridor ecosystems in Budapest, Constanta, Lisbon, London, and Malmo. The aim is to redesign the layout and function of corridor space to better reflect the needs of travellers, residents and businesses – and the policy goals of sustainable mobility, sustainable development and low carbon. The tools developed from MORE will enable other cities in Europe and beyond to assess and plan their road ecosystems, achieving a better balance between transport efficiency and the design of quality spaces for local communities.

It is important that the design and functions of today's road ecosystems are planned to anticipate the needs of tomorrow. How will the characteristics of road ecosystem users change by 2030, or by 2050? How will their lifestyles differ from today's road users? And how will this relate to the demand and supply for transport, and the functions of urban space?

This report therefore takes a wider view of the factors that will shape the needs of road users in the decades to come. It provides an assessment of the trends and factors that will be influential in changing the current landscape on road corridors.

The research involved three strands:

- Desk research;
- Interviews with multi-disciplinary experts on social and lifestyle trends;
- Group discussion with the key stakeholders.

Key findings

Age

Europe is the continent with the most acute population ageing issue. A key message here is that the designs of the future road eco-system have to be part of a wider solution to retain independence for people in older age – many of whom will still be working at some level. While the Internet will play an important role in accommodating this trend, sensitive urban design and accessible transport services will be central.

Core values

Across the generations, four key transitions will be observed in the values people have to life in general but also for their mobility:

- Competitive to collaborative;
- Environmental protection to sustainable mobility to carbon reduction;
- Ownership to sharing to individually customised;
- Digital illiteracy to digital competency to digital normality.

The values that road ecosystem users will have in future decades toward their mobility will be the values that are currently held by the younger 'digital' generations – values that they will retain as they move into middle age and approach the official retirement age:

- Prioritising anything that is low carbon in all areas of lifestyle, including transport;
- Emphasising sustainable mobility;
- The need to create safer more liveable spaces for all;
- The ability to control, tailor and customise affordable multi-modal mobility offers to suit more diverse lifestyle models;
- A preference for sharing mobility over individual ownership.

These will be the five core value sets that will determine the acceptance or rejection of new transport/IT technology developments in the road ecosystem in the years to come.

Lifestyles

Translating values into lifestyles, we can identify 6 lifestyle characteristics within which future mobility patterns will be planned:

- People living 'Somewhere and Anywhere' – *'Anywhere people' are younger, cosmopolitan, craving flexibility, mobile, global and creative – 'Somewhere people' are older, disruption and change are pressure, they crave habit.*
- People 'Trading places' – *families choosing to move inside 'yoghourt cities' with an active culture, and younger people seeking peri-urban locations for green spaces – traditional stereotypes no longer hold.*
- People building 'Progressive Provinces' – *settlements consisting of a social mix – urban 'anywhere' people and indigenous 'somewhere people'.*
- People 'Uncoupled' – *The increase in diverse social relationships and partnerships, multiple parents for children. and a blurring of traditional gender roles.*
- People with 'phygital lifestyles' - *a pattern of behaviour that blends physical with digital activities. All trips have a virtual alternative. The Phygital society of the future will provide for greater diversity of living and working options.*
- People 'changing social norms' - *A blurring of traditional gender roles changing lifestyles between the generations. Men and women in younger, digital, generations have closer gender role values than those in old age.*

In combination, these 6 lifestyle trends point to an increasing social flexibility and the blurring of traditional lines of social values and behaviour. Future mobility in the road ecosystem will have to fit into this emerging social model in Europe.

Phygital Mobility

The “phygital” (i.e. physical and digital) dimension of mobility will have a major role in shaping future mobility patterns as a result of (i) the fast pace of the technology advance and (ii) the ease with which future generations will incorporate digitally-related technology into their lives. The phygital mobility will influence travel patterns and especially those trips that have a major importance: trips for work, shopping, health care and leisure. In addition, phygital lifestyles will have a major influence on social relationships and social interaction across all generations that urban space and street designs will have to adjust to.

Goods mobility

In the decades to come, the needs of goods transport operators in the road ecosystem will be strongly influenced by 4 primary factors:

- Increasing urbanisation and changing lifestyle demands.
- Increasing demand for frequent and just-in-time deliveries in urban areas.
- Increasing competition for limited infrastructure in the road ecosystem.
- Increasing complexity of the problems both faced and caused by urban goods transport.

At the road corridor level, the 7 key elements for meeting the needs of road users are:

- Consolidation of deliveries in networks of transhipment centres;
- Smaller, cleaner vehicles - Create the opportunities for the investment in shorter range, but cleaner, low noise, energy and emission efficient vehicles – last mile deliveries;
- Innovative infrastructure – i.e. used on a 24-hour basis to improve capacity;
- Quality logistic facilities – such as real time parking reservation for loading/unloading, off-road parking, charging points;
- Physical measures and segregated spaces to reduce road safety risk from goods vehicles, sensitive location of parking bays;
- Reverse logistics for packaging and waste;
- Digital communication to ensure first time delivery and real time capacity to adapt.

Business models

Start-up companies in the mobility sector are one of the most vibrant sectors of the European economy in the last 10 years, in response to the growth of the sharing economy building on App. technology. A diversity of new business enterprises from small local mobility initiatives to global companies have sprung-up. It is likely that, in future decades, major business opportunities in the transport sector will grow as road ecosystems respond to changing user needs. A return to the old practices of fully regulated and planned transport ‘systems for all’ is unlikely – flexible, diverse and customised mobility solutions will be more commonplace, using the strengths that Internet-based technology provides. Beyond 2030 it is likely that business models for transport services will consist of business models that integrate across sectors and maximise public/private collaboration.

Future road corridor needs

The report identifies 12 conditions for future road ecosystems:

- More attractive public spaces;
- Seamless mobility integration;
- Regulations for new transport modes;
- Safe streets for all;
- Cyber security for mobility;
- Personalised mobility solutions - also including the needs of marginalised social groups;
- Adapted parking policy to future mobility;
- Alternative fuels provision;
- Increased capacity for public administrations;
- Embracing new operating/business models and new modes of governance;
- Environmental quality;
- Vision and validate as the new planning practice.

This report has taken a broad look at the factors that identify the road ecosystem users and their likely needs in forthcoming decades. It provides one arm of intelligence from which the MORE project will produce a number of road ecosystem scenarios in Deliverable 3.3.

2 Introduction

This report tries to offer a brief overview of how the change in major factors – socio-demographics, economic, lifestyles, business models – may influence the way the city roads develop. The scope of the MORE project is to conceptualize the road as multi-functional, multi-users and multi-level space that could be defined as an ecosystem (Jones P. & all, 2019). In this context the analysis of future users' needs offers an early understanding of different conditions or factors that cities should take into account when re-designing urban corridors. The work done in the H2020 CREATE project to understand development of sustainable policies and the knowledge about mobility behaviour collected and generated in the H2020 MIND-sets project are the major pillars for the work done in this research.

2.1 MORE

The primary aim of MORE is to provide a comprehensive and objective approach to the planning, design, management and operation of road-space on major urban corridors feeding the inter-national TEN-T road networks, where expanding or building new urban roads is not an option. So that the limited road-space and capacity can be optimised, through the development of new concepts, tools and processes (which it is developed and tested in five cities). This takes into account the multi-modal functioning of the corridors and their links with major inter-modal interchanges (e.g. ports), as well as other policy requirements; thereby enabling city authorities to optimally allocate the limited available capacity, in space and time.

The MORE ambition is to understand the current situation of the corridors in the partner cities, but also to understand how future trends may influence the way the roads are used. In this sense an entire line of research has been developed: from understanding the technologies that are influencing the roads – infrastructure, vehicles, operations etc. to future users' needs and future scenarios for city administrations that will allow them to better understand how to be proactive in embracing the changes.

2.2 Understanding future users' needs

Besides the current user needs assessment carried out by IRU at the outset of the project, an analysis of the future road user needs has been carried out.

The research on future users' needs intended to understand the changing demographics and future patterns of demand, that are likely to have a high impact on requirements for physical and digital transport infrastructure on main corridors in urban areas. All potential changes in demographics and lifestyles, in social and business practices and covering both passenger and freight transport requirements. The research has been based, in particular, on authors' experience and research developed in the Horizon 2020 MINDSETS project, which identified different motivational and lifestyle mobility groups.

Thinking about the future is fundamentally important to dealing with the challenges of today. In order to confront these problems successfully, we have to think carefully about the implications and results of the steps we might take, not just in the immediate moment, but also as conditions continue to evolve.

This means of putting both the problems we face today and the solutions we might try for an efficient road system in a larger context. It does so in three key ways:

1. It expands our understanding of the **scope** of the situation. How do these various problems connect to each other? Are there underlying similarities? How the outcomes that we fear would arise from a particular problem?

2. It expands our understanding of the **horizon** of the situation. Not just how does this affect us now, but how would this affect us over time. In parallel, it allows us to think through what happens with different kinds of solutions we may want to use to deal with a problem. What's the potential for undesirable consequences?

3. It expands our understanding of the **kind of system** we want. By bringing into focus the potential impacts and implications, the analysis of future trends allows us to understand the path we need to take to achieve a better world. It clarifies also the responsibility and capacity needed to create the desired system.

The goal of this research was to examine *tomorrow* for giving us a better understanding of how to prepare for it *today*.

2.3 Methodology

The analysis developed in this report is based on an extensive research done using different sources of information, qualitative methods such as interactive group interviews and workshops. The research has been designed in such way to achieve the following goals:

- to understand what are the trends of the main macro-economic factors that could influence the decisions taken at local levels;
- to understand the impact of emerging technologies on lifestyle and how this will influence the users' travel patterns.

The research was not done in isolation; it was done in correlation with activities developed in other areas of the project. The following figure illustrates the connection between different areas of research in the project and the responsibilities of the partners. The main beneficiaries of this research will be those supporting the development of future scenarios for cities and supporting with key knowledge the development of future plans to re-design roads in the partner cities. Dynniq is responsible in understanding what are the developments in technologies that could influence the road design, usage, maintenance etc. EIP is responsible in understanding what are the major future road users' needs. UCL is helping cities to develop future scenarios with the results of the research done by Dynniq and EIP.

Figure 1 The integration of different areas of research and the respective responsible partners

Source: Prepared by the Author

The research done for understanding the users' needs has involved mainly qualitative methods from desk research to structured interviews and interactive workshops. The activity started with the desk research when more than 160 sources of information have been analysed and reviewed. Once the major working hypotheses had been structured, a workshop with experts in different domains was organised. There were group discussions with cities representatives and local stakeholders and technicians – organised in collaboration with Sciences Po and UCL (Constanta and Lisbon). Jointly organised workshop with IRU for validating the results of the research with the major stakeholders and major users' gatekeepers' organisations.

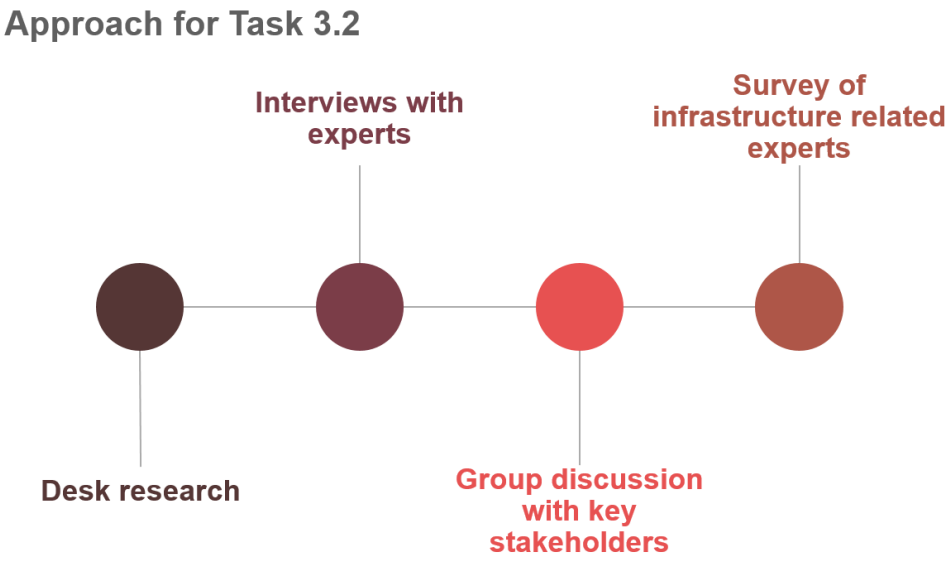

Figure 2 Future Users Needs analysis – the approach

Source: Prepared by the Author

EIP and Vectos have shared the work for the research of user's needs. The following table shows the involvement of the partners and their respective areas of research. Both partners have used different forms of analysis from desk research to workshop organisation.

Table 1 Future Users Needs analysis – involvement of partners

Partners involved in the future road users' needs	Area of research	Type of research
EIP	Socio-demographic trends, dynamic of the economics, technology, operating and business models	Desk research, interviews, workshops, analysis of the data collected
Vectos	Lifestyle and freight	Desk research, workshop organisation
Sciences Po	Governance, organisation models	Discussions with city representatives, local stakeholders

The need to continue of the work through specific interactive workshops with the major stakeholders and other cities throughout the project will be done with the support of Polis. The topics of these discussions and the questionnaire have been already developed and they are ready to use.

This research can be revisited towards the end of the project and updated with the latest trends for the identified drivers for future demand for road space.

PART A - People

3 Who are the future road users?

Socio-demographic trends

It is difficult to predict the future road user behaviour. Future traffic trends, technological advancements have also to be analysed especially in the context of socio-economic developments. However, by knowing certain challenges one may have an early indication of

education and enhanced with alternative sets of assumptions on future fertility, mortality, migration, education, and urbanization trajectories.

- For population projections in the EU, the "Demographic and human capital scenarios for the 21st century" uses an approach similar to the Wittgenstein Center for Demography and Global Human Capital. The scenarios developed for the EU are based on multidimensional population projections by age, sex and level of educational attainment for 201 countries of the world together with labour force participation for all the EU Member States. The chapter will present data for the medium scenario, CEPAM Medium (SSP2).
- "Demographic scenarios for the EU" (2019), developed several scenarios: (i) Central scenario, (ii) Zero International Migration (ZIM), (iii) High immigrations scenario, and (iv) 3 scenarios that combine the ZIM with increased fertility. Figure 4 presents population projections until 2060, for all six scenarios. The current report uses data from the Central scenario.

There is an agreement about the fact that world population will continue to grow during the second half of the 21st century. However, there are major differences between projections for future population.

Based on the medium-variant projection of the 2017 UN projections, the world population is expected to reach 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100. This projection was determined based on future levels of fertility, mortality and migration.

Based on the medium scenario developed by Wittgenstein Center for Demography[3] and Global Human Capital, world population is predicted to peak during the second half of the century, reaching 9.4 billion in the 2060-2080 period. The population will then slightly decline by 2100, reaching about 9 billion. This projection is developed based on fertility, mortality, migration, and education, being a more complex analysis than the UN's.

Although certain growth oriented scenarios estimate the world population almost doubling by 2100, reaching about 13.2 billion, this is seen as extremely unlikely.

The Figure 3 shows the historical trend and projections according to the medium scenario (SSP2) for the world population by six levels of educational attainment (see colour coding). The additional lines superimposed on this graph show the projections of total population size according the stalled development scenario (SSP3), the rapid development scenario (SSP1), and the medium variant of the UN 2012 projection.

3

World Population and Human Capital in the 21st Century, Wittgenstein Centre for Demography and Global Human Capital

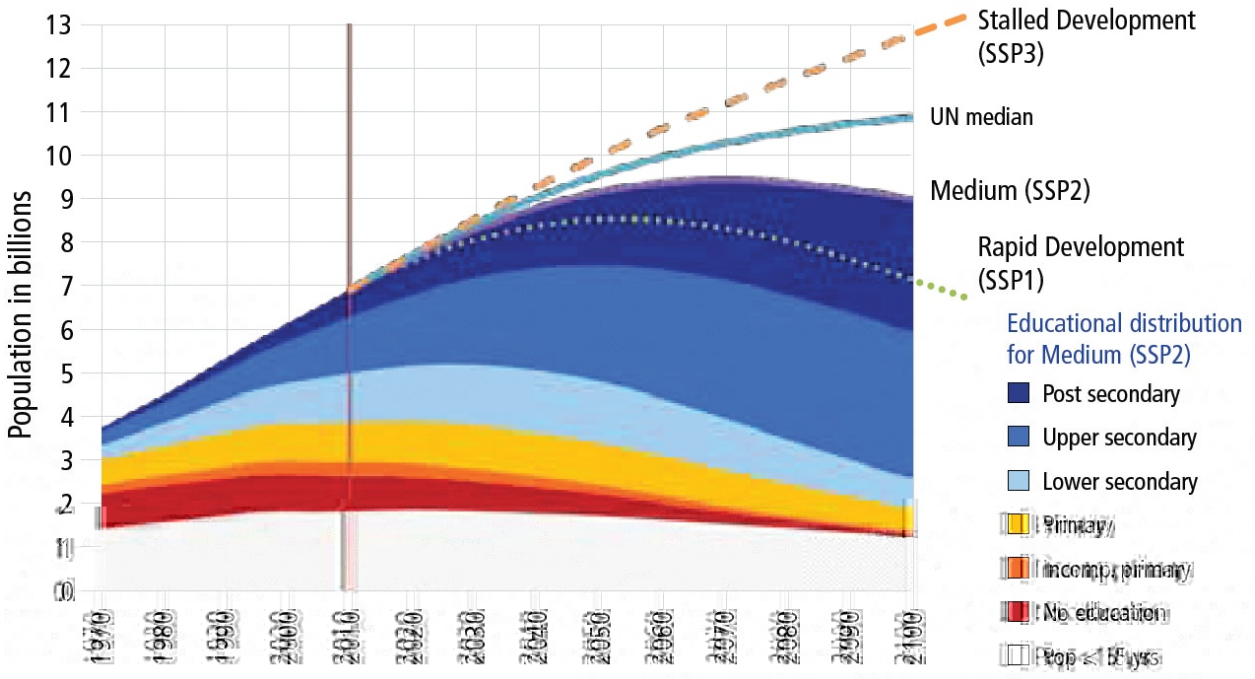

Figure 3 Historical trend and projections for the world population by six levels of educational attainment

Source: World Population and Human Capital in the 21st Century, Wittgenstein Centre for Demography and Global Human Capital

Based on the medium-variant projection of the 2017 Revision of UN projections, population in Europe is expected to ***decline-increase-decline*** from 742 million in 2017, to 739 million in 2030, 780 million in 2050, reaching 712 million in 2100.

For the EU 28, population trends are different than for the whole continent. There are also differences between projections in terms of expected population per time period, but the general trend shows an increase in population for the following decades followed by decline in population until 2100. The major trends are:

- Population to reach 524.6 million by 2060, with an increase until 2045 (i.e. maximum of 539 million) and then decrease – based on the Eurostat baseline scenario, 2015 [4]
- Population to reach 507.7 million people by 2060 with an increase until 2035 (i.e. maximum of 511.6 million) mainly resulting from immigration and increased life expectancy and then decrease - based on the CEPAM Medium (SSP2) scenario[5].
- Population expected to peak at 510 million in 2030 and then decline to 465 million by the end of the century[6]

4

- Eurostat's main scenario, from 2013, projects that the population will grow until 2050[7].

The most recent EU population projections (2019) predict that the EU's population will grow from 508.5 million in 2015 to around 521 million by 2060 (i.e. an increase of 2.5%). This was estimated for the central scenario (assumes a small increase in fertility and approximate 2.000.000 external immigrants/year). Without international migration, the EU population is expected to reduce to 466 million people by 2060 (i.e. an decrease of 9%)[8].

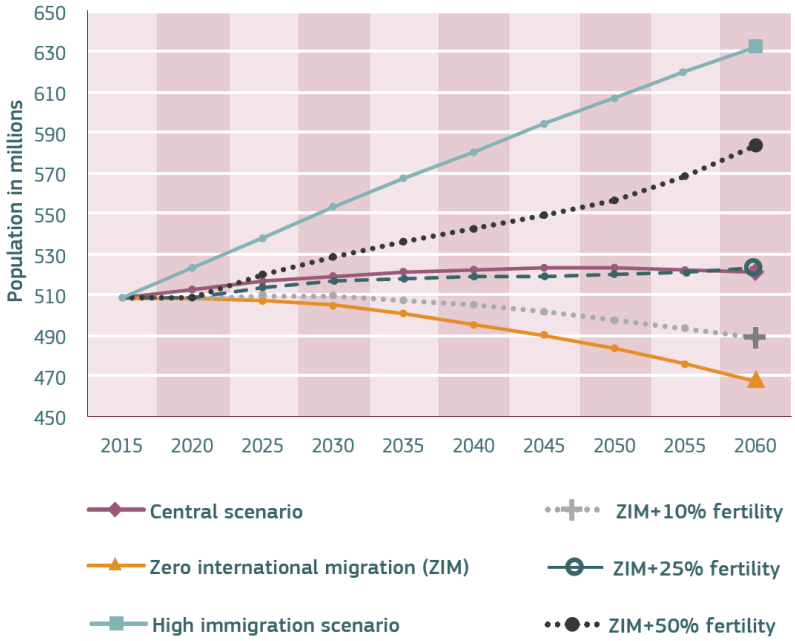

Figure 4 Population size of EU-28 in 2015-2060, by scenario

Source: Demographic scenarios for the EU, 2019

3.2 Ageing Population

Population ageing is a major demographic challenge for humanity. The world population is getting significantly older. In 2017, there were 962 million people aged 60 or above and 137 million aged 80 or above.

Based on UN projections[9]:

7 The impact of demographic change on European regions

8 Demographic scenarios for the EU, 2019;

9 United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, World Population 2017 Wallchart.

- Globally the number of persons aged 60 or above is foreseen to double by 2050 (i.e. 2.1 billion) and triple by 2100 (i.e. 3.1 billion)
- Globally the number of persons aged 80 or above is foreseen to triple by 2050 (i.e. 425 million) and increase 7 times by 2100 (i.e. 909 million)
- Europe currently has the largest proportion of population aged 60 or over (i.e. 25% in 2017) and this is expected to increase even further (i.e. 35% by 2050 and 36% by 2100).
- Africa, currently having the youngest age distribution, is expected to be the least influenced by ageing as the population aged 60 and over is expected to grow from 5% in 2017 to about 9% in 2050.

These trends for ageing population will determine a higher old-age dependency ratio in 2050, with the highest values expected for Europe (i.e. 48 dependent older persons per 100 persons of working age) [10] and the lowest values expected for Africa (i.e. 10 dependent older persons per 100 persons of working age)[11].

Ageing is considered the "**core long-term structural development change**"[12] for EU-28, being a result of declining fertility rates together with the 'baby boom generations' reaching the age of retirement.

The EU has the age expectancy of about 81 years, which is nine years higher than the global average.

The most recent EU population projections[13] (2019) predict that the EU population aged 65+ will continue to grow, from 19% in 2015 to 28% in 2040 and 32% in 2060 (central scenario). Similar increases are projected in the zero international migration scenario, which predicts the 65+ age group will represent 34% of the EU population in 2060. [14]

When studying the ageing population the focus was always the age aspect; although this focus is understandable it is not always correct[15]. Ageing is not exclusively about the size of the elderly population but how the population is distributed by age. Therefore, to better understand ageing, the focus should be on the evolution of the age structure of the entire population, not just the elderly part.

10 International Migration Report 2015

11 International Migration Report 2015

12 European Union, Committee of Regions, 2016, The impact of demographic change on European regions

13 Demographic scenarios for the EU, 2019

14 Demographic scenarios for the EU, 2019

15 Regional population structures at a glance, published in the The Lancet journal, Vol 392 July 21, 2018

The diverse picture of the colour coded age structure of European regions (Figure 5) indicates the varying stages of population ageing across Europe. The authors of the study chose this way to represent how the population is ageing across Europe. It is evident that the process of population ageing is not occurring equally in all areas of Europe and regions differ substantially:

- Eastern Europe still has a demographic advantage from a high proportion of younger population;
- Southern European regions are forming a cluster of lowest-low fertility, while the baby boomers are ageing in Western Europe;
- Urban regions are attracting young professionals and forcing out young parents, and peripheral rural regions are losing their young population.

In the Figure 5, we can clearly see large-scale and small-scale regional differences in population structures. At the macro level, between Eastern, Western, and Southern Europe the differences are evident.

The map in the Figure 5 also reveals the signs of recent changes in population structures. For example, Spain received a large influx of international migrants in the 2000s, Eastern Germany experienced a draining effect of out-migration coupled with a decrease in fertility in the past few decades, and Poland has had a massive labour out-migration because of European Union integration and more labour migrants moved from major Polish cities.

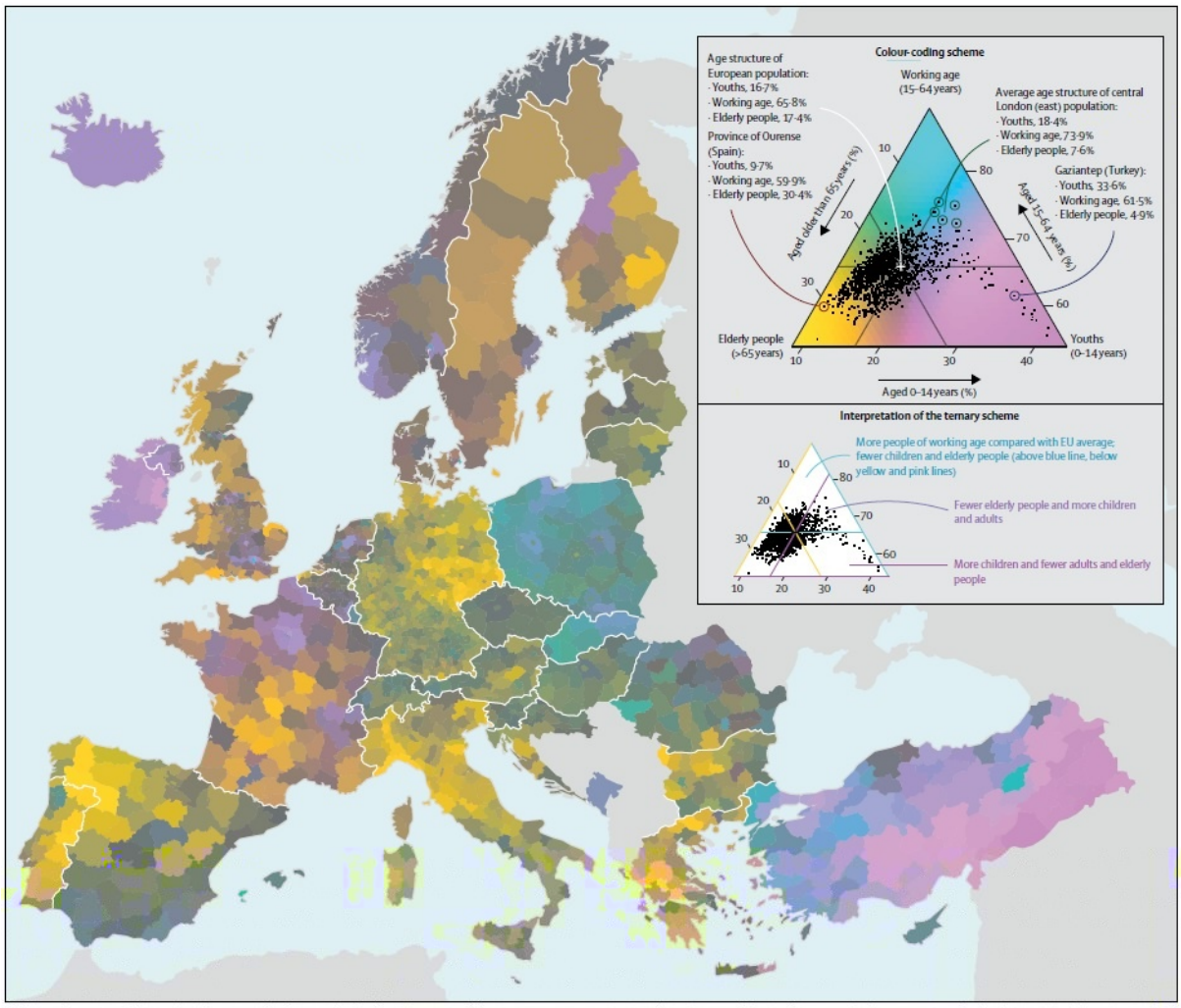

Figure: **Colour-coded map of population structures in European Nomenclature of Territorial Units for Statistics 3 regions in 2015**
Each population composition in the European Nomenclature of Territorial Units for Statistics 3 regions is uniquely colour coded. Colours show direction and magnitude of deviations from the centrepoint, which represents the average age of the European population, and is dark grey. The hue component of a colour encodes the direction of deviation: yellow indicates an elderly population (>65 years), cyan indicates people of working age (15–64 years), and magenta indicates children (0–14 years). Chroma and lightness components signify the distance from the centre ranging from desaturated and dark colours near the centre to vivid and bright colours at the corners. We provide R code to fully reproduce this map.[10]

Figure 5 Colour-coded map of population structures in European Nomenclature of Territorial Units for Statistics 3 regions in 2015

Source: The Lancet journal, Vol 392 July 21, 2018

In EU28, the total cost of ageing (public spending on pensions, health care, long-term care, education and unemployment benefits) is expected to increase to 26.7% of GDP in the 2016 – 2070 period (i.e. increase with 1.7% points). [16]

The old-age dependency ratio has been increasing in the 2006-2014 period from 23.6% to 28.1%. The old-age dependency ratio in EU28 is expected to reach **39% by 2030** and expected to stabilize around **50% after 2050**.

16

According to the International Migration Report from 2015, immigration was seen to have little impact on the ratio of non-working to working persons, even if it affects the population size.

It is very important to understand the ageing population projection as decision-making guidance, and not as predictions of future development. The ageing population can provide an indication of future developments to be expected if current patterns and trends are allowed to continue and simulate results of possible changes.

The road users in the future will be increasingly older. They may be healthier older, however, the WHO statistics mention that the major causes for death will be loneliness, depression, anxiety, agoraphobia and obesity (sedentary life)[17]. These are seen as the 5 core health problems. They in turn produce heart disease, increase the risk of cancer, strokes etc. and they are the key mental health problems.

A higher proportion of elderly people although relatively healthy or ensured a healthier life will have many frailties, which will request attention especially in choosing the way to travel. It will be an increase of the disabled people or people with particular needs that will put pressure of urban and transport planners of how they design the urban spaces and cater for the transportation in the future.

There will be elderly people that will try to preserve a high level of health and try to be as active as possible, preserving their mobility. They could use new forms of mobility if their health will allow. Of course, the main question to ask: will millennials bike-share when they will be in their old age?

3.3 Migration

Based on the International Migration Report from 2015, **Europe has the largest population of international migrants in the world (76 million),** followed by Asia (75 million) and Northern America (54 million). In **Europe** and Northern America international migrants are more than **10% of the population.**

Large movement of migrants from low and middle-income countries to higher income countries is expected to continue.

The UN projects the **top net receivers of international migrants**, for the 2015-2050 period, to be the United States of America, **Germany**, Canada, the United Kingdom, Australia and the Russian Federation, with more than 100,000 migrants annually.

The UN projects the top net senders of international migrants, for the 2015-2050 period, to be India, Bangladesh, China, Pakistan, and Indonesia, with more than 100,000 migrants annually.

17

H2020 MIND-sets project, Deliverable D2.1A: MIND-SETS: A new vision on European mobility, 2015

Figure 6 The global flow of people; Based on 2005-2010 data

Source: http://download.gsb.bund.de/BIB/global_flow/

Based on the International Migration Report from 2015, Europe has the largest population of international migrants in the world (76 million). The top net receivers of international migrants in Europe are: Germany and the Russian Federation, with more than 100,000 migrants annually.

For Europe, it is considered that **current trends in migration will reduce the population decline, without being able to fully compensate the low fertility levels**. Positive net migration prevented population decline in the 2000-2015 period[18]. This is supported by UN projections, which estimates that for the 2015-2050 period the excess of deaths over births in Europe will be around **57** million, while the net inflow of international migrants is expected to be around **32 million between 2015 and 2050.**

18

International Migration Report 2015

The most recent EU population projections (2019) consider two millions international migrants (from third countries)/year as a realistic value while projecting EU population evolution[19].

Internal EU migration (from eastern to western member states) is predicted to emphasize the population and workforce decline in Eastern Europe, while supporting the population growth for Western and Southern states:

- Projected increase in population for western member states, as in 2015 these states accounted for 54% of EU population and will account for 59-61% of EU population by 2060.
- Projected decline for population in eastern member states, as in 2015 these states accounted for 20% of the EU population and will account for 15-18% of EU population by 2060 (decrease from 103 million to 82-93 million).
- “The Baltic States and Bulgaria lost between 26% and 16% of their population, intra-EU mobility being one of the drivers of this decline”;
- “The population of Romania would shrink from 19.9 million in 2015 to 13.8 million in 2060 in the central scenario (losing 30% of its population)”. With no EU migration, the reduction of population is projected to be only 15% in the same period.

19 Demographic scenarios for the EU, 2019

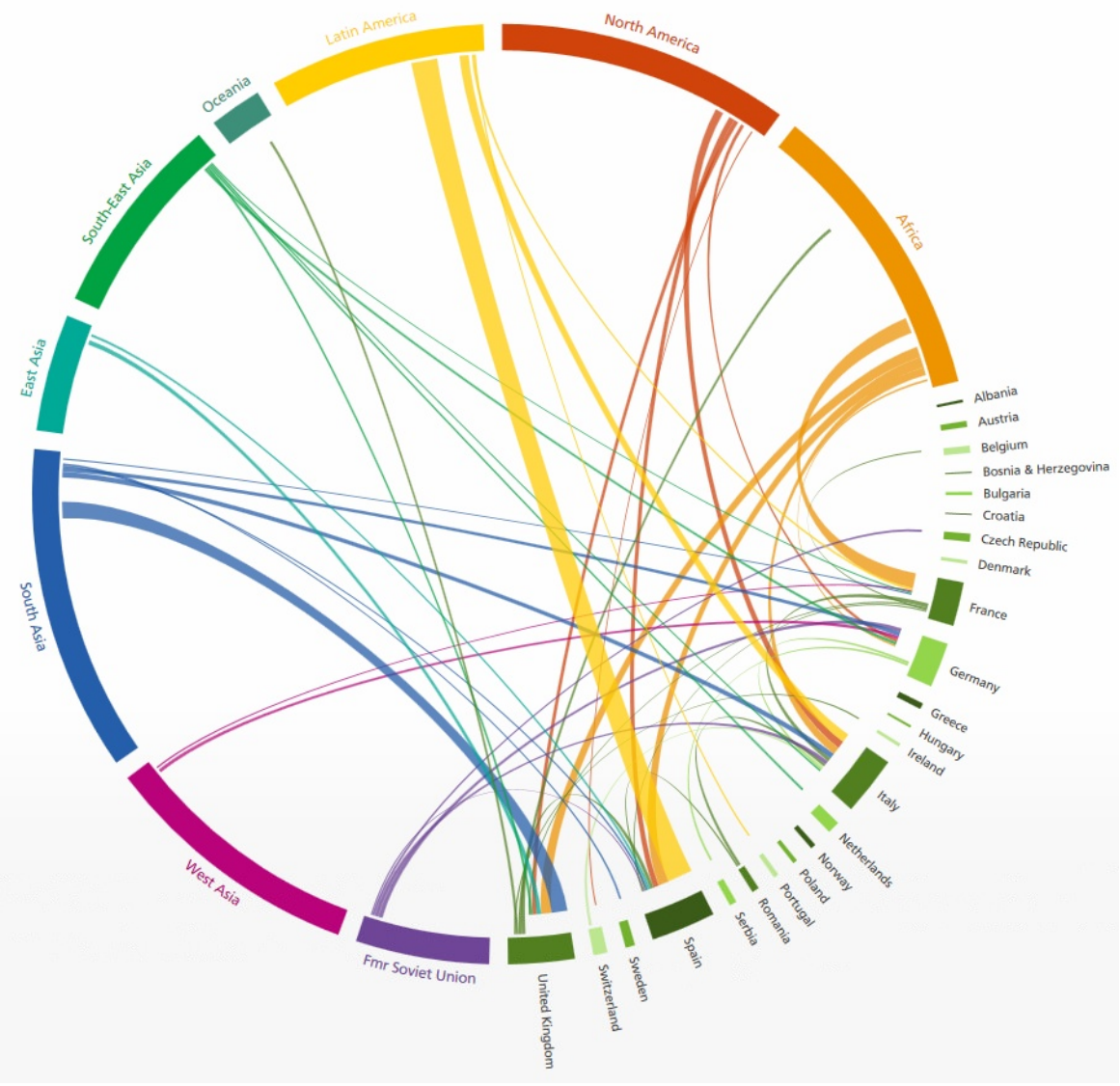

Figure 7 The global flow of people – detailed selection for Europe; Based on 2005-2010 data

Source: http://download.gsb.bund.de/BIB/global_flow/

3.4 Work force – what are the projected trends?

The most recent EU population projections (2019)[20] predict that the EU working age population would decrease from 306 million in 2015 to 256 million people in 2060 (i.e. a decrease of 16%, according to central scenario). Taking into account the ageing population trend, it is projected that the ***working age population will be smaller than the non-working age population in 2060***. The total age-dependency ratio at EU level will grow from 76 in 2015 to 99 in 2040 and reach 114 in 2060[21].

20

Demographic scenarios for the EU, 2019

21

The zero international migration scenario predicts a high decrease in working age population, by approx. 30%, reaching 222 million people in 2060. However, this would not generate high differences on the long term. It is projected that there will be small changes for the working age population compared to non-working age population in 2060 as the total age-dependency ratio[22] at EU level would grow from 76 in 2015 to 103 in 2040 and reach 118 in 2060[23].

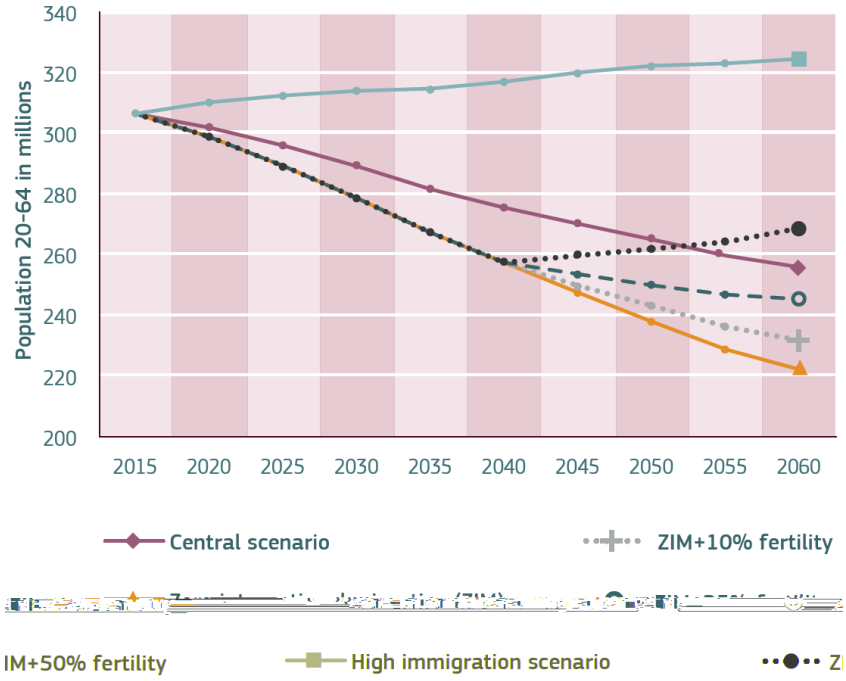

Figure 8 Working-age population (20-64) of EU-28 in 2015-2060, by scenario

Source: Demographic scenarios for the EU, 2019

In the context of increased life expectancy and ageing population, the EU28 labour force is transforming. It is expected that the future workforce will be smaller than today, but more educated. This might not prove an economic challenge if future jobs are fewer and requiring a higher skill level. [24]

It is expected that the total size of the EU 28 labour force will decrease with 13%, from 245.8 million in 2015 to 214.1 million in 2060 (under the constant participation scenario – average scenario). [25]

[22] For 100 working aged people there will be 114 non-working age people, predominantly 65+

[23] A ratio between the economically inactive (age 0-19 and 65+) and working age population (age 20-64)

[24] Demographic scenarios for the EU, 2019

[25] Demographic scenarios for the EU, 2019

- Other projections, estimate a 3.5% increase in working age population in EU-28 until 2030. This however leads to only a minor increase (i.e. 0.6%) in the labour work force until 2030.[26]

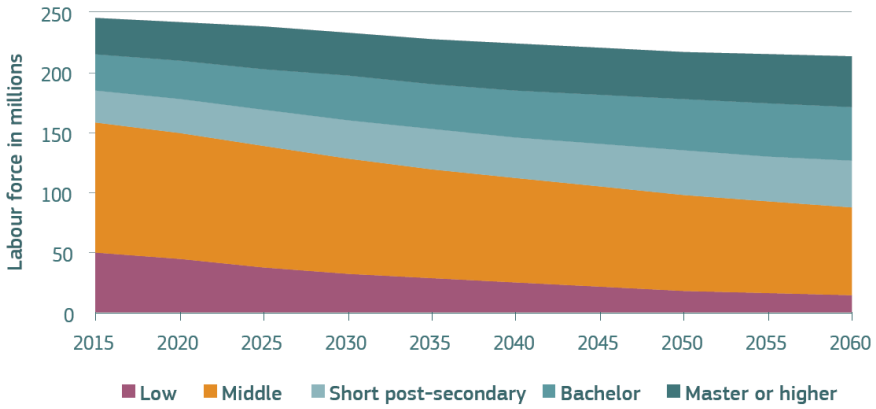

Figure 9 EU labour force by education level, the constant participation scenario, 2015-2060

Source: Demographic scenarios for the EU, 2019

This decrease in the size of the labour work force is not expected to generate changes in Western Europe, where values will remain stable, but will affect Eastern and Southern EU Member States. [27]

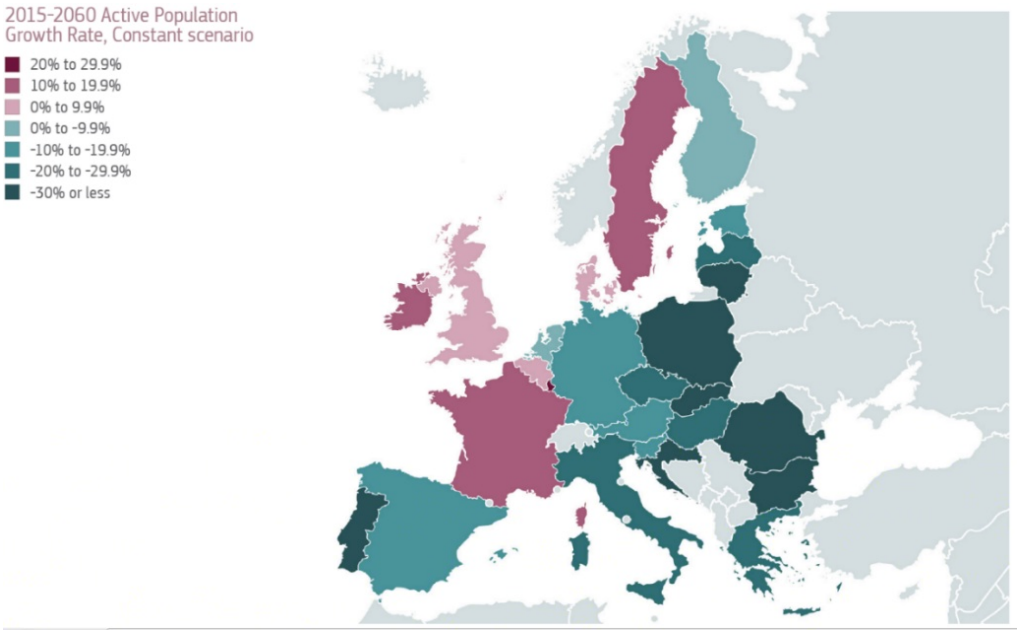

Figure 10 Changes in the size of the labour force 2015-2060 under the constant participation scenario

Source: Demographic scenarios for the EU, 2019

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Skills Forecast: key EU trends to 2030, 2018

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Demographic scenarios for the EU, 2019

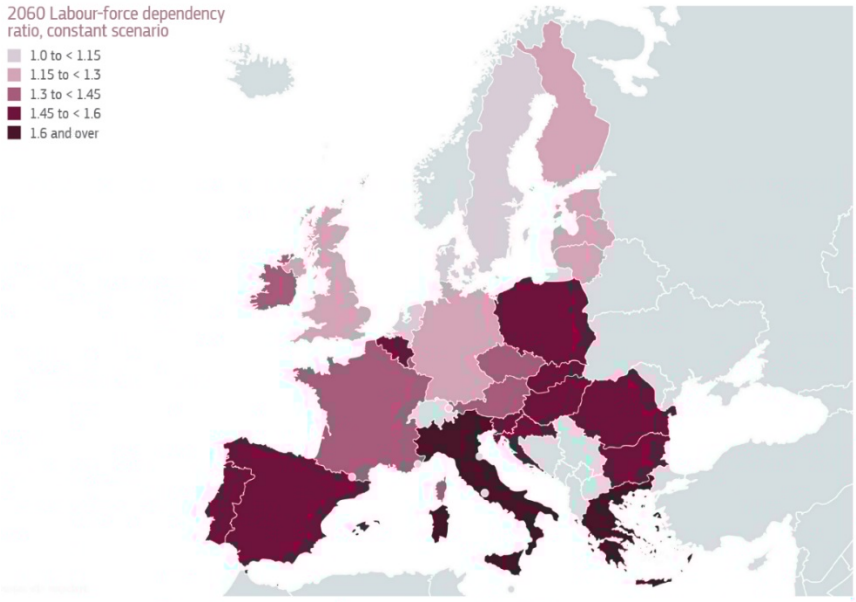


Figure 11 Labour-force dependency ratio, constant participation scenario, 2060

Source: Demographic scenarios for the EU, 2019

3.5 How will population be distributed at regional level

Europe is one of the most urbanized regions of the world with about **73% of the population currently residing in urban areas**. This value is expected to **surpass 80% by 2050**, according to UN projections[28].

The vast majority (**74%**) of European countries are expected to face **urban population growth together with rural population decline**.

Compared to other regions of the world, for the 2014-2030 period, Europe is expected to have **smaller annual urbanization growth rates**, rarely surpassing **1%** and in no cases surpassing **3%**.

European population living in urban and rural areas will differ from region to region. The forecasts are showing this difference as follows:

- The share of the **European population**[29] which live in urban versus rural areas, future projections: 2020 – 74.9% in urban areas and 25.1% in rural; 2030 – 77.5% in urban areas and 22.5% in rural; 2040 – 80.6% in urban areas and 19.4% in rural; 2050 – 83.7% in urban areas and 16.3% in rural;
- The share of the **Western European population** which live in urban versus rural areas, future projections: 2020 – 80.2% in urban areas and 19.8% in rural; 2030 – 82.2% in urban areas and 17.8% in rural; 2040 – 84.6% in urban areas and 15.4% in rural; 2050 - 87% in urban areas and 13% in rural;

28 UN, World Urbanization Prospects; The 2014 Revision,

29 Mapping the World's Urban Population in 2050, 2018

- The share of the **Southern European population** which live in urban versus rural areas, future projections: 2020 – 72.2% in urban areas and 27.8% in rural; 2030 – 75.4% in urban areas and 24.6% in rural; 2040 – 78.9% in urban areas and 21.1% in rural; 2050 – 82.1% in urban areas and 17.9% in rural;
- The share of the **Eastern European population** which live in urban versus rural areas, future projections: 2020 – 69.9% in urban areas and 30.1% in rural; 2030 – 72.2% in urban areas and 27.8% in rural; 2040 – 75.7% in urban areas and 24.3% in rural; 2050 – 79.4% in urban areas and 20.6% in rural.

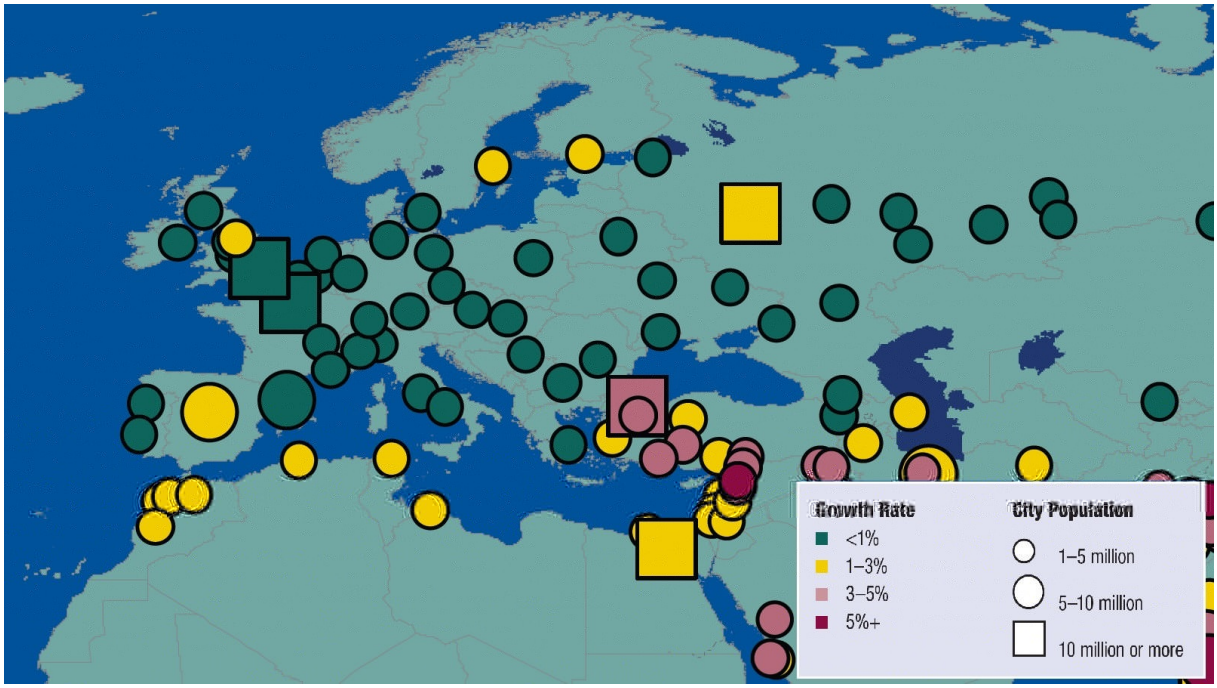


Figure 12 Average annual rate of change of city population 2014-2030, excerpt for Europe

Source: UN, World Urbanization Prospects; The 2014 Revision

The growth in urban areas is everywhere but the growth in Europe is slower than other areas. The only few exceptions in faster pace of growth of urban areas are in North of Italy, UK and Ireland; in general, the urban areas in Europe will have a steady growth, compared with urban areas in the rest of the world.

According to the UN World Urbanization Prospects (2014), **54% of the world population currently** resides in urban areas and global urbanization is going to continue in the future. However, there are differences between projections for future population.

- UN World Urbanization Prospects (2014) projects that **66%** of the population will live in urban areas by **2050**;
- This value might reach **70-75% in 2050** according to an ARUP analysis, Future of Highways published in November 2014.

As urban population continues to grow, there are two possible trends for rural areas: the majority of countries, i.e. **two-thirds**, are experiencing **reduction in rural population**, while

the remainder are experiencing either **uniformity or slight growth (mainly in Africa)**, according to UN projections.

A significant increase in the number of Megacities (10m+ inhabitants) is projected for 2050, but this increase is concentrated in Asia (i.e. China and India). The growth of these Megacities may lead to exaggerated urban sprawl and "slum-isation" while there is an increasing disparity between rich and poor. There will also be vast differences between city centre and peri-urban areas affecting the demand profiles.

The projection of the **World population** which live in urban versus rural areas are: 2020 – 56.2% in urban areas and 43.8% in rural; 2030 – 60.4% in urban areas and 39.6% in rural; 2040 – 64.5% in urban areas and 35.5% in rural; 2050 – 68.4% in urban areas and 31.6% in rural.[30]

In studying the differences between urban and rural areas a clear understanding of how these areas are defined is very important. There are many studies that are looking into the urban and areas characteristics and evolution, but without giving a clear reference or baseline of their characteristics, dimensions and nation/geography. However, whichever classification or definition is used the rural areas are decreasing and urban areas are increasing. It is recommended to consider in the future a classification based on the area of influence of a city or a village and not its actual administrative boundaries.

Conclusions: The ascending trend in population is very important to be known by city authorities. The growth of the population is in fact the major factor for cities growth that is done rather chaotically, without taking into account particular social needs or environmental issues. The most successful cities (in terms of functionality) in the future will be those that will combine the development of the public places with the needs and values of those that use these places.

4 Generations and future lifestyles

Who will be the users of the future road ecosystem? They will comprise people who will travel on the road corridors and those who will live in proximity to them. How much will they differ from the profile of people in today's road ecosystem? If they do have a different profile, what does this mean for the way we plan the road eco-system of the future. This section examines what the lifestyles of the future might look like in Europe and what that will mean for the way we plan the road ecosystem in future decades.

30 Mapping the World's Urban Population in 2050, 2018

4.1 Factors influencing lifestyle

Lifestyles are a compromise between our ideals and the reality that exists around us. Figure 4.1 shows a 4-layered 'onion' of behaviour from the EC MIND-SETS project (MIND-SETS 2017). The outer 2 layers describe the behaviour patterns that we observe, and the attitudes and opinions that people have towards different aspects of behaviour. These two layers define a person's lifestyle. A majority of travel behaviour research limits itself to these two layers. However, interest is now increasing in the third layer. This layer defines a person's inner values and these values remain fairly constant over a person's lifetime. The final core of the 'onion' is a person's personality – that is what psychologists call their 'personal construct' – are they introvert/extrovert and so on. When a person tries to live-out their core values in the real world, they find a host of barriers with which they have to compromise. The result of this process is their lifestyle.

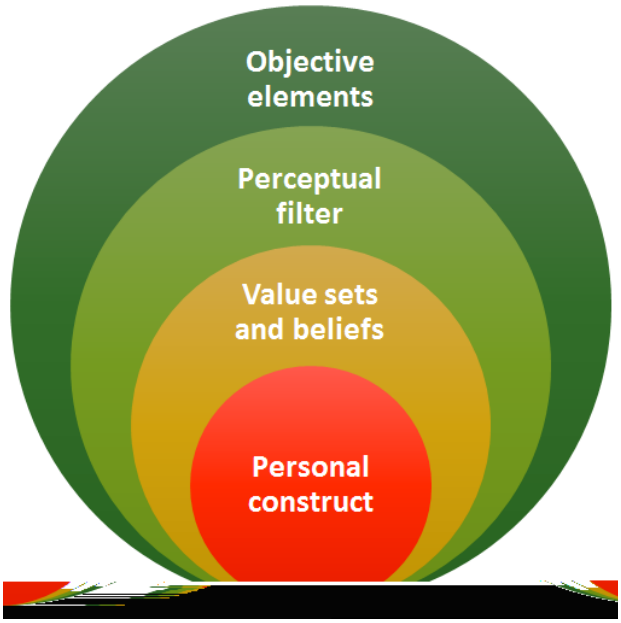


Figure 13 The MIND-SETS layers of decision-making

Source: The MIND-SETS Approach. Deliverable 3.1 of the MIND-SETS Project, European Commission Horizon 2020 Programme

There are 3 factors of behaviour that we have to consider when we look at future road use – Age, Period and Cohort (APC):

- Age relates to lifecycle stages – e.g. childhood, puberty, adolescence, childbirth, frailty and ageing and death.
- Period relates to factors specific to a particular period in time
- Cohort relates to the age group or generation

The influence of demographic changes has been discussed in a previous section. This section focuses on the characteristics of future generations and, from this evidence, what we can say about future lifestyles of those using the road ecosystem. Generation values are developed in quite short periods of 4 or 5 years and are therefore the period-related factors

in which generation values are formed that shape future behaviour – we will call this the 'Generation footprint period' or (GF period)

4.2 Generation footprints and lifestyle models

In recent years, much has been learned about the behaviour patterns of different generations (references from MIND-SETS D2.1c). Each generation forms core values in late adolescence/early adulthood. These core values form the basis for lifestyle development and, importantly for the MORE project, they are resistant through the lifecycle. These core values will play a strong role in determining how each generation influences:

- The direction of mobility/place-making innovations and
- Responds (accepts or rejects) to new mobility products and services, and to new concepts on place-making and urban design.

The evidence suggests that a generation can be defined in roughly 15-year time periods, although there are clearly 'blurred lines' in which some core values occur in the adjacent generations. Generations can either develop values during the GF period that reject the values of the previous generation, or they can take some of what they see to be positive elements or can fully adopt and intensify those values. The term used for these value-sets is a generation's 'footprint'. The MIND-SETS project has shown that each generation has a quite different footprint in relation to those aspects of behaviour that relate to mobility (MIND-SETS, 2017).

What it is possible to do is to combine the generation assessment with that of the demographic assessment in Chapter 3. This will map the values that each generation of the population will hold in future decades, as they age. Such an analysis can provide some clarity on the nature and profile of future users of the road ecosystem.

4.3 The impact of generation values on the future user of the road ecosystem

At the present time in 2019, we can define 7 generations:

- The 'Silent generation' – people aged 80 years and older – born in the pre-war era. (The GF period being the Second World War)
- The 'Master boomer' generation –people aged between 70 and 80 years – the oldest sub-group of the Baby Boomer generation born since the onset of the Second World War (The GF period being the mid to late 1950s)
- The 'Baby Bloomers' – people aged between 55 and 69 years – the younger sub-group of the Baby Boomer generation born after the War (The GF period being the mid to late 1960s)
- The 'Prime Busters' or 'Generation X' - people aged between 40 and 54 years – born after 1965 (The GF period being the early1980s)

- The ‘Millennials’ or ‘Generation Y’ – people aged between 25 and 39 – born after 1980 (The GF period being the turn of the 21st Century)
- The ‘Screenagers’ or ‘Generation Z’ aged between 10 and 24 – born after 1995 (The GF period for the oldest in the group being the austerity years following the 2008 economic crash)
- The Digital Aboriginals or ‘Generation Alpha’ – aged 9 years or under (Yet to approach the GF period)

Each successive generation adopts some values (perceived as positive) from previous generations, and creates its own set of values that can be identified specifically as for example ‘Millennial’ or ‘Master Boomers’ – collectively they form the generational footprint. Increasingly over time in the post-war period, new generations have developed values that challenge traditional social roles. We can look at the value sets of each generation and draw some conclusions as to how they may behave in the road ecosystem of the future.

4.3.1 Digital Aboriginals (Generation Alpha)

These children have yet to form their value sets. However, we can make some observations from their patterns of behaviour. Born since 2010, the youngest will be in early middle age by 2050. In 2020, there were 5.6 million children in this age group in EU28.

This is a generation born into the Internet and social media – and of ‘Fake-news’ and the Trump era. Thus it is no longer novelty but normality. They know how to use and exploit technology and new novelties – such as the novelty of talking to the technology. They are very self-aware at a young age and create ‘proto- images’ on social media. They are more exposed to different cultures and countries from their early years. If they are born in cities, then they spend a lot of time in the apartment. They have continued the digitally induced trait (since the Millennials) of needing constant variation and getting bored easily. Many are lone children at home from separated/divorced parents, who give in to their children’s demands. In contrast to the Screenagers (see below), they would be prepared to accept intrusive technology. Their lifestyle underlines the importance to give this generation safe places that they can socialise and exercise, outside of the immediate school environment. Their mobility currently depends on being escorted, as dependents.

This generation will become clearer in the coming years. What is observed at the present time is that the normality of the Internet to this generation is focusing them on a footprint based on non-technological values. In this context the importance of developing lifestyles that address climate change is emerging as a key value among the teenagers of this generation. This would intensify the pressure to develop a road ecosystem around greater place making, active mobility and the so-called micro-modes.

4.3.2 Screenagers (Generation Z)

This generation aged 10 to 24 years comprise 86 million people in EU28 in 2020. While not being the instigators, this generation has witnessed the decline in car use by their immediate Millennial peer generation and the impact of financial austerity growing-up, which is their primary social marker. While they show an interest in automation and artificial intelligence, they do not favour invasive technologies such as brain to vehicle.

Importantly, the Screenagers have been to first ‘phygital’ generation in the sense that they are fully digital on social media but they also like to hang-on to physical activities (e.g. coffee shops, book stores, food trucks, vinyl discs etc.). They like to escape from the technology but not to neglect it and remain very connected. In comparison to the Millennials, Screenagers are more individualistic, wishing for things to be customised and personalised by technology. They have a greater tendency to trust the technology and digital advice sources and have a greater repertoire of skills and identities (in real life and on social media).

They have particular lifestyle values and are not as gender-strict as older generations (for example with men comfortable showing greater emotion). They do not like predictability in others. Like the younger Digital Aboriginal generation, they get bored easily; they have a dislike of habit and like to be surprised. Their attention span is limited, they like data. Lifestyle has to be unpredictable accept for their mobility which has to be there when they need it. This is not a generation that will seek lifelong careers.

Screenager values will look for quality in their mobility above social status and brand. They have an acceptance of automation and they require technology to provide customised mobility for them, controllable from smart devices – mobility has to be trustworthy and safe and above all to this generation – affordable.

4.3.3 Millennials (Generation Y)

In 2020, there will be 96 million Millennials in EU28. A key influencer for this generation was the 9/11 tragedy in New York. This generation was the first time a younger generation became the ‘benchmark’ generation – previously, benchmark generations had always been the older, ‘experienced’ generations. Millennials had however, gained benchmark status through mastering the Internet and latterly social media.

They have important values that have been able to be realised in lifestyle:

- They value a good blend of working and home life
- Their mind-set is a cooperative one, but to realise individual goals
- They do not place such emphasis on owning things and have been the primary drivers of the ‘sharing economy’
- They require constant feedback and transparency in communication

A further development with Millennials is the closer relationship they have with their (Boomer) parents – to a level not previously experienced with older generations.

In terms of mobility, this generation have championed the cause of sustainable mobility and the growth of shared mobility. After 2003, they have reduced car use beyond what their older Prime Buster generation started in the 1990s. They seek sustainable mobility options and the use of technology on smart phones as a control mechanism to schedule trips across different connecting modes.

4.3.4 The Prime Busters (Generation X)

There were 99 million Prime Busters in EU28 in 2020. This is the generation whose footprint was influenced by the events of the 1980s. They are now in middle age with growing children

(Digital Aboriginals and Screenagers). This generation is on the cusp between the younger collaborative generations and the older, more competitive generations: The 1980s social norms favouring self-improvement, individualism and the private sector.

This generation exemplify the way in which lifecycle can influence the generation footprints. The pressures of combining family and work roles dominate prime Busters' lifestyles: There are associated gender role pressures to this. Lifestyles are dominated by time shortage and an imbalance of home and working life plus lack of financial resources. They have the highest rate of divorces and have been the first generation where divorce rates and family breakdown has increased rapidly.

In terms of their mobility they are not attracted by automation, preferring control of their mobility. However, they do favour connected vehicles and technological advances that assist the process of controlling one's own mobility. They have moved out into suburban and peri-urban areas, combining semi-rural lifestyles with a progressive mind-set.

4.3.5 Baby Bloomers

This group is the youngest part of the post-war baby boom. They have greater prosperity and engage in active mobility and travel – hence the term 'Baby Bloomer'. In 2020 there will be 101 million Baby Bloomers in EU28. This generation was formed of the values of the later 1960s and the Cultural Revolution that transformed lifestyles in that time. It was the first generation to develop values to protect the environment and had a strong social equity component. The marker for this generation was the moon landing in 1969.

The lifestyle of Baby Bloomers, as the name suggests is active – 'wishing to die young, but as late as possible', they are wealthier than younger generations with greater time to spend on active culture (in many cases relocating from suburb to city locations).

4.3.6 Master Boomers

These older Baby Boomers cover the period from the outbreak of the Second World War. In 2020, there will be 49 million Master Boomers. The key period for this generation was the late 1950s, the beginning of mass consumption and Expo 58. In this generation ownership has a strong status element with symbolic consumption. Increasing longevity of the lifecycle means that this generation can 'add years to life and life to years'.

In terms of mobility, this generation has a high car ownership level and emphasis on private mobility. There are a proportion of the older women in this generation that have never driven.

4.3.7 The Silent generation

This generation was born before the War and are aged over 80 years old. For them, values were formed during the War and its immediate aftermath - a period of austerity, rationing and 'making do' – prior to the supermarkets and mass consumption of the 1950s. In 2020, there will be 30 million of the Silent generation in EU28. This generation is affected by the differing mortality rates of the genders – 75% of them are women. For this generation, holding on to what you own is important as frailty increases with dependency on others. This was the 'radio generation'. They are digitally illiterate and require assistance in navigating the new digital age. Many of them are the first generation of mass motorists, they are faced with

giving-up their cars. Mobility is increasingly restricted, losing confidence and having a fear of falling – increasingly dependent.

4.4 Demographic projections of generations' values up to 2050

We therefore have 7 generations, each with its own set of values towards their mobility:

- Digital Aboriginals indicating an emphasis on low carbon mobility and embracing technology advance as 'normal' behaviour
- Screenagers are 'individuals' requiring customised and personalised mobility, comfortable with automation, consciously balancing their digital life and physical life
- Millennials place less emphasis on mobility ownership in favour of sharing, environmental concern and sustainable mobility and also working for a balance in their lifestyle. Connected mobility if favoured, individually controlled by smart phones.
- Prime Busters prefer connected to automated mobility. A generation heavily influenced by the family pressures of their lifecycle stage – mixed values favouring both public and private mobility.
- Baby Bloomers are the first generation to have concern for environmental protection. Despite this, Baby Bloomers are a mobile, wealthier, free of their children generation with an emphasis on personal mobility.
- Master Boomers are the generation where values of high mobility have strong social status (compared with their older generation), but with the increasing lifecycle impacts of ageing bearing down on them.
- The silent generation have the greatest values of austerity. Lifestyle is increasingly dominated by frailty, dependency and mortality.

The four key value transitions across the generations are:

- Competitive to collaborative;
- Environmental protection to sustainable mobility to carbon reduction;
- Ownership to sharing to individually customised;
- Digital illiteracy to digital competency to digital normality.

Figure 14, Figure 15 and Figure 16 return to the demographic trends discussed in Chapter 3, subdivided into the 7 generations. We can interpret the balance of mobility values in the future and the impact that this will have on the road ecosystem, in addition to the demographic impacts per se.

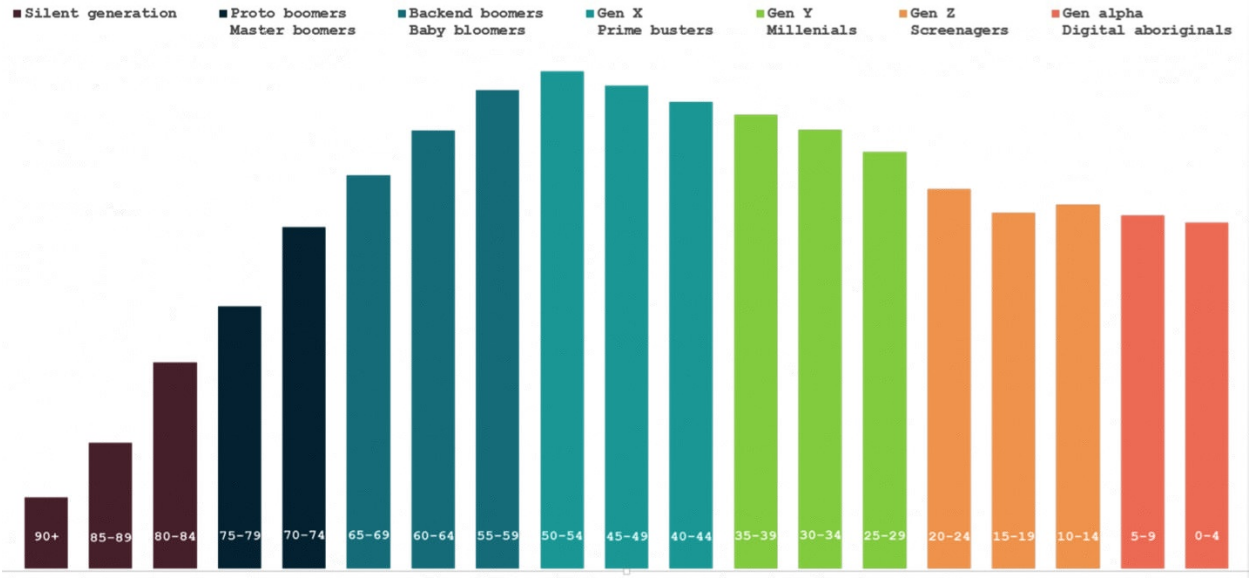


Figure 14 Projected population – EU-28 – 2020

Source: Prepared by the Author, based on Eurostat projections

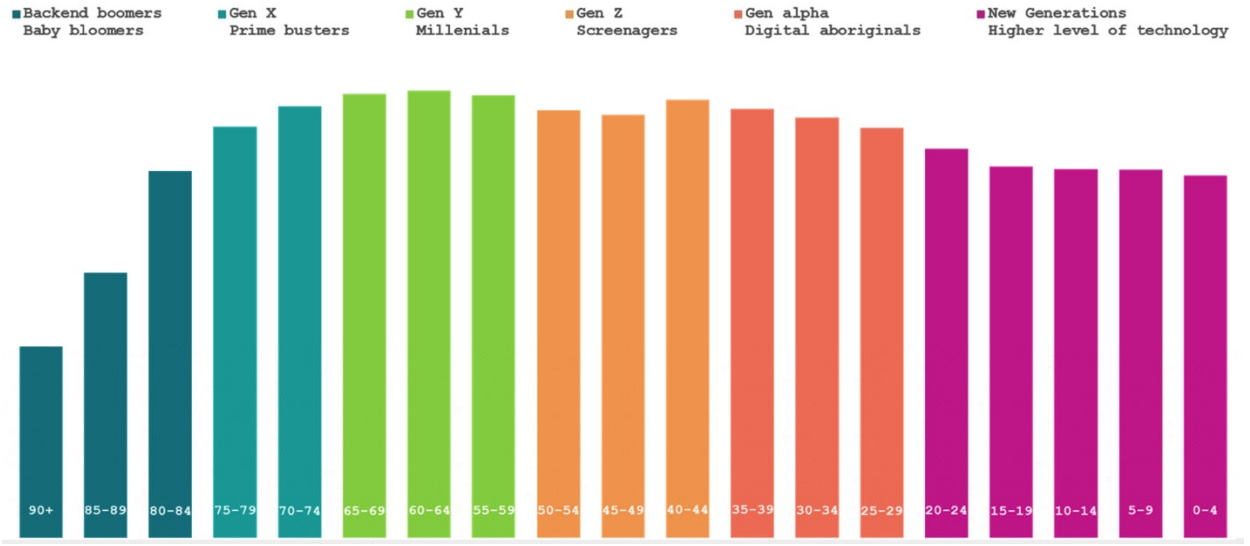


Figure 15 Projected population – EU-28 – 2050

Source: Prepared by the Author, based on Eurostat projections

In 2050, the Millennials will be aged 55 to 69 years. Increasing survival rates will increase the number of Prime Busters and younger Baby boomers in their early retirement and old age in greater numbers than current Master Boomers and the Silent generation.

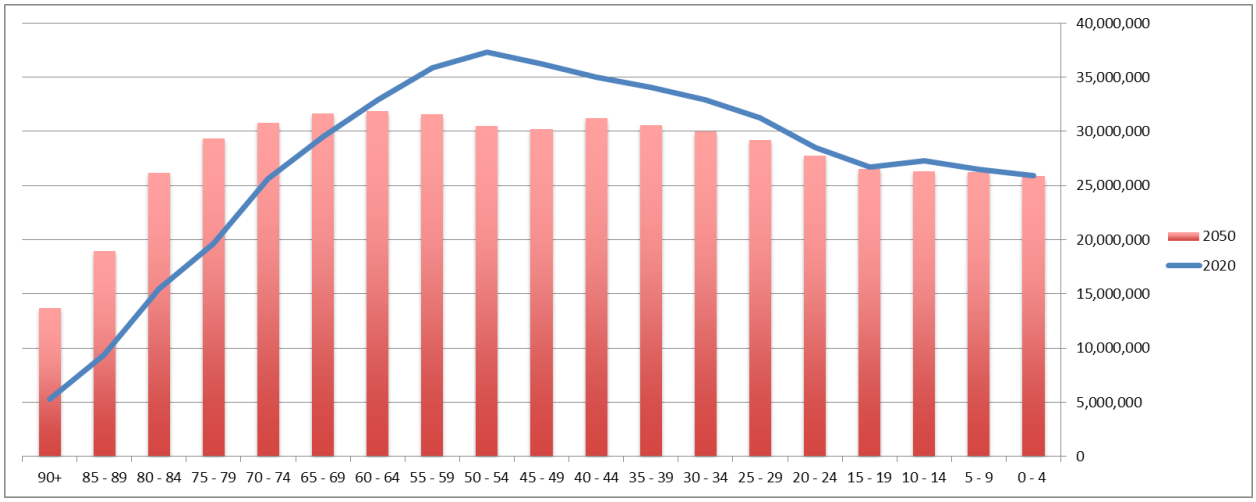


Figure 16 Projected population – EU-28 – 2050, with highlight on changes from 2020 population projections

Source: Prepared by the Author, based on Eurostat projections

Users of the road ecosystem of the future will increasingly be dominated by the values and lifestyles of the current younger generations:

- Prioritising anything that is low carbon in all areas of lifestyle, including transport;
- Emphasising sustainable mobility;
- The need to create safer more liveable spaces for all;
- The ability to control, tailor and customise affordable multi-modal mobility offers to suit more diverse lifestyle models;
- A preference for sharing mobility over individual ownership.

These will be the five value sets that will determine the acceptance or rejection of new transport/IT technology developments in the road ecosystem in the years to come. In contrast, by 2050, the ageing society will produce a significant number of older people, losing the high level of mobility and dependency that they enjoyed through their lives, while retaining the strong values of ownership and individual mobility that have been a pillar of their social status over the years – how will they adapt? The psychological impact of mobility loss in the older generations will have considerable impact on lifestyle.

4.5 Developing values and lifestyles towards and beyond 2030

Mobility going forward has 4 key values – low carbon, sustainable, customised and shared. In the medium term to at least 2030, we can identify **6** lifestyle characteristics within which future mobility patterns will be planned:

- People living ‘Somewhere and Anywhere’;
- People ‘Trading places’;
- People building ‘Progressive Provinces’;
- People ‘Uncoupled’;
- People with ‘phygital lifestyles;’

- People ‘changing social norms’.

In combination, these 6 lifestyle trends point to an increasing social flexibility and the blurring of traditional lines of social values and behaviour – an increasing emphasis with younger generations on time pressures and the speed of digital lifestyles – blurred gender roles and increasingly diverse forms of relationships. Future mobility in the road ecosystem will have to fit into this emerging social model in Europe. Of course, these 6 lifestyle characteristics are not mutually exclusive and individual people; households and communities in the future will have behaviour patterns that reflect several of the above characteristics.

Each lifestyle characteristic is described in general terms in the following subchapters.

4.5.1 People living ‘Somewhere and Anywhere’

This category compares two contrasting lifestyles that have emerged since the growth of the so-called ‘Digital Society’, which will be a continuing lifestyle feature.

‘Anywhere people’ reflect primarily those in younger generations, but not exclusively: A lifestyle with the keywords - cosmopolitan, flexible, mobile, global and creative. This lifestyle is flexible, volatile behaviour patterns, hedonistic and loving of urban street life. Their mobility is multi-modal. In contrast, ‘somewhere people’ are more characteristic of older generations. Rather than embracing constant changes in technology and social innovation, these people see disruptive change as pressure – they are comfortable without change. They seek habitual lifestyles, career employment and are reluctant to relocate or modify travel habits. They are most numerous in rural and peri-urban areas and traditional towns. They prefer private mobility.

4.5.2 People ‘Trading Places’

At the present time, a transient renting population (young professionals, students) mean that the age profile in many European city centres and inner cities is skewed to Millennials. However, there are signs that this is changing. Throughout Europe there is a trend of baby boomers moving from the peri-urban areas back into larger cities. Middle class, double income baby boomers want to move back to cities, especially to those considered “Yogurt cities” (i.e. those with an active culture) and they have the financial potency to do this. At the same time younger generations (with creative, academic mind-sets), with lower incomes are determined to move to peri-urban areas, which are more affordable compared to city centres and offer the green spaces lacking in the cities. Thus the emphasis on developing sustainable mobility, which has focused on cities, will need to refocus on suburbs and the urban to rural continuum. Older generations will enjoy city lifestyles with affordable and accessible mobility inside the road ecosystem; and that will not threaten the level of mobility that they have become accustomed to throughout their lives, primarily on the urban fringe.

4.5.3 People building ‘Progressive Provinces’

The spatial implications of lifestyle changes will be significant. This no better illustrated than the way the values of the generations are leading to lifestyle preferences in specific types of settlements. The definition of a “Progressive province” in this context is where there are settlements consisting of social groups of diverse values. Rural or peri-urban areas with

small and medium sized towns and cities in many areas of Europe are witnessing mixed populations of indigenous ‘Somewheres’ and out-migrant ‘Anywheres’. This social cocktail is changing the mind-set and character of traditional areas, where the urban mind-set and rural charm are both mixed together. This generates a lot of opportunity for rural areas and at regional level, making those as attractive and active in some regards, as urban cores. For example, this pattern is seen in the Antwerp region of Belgium and in the Outer-London commuter belt. While these ecosystems could benefit from importing urban lifestyles, the Progressive Provinces of Europe have to respect the traditional home grown lifestyles of the indigenous society.

4.5.4 People ‘Uncoupled’

There have been radical changes to social relationships over the last 30 years, witnessed in rising divorce rates, common law relationships and people choosing to live outside of formal or informal partnerships, the increasing visibility of the LGBT community in partnerships – and conventional marriages. In the past, mobility was purchased and its use distributed within traditional forms of households – in the future, this pattern will be far more diverse.

At the European level, in 2017, 34% of houses had only one occupant (defined as a person “not sharing their laundry basket with another person”). Such households are more common in cities than in rural areas – ‘anywhere’ rather than ‘somewhere’ communities. This trend is acute. In France for example, the proportion of single person households has grown, and is projected to rise, by 75% from 2005 to 2025 – inside one generation-span. In Germany and the UK, the comparative statistics are 17% and 22% respectively. There is also a rapid increase in the number of single parent families, a majority headed by a woman. In the future, single parent families are expected to rise further – for example by 9% in Holland and 22% in UK up to 2025.

4.5.5 People with ‘phygital’ lifestyles

Younger generations that have grown-up or been born into the Internet/social media age form the ‘Digital society’. Older generations are ‘immigrants’ into this society. The digital society has given rise to what is called ‘phygital lifestyles’ – a pattern of behaviour that blends physical with digital activities. This can involve a lifestyle of full or part teleworking, of substituting trips for weekly shopping, health and social services, instant food delivery and recreation. All categories of trips have a virtual alternative. Computer-based lifestyles also present mental challenges: Attention spans are reduced; people suffer Thaasophobia (fear of being bored), they require punctual service, and are more quickly frustrated. Services have to be individualised. Thus lifestyles in the Phygital society of the future will provide for greater diversity of living and working options, but could present psychological and mental challenges.

4.5.6 People ‘changing social norms’

With the evolution of the generations, future lifestyles will increasingly blur the traditional social values of the 20th Century – both in terms of the patterns of the way people live together and apart, and the relative positions of men and women in society. Gender role values are changing lifestyles between the generations. Men and women in younger, digital,

generations have closer gender role values than the wider, more traditional gender role values held among the older generations.

Successive generations of women and men have grown-up with the changing gender roles of their parents. Female Baby Bloomers were working mothers using low mobility to manage a 'work-life balance'. In contrast, their Prime Buster children (now aged 34 to 48) have been more insistent on achieving a 'life-work balance', sharing roles and having higher mobility to manage them. Millennials have grown up seeing women and men as having equal life-potential, each adopting the other's values. It is likely that this lifestyle trend will continue, with more blurring of gender roles in the youngest generations.

Changes in women's role and their greater independence have driven social change and, in turn, influenced changes in male roles and their lifestyles: these gender-rooted changes have driven reduced birth rates in recent decades and increased female labour participation. These shifting gender values and life expectations have placed pressure on traditional household relationships and have increased the rate of divorce, particularly among the Prime Busters have been realised in new and more flexible models of households, partnerships and individual living. Such changes are already, and will have, marked changes in patterns of behaviour and mobility.

4.6 Future lifestyles in the road ecosystem

Previous sections have underlined the lifecycle impacts of the ageing society and the increasing multi-national, multi-ethnic nature of people using the road ecosystem. This section has looked at the trends in the lifestyles of those people. We have identified the core values – the mind-sets - that successive generations of road ecosystem users have, and the way this translates into changes in lifestyles 'on the street'. The younger generations and the increasingly digital world into which they are born are driving future changes in street lifestyles. Social patterns that have been based on stability, security and habit in the 20th Century are now giving way to more flexibility and volatility in lifestyle. This lifestyle evolution is blurring the boundaries of traditional social roles with emphasis on individually customised services. The road ecosystem and mobility of the future has to be designed to meet this flexibility.

4.7 Future "phygital" activity patterns

Mobility is not just the ability to get around. Mobility is a basic freedom – even if you do not use the mobility you have, it is the freedom you feel from your mobility that is fundamental to the way you behave – your confidence and control over your life, and therefore your feelings of safety, security and well-being. The freedom your mobility gives you also influences the relationships you make, the opportunities you make the most of (and the ones you are deprived of), who your social networks are, and how you interact with people. Mobility freedoms will give you social status in certain situations, dominate conversation, and strengthen your self-esteem– mobility can strongly project your personality, and in return, define the characteristics of your identity, as others see you.

The MIND-sets H2020 project identified 4 major dimensions to understanding mobility:

- **Mobility as a lifestyle concept** – mobility influences our lifestyle and it is a major component of how we live.
- **Digital mobility provision** - this is the new dimension to living introduced by the Internet. Virtual mobility on the Internet cannot be separated from physical mobility on the ground - the 'Phygital' mobility (***phy***sical and di***gital***).
- **Physical Mobility** (as a service or as a possession) – the actual mobility on the ground, in the traditional acceptance.
- **Mobility eco-system** – the different spatial and temporal dimensions in which mobility occurs – the characteristics of the physical and built environments, the social networks and business networks etc.

The interaction between the 4 elements relies on policies, regulations, business models and the ability for behavior to adapt and change to new personal or external circumstances or to new mobility products and services.

The "phygital" dimension of the mobility will have a major role in the future determined mainly by (i) the fast pace of the technology advance and (ii) the easiness of how future generation will incorporate digital aspects in their lives (see Chapter 4.3). The phygital mobility will influence the travel patterns and especially those trips that have a major importance: trips for work, shopping, health care, leisure. Of course, this will have a major influence on social relations, too. These changes should also be correlated with developments of technology and of the lifestyles.

4.7.1 How phygital mobility will influence the work trips?

As described previously, the new workforce wants more flexibility; the idea to have a workplace as a windowless cubicle, a fixed working time from nine to five it is not any more something that they want. In the same time, the companies have problems in recruiting talented people, they recognise that they are working more with flexible talents (freelancers, temporary staff or employed specialised agencies).

Many studies show that the employees consider that they will work remotely in the future; the figures released a significant annual increase of employees working from home or from remote places (a US study showed an increase of 118% of people working from home in only one year). The offices will become less frequented; many departments in the traditional companies have at least one employee that works remotely. However, this put a pressure on the companies to change their policies to accept remote working.

The advance in technology allows companies to have a more flexible working model. They could have employees in many parts of the world, producing and contributing in the same time – allowing them to offer a better service to their clients. New collaborative tools make remote work easier: digital platforms to engage with the teams, new technologies in the service of human productivity and organizational performance. Many managers consider that dynamic (agile) teams will become the norm in the future.

Having a flexible schedule will lead to a better life-work balance. Many countries recognised that the flexibility offered in working time increased the productivity and the happiness of the employees. Trip time-savings are not the major concern.

In the future, the transport models should take into account the new life-styles with people wanting to work remotely or from third-places (such as mobility hubs). The traditional peak hours could have a significant decrease of users and the management of the transport systems should be more flexible to accommodate the influence of the new life-style.

4.7.2 How Phygital mobility will influence the shopping trips?

It is an increase in the appetite for on-line shopping because it is more comfortable, less time consuming and can be done anytime. The technology caters for this increasingly attractive habit of the consumers by providing many facilities. For example, there are companies that are using augmented reality technology to allow the customers to have their measurements correctly taken – in this way, the propensity of returned goods decreases.

However, irrespective how tempting, comfortable and easy the on-line shopping is there are a few challenges to overcome:

- Physical shops face decrease in consumers and business revenues as more and more shoppers buy on-line;
- The logistics aspects have to be improved as the number of trips generated by this practice contribute significantly to the increased pollution levels; it is expected that in the future the light electric freight vehicles will be used. It is also expected an increase in the delivery by bikes (cargo-bikes) or by automated vehicles;
- The street space re-allocation needs to support the future urban logistics (kerb space management).

In the future, it is expected to decrease the number of traditional trips made for shopping, but to increase the short and medium distance delivery trips.

The conventional transport model it is out-dated and it needs to incorporate more accurate future reality: a decrease of shopping trips, in the traditional accept, but an increase of freight trips (including the returned goods, refused by clients that bought them on-line).

4.7.3 How Phygital mobility will influence the health trips?

Virtual healthcare refers to the online visits that take place between patients and clinicians via communications technology; ICT video and audio connectivity allows meetings to occur in real time, from virtually any location. There are two basic types of telemedicine applications: virtual visits and remote monitoring. A virtual visit can be a videoconference between a doctor and a patient at home; or a patient can interact with an offsite medical specialist from his or her local clinic, instead of traveling to another city. Telemedicine also better enables specialists to monitor situations or procedures from remote locations, particularly useful when treating patients with chronic conditions.

Potential barriers to virtual healthcare development include: human or cultural factors (resistance to non-traditional approaches, lack of ICT literacy, linguistic and cultural differences between patients and service providers), lack of studies documenting economic

benefits and cost-effectiveness of telemedicine applications (there is a need for a solid business cases to convince policy-makers), legal considerations (concerning privacy and confidentiality, but also health-professional authentication and the risk of medical liability), the risk of eventual technological malfunction.

4.7.4 How Phygital mobility will influence the social aspects?

The social relations are influenced by the development of the Internet. People tend to spend more time in the virtual space, rather in the physical one. This is also reflected in the way people travel, and two theses could be underlined in (i) the access to the virtual space could substitute some of the physical trips and (ii) how it will enhance the travel experience.

Moving some of the daily interest on-line (tele-working, social media etc.) the physical trips may reduce in numbers. However, the flexibility given by this life-style may conduct to more trips to be made during the day, that otherwise they weren't in the diary. It can be concluded that traditional trips to work, may be substitute by other trips done during the day: meeting clients, going to third-places to work, etc. Moreover, to these trips could be added other trips that if traditionally the time was spent in an office there weren't made: sipping the favourite coffee in the famous bar in the central of the city or making errands to elderly family or simply going for a nice stroll in the park.

There is also the possibility in the future that by having more virtual mobility will influence the distances that we are travelling. It may reduce the short, non-motorised trips, but it could increase the long motorised ones. Socially, people have more interaction in the virtual space; however, they will be prepared to travel longer distances in the physical space to meet with each other.

The technology will influence the perceived quality of travel time; thanks to the technology the travel time itself is used fruitfully – the "positive utility"[31].

31 Lyons and Urry, 2005

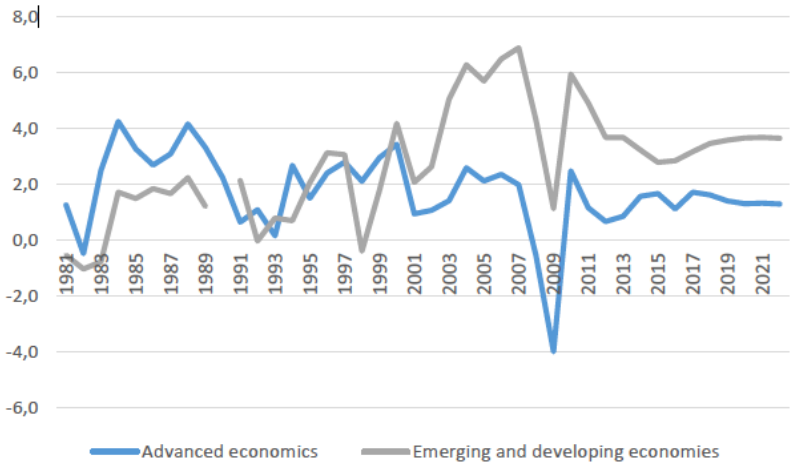
PART B – Goods and services

5 Future sectors of economic growth

5.1 Economic Growth

The last decades have witnessed a very interesting dynamic of the economies irrespective of the size (developed or emerging economies). Almost all available projections and forecasts assume that a narrowing trend will be expected into the indeterminate future.

While until the end of the 1990s, the per capita growth rate of OECD economies was, most of the time, at least as high, if not higher, than that of the rest of the world, this changed in the following years mostly driven by China in the early stage, and then Asia in general. While the contribution of Africa to the convergence process has always been very limited.



Source: IMF.

Figure 17 Growth rates of GDP per capita

Source: International Monetary Fund

It is difficult to identify the factors that could influence the growth or the slowdown of the economies, as there are large differences within the emerging and developing economies. This is also reflected in the predicted GDP per capita in the world of 2035. As shown in Figure 18, looking at the BRICS, only Russia will have a GDP per capita above half that of the EU (in PPS). Brazil is predicted to remain at its current level of GDP per capita relative to the EU. China will double its GDP per capita from currently 10,000 USD to 21,000 USD by 2035, but still remain at just below 50% of the EU value. Likewise, India will achieve a substantial relative improvement, reaching 20% of EU average income.

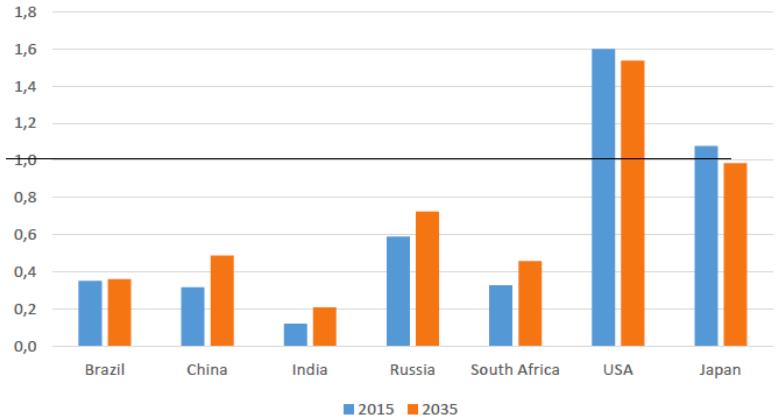


Figure 18 GDP per capita (PPS), relative to the EU, 2035

Source: Global Trends to 2035. Economy and Society, 2018

5.2 Employment Growth

The EU 28 is progressing towards the 75% employment target, reaching in 2018 the highest employment rate since 2005. In the 2005-2018 period the gender employment gap has decreased and there have been increases in employment for the senior population.[32]

The employment growth for future years will be influenced by the demographic trends. In the 2020-2030 period it is expected that the employment growth will be slower than before the financial crisis and employment might actually decrease in some countries as a result of ageing. Furthermore, employment for the 2025-2030 is expected to be lower than employment for the 2015-2025 period.[33] For Germany, Estonia and Romania, employment is expected to decline until 2025 while Belgium, Cyprus, Iceland and Ireland, employment is predicted to have the strongest growth towards 2030.

Figure 19 Past and likely future employment in EU-28+ (million, % growth rates on secondary axis)

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Cedefop skills forecasts, 2016

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Cedefop skills forecasts, 2016

Source: Cedefop skills forecasts, 2016

Employment in 2030 will be 6% higher compared with the value in 2016, with a predicted 0.4% growth rate per year. Employment growth is estimated to be the highest between 2021 and 2026 (i.e. 2.6%), with a mild slowdown after 2026.

Figure 1 EU28: Employment Growth (%), 2011-2030

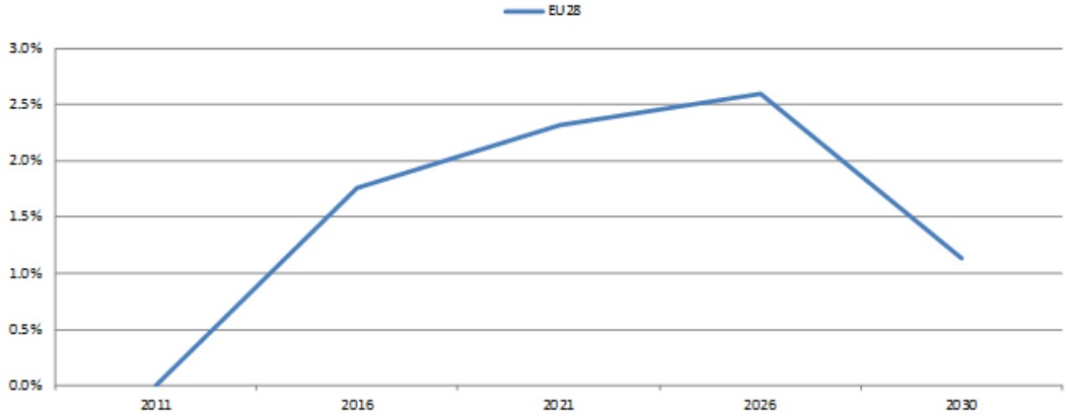

Figure 20 Employment growth for EU28 for the 2011-2030 period

Source: Cedefop skills forecasts, 2016

5.2.1 New jobs at EU level

Technological developments and particularly automation is expected to have a strong impact on employment and lead to an increase in high-level occupations. There are projected that there will be more than 150 million total jobs opening for the 2016-2030 period[34] from which:

- 9% will be created from new job openings, mainly because of the economy expansion;
- 91% will be created due to replacement needs[35].

In terms of capacity it is expected that about 4 out of 5 new job openings will relate to high skilled occupations. From the total new job openings, it is expected that most jobs will require medium level of education (46%), while 43% of jobs will require a high level and only 11% of jobs will require low-level qualifications.[36]

34 Skills Forecast: key EU trends to 2030, 2018

35 Replacement needs arise as the workforce that leaves the occupation due to retirement or career changes

36 Skills Forecast: key EU trends to 2030, 2018

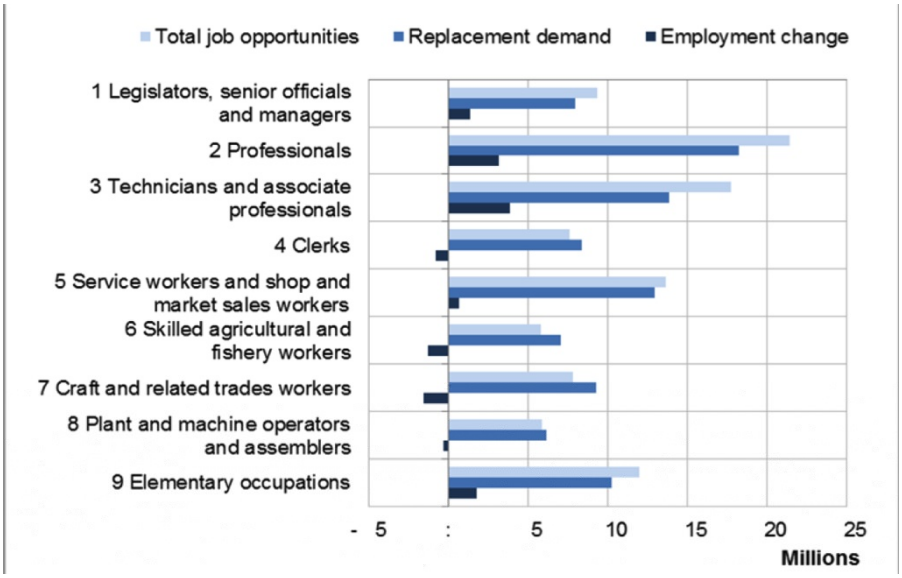

Figure 21 Total job opportunities by occupations in EU-28+ (2015 to 2025)

Source: Cedefop skills forecasts, 2016

The jobs openings will be mainly in those sectors of the economy that will face a dynamic growth. Projections for job openings per occupational group are as per below[37]:

- Business and administrative associate professionals are expected to have the highest contribution to the economy;
- Occupations such as sales workers, cleaners and helpers will provide substantial number of job openings for medium skilled occupations;
- The job opportunities for professionals are expected to be numerous, with almost 29 million job openings projected, leading to an approx. 19% contribution in the whole economy;
- Job opportunities for craft and related trade workers will be substantial, although mostly needed to replace existing workers.

5.3 Evolutions of sectors of economy, from an employment perspective

Major long-term trends[38]:

- Decline of employment in primary industries and basic manufacturing
    - Increase for several sector of basic manufacturing: (i) motor vehicles subsector – expected to grow with about 4% in the 2016-2025 period;

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Skills Forecast: key EU trends to 2030, 2018

38

Cedefop skills forecasts, 2016

- Stable evolution (i.e. increase / decrease by less than 0.5%) for other transport equipment or electronics and optical equipment subsectors.

- Increase in employment in tertiary sectors (i.e. business services or distribution and retail)
- Non-marketed services (i.e. health services and education, public administration) are expected to see a slow increase in employment for the 2015-2025 period.

For the 2016-2030 period, the fastest growing sectors, from an employment point of view is: Business and other services with 1%; Distribution and transport with 0.6%.[39]

The following trends are predicted for sectorial employment[40]:

- other business services (i.e. telecommunications, real estate activities, advertising and market research), and miscellaneous services (i.e. libraries, archives, museums and other cultural activities, gambling and betting activities) are expected to have the highest annual increase;
- the primary sector and utilities are expected to shrink, with the highest decrease predicted for mining & quarrying;
- the construction sector is expected to face a slight increase after 2020.

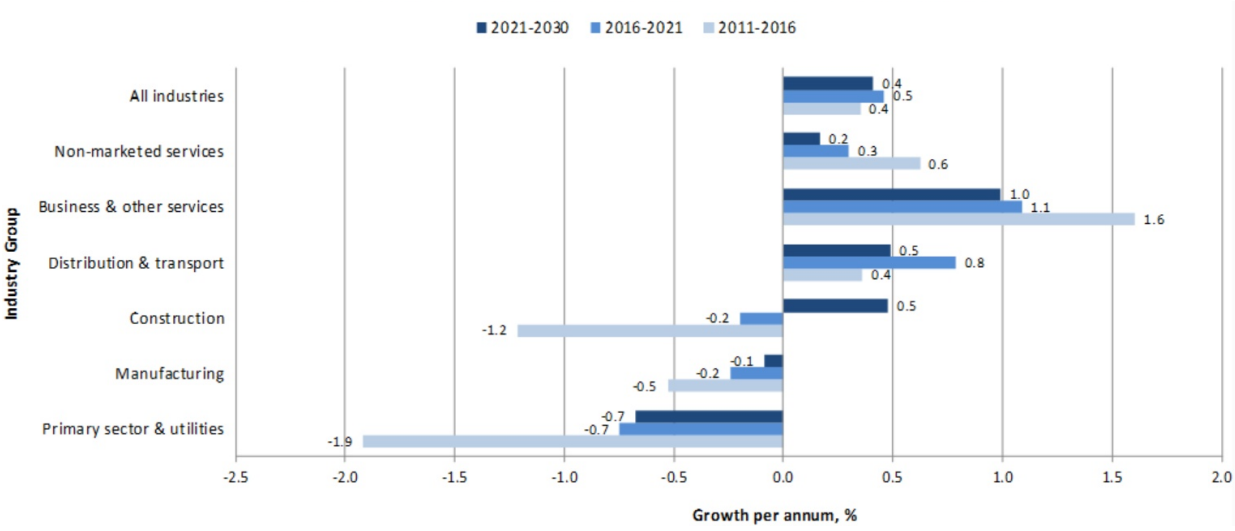

Figure 22 Employment growth by broad sector of economy activity for the 2011-2030 period, for EU-28

Source: Skills Forecast: key EU trends to 2030, 2018

Previous decades have seen the European economy develop to the World's second largest economic block after the USA, in terms of GDP. This situation is forecast to continue into the 2030s.The impacts of the ageing society in Europe are being counterbalanced by a growth in the female workforce an older workforce over official retirement age; and by immigration. This will need to be met by a road ecosystem that is more gender-balanced and age-

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Skills Forecast: key EU trends to 2030, 2018

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sensitive. These trends will continue into the future. What the statistics have shown is a future European economy where the skill level of jobs increases, particularly in the professional sector and with a strong influence of automation in production and processing. Additionally, the ageing society will increase the number of people working in the caring sector. The number of jobs that can be done remotely is likely to continue to increase with the growth of these economic sectors.

Transport is seen as one of the major economic growth areas in coming years, in particular vehicle manufacture – this has been a major economic growth area in Europe since 1945. However, it is hoped that an increase in sustainable mobility and climate mitigation policies will move the emphasis to hybrid and fully electric powered vehicles. The workforce requirements for this manufacture are significantly less than for conventional vehicles but the energy and infrastructure requirements to support electrification may compensate for this in terms of overall numbers of jobs in the wider sector. What is marked about future economic growth areas is the increasing diversity, with significant growth in areas such as 'other business activities' (for example tourism) and 'miscellaneous, suggesting the need for new typologies to meet changing patterns.

6 Delivering goods

Servicing the new urban lifestyles, feeding future urban populations and oiling the wheels of economic activity in urban areas depends on the ability of goods and service deliveries to meet changing needs. The key phrase that has dominated the goods transport sector over the last half century has been 'Right product, right time, right place': These 3 elements are usually determined by the consumer, who is put at the centre of the goods supply chain. Hence, to understand the future needs of logistics operators and the impact goods movements will have on the road ecosystem, we must understand if current patterns of goods deliveries in urban areas are likely to change in the future and if so, how and when.

What is the starting point in 2020?

- Urban freight is an important traffic component in the road ecosystem (10 to 15% of vehicle equivalent miles).
- There are very low load factors for delivery vehicles in cities (e.g. 38% for vans in London).
- Urban freight is responsible for 25% of urban transport related CO2 emissions and 30 to 50% of other transport related pollutants (Particulate matter, Nitrogen Oxide).
- Urban freight service companies are generally small (85% of short distance truck companies have less than five employees).
- Urban freight accounts for a significant part of ambient noise levels on urban corridors.

The goods transport sector in the road ecosystem, in terms of the number of companies (i.e. the users in this context), comprises predominantly small local operators. However, in terms of market share a few large freight companies in urban areas operate their logistics operations on a national or international scale.

6.1 Future goods delivery needs in the road ecosystem – multi-modal, multi-level?

From a technological viewpoint, there are many innovations that could have a positive impact to reduce all types of motorised goods vehicles on urban road corridors in future decades. Here are the 6 transport innovations with considerable potential for reducing the impact of goods movements on urban corridors while not compromising delivery.

- **Hyperloop technology** proposed for high-speed inter-urban goods and passenger movements. At the trip ends, cleaner, surface and sub-surface tubes for goods deliveries could free-up road space for place making and quality urban spaces. In CIVITAS RENAISSANCE (2012), a feasibility study for a periphery to centre tube for goods deliveries in Perugia (involving both surface pipe and sub-surface tunnels) showed that a reduction of 70% of goods vehicles on the urban streets was possible.
- **Urban air goods deliveries** are now being used in some low-density insular European cities such as Reykjavik. The 2020s will see increased activities in this sector, testing the public acceptance for low altitude transport.
- **Urban waterway goods deliveries** – urban waterways have been an underused asset and recent innovations in clean vessels could provide important channels of access for urban goods deliveries in many cities, taking traffic off the road corridors.
- **Maximising the use of urban rail infrastructure** – as an alternative to road use. Many European cities have under-used rail infrastructure that could be developed in future for conventional goods transport or new innovations such as the surface pipe innovation assessed in Perugia that would use old rail track.
- **Micro-mobility goods deliveries -** In the form of a range of cycle delivery vehicles, motorbikes, new designs of small last-mile electric delivery vehicles and so on.
- **Automated goods vehicles** – Automated pods for goods vehicle deliveries are now reality and projects are progressing to assess how they could operate in urban road corridors.

These examples underline that the future road ecosystem will need to be seen as multimodal, multilevel corridors that need to integrate a mix of new technologies within the built environment to ensure that goods are delivered with low carbon, with efficiency and sustainably. For a full discussion of new technologies for the road ecosystem, refer to MORE Deliverable 3.1.

6.2 Production chains, supply chains and service provision

Overarching the new lifestyle ambitions and economic realities in Europe, discussed in previous sections, will be the increasing urgency to address global warming and to intensify the investments made in sustainable mobility and in the building quality urban spaces over the last 20 years. How will society address the mobility dimensions of this major challenge – and what will be the impact on goods trips in the future so that economic growth and customer service is not compromised?

The more customised consumer demands of the future (Section 4) will impact on patterns of goods transport, as will the increasing complexity of products that also may require more 'factory to factory' transportation as part of product production, in addition to the final last-mile delivery chain. Increased specialisation in production can occur across sites, each one having a demand on the road/rail system. Single site production saves trips but the transport system has been used increasingly as a mechanism for specialisation of production – for example in car assembly across many sites. These production chains can place added pressure on road corridors in port cities for example.

Dispersed activity patterns place greater demands on goods logistics and on the service sector to deliver at-place and on time. Effective supply chains serve economic growth. In addition, goods and services cover a wide range of vehicles in the road eco-system – from large HGV vehicles with trailers to light vans for local delivery, to new innovations such as cargo bikes and motorcycles. Each type of vehicle has very specific needs in terms of the road and roadside infrastructure that is required to enable them to operate, particularly at the upper ranges of weight and physical dimensions. The infrastructure, whether it is physical or digital or the hybrid 'phygital', is therefore the key enabler that will make the difference between a viable operating model on future roads or not.

However, just as the trips people make are part of a wider lifestyle of activities, so goods deliveries do not operate in isolation. Without the associated manufacturing capability, warehousing infrastructure and overarching management and coordination, there would be no control over the conditions that are required for a stable and predictable supply chain. So this will involve physical infrastructure on the road eco-system, working with digital support systems for deliveries (from bulk delivery to pizza home delivery) – fully phygital provision.

In this context it is important to realise that meeting the needs of a future road eco-system will involve:

- Measures directly involving elements of the transport part of the logistics chain (for example, loading/unloading bays on street), or
- Measures targeted at the non-transport side of the logistics chain but which have important impacts on the nature of goods deliveries (for example the innovation of 3D printing, consolidation centres)

So to understand the future of goods mobility in the road eco-system, it is important to look at the role it will play in the wider supply chain – and the likely compromise between what the optimal road/roadside conditions would be for the most effective goods operations and the other competing social and environmental demands on the road eco-system.

In the 2020s and 2030s, the key challenges will be:

- Growing environmental concerns and developing regulatory responses;
- More consumer demands for convenience and service quality;
- Increased traffic volumes and congestion of public spaces (curb space for loading and unloading);
- Emergence of new distribution channels and growing complexity of goods;
- Incorporating innovation into already complex urban supply chains;

- Wide array of stakeholders involved in the policy planning process (government, transporters, residents/consumers…) and, often, diverging views about the place of logistics in the city's future.

In structural terms the goods supply chain has evolved over decades into an integrated network of complex arrangements shared by many operators and interested parties, all dependent on the road ecosystem. Routes to market are many and varied but we can take a typical example from the food supply chain to illustrate graphically how the supply chain works.

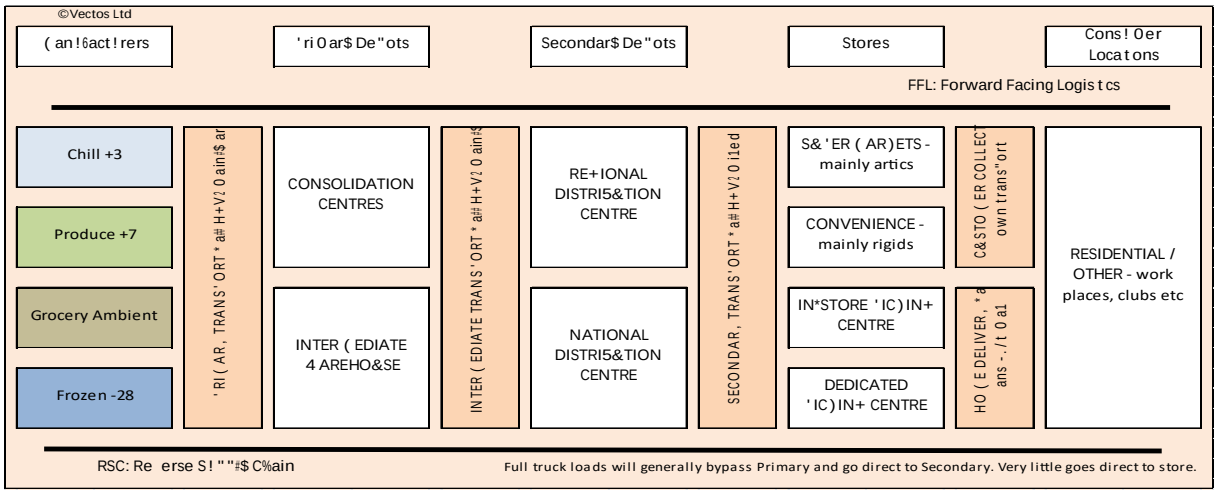

Figure 23 An example of supply chains in the food-retailing sector.

Source: Prepared by Paul Green, Vectos

Figure 23 is an overview of the interrelationship of the various stages that come together to form a viable supply chain, in this case from the example of the food sector. Products pass through this supply chain, being transported and transferred between vehicles at each stage. At certain points in the supply chain, it is possible to combine goods from several sectors for delivery. This is very good for efficiency and emissions but adds significant complexity to the process – this is termed Supply Chain Management (SCM). SCM integrates supply and demand management not only within companies but also across companies. It includes coordination and collaboration with other goods road users, which can be suppliers, intermediaries and third-party service providers. What is significant for the future of goods deliveries in the road eco-system of the future is that the supply chain now includes the customer.

Prior to the growth and growing popularity of home consumerism, customer's interests were mostly represented by store or product and service based availability but today customers are direct stakeholders in supply chain functionality. The extension of consignment visibility now extends to the front door, whether that is a residential or business customer – the last mile – using app based real time consignment tracking. In the future, for some products, this process could be taken a step further with 3D printing at the destination.

As part of that physical extension of the supply chain, service providers in future will have to satisfy not only instant availability but ever-shorter lead times and ever more precise time (delivery window) accuracy. These requirements reverse all the way back through the supply

chain emphasising the need for end-to-end connectivity. This demonstrates the supply chains' dependence on technology. Pre-digital supply chains were not capable of this level of service. Additionally, the majority of supply chains are part of private enterprise and as such within sector competition puts supply chain against supply chain. The ability to 'deliver' (or not) can therefore be a source of competitive advantage.

In recent years, working against supply chain competition, there have been attempts to encourage cross-company goods consolidation centres for last mile delivery: These have had a mixed success. A successful operation, with public subsidy, was established in the Bristol region of the UK, serving the cities of Bristol and Bath with electric powered vehicles. The results, (CIVITAS VIVALDI and CIVITAS RENAISSANCE) showed a significant reduction in the number of goods vehicles on road corridors in the two cities. In the historic city of Bath, where there are many small shops for tourists, proprietors were able to use the consolidation facility for stock storage, releasing shelf space in the shop to increase sales, relying on the consolidation centre for just-in-time delivery when stocks were low – thus increasing the number of goods deliveries/refuse collection required. While cross-company goods consolidation is a current theme, it is clear that such options should form part of future strategies to reduce pressure on road corridors.

6.3 Factors influencing future goods transport in the road ecosystem

Smaller vehicles performing the same amount of work

Looking into the next 20 years, given EU economic long term forecasts, the amount of freight that is moving will at least continue at present level. However, if demand continues to move towards less efficient small consignment work we could see a reduction in tonne kilometres (lifted) resulting in more vehicle movements to do the same amount of work. This will not be acceptable to those engineering a road ecosystem that meets future social and environmental needs.

Urbanisation could increase goods transport demand on corridors

One trend is the increase in urbanisation, shown in Section 3.5, although definitions of what constitutes the 'urban area' can vary widely between member states. If urbanisation does increase, it will have the effect of concentrating the demand in our towns and cities. From a logistics perspective that could be a good thing in that critical mass is always a key issue for logistics efficiency and especially helpful if, as predicted above, the trend towards shorter and shorter lead times has a negative impact on transport efficiency. However, this will put yet more servicing traffic on the urban corridors, particularly in town and city centres.

Energy requirements on road corridors could be considerable

As the transition from fossil fuelled vehicles increases, there will be a significant need for roadside charging infrastructure, considering the requirements from HGV vehicles to light vans, electric cargo bikes etc. Distributed lorry parks may be able to consolidate and ease the greater part of this impact, although this will require a forward-looking approac fom

SUMPs and future land use planning. In a road ecosystem where vehicle types are uncontrolled in the future, goods operators will only adopt cleaner vehicles if they provide the same level of efficiency for the same cost. The road ecosystem of the future is therefore one where increasing regulations will be placed on goods vehicles.

Goods traffic demand management measures could reduce road traffic volumes

Another future response could be the creation goods demand management systems using access control systems, such as those being introduced in some Italian cities, or regulations within low emission zones. In these cases, the entry of goods vehicles onto the urban road corridors is controlled with the option to set strict conditions for timed deliveries, vehicle type and potentially vehicle numbers – loading spaces could be booked in real time. Ultimately, this approach could potentially lead to city consolidation becoming mandatory thereby offering the critical mass needed to make such an operation viable.

Home delivery services will continue to add logistics traffic throughout town and city centres, sub-urban and peri-urban areas

The trend towards shorter lead times has been a gradual evolution. However, the pace at which change takes place has undeniably accelerated – most recently with the expansion of home delivery. What might previously have taken a generation to transition may now occur in a single disruptive event. The lifestyle trends discussed in Section 4 will lead to shorter and shorter lead times, set to continue into the future and introducing a new level of goods vehicles onto road corridors – from walking deliveries, cycles, motorbikes and vans. These will require roadside space for intermittent deliveries. It is likely that, over time, motorised deliveries will be increasingly electric.

6.4 The future needs of goods transport operators

In the decades to come, the needs of goods transport operators in the road ecosystem will be strongly influenced by 4 primary factors:

- Increasing urbanisation and changing lifestyle demands
- Increasing demand for frequent and just-in-time deliveries in urban areas.
- Increasing competition for limited infrastructure in the road ecosystem.
- Increasing complexity of the problems both faced and caused by urban goods transport.

The primary objective for goods transport in the coming decades will be the achievement of sustainable urban goods mobility. This has been the basis behind the development of the

public acceptance, a regulatory (demand management) environment for urban goods mobility, a solid economic argument and so on.

At the road corridor level, the key elements for meeting the needs of road users are:

- Consolidation of deliveries in networks of transhipment centres;
- Smaller, cleaner vehicles - Create the opportunities for the investment in shorter range, but cleaner, low noise, energy and emission efficient vehicles – last mile deliveries;
- Innovative infrastructure – i.e. used on a 24-hour basis to improve capacity;
- Quality logistic facilities – such as real time parking reservation for loading/unloading, off-road parking, charging points;
- Physical measures and segregated spaces to reduce road safety risk from goods vehicles, sensitive location of parking bays;
- Reverse logistics for packaging and waste;
- Digital communication to ensure first time delivery and real time capacity to adapt.

Perhaps the greatest challenge will be to develop future urban goods mobility as a multi-modal, multi-level system on road corridors, in the same way that we view the transport of people. In this context we might have two visions for goods transport in road ecosystems for 2030 and 2040 (although many other combinations may be suggested):

2030 Model

- Goods consolidation on the urban periphery;
- City-wall policy to restrict certain classes of vehicles from entering the urban corridors;
- Last-mile 'Green delivery' with ability to use road lanes and bicycle lanes as appropriate;
- Smart phygital infrastructure on 24-hour management for loading/unloading;
- Use of drones for emergency goods response.

2040 Model

- Goods consolidation on the urban periphery;
- City-wall policy to restrict certain classes of vehicles from entering the urban corridors;
- Tube delivery system from consolidation centres to 'goods stations' on the road corridors with smart infrastructure for loading/offloading coordination;
- Last-mile 'Green delivery' with ability to use road lanes and bicycle lanes as appropriate;
- Use of drones for emergency goods and priority class deliveries.

Evidence from recent SUMPs suggests that cities remain uninformed of the possible options for sustainable, low carbon goods transport delivery, although best practice solutions are emerging in some areas (such as green mode and last mile delivery) that can provide the start of a longer-term strategy. However, in combination with these advances, technology is providing more radical solutions that will meet future user needs on the road ecosystem that will harmonise economic efficiency in logistics with a low carbon, more liveable urban space.

7 Future evolving business models for transport operations in the road ecosystem

It is clear from previous sections of this report and MORE Deliverable 3.1 that the prospect exists in future decades to develop smarter road corridor ecosystems - to achieve low carbon, sustainable mobility with high quality urban spaces and at no loss to economic efficiency. Technology has been developed or is at least in the latter stages of development to provide smart transport and ITS systems that could be deployed across European road ecosystems. So will it happen - will it happen quickly enough – and of relevance to this section, who will pay for it?

7.1 The future transport business in the road ecosystem – moving from a 'public' marketplace to a marketplace of diverse individuals

Future lifestyle trends across the generations would appear to prefer a more flexible, customised supply of transport (people and goods) – just on time and responsive to their increasingly diverse lifestyle needs. In addition, the public mood is also supportive of sustainable mobility and low carbon solutions, a mood that is being championed by the younger 'digital' generations.

The growing 'Green economy' is seen as a major World economic growth sector for the coming decades, in which transport has a major stake. However, the public sector has problems of capacity shortage and financial scarcity to take-up the new solutions that are now emerging and that many think are within the 20-year planning time horizon of a SUMP. One answer to this problem has to be private sector finance and *new forms of business model*s - Business models that respond to the values of the future mobility marketplace that can meet the needs of future users of the road ecosystem. In encouraging the private sector, the public sector still has a central role. Services built on new mobility business models will not survive in the market unless they have an injection of public finance (for example for physical or ITS infrastructure).

There is a widely held vision among transport planners that the future of mobility is characterized by a shared, connected, highly automated and electrified transport system, providing comfortable, door-to-door and schedule-less travel. Recent transport history reminds us that such technologies can take decades to become commonplace modes of transport, from the time they first emerge as technically viable systems. The implementation of connected, automated mobility for example will require public/private investment on a large scale. During this evolution from the early 2020s, mainstream transport modes will continue to be the backbone of urban road ecosystems.

The same cannot be said for ITS systems. Software, as recent years have demonstrated, does not necessarily have the long implementation path that new transport technologies have. Applications to support new transport services have been successful in penetrating the market and this pattern is likely to intensify in the 2020s. Software systems have low investment costs and potentially high profit margins if the product can achieve a critical mass market. Software mobility products such as Uber or Waze provide a transport service through the use of Application for information, booking and payment – the business model makes the distinction between the 'digital transport service' and the vehicles and operators on the ground.

These 'user oriented business models' will diversify in the coming years, enhanced further by new technological advancements related to the Internet of things, machine learning, blockchain and artificial intelligence.

7.2 The 2020s – a streamlining period for new mobility-related business models

In developed countries such as the EU member states, transport in 2020 operates on a highly regulated regime of licensing driving and regulating the ability to operate and drive public transport, taxis or goods vehicles. Regulations specify the conditions for operations. Transport networks are planned and operated either by public transport companies or, more commonly, tendered to private transport operators who compete to run services, either as a whole network or on a route-by-route/sector by sector basis. In other areas of the World, mainstream public transport shares the mobility market with a range of informal and popular transport modes, such as Dolmus (Turkey), Matatus (Ethiopia), Jitneys (The Philippines) and so on – 'mobility populism'

Urban transport users remain dependent on the primary regulated public transport networks. These generally operate on a business model where the commercial risks on levels of use are taken either by the public authority or by the operator. In recent years, with the growth of the 'sharing economy' there has been the growth of growth of a new range of transport services whereby motorised vehicles and bicycles are shared rather than owned. These services are highly diversified and operate in most cities in Europe. Despite their popularity, they remain at the margins of transport provision. However, it is accepted that these services may increase in future years, having a strong appeal to younger generations.

The International Transport Forum have been classified new business models for the mobility sector by in three types[41], which will continue and be refined in the 2020s:

- **Business-to-Consumer (B2C)** service models: This is the business model of vehicle sharing (car, bike, scooter) and of Microtransit[42]. Vehicle providers usually own or lease and maintain a fleet of vehicles and users are allowed to access the service via membership or usage fees.

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ITF/OECD, 2017. Shared Automated Vehicles: Review of Business Models

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- **Peer-to-Peer (P2P)** service models: This business model is where several people can provide vehicles for vehicle sharing – either for car sharing, ridesharing (carpooling) etc. Transactions occur between individual owners or renters using a company developed online platform. The company only supervises the service but does not own the assets being shared.

- **For-hire service** models: This model involves hailing a ride and splitting a ride with other passengers. The customer hires a driver for transport services, on an as-needed basis. The vehicles can be pre-arranged either by reservation or booked on-demand using different options (street-hail taxi, phone dispatch, e-hail and other internet enabled devices).

Such services have evolved with the new life values of younger 'digital' generations. These generations place less importance and status in owning mobility and express a preference in sharing modes when they need them - and this is a considerable market opportunity.

In the road ecosystem in 2020, there are a plethora of new transport modes operating these new business models, each one competing for finite road space. The infrastructure requirements rely on linking standard public transport with shared modes in what are termed 'mobility hubs'. These can be developed as extensions to existing multi-modal interchanges or as small on-street sites for example for bike or scooter sharing (conventional and electric). However, many locations lack suitable pick-up spaces for ride sharing, or for parking for car sharing. The 2020s will see the development of more effective hubs in the road corridors, improving and streamlining current designs into the street architecture. Mobility hubs will also develop areas for remote working and lifestyle facilities – the so-called '3rd Places'. Mobility hubs of all sizes present commercial opportunities and the development of surrounding high quality public space.

7.3 Business models beyond the 2020s – a mix of diversity and integration

In the decades beyond 2030, earlier sections of this report have shown the demographic challenges and lifestyle transitions that the road ecosystem will have to prepare for. In addition to the current mix of private cars, road and rail based transport modes, active mobility and shared mobility; completely new transport modes are now on the table for the middle of the century or perhaps before:

- Automated vehicles;
- Low altitude air mobility;
- Hyperloop technology (urban adaptations).

Microtransit represents public transport services operated with small dimension vehicles, characterized by a degree of flexibility. Current microtransit options fall into one of the following: services with fixed route and fixed schedule or services with flexible route and on-demand scheduling.

What is clear from 2020 is the gradual transition to electric mobility and the phasing out of fossil fuels.

Economic operating models in the future road ecosystem will be dependent on a number of factors:

- **Restraint** - The extent to which policies discouraging car use are beginning to be effective;
- **Digital mobility** – the extent to which mobility patterns will start to be substituted by virtual travel online;
- **User preferences** - Whether the current reduction in car use among younger generations will continue (for example when Millennials start families);
- **Fiscal pressures** - policies to raise taxes on multi-car ownership may encourage households to forego a second or third car in favour of joining a car or cycle sharing scheme – or simply to walk and use a privately owned cycle;
- **New public transport opportunities** – such as demand responsive services and mobility as a service (MaaS).

These policies will increase the market for public transport and shared mobility schemes. Mobility schemes could become more 'bankable' for inward investment as patronage increases. In addition, innovative measures will continue to be introduced. For example, in Cardiff, UK in 2020, doctors will be able to give medical prescriptions of six months free cycle hire to patients suffering obesity. Cross-sector business models could become more prevalent; particularly as the health benefits of active mobility take a high priority, given current trends.

Two key features may then dominate the transport provision in road ecosystems – a greater diversity of business models and public/private investment in the mainstream transport systems:

Diversity in business models will increase:

- **New entrepreneurial niche business models** - The market for mobility services is contestable – entry into the market as micro-businesses is possible to enable a wide variety of mobility services to come onto the market, offering the niche and customised mobility that future lifestyles will demand.
- **Public-private business models for primary investments** - Business models based on public-private cooperation may increase for primary public transport investments, including long term investment and risk sharing to provide high quality services to customers to compete with car use that will be coming under increasing pressure in the face of carbon reduction targets and households reassess their mobility needs.

Integration – a new development of hybrid business models could increase

- **Cross-sector business integration** - Transport is a derived demand linking all areas of lifestyle activities. In future years there could be the development of hybrid business models integrating transport investments with business models in other sectors. Also the possibilities of transport services attracting inward investments from companies and

institutions that see the benefit of having a transport acquisition – for example as a result of the instant fare revenue on the group cash flow.

- **Digital mobility business integration** - In countries where market penetration of mobility services is high, and a variety of services are available for the user, the next step is to integrate all services into a "one-stop-shop" – a one-payment platform. It was noted that having several services with independent platforms for users is not as attractive and easy. Multiple logins are needed reducing the willingness to use the available services in an integrated way, for a door-to-door experience.

There is a body of work looking at transport developments for 2030 and beyond. Much of this work focuses on the potential impacts of automated vehicles – for example studies in Oslo[43] and Lisbon[44]. An example of these types of studies is shown in Figure 24 that compares the costs of transport modes in the UK against an automated vehicle Mobility as a Service model (electric powered). As approximately half the cost of on-demand private hire vehicles relates to the costs of the driver, the authors estimate that AV MaaS provision could be up to 40 per cent cheaper than private vehicle ownership by 2030.

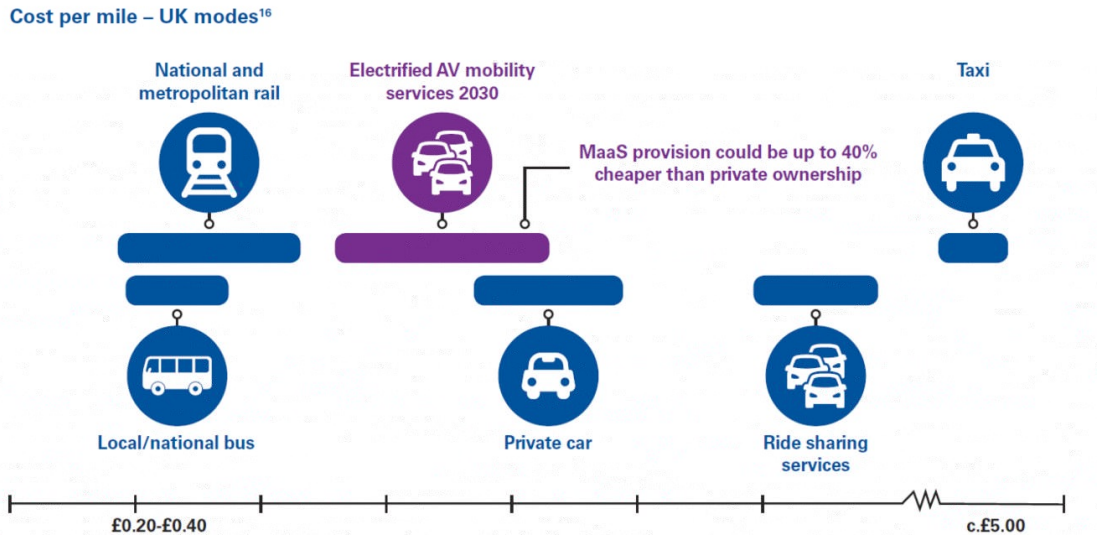


Figure 24 The predicted costs per mile in 2030, comparing different travel modes and a hypothetical automated MaaS service

Source: Mobility 2030: Transforming the mobility landscape, 2019, KPMG International Cooperative

Some predictions have been made about the potential changes to business models if automated mobility is implemented in future decades. These are based on current developments and existing knowledge about shared mobility services:

- **Ownership and control** - The most important elements for defining future 'automated' business models are predicted to be whether vehicles will be privately owned and who would manage and operate the automated vehicle network.

43 The Oslo Study – How autonomous cars may change transport in cities, COWI, PTV, RUTER, 2019

44 Urban Mobility System Upgrade. How shared self-driving cars could change city traffic, ITF/OECD, 2015.

- **Private versus public ownership** of vehicles was not shown to generate significant differences as it does in current practices.
- **Shared automated options** - With a fully automated fleet, car sharing and ridesourcing become very similar services. Users will be able to call a vehicle on-demand and be driven to the intended destination.
- **For-hire and Business-to-Consumer** (or Peer-to-Peer) services are predicted to become quite similar in case of full automation. This is a result of eliminating the need to hire someone to drive and only focusing on sharing the vehicle

Transport business models beyond 2030 will depend on the speed with which urban authorities and national governments are able to implement policy. Past experience would suggest that the speed of implementing new transport technologies may be slower than many studies predict – particularly with regard to automated vehicle penetration in the market – while the transition from fossil fuels to electrification is more likely to be commonplace in most European road ecosystems by 2040.

7.4 Business models for future transport in the road ecosystem

In 2000, a city holding an event such as a 'mobility marketplace' would not have been thought possible, nor even would the concept have been understood by many. Yet by 2020, such events are becoming commonplace as the mobility arena is opened up to a wealth of new mobility opportunities. Indeed, start-up companies in the mobility sector are one of the most vibrant areas in the last 10 years. A diversity of business models from small local mobility initiatives to global companies have sprung-up. Where will this develop beyond 2020? A return to the old practices of fully regulated and planned transport 'systems for all' is unlikely.

Not forgetting that a majority of city travellers are car commuters or use mainstream public transport, there is no denying the explosion in new business models generated by the goals of the Green economy. Moving forward, we have seen that future decades may hold major business opportunities in the transport sector as road ecosystems respond to changing user needs. However, these opportunities have significant challenges to overcome to realise their full business potential:

Opportunities:

- Develop attractive transport alternatives to private car use on the market;
- Increase public – private cooperation to enhance the viability and sustainability of new business models;
- Develop business models for user oriented 'customised' services ensuring door-to-door travel (planning) with a high level of integration;
- Maximise the potential to use pricing and other types of incentives to encourage a shift in mobility behaviour away from private motoring;
- Maximise the potential to reduce operating costs per mile and consequently user cost, based on selected business models.

Threats:

- Strategies for design and operations on urban road ecosystems need to implement more radical policies to accelerate a change in the modal share, encouraging a higher take-up of shared mobility services by current car users and continuing to promote mainstream public transport and active mobility strategies in local streets;
- We know from UK evidence that competition between operators for the mobility market in road ecosystems can divert the focus toward 'operator against operator' and away from 'operators against private cars';
- Future business models, to achieve their full benefits may involve the integration of efforts among many stakeholders – for example for a one-stop shop for customer payment. There would have to be a common ground between operators in term of technology interoperability;
- Lack of precedence –mobility operators in the new mobility world will have to prove their credibility with local communities on the road corridors where they operate.

In 1985 in the UK, bus services were fully privatised, against a history of full public subsidised public transport. Many lessons were learned from this experience that will still be valid in the future (Pickup et. al., 1989) Many at that time argued that the bus market was not contestable – it would not operate like a normal industry –they were proved wrong. Public transport has become a competitive marketplace that has expanded into a range of other mobility-related markets. The other lesson that was learned in generating a competitive marketplace for mobility is that disadvantaged mobility groups suffer and require public support mechanisms. This latter lesson will be important in the future road ecosystem to ensure future mobility business models benefit all people.

PART C – Road Users – Reaching a consensus

8 Future users needs – building a consensus

The definition of the "road eco-system" concept is ambitious but it will be incomplete if it won't take into account the actual intrinsic value of the road itself for the diversity of its users. The understanding of this value is important when re-designing a road or a street.

8.1 Consensus building between the experts

The consensus building exercise has been organised with the participation of different experts such as: sociologists, economists, behavioural economists, future trends watcher, psychologists, public managers, communicators or anthropologists.

The experts have been invited to join a one-day group discussion in Antwerp, Belgium (March 2019). The discussions have been very interactive and generated valuable information. The participants in this consensus building exercise were:

- a professor, anthropologist;
- a public officer, communicator;
- a psychologist, future trends watcher;
- a behavioural economist (remote);
- a professor, sociologist (remote);
- a social scientist (moderator);
- an economist (organiser);
- an urban engineer (secretariat).

8.1.1 How have major cities in Europe managed to reduce car use on their streets?

The car use and congestion levels started to increase in post war times and by about 1980 this car use increase starts to even out. Authorities implemented different policies to tackle congestion; in the 1998-2002 period the car use in cities started to decrease and city planners consider this decrease a result of implementing mobility policies and measures. Major cities in Europe observed a decrease of the car use values to the level that almost converged to the same value. The question is why did all these cities reduce the car use to the same point, as they have applied different policies or measures? Can this be related to some changes in the society and the lifestyles? How and why would this be?

The experts mentioned that the global warming awareness might be a catalyst for such changes. The global warming discussion got a lot of traction in 2006 - people became more aware of it, it became mainstream, as a result of the film “The Inconvenient truth of Al Gore”, which was highly distributed (e.g. Belgium it was free with magazines).

Climate change is an important reason for lower level of car use as cities have targets for protecting the environment and this might determine the convergence of traffic values in 2016. These targets are not only for traffic but a general trend in most aspects of a city (recycling, reducing emissions, etc.)

Environmentalists nowadays have a very positive image; being environmental friendly is seen as desired feature by the majority of the society and it is connected with moral goodness. The people who engage in active mobility (walker, jogger, biker, etc.) are considered “moral heroes” in society while car users are completely opposite seen in the society. This current perception resulted from a shift of opinion, through time:

- “*Nothing can be gained without loss*” – Before cars, horse transport was very dirty and usually connected with diseases, etc. The car was the cleanest, best solution to horse

movement. After car usage increased and as society evolved, cars are considered dirty and bad, while other modes are perceived as being better.

- "*Anthropocene*" – term defining the human's impact on nature. It was defined in the last 50-60 years.
- The *moral component* nowadays:
    - "Walker is an exemplar of rebellion and freedom in the city. He is the pedestrian hero."
    - "Walking is wrapped up in narratives of resonance, morality and aesthetics that constantly contrast with mechanized forms of movement which are represented as less authentic, less worthy and less ethical."
    - When discussing morality, it is important to understand who the judges of morality are. In these cases, it is mostly the peers and the establishment.

The tourism industry has contributed to the awareness of climate change; the industry recommendations to not wash towels daily became standard criteria for major hoteliers. Young generations are interested in transparency, generating an interest to know how tourism providers (hotels, etc.) are using the additional revenues resulted from eco-friendly initiatives (reducing towel washing). This in turn generated a response from the tourism industry; with some hotels leaving messages in the rooms about how they use the revenues from savings resulted from environmental actions (i.e. planting trees).

Increased access to information and ideas is huge nowadays. Societies transcend national boundaries; there are many elements that support interaction. The technological advancements made it possible to access information ("avalanche of information") and the speed of propagation of new ideas has increased. The correlation between the period when Internet became mainstream and the changes that occurred in cities should be further investigated.

The generational aspect should be taken into account as something happens in the way technicians changed the way they do things. Young professionals working in transport in the '80s were highly environmental conscious but had no power of decision; at mid '90 they came into positions of decision and remained as environmental conscious as before and they were finally able to implement sustainable mobility.

The younger generations are highly influencing the car usage reduction trend. The number of car ownership or driving licenses has been falling down in recent years. For the 1995 – 2018 period, number of new driving licenses in Belgium has decreased by 22%, most of the decrease being in the last 15 years.

Car usage is determined by financial considerations as well, as it implies higher costs of driving for the young generation, an investment that brings limited return as there is not much use for a car in urban areas as there are a lot of new alternatives to move in the city.

Gender balance in car usage - some changes occurred as women started to have more independence, and freedom of driving oneself. In the past a reduced number of women were driving, while in current times the percentage of women driving has increased, also generating an increase in households owning more than one car.

There are different trends in urban society based partially on its multi-cultural character:

- The less fortunate tend to be closer to major road infrastructure, a major road infrastructure becomes a barrier that segregates communities (including community characteristics).
- Closer to the city centre there are more elite communities and the social interaction is more diversified as there are less barriers.

There are 3 major theories about how social groups will behave and the result, in reality, is a mix of these:

- Society is a group that behaves similar to an organism, it has a life of its own;
- Society is made out of individuals, and some of them have similar opinions and behaviours;
- Society is made of different groups that sometimes get into conflict.

The touristic potential of cities that show a decrease in car usage is significant. Major cities are usually top touristic destinations and such cities face an over-tourism problem, felt keenly by smaller cities. For example, people mostly rent houses in Amsterdam they don't own them. Airbnb makes renting in the city for locals highly costly as the tourism systems is evolving from a closed systems (hotel) to an open system (direct local renting). The rental prices in Amsterdam did not decline during the economic crisis, they increased. The tourists are staying in former local residences and the local population is leaving the city which generates less car usage and ownership in the city as tourist generally use public transport and alternative modes for transport during their visits. The local fabric of the city is now breaking as locals are leaving the city.

Price of retail, on street level (ground floor), is also increasing (increase of 15-20% of rental prices). The local, artisanal shops cannot compete with on-line shops and increasing rents. The shops are converted to touristic responsive businesses. French median dimension cities show similar trends as the Amsterdam example.

Although car usage is decreasing in major cities, the number of delivery vans is increasing and they need to use the city's space differently than other cars. This is generated by a growth in e-commerce.

8.1.2 How are cities changing and how is street use changing?

MORE capitalizes on the CREATE research looking at urban corridors and taking the research further. In this context it would be interesting to look at how the role and usage of streets has evolved, in the context of increased auto mobility and what this evolution is generating, in terms of communities wanting to reclaim the space of the street and how this can be done or prioritise.

Examples of how road usage has changed in time and n□c□ peoRaps sagcorenchs sagIs□ sagi□of

situation has changed in the ‘80s, as it became too dangerous for children to play in the street.
- Reallocation of the street space in urban areas are now products of co-creation exercises: people are showing interest in reclaiming street space to create room for children playing by removing parked cars.

Car ownership is still high in cities and this could be a consequence of the existing distrust in the public transport system. People prefer to use public transport but are not convinced by its reliability so they keep cars to compensate a lacking public transport system. This is expected to change as mobility services evolve towards sharing and connected transport, providing user-responsive services, compared to a rather fixed public transport system not fully tailored to user needs.

For sharing start-up services, scale and fragmentation is a problem. They are not able to scale up initial projects, lacking in funding or understanding of user needs or methods for scaling up so there is a potential for the government to step in and support the scale up. There is also a lot of interest in developing a service / product at an individual level, although developers are connected, they do not interact with their peers.

One size does not fit all – this applies to services developed in the city, so several services are needed to complement one another and provide options for a wide spectrum of demands.

How will the road evolve from an anthropologic perspective and what is the road’s potential to change the environment? How are local authorities seeing these recommendations? The answer is found in “going back in the future” and embracing the social perspective of streets, places where people meet and interact and move. Texturing, consideration for pedestrians, lighting, and design particularities are what give or channel the focus of a street as a place not a moving corridor.

The new neighbourhoods should have attraction points to generate movement as well; dead end streets are not attractive. The priority is for places before movement, but movement must be there as well.

Roads have “atmospheres” and these will connect with the new functions given to roads (streets focused on living, connection, shopping etc.). Fostering different “atmospheres” is done with different street space allocations to support their function, such as more space for pedestrian on shopping streets.

Engineers who are not focusing on user needs but rather on design standards develop the streets. Some elements providing comfort for pedestrians and emphasizing the “atmosphere” concept:

- Lighting is important for safety and perceived safety on the road and comfort during usage: orange light is good for cars but not great for pedestrians and bikers; yellow light is attractive and comfortable for pedestrians. Atmosphere is influenced by lighting, which can be “unseen”, provided by architectural lighting (e.g. Ghent) while at the same time ensuring enough clarity for safety.

- Pavement should be safe and comfortable for walking for all user groups, including people with reduced mobility;
- Spaces for rest throughout the route;

The concept of street atmosphere implies that streets can be developed to increase relaxation, diminish the 5 main categories of anxiety related states. This would also imply a different attachment to streets;

“Airpocalipse” – the air pollution issues – in some cities (e.g. Antwerp, Brussels) where air pollutants are measured, the streets / neighbourhoods are classified based on this values and citizens are aware of the air quality in their neighbourhood. This firstly generates awareness but it also generates outrage from the community. At the same time this awareness is affecting the urban-rural migration patterns, as people move to areas with better air quality.

Questions to be further analysed throughout MORE research:

- *How will these trends evolve in the future?*
- *How communities around these roads may evolve in the future with technologies? Are there on MORE corridors examples of communities where housing / retail spaces have been restored from low income housing to higher quality catering to tourists?*

8.2 Wider European assessment of future road users’ needs

The wider European understanding of the future of road users’ needs have been analysed in a workshop organised in June 2019. This interactive workshop has been jointly organised with IRU in the context of the analysis carried out by them on the actual road users’ needs.

The results of the research on the future users’ needs has been discussed and validated together with all the main road stakeholders invited.

8.2.1 Stakeholders – pedestrians

The major recommendations of the stakeholders in pedestrians is to shift the focus in the future:

- The focus should be on safety aspects and not on number of collisions;
- The need to improve Vision 0, and not focus only on fatalities and injuries: ***“If our dream is not to be killed by our streets, that’s a poor dream”, said a participant.***
    - Focus on fatalities > Focus on Modal shift;
    - Road Safety > Road Danger reduction;
    - Traffic calming > Livability;
    - Ethical imperative > Political choice.

Current and future user needs:

- A more attractive and well equip public realm: more resting places, more shade, good pavement, active frontages;
- Safety for vehicle – pedestrian interactions;
- Improve pedestrian crossing: abundant in numbers and with sufficient time for all type of users to cross comfortably;
- Improve air quality and reduce noise pollutions (first type of pollution perceived by pedestrians);
- It is important to create an assessment method (set of indicators) to assess walkability.

8.2.2 Stakeholders – cyclists

Current and future user needs:

- Safety – it is important to ensure separation of cycle routes from fast and heavy traffic. The need increases with the speed;
- Increased connectivity at regional level combined with support for using electric bicycles – a combination between electric bicycles and cycle highways enhances the distance of travel for potential users. If a classic bicycle is preferred for distances up to 5 Km, an electric bicycle is comfortable for distances up to 20 km on a cycle highway. This also implies a need for higher design standards.

8.2.3 Stakeholders – Commercial Road Transport Operators

(bus, coaches, and trucks)

The latest fleets of vehicles are characterised by very low emission productions (comparable/ rival to their electrical counter-parts);

Proposals for the future:

- At EU level – to have a framework for consultation, information and mutual recognition.
- At local level – to focus on prioritization rather than restriction for commercial vehicles (including delivery vehicles). This could be achieved by better connections between commercial services and the traffic management system of the city.

8.2.4 Stakeholders – the cities

The role of cities is changing, as they need to extend their previous areas of focus and improve their practices:

- Sustainable urban mobility policies have evolved towards: “multimodal – intermodal – clean – safe – flexible – affordable – connected – user-centric – inclusive – shared – healthy - seamless” and local authorities must be able to take on new roles in order to cater for all those characteristics/requirements:
- “Regulate to innovate” as one of the participants mentioned:
    - Anticipate, build understanding of possible impacts and identify where innovation can deliver positive outcomes or where there are risks;
    - Base the local initiatives on common conclusions between stakeholders through talks and cooperation;

    - When defining measures, focus on maximizing the opportunities and minimising the risks;
    - “Lead by example”.
- Public authority as urban space manager, is characterised by responsibilities for the following:
    - Land use planning that supports densification;
    - Transport interchanges;
    - Prioritizing modes through space reallocations;
    - Pricing public space;
    - Dynamic kerbside management.

All user groups’ representatives considered safety issues are important and it will be a major aspect to take into account when focusing on how to make the traffic better, especially increasing safety by reducing the traffic. They also considered that sharing information between different stakeholders it should be the fundament of any future developments. Although the main aim in redesigning roads to encourage the private car traffic, the focus still should be how to obtain a balanced modal share and ensure a quick access to the city to all traffic participants (e.g. delivery, coaches, etc.).

9 Drivers for future demand for road space

In the previous sections of this report we have looked at different dimensions that will determine future road users’ needs. The results of this research could be summarised in twelve major drivers for future demand on the road space, identified as the future road users’ needs.

1. More attractive public spaces

The public spaces in cities are in a dynamic change. The economy changes, the trends in fashion, the advancement of technology influences how people use the public spaces. In the same time, the configuration of these spaces influences how people behave or use their social networks.

The change in the configuration of a neighborhood will contribute significantly to improve the quality of life of their residents. The function of the roads and the intrusive role in the areas they’re crossing could be changed. Better design roads and public places could allow people to spend more time outdoors, to socialize more, children could feel safer going to schools. It will also influence the decrease of the road collisions and make the space safer.

By investing in good quality public spaces and in the infrastructure for active mobility could influence the levels of pedestrian, of cycling and of micro-mobility use.

The redesign of new public spaces should take into consideration the demographics trends with ageing population. The future street furniture and the basic road infrastructure should cater for the ageing population.

Understanding of how loneliness and depression will also be essential in how you design spaces is very important; the future design of public spaces and of the road infrastructure it will be essential that the people should not feel isolated and moreover will encourage them to meet and talk. Equally, if the spaces are well designed will encourage the sedentary people or even children (growing trend) to exercise more.

The improvements of public spaces have demonstrated, through increased house sale prices and retail rents in the local area, that individuals and businesses place an economic value on improved public realm.

2. Seamless mobility integration

In the future, people will demand seamless integration between modes, and this will determine how they use their mobility choices. People will have high expectations for their mobility, they are much more demanding because they do not want to lose their time, but use it efficiently. Seamless integration could be facilitating by the integration hubs that could also host commercial or social developments. The future expectations of people are to get everything instantly: food, shopping, mobility etc. It is important to allow people easier access to their interests; the future road system should facilitate this access to cater for the future people needs.

The technology advance and the digitalisation influence how older generations will use the mobility system. The better digital competences of the older age population in the future will influence how the mobility system is developed and managed; they will demand a seamless mobility that they can own – they will have great expectation for their mobility (see Chapter 4).

3. Regulations for new transport modes

In the last few years, it is noticeable the influence of new transport modes and their take up. The local authorities however are sometimes slow in acknowledging their take-up or high demand. The lack of control for the traffic flows, the influences of disruptive technologies or of new transport business models need to be regulated. However, in the future, the regulations should meet preferences of people for new mobility products and services. It could be conflicts, as there could be many mobility providers and ideas developed, but the space is limited and the regulations have to arbitrate between the competing needs. The politicians will have a very important role in the future to support policies that will not restrict the innovation but to act as facilitators of trends to will better address the needs of road users. Regulations could be a great enabler or a huge barrier in the future development of new mobility products and services.

4. Safe streets for all

Society is less safer these days: streets are places where crime, harassment and attack take place. If we consider that the street space is limited and many people and tys lns□s□ee □ng nalS@O th

future, electric vehicles, automated vehicles and any new forms of mobility for people and goods would be developed, so the safety should prevail as criteria of using public spaces.

Specifically, the reduction in speed limits could be seen as a traffic management issue but actually reduced speed zones and areas promote walking and cycling; they have a great effect on reducing collisions. Shared space, integrating users into the same space can have dramatic effects on safety and reduction in vehicle speeds. Drawbacks of these schemes are that the mobility impaired user groups can struggle with using them effectively due to the inability to visually interact with traffic.

5. Cyber security for mobility

The concept of “Smart Cities” revolves around the interconnection of different operators from domains of activity such as public transport, energy, communication, etc. These operators rely on Information and Communication Technology (ICT) systems to retrieve, process, and exchange data in order to improve their services and the quality of life of citizens.

The integration of several ICT systems enables that vehicles, cyber-physical devices, communication networks and central servers optimize the transport service up to a certain degree of automation. While this fusion of cyber technology, physical infrastructures and mass transport vehicles creates new opportunities for improving services and functionality, it also has the effect of introducing cyber security risks into transport networks that have not historically been susceptible to such risks.

In the future, decision makers should integrate and converge security efforts made in different sectors of activity and should foster the development of harmonized cyber security standards.

6. Personalised mobility

The people would like to be in control of their movement through roads and streets; they can use the technology. There is quite a significant provision of multi-modal transportation and now it be accessed through the phone. This gives users a lot of options and give them the possibility to set preferences.

The take-up of MaaS applications in different forms and shapes it is expected, however there is little evidence at this moment if this will influence an increase in public transport or active modes trips. Most importantly, based on the demographic trends and on the advance in technology, the multitude of future mobility products and services will need to be better adapted to the users’ needs. The future transport systems should take into account the need of road users to control their choices.

7. Adapted parking policy to future mobility

Proactive planning, engineering and design—focusing on what makes our cities liveable places—is essential to ensuring the most beneficial outcomes for cities and for the people who work, play, learn and live in these communities. Finding ways to reduce, re-use and think creatively about how and where vehicles are stored means more space for the types of uses that are fundamental to livability: more and less-expensive housing, more public space,

and more recreational space for people.

With the broad range of shared transportation options on the horizon, municipalities and developers can take proactive steps today to reduce and future-proof parking that is required within cities. Promoting shared parking solutions would allow for a more efficient allocation of space and free up projects to integrate creative shared mobility options from the start.

Electric vehicle charging should be omnipresent given that a shift in vehicle fuel sources is expected to occur well within the immediate future.

8. Alternative fuels provision

There is expected that in the new future the transport electrification to have a quick take-up. The need for specific infrastructure and energy provision is required; however, this is not possible unless appropriate regulations are set in place. Moreover, policies developed to encourage the usage of alternative fuels need to set clear targets and deadlines. Once the electrification will be deployed, the streets of the future will be quieter. In case of mass electrification, the streets will be quieter, which means that people voices, noises made by children playing, birds singing will be heard. It is difficult to imagine a sound of a village in the middle of a city! But would people feel more relaxed? The people tolerance of loud noises will increase. Psychologically the streets will be different.

There are other alternative fuels that will have a quite fast take-up in the future, such as hydrogen. Its fast take-up is influenced by the speed of how new technologies are developed for vehicles based on this fuel.

9. Increased capacity for public administration

The public sector plays a decisive role with regard to socio-economic development and competitiveness. Being faced with global challenges such as the economic crisis, demographic change, and strains of increasing expectations in public services and institutions, it is indispensable for the public sector to modernize and innovate.

The administrative capacity creates the pre-condition for making innovation happen in the public sector through reform and the strengthening of institutions, as well as human capital.

10. Embracing new operating/business models and new modes of governance

Start-up companies in the mobility sector are one of the most vibrant sectors of the European economy in the last 10 years, in response to the growth of the sharing economy building on App. technology. A diversity of new business enterprises from small local mobility initiatives to global companies have sprung-up. It is likely that, in future decades, major business opportunities in the transport sector will grow as road ecosystems respond to changing user needs. A return to the old practices of fully regulated and planned transport ‘systems for all’ is unlikely – flexible, diverse and customised mobility solutions will be more commonplace, using the strengths that Internet-based technology provides. Beyond 2030 it is likely that business models for transport services will consist of business models that integrate across sectors and maximise public/private collaboration.

In order to navigate effectively the waves of change pubic authorities in general and governance structures in particular will need to express greater degrees of agility. Most likely, they will be forced to join transversal participatory networks and collaborate with stakeholders that will escape their traditional chains of command and control. On one hand, new societal models would need to include an improved capacity for resilience. On the other hand, they would need to exercise trust horizontally as a fundamental element of relationships.

11. Environmental quality

In the future, people will be more environmentally conscious and they will demand and take action in support of the low-carbon footprint (see the example of Greta Thunberg and the Swedish model of flying shame). From the society point of view people need a strong idea to follow and to have the feeling of control and ownership of it. In fact the future of society is having an enhanced control by using all the existing freedoms we experience.

12. Vision and validate

“Vision and validate” is the opposite of predict and provide. Policies that are being developed against a background of reducing car use – the ‘P’ or ‘place-based’ policies, need a new approach. This latter approach develops a wider vision of the city that combines lifestyles and mobility with the development of public spaces in the city. Using this vision based approach for your city, you start with the vision and then see what types of policies and strategies, phased over time, will be the most effective in reaching the vision – this is called ‘backcasting’ as an antonym for the more commonly used ‘forecasting’.

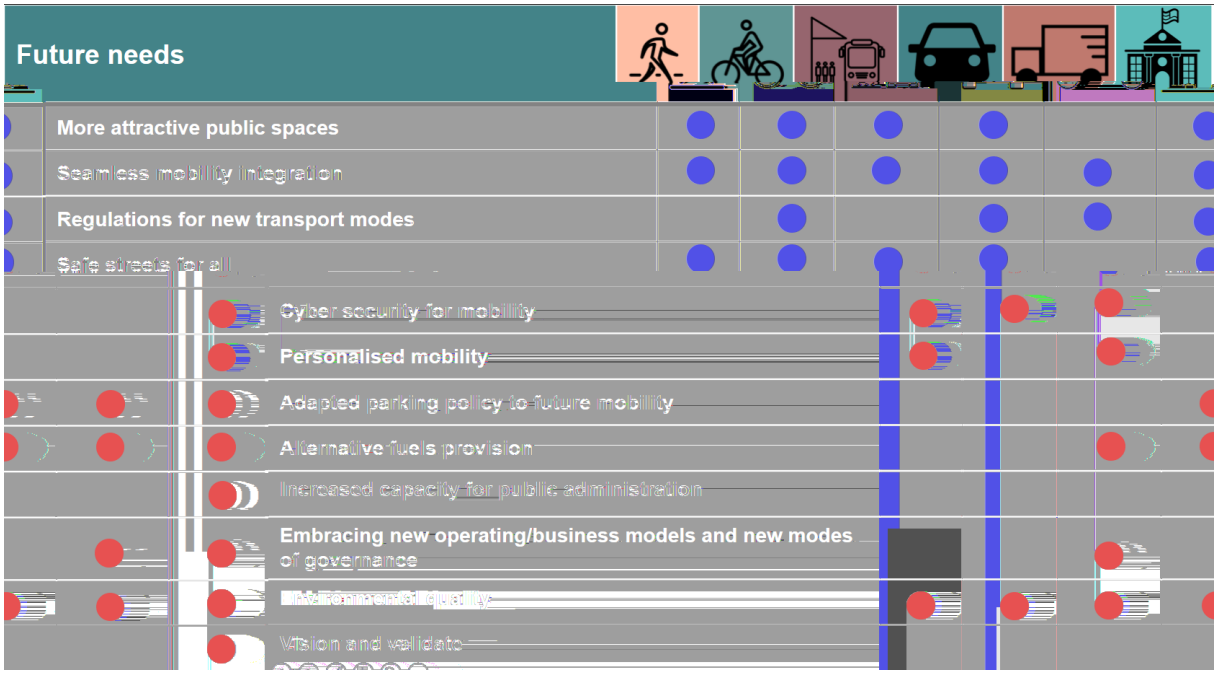


Figure 25 Future needs and their corresponding users groups

Source: Prepared by the Author

The mobility is not changed by the technology, the transport system organisation or reorganisation. The mobility is influenced by many different factors, such as socio-demographics, lifestyle change, macroeconomics etc. The lesson for the cities is to pay attention to technologies and operational modes for transport in their cities, but mainly to pay attention to the changes that influence the people that use the transport system in their city.

List of references

Accenture Consulting, 2018. Consumer Survey on Digital Health: US Results. Retrieved online: https://www.accenture.com/t20180306T103559Z__w__/us-en/_acnmedia/PDF-71/accenture-health-2018-consumer-survey-digital-health.pdf;

Antoniou L., Sørensen S., 2018. Changing mobility with innovative new business models. Retrieved online: https://www.intelligenttransport.com/transport-articles/67433/changing-mobility-innovative-models/;

Arup, 2014. Future of Highways. Retrieved online: https://www.arup.com/perspectives/publications/research/section/future-of-highways;

Balm, S., Moolenburgh, E., Anand, N., Ploos van Amstel, W., 2017. The potential of light electric vehicles for specific freight flows: Insights from the Netherlands. *City Logistics X*, pp. 539-553;

Barbaresso J., 2019. Getting infrastructure ready for the rising generation of vehicles means rethinking from the ground up. Retrieved online: https://www.roadsbridges.com/getting-infrastructure-ready-rising-generation-vehicles-means-rethinking-ground;

Bedgood, L., 2016. Mobility, Car Sharing and the Future of the Automotive Industry. Retrieved online: https://v12data.com/blog/mobility-car-sharing-and-future-automotive-industry/;

Bischof, J., 2019. Would AI be better at governing than politicians? Retrieved online: https://www.weforum.org/agenda/2019/03/a-surprising-number-of-people-trust-ai-to-make-better-policy-decisions-than-politicians;

Bloomberg, 2018. Startups Have Started a Scooter Revolution. Can They Control It? Retrieved online: https://medium.com/bloomberg/startups-have-started-a-scooter-revolution-can-they-control-it-b4a7aac604b2;

Briggs, M., Frost & Sullivan. Introducing the New Business Models Revolutionising Urban Mobility. Frost & Sullivan's Intelligent Mobility Workshop. Retrieved online: https://ww2.frost.com/files/7114/3620/7732/FS_Future_of_Mobility_ MBv5.pdf;

Brustein, J., 2018. This Scooter-Sharing Company Wants to Fill the Streets with 'Transit Pods'. Retrieved online: https://www.bloomberg.com/news/articles/2018-05-10/this-scooter-sharing-company-wants-to-fill-the-streets-with-transit-pods;

Buffer, Workfrom and Hubstaff, 2018. State of Remote Work report for 2018. Retrieved online: https://www.slideshare.net/Bufferapp/state-of-remote-work-2018-data-analysis;

Carroll, J., 2018. Trend: The Future of Intelligent Roads and Intelligent Highway Infrastructure. Retrieved online: https://jimcarroll.com/2018/06/trend-the-future-of-intelligent-roads-and-intelligent-highway-infrastructure/;

Cedefop, 2016. Future skill needs in Europe: critical labour force trends. Luxembourg: Publications Office. Cedefop research paper; No 59. http://dx.doi.org/ 10.2801/56396;

Chacko, L. 2018. Make Digital Literacy a Strategic Workforce Priority. Retrieved online: http://www.brinknews.com/make-digital-literacy-a-strategic-workforce-priority/;

Chatterjee, K., Goodwin, P., Schwanen, T., Clark, B., Jain, J., Melia, S., Middleton, J., Plyushteva, A., Ricci, M., Santos, G. and Stokes, G., 2018. Young People's Travel – What's Changed and Why? Review and Analysis. Report to Department for Transport. UWE Bristol, UK. Retrieved online: www.gov.uk/government/publications/young-peoples-travel-whats-changed-andwhy;

CIVITAS WIKI, 2015. Civitas Policy Note: Making urban freight logistics more sustainable. Retrieved online: https://civitas.eu/sites/default/files/civ_pol-an5_urban_web.pdf;

CoMoUK. Co-mobility & Themes - Mobility trends. Retrieved online: https://como.org.uk/shared-mobility/co-mobility-themes/mobility-trends/;

Cosgrove, C., 2018. IoT Applications in Transportation. Retrieved online: https://www.iotforall.com/iot-applications-transportation/;

COWI, PTV, RUTER, 2019, The Oslo Study – How autonomous cars may change transport in cities, Report. Retrieved online: https://www.ovmagazine.nl/wp-content/uploads/2019/05/NO_Report_RUTER_Frokostmoede-410-gecomprimeerd.pdf;

CREAPILLS, 2019. La ville de Toulouse va mettre à disposition des fauteuils roulants électriques en libre-service. Retrieved online: https://creapills.com/fauteuils-roulants-libre-service-toulouse-20190605;

The Scottish Government, 2010. Designing Streets. A policy Statement for Scotland. Retrieved online: https://www.gov.scot/binaries/content/documents/govscot/publications/corporate-report/2010/03/designing-streets-policy-statement-scotland/documents/0096540-pdf/0096540-pdf/govscot%3Adocument/0096540.pdf;

EBRD Press office, 2019. Age against the machine and the future of work. Retrieved online: https://www.ebrd.com/news/2019/age-against-the-machine-and-the-future-of-work.html;

Ericsson, 2018. Ericsson Mobility Report, November 2018, Revision B. Retrieved online: https://www.ericsson.com/en/mobility-report/reports/november-2018;

Ericsson, 2019. Internet of Things forecast. Retrieved online: https://www.ericsson.com/en/mobility-report/internet-of-things-forecast;

EUROCITIES, 2019. Culture and demographic change, Recommendations for cities, cultural institutions and practitioners. Retrieved online: http://www.eurocities.eu/eurocities/news/Culture-and-demographic-change-new-EUROCITIES-recommendations-WSPO-BAVJNS;

European Union, Committee of Regions, 2016, The impact of demographic change on European regions. Retrieved online: https://cor.europa.eu/en/engage/studies/Documents/The%20impact%20of%20demographic%20change%20on%20European%20regions/Impact_demographic_change_european_regions.pdf;

European Union, 2018. Global Trends to 2035, Economy and Society. European Parliamentary Research Service, Global Trends Unit. Retrieved online: http://www.europarl.europa.eu/RegData/etudes/STUD/2018/627126/EPRS_STU(2018)627126_EN.pdf;

European Commission, Joint Research Centre, Demographic and Human Capital Scenarios for the 21st Century: 2018 assessment for 201 countries, Wolfgang Lutz, Anne Goujon, Samir KC, Marcin Stonawski, Nikolaos Stilianakis (Eds.), Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-78024-0, doi:10.2760/41776, EUR 29113

European Commission, 2018. Automation in transport: how does it affect the labour force, Report. Retrieved online: https://ec.europa.eu/transport/sites/transport/files/2018-11-20-automation-in-transport-report.pdf;

European Commission, 2018. European Economic Forecast, Institutional Paper 089. Publications Office of the European Union, Luxembourg. Retrieved online: https://ec.europa.eu/info/sites/info/files/economy-finance/ip089_en_0.pdf;

European Parliamentary Research Service, 2019. Demographic trends in EU regions, Briefing for the European Parliament. Retrieved online: https://ec.europa.eu/regional_policy/en/newsroom/news/2019/01/31-01-2019-demographic-trends-in-eu-regions;

Eurostat, 2019. Population future projection, for EU-28.

Figg, H., 2019. France is investing €200 million to launch and legalise autonomous shuttles. Retrieved online: https://www.eltis.org/discover/news/france-investing-eu200-million-launch-and-legalise-autonomous-shuttles;

Frary, M., 2018. Rise of the digital nomad. Retrieved online: https://www.raconteur.net/business-innovation/rise-of-the-digital-nomad;

French Senate, 2018. PROJET DE LOI (PROCÉDURE ACCÉLÉRÉE), d'orientation des mobilités. Retrieved online: https://www.senat.fr/leg/pjl18-157.html;

Gao P., Hensley R., and Zielke A., 2014. A road map to the future for the auto industry. Retrieved online: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/a-road-map-to-the-future-for-the-auto-industry;

Gas to power Journal, 2018. Automation of electric vehicles may halve energy demand in transport. Retrieved online: https://gastopowerjournal.com/markets/item/9162-automation-of-electric-vehicles-may-halve-energy-demand-in-transport;

Ghosh, I., 2018. Mapping the World's Urban Population in 2050. Retrieved online: https://www.visualcapitalist.com/mapping-the-worlds-urban-population-in-2050/;

Gleave, J., 2018. Why most talk about AV-driven mobility business models is bullshit. Retrieved online: https://transportfutures.co/why-most-talk-about-av-driven-mobility-business-models-is-bullshit-eb0a80363614;

Government of South Australia, 2018. Local Motors Olli Shuttle and SAGE Automation Olli Stop Trial at Glenelg. Retrieved online: https://dpti.sa.gov.au/news?a=422018;

Griffis, H., 2018.State of Remote Work 2018 Report: What It's Like to be a Remote Worker in 2018. Retrieved online: https://open.buffer.com/state-remote-work-2018/;

Guo, Y., Liu, P., Liang, Q., Wang, W., 2015. Effects of parallelogram-shaped pavement markings on vehicle speed and safety of pedestrian crosswalks on urban roads in China. *Accident Analysis & Prevention, Volume 95, Part B*, October 2016, pp. 438-447.

Handury M., 2019. Amazon wants its fleet of delivery robots to be treated like pedestrians when they take to the streets. Retrieved online: https://www.businessinsider.com/amazon-wants-delivery-robots-to-be-treated-like-pedestrians-2019-6?fbclid=IwAR14MHwELVtYnatgiwzXYZjHew1VIXE9Bo%207IFQamxiKMVfk5GHWOfrFPndQ

Hjorthol, R., Gripsrud, M., 2009. Home as a communication hub: the domestic use of ICT. *Journal of Transport Geography* 17, pp.115–123.

Hsu J., 2017. Africa's Delivery Drones Are Zipping Past the US. Retrieved online: https://www.wired.com/story/africas-delivery-drones-are-zipping-past-the-us/;

IATA, 2017. 2036 Forecast Reveals Air Passengers Will Nearly Double to 7.8 Billion. Retrieved online: https://www.iata.org/pressroom/pr/Pages/2017-10-24-01.aspx;

Iceland Magazine, 2017. Photos, Video: 3D crosswalk in Ísafjörður helps slow down speeding motorists. Retrieved online: https://icelandmag.is/article/photos-video-3d-crosswalk-isafjordur-helps-slow-down-speeding-motorists;

Iceland Magazine, 2018. Icelandic 3-D crosswalk inspires city of Kansas to try novel way to increase road safety. Retrieved online: https://icelandmag.is/article/icelandic-3-d-crosswalk-inspires-city-kansas-try-novel-way-increase-road-safety;

IIASA, 2007. The growing divergence in population trends and concerns. Retrieved online: http://www.iiasa.ac.at/web/home/research/researchPrograms/ WorldPopulation/Reaging/The-growing-divergence-in-population-trends-and-concerns.pdf;

Inavero and Upwork, 2018. The Future Workforce Report. Retrieved online: https://www.slideshare.net/upwork/2018-future-workforce-report-hiring-manager-insights-on-flexible-and-remote-work-trends/1;

Intelligent Transport, 2019. Roundtable: Mobility-as-a-Service, Discussion report. Retrieved online: https://www.intelligenttransport.com/transport-articles/76869/industry-experts-roundtable-mobility-service/;

Intelligent Transport, 2019. The future of public transport: a roundtable discussion. *Intelligent Transport, Volume 03, Issue 02,* pp.12-19; Retrieved online: https://www.intelligenttransport.com/transport-articles/80751/the-future-of-public-transport-a-roundtable-discussion/;

Intelligent Transport webinar, 2019. Mobility-as-a-Service (MaaS) - Creating smarter, more liveable cities, Webinar. Retrieved online: https://www.intelligenttransport.com/transport-webinars/75603/mobility-as-a-service-maas-creating-smarter-more-livable-cities/;

Intelligent Transport webinar, 2019. Top trends series: Connecting our society and reducing impacts on the environment. Retrieved online: https://www.intelligenttransport.com/transport-webinars/76616/connecting-our-society-and-reducing-impacts-on-the-environment/;

International Monetary Fund, 2019. Real GDP growth, annual percentage. Retrieved online: https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/ OEMDC/ADVEC/WEOWORLD;

Italian Ministry of Infrastructure and Transport, 2019. Micromobilità elettrica, decreto firmato. Ecco tutte le novità. Retrieved online: http://www.mit.gov.it/comunicazione/news/micromobilita-elettrica-decreto-firmato-ecco-tutte-le-novita;

ITF, 2019. Smart Use of Roads. ITF Research Reports, OECD Publishing, Paris. Retrieved online: https://www.itf-oecd.org/smart-use-roads;

J. P. Morgan, 2018. Driving into 2025: The Future of Electric Vehicles. Retrieved online: https://www.jpmorgan.com/global/research/electric-vehicles;

Johan R. Meijer et. all 2018. Global patterns of current and future road infrastructure. *Environ. Res. Lett.* 13 064006. Retrieved online: https://iopscience.iop.org/article/10.1088/1748-9326/aabd42/pdf;

Joris, L., 2019. Regular drone service between 21 Belgian hospitals. Retrieved online: https://newmobility.news/2019/08/12/antwerp-starts-a-drone-service-between-21-hospitals/;

Juan, A. A., Mendez, C. A., Faulin, J., de Armas, J. and Grasman, S. E, 2016. Electric Vehicles in Logistics and Transportation: A Survey on Emerging Environmental, Strategic, and Operational Challenges. Energies 2016, 9, 86. Retrieved online: https://www.researchgate.net/publication/292177445_Electric_Vehicles_in_Logistics_and_Transportation_A_Survey_on_Emerging_Environmental_Strategic_and_Operational_Challenges;

Kashnitsky, I & Schöley, J., 2018. Regional population structures at a glance. The Lancet, Vol 392 July 21, 2018, p.209-210. Retrieved online: https://www.thelancet.com/action/showPdf?pii=S0140-6736%2818%2931194-2;

Konings, H, S, Van Dist, L, Franckx, A, Kershaw, L, Pickup, L, P Plaut, D Shach Pinsley and B, Unal, 2016. The MIND-SETS Approach. Deliverable 3.1 of the MIND-SETS Project, European Commission Horizon 2020 Programme, DG Research, Covent garden, Brussels.

Konrad, K., Wittowsky, D., 2018. Virtual mobility and travel behavior of young people – Connections of two dimensions of mobility. *Research in Transportation Economics*, 68, pp. 11-17.

Korosec, K., 2019. In Ford's future, two-legged robots and self-driving cars could team up on deliveries. Retrieved online: https://techcrunch.com/2019/05/21/in-fords-future-two-legged-robots-and-self-driving-cars-could-team-up-on-deliveries/?guccounter=1&guce_referrer_us%20=aHR0cHM6Ly90LmNvL2o5NFdXSVRRZFQ&guce_referrer_cs=nQbiAta36XEoA8WJ-5nLhQ;

KPMG International Cooperative, 2019. Mobility 2030: Transforming the mobility landscape. Retrieved online: https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-mobility-landscape.pdf;

Lambert, F., 2017. Two massive ferries are about to become the biggest all-electric ships in the world. Retrieved online: https://electrek.co/2017/08/24/all-electric-ferries-abb/;

Lambert. F., 2018. Large 'Tesla ships' all-electric container barges are launching this autumn. Retrieved online: https://electrek.co/2018/01/12/large-tesla-ships-all-electric-barges/;

LaunchForth.io, 2019. Future of Mobility for Families in the Urban Core. Retrieved online: https://medium.com/@LaunchForth_io/future-of-mobility-for-families-in-the-urban-core-cef3e5a86560;

Lime, 2018. Year-End Report. Retrieved online: https://www.li.me/hubfs/Lime_Year-End%20Report_2018.pdf;

Lohrmann, D., 2018. The Future of Remote Work. Retrieved online: https://www.govtech.com/blogs/lohrmann-on-cybersecurity/the-future-of-remote-work.html;

Loucks, J., Davenport, T., Schatsky, D., 2018. State of AI in the Enterprise, 2nd Edition. Retrieved online: https://www2.deloitte.com/insights/us/en/focus/cognitive-technologies/state-of-ai-and-intelligent-automation-in-business-survey.html;

Lutz, W., Amran, G., Belanger, A., Conte, A., Gailey, N., Ghio, D., Grapsa, E., Jensen, K., Loichinger, E., Marois, G., Muttarak, R., Potancokova, M., Sabourin, P. and Stonawski, M., 2019. Demographic Scenarios for the EU, EUR 29739 EN, Publications Office of the European Union, Luxembourg. Retrieved online: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/demographic-scenarios-eu;

Lutz, W., 2015. World Population and Human Capital in the 21st Century, New book implies need for new population policy rationale. Population Network Newsletter, POPNET., No. 45. Retrieved online: http://www.iiasa.ac.at/web/home/research/researchPrograms/WorldPopulation/PublicationsMediaCoverage/POPNETNewsletter/Popnet46-web.pdf;

Lyons, G., 2009. The reshaping of activities and mobility through new technologies. Guest editorial / *Journal of Transport Geography* 17, pp. 81–82;

Macharis, C., Lebeau, P., Van Mierlo, J., Lebeau, K., 2013. Electric versus conventional vehicles for logistics: A total cost of ownership. *EVS27 International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium*, 13-20 November 2013, Barcelona, Spain, *World Electric Vehicle Journal* Vol.6, pp 0945-0954;

Madrigal, A. C., 2018. How Automation Could Worsen Racial Inequality. Retrieved online: https://www.theatlantic.com/technology/archive/2018/01/black-workers-and-the-driverless-bus/550535/;

Marr, B. The 10+ Best Real-World Examples of Augmented Reality. Retrieved online: https://www.bernardmarr.com/default.asp?contentID=1841;

Marr, B., 2019. How Is Augmented Reality (AR) Transforming Retail? Retrieved online: https://www.linkedin.com/pulse/how-augmented-reality-ar-transforming-retail-bernard-marr/;

Marr, B., 2019. 5 Important Augmented and Virtual Reality Trends for 2019 Everyone Should Read. Retrieved online: https://www.bernardmarr.com/default.asp?contentID=1795;

Meister, P., 2018. The business model of Mobility as a Service (MaaS). Retrieved online: https://medium.com/@paulaaronmeister/mobility-as-a-service-business-model-601ddb91ea52;

MIT Technology Review Insights, 2017. Autonomous Vehicles: Are You Ready for the New Ride? Retrieved online: https://www.technologyreview.com/s/609450/autonomous-vehicles-are-you-ready-for-the-new-ride/;

Mitel, 2018. How to Create a Path to Virtual Healthcare With Mobility. Retrieved online: https://www.mitel.com/es-es/blog/how-to-create-a-path-to-virtual-healthcare-with-mobility;

Mobility4EU, 2018. European Mobility for The Future, Strategic Roadmaps and Performance Assessment. Workshop report. Brussels;

MOVIN'ON Summit, 2018. MaaS: A "one-stop shop" business model for transportation. Retrieved online: https://summit.movinonconnect.com/en/mobility/maas-business-model-for-transportation/#/;

Muhammed, A., 2018. 5 Reasons Why a Remote Work Arrangement Isn't Working for You. Retrieved online: https://www.forbes.com/sites/abdullahimuhammed/2018/12/03/5-reasons-why-a-remote-work-arrangement-isnt-working-for-you/#6b156fa26487;

Naughton, K., Welch, D., 2019. This Is What Peak Car Looks Like. Retrieved online: https://www.bloomberg.com/news/features/2019-02-28/this-is-what-peak-car-looks-like;

Nedopil, C., 2019. Shared mobility — nothing but a hype? Retrieved online: https://medium.com/@nedopil/shared-mobility-nothing-but-a-hype-4b418eb5c36;

Nelson Nygaard. Transit & Emerging Technologies. Retrieved online: https://umjp9n8g2j2ft5j5637up17u-wpengine.netdna-ssl.com/wp-content/uploads/2019/02/Transit-and-Emerging-Technologies.pdf;

NTUA – Digitalisation and Road Safety Research Workshop, Athens 2019. Retrieved online: https://www.nrso.ntua.gr/ntua-digitalisation-and-road-safety-research-workshop-athens-2019/;

OEDC, 2018. Global Material Resources Outlook to 2060, Economic drivers and environmental consequences, Highlights. Retrieved online: https://www.oecd.org/environment/waste/highlights-global-material-resources-outlook-to-2060.pdf;

OECD, 2019. Digitalisation and productivity: a story of complementarities. *OECD Economic Outlook, Volume 2019, Issue 1: Preliminary version*, pp 55-83. Retrieved online: http://www.oecd.org/eco/growth/digitalisation-productivity-and-inclusiveness/;

OECD / ITF, 2015. Urban Mobility System Upgrade, How shared self-driving cars could change city traffic. Retrieved online:

Snopko J., 2012. Analysis of changes in the organizational structure of municipal offices. *Management The Journal of University of Zielona Góra*, Volume 16, Issue 2, pp. 296-310. Retrieved online: https://content.sciendo.com/abstract/journals/manment/16/2/article-p373.xml;

Statistica, 2019. Global smartphone penetration rate as share of population from 2016 to 2020. Retrieved online: https://www.statista.com/statistics/203734/global-smartphone-penetration-per-capita-since-2005/;

Stocker, A., and Shaheen, S., 2017. Shared Automated Vehicles: Review of Business Models. Retrieved online: https://www.itf-oecd.org/sites/default/files/docs/shared-automated-vehicles-business-models.pdf;

Strasbourg.eu, 2019. Aires de Livraison: Une Utilisation Réglementée (Delivery Areas: A Regulated Use). Retrieved online: https://www.strasbourg.eu/aires-livraison-utilisation-reglementee;

SUITS webinar, 2018. Public Procurement and Innovative Financing of Sustainable Urban Transport. Retrieved online: http://www.suits-project.eu/business-models-for-transport/;

United Nations, Department of Economic and Social Affairs, Population Division, 2015. World Urbanization Prospects: The 2014 Revision, (ST/ESA/SER.A/366). Retrieved online: https://population.un.org/wup/Publications/Files/WUP2014-Report.pdf;

United Nations, Department of Economic and Social Affairs, Population Division, 2016. International Migration Report 2015: Highlights (ST/ESA/SER.A/375). Retrieved online: https://www.un.org/en/development/desa/population/migration/publications/migrationreport/docs/MigrationReport2015_Highlights.pdf;

United Nations, Department of Economic and Social Affairs, Population Division, 2017. World Population Prospects: The 2017 Revision, Volume I: Comprehensive Tables. ST/ESA/SER.A/399. Retrieved online: https://population.un.org/wpp/Publications/Files/WPP2017_Volume-I_Comprehensive-Tables.pdf;

United Nations, Department of Economic and Social Affairs, Population Division, 2017. World Population Prospects: The 2017 Revision, World Population 2017 Wallchart. ST/ESA/SER.A/398. Retrieved online: https://population.un.org/wpp/Publications/Files/WPP2017_Wallchart.pdf;

Wadud Z., Huda F.Y., 2019. Fully automated vehicles: the use of travel time and its association with intention to use. *Proceedings of the Institution of Civil Engineers – Transport*, https://doi.org/10.1680/jtran.18.00134;

Wadud, Z, 2019. Driverless cars: how you'll use free time for work and rest – according to research. Retrieved online: https://theconversation.com/driverless-cars-how-youll-use-free-time-for-work-and-rest-according-to-research-113090;

Wang. B., 2017. Price Waterhouse updates GDP projections for 2050 and still expects China and India to be far larger economies than the USA. Retrieved online: https://www.nextbigfuture.com/2017/02/price-waterhouse-updates-gdp.html;

Whalley, S., Havarneanu, G., Dreßler, A., 2018. Human Factor at Level Crossings: Towards a design for self-explaining and forgiving infrastructure – presentation. SAFER-LC Mid-term Conference, Madrid, Spain, 10.10.2018. Retrieved online: http://safer-lc.eu/IMG/pdf/02-saferlc-20181010_mtc-wp2-human_factor.pdf;

Whills US, Retrieved online: http://whill.us/maas-business/;

Wood, J., 2019. These are the top 10 emerging technologies of 2019. Retrieved online: https://www.weforum.org/agenda/2019/07/these-are-the-top-10-emerging-technologies-of-2019;

World Economic Forum, 2018. The Future of Jobs Report2018. Retrieved online: http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf;

World Economic Forum, 2019. These are the jobs increasingly at risk from automation. Retrieved online: https://www.weforum.org/agenda/2019/03/how-globalization-and-robotics-speed-up-job-losses;

Wright, R., 2019. Why the soft machine will dominate urban transport. Retrieved online: https://amp.ft.com/content/e7bcac30-7262-11e9-bf5c-6eeb837566c5?shareType=nongift&__twitter_impression=true;

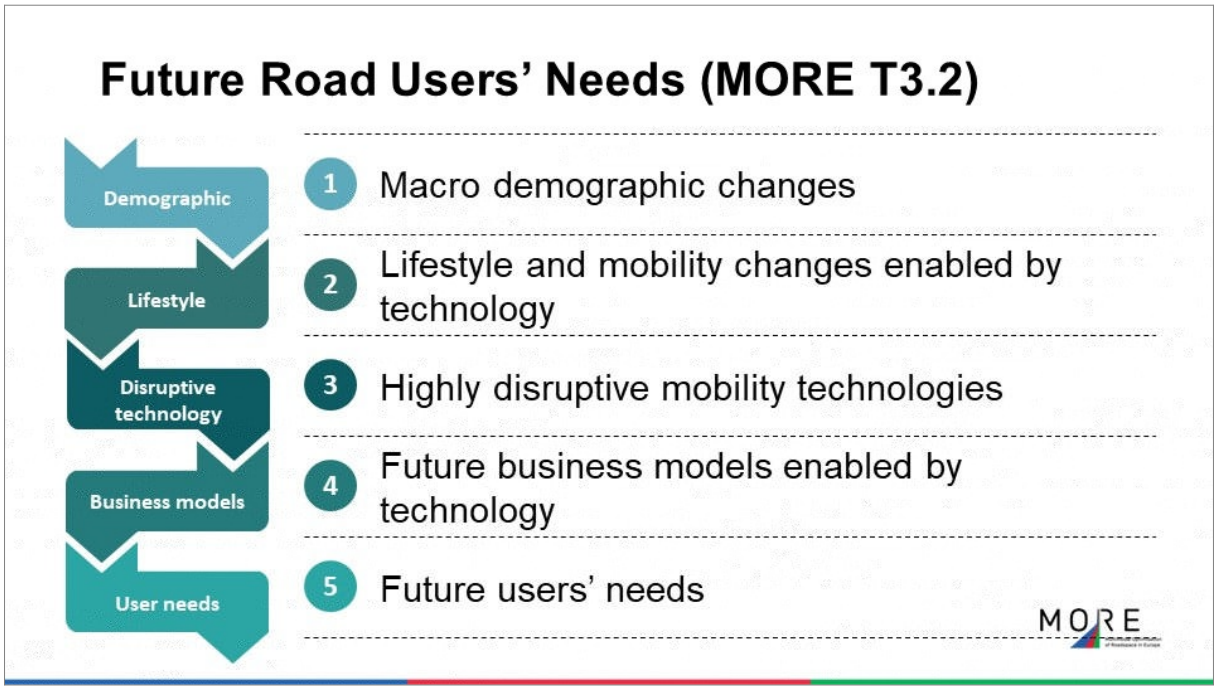
WSP Global Inc., 2017. New mobility now – A Practical Guide. Retrieved online: https://www.wsp.com/en-JP/insights/business-models-shaping-new-mobility;

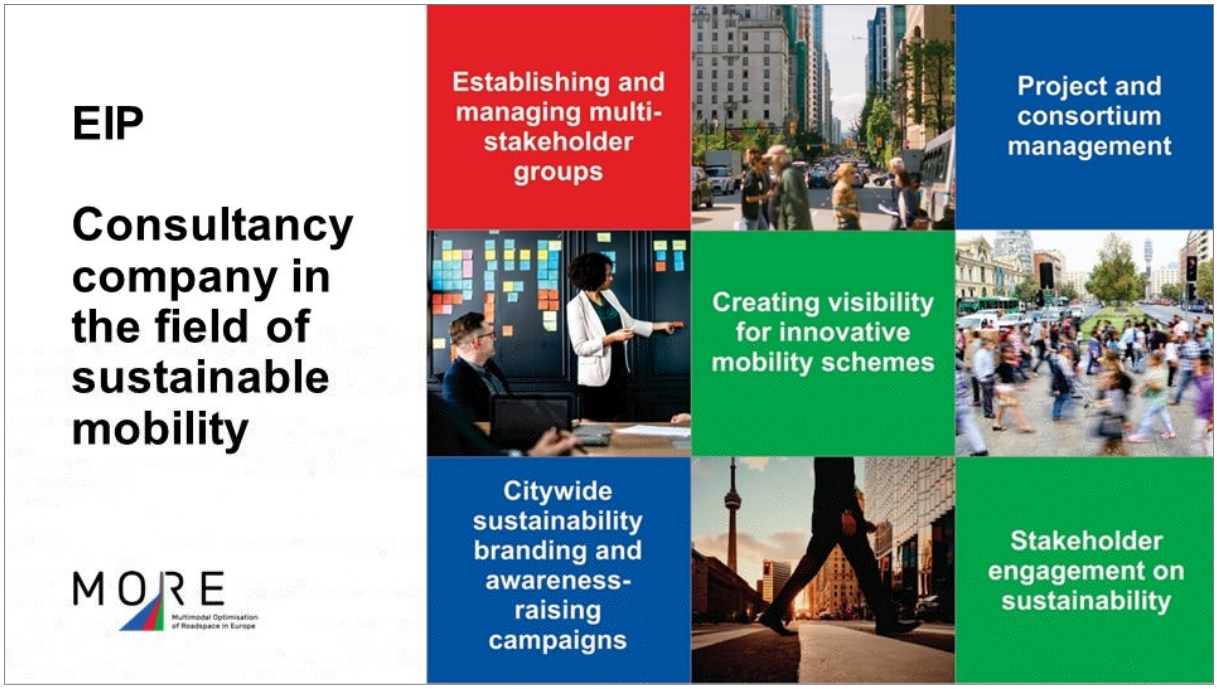
Yahoo Canada Original Videos, 2018, Montreal goes for 3D crosswalk to slow down fast drivers. Retrieved online: https://finance.yahoo.com/video/montreal-goes-3d-crosswalk-slow-150356550.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAAyt6-W-UTCEASdFvamZjcDS52cmM-pigk6YMuvKu0hAlQHeWRreQE0_rVcLHWIHbJNH4VXAsea0dg1yz08TO8oPl42eMHmJpXOKFeT-FG64sjnARoVHnM4wHiKEqLUkSshj8O3LUXdrW84YaZeYjpOfe_lpBWnk-hl4Gfe1wfEy;

Young, S., 2019. 10 trends of Artificial Intelligence (AI) in 2019. Retrieved online: https://becominghuman.ai/10-trends-of-artificial-intelligence-ai-in-2019-65d8a373b6e6;

Zenith, 2017. Smartphone penetration to reach 66% in 2018. Retrieved online: https://www.zenithmedia.com/smartphone-penetration-reach-66-2018/;

Annex 1 - Future user needs – presentation for Task 1.1, Task 3.2 joint webinar





Population Trends

2100 – approx. 9-11 billion

World population will **continue to grow** during the second half of the century and a slight decline closer to 2100 is possible.

2100 – approx. 712 million

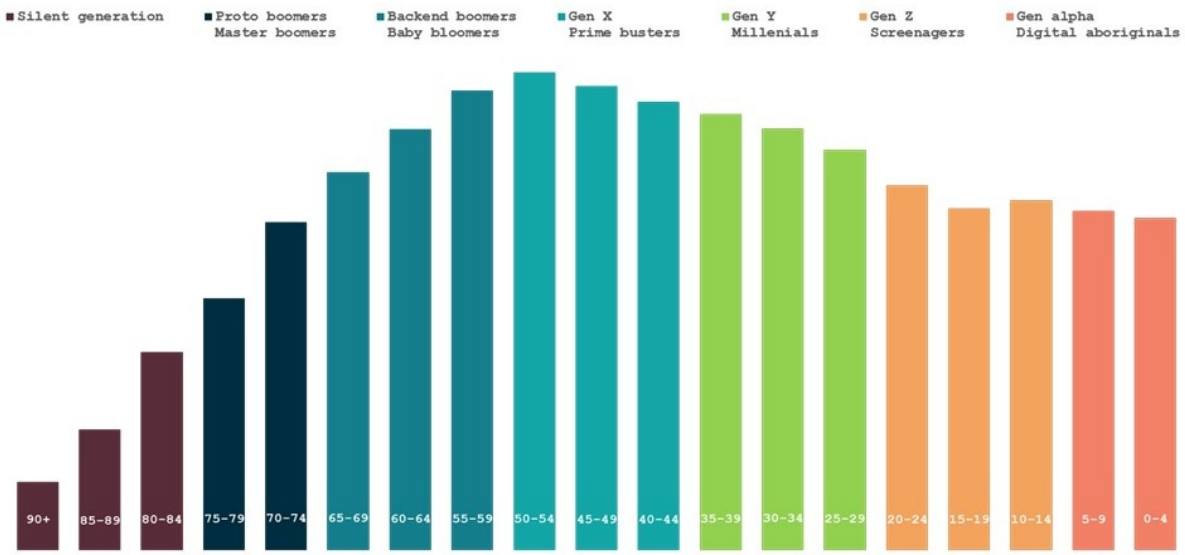
Population in Europe is expected to **decline** (until 2030) – **increase** (until 2050) – **decline** (until 2100).

2080 - approx. 518.8 million

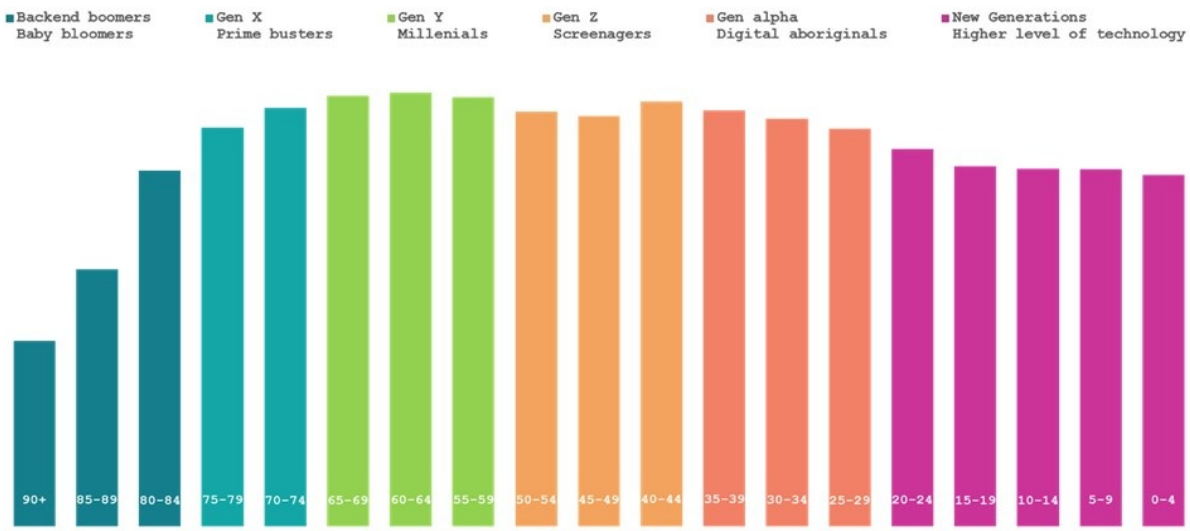
For EU-28 the general trend shows an **increase** in population for the following decades (until 2035-2050) followed by **decline** in population until 2100.

MORE

Population – EU-28 - 2020

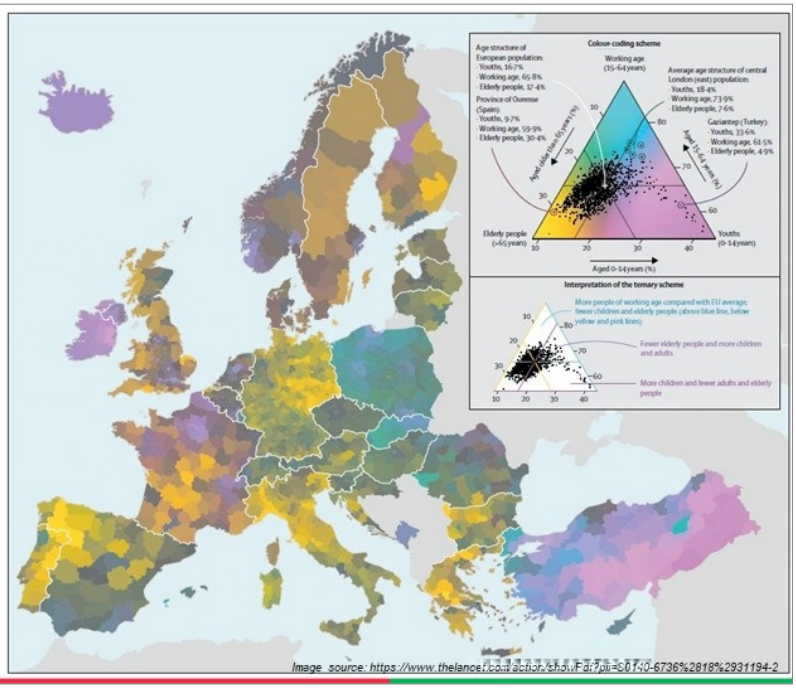


Population – EU-28 - 2050



Ageing population

- Ageing - core long-term structural development for EU-28.
- Population aged 60 or over is expected to increase from 25% in 2017 to 35% in 2050 and to 36% in 2100.
- Old-age dependency ratio is expected to reach 39% by 2030 and expected to stabilize around 50% after 2050.



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Migration and Urbanization

- Europe - largest population of international migrants in the world, approx. 76 million).
- Current trends in migration will reduce the population decline, without fully compensating the low fertility levels.

- Europe - one of the most urbanized regions - 73% of population is in urban areas.
- In Europe, population in urban areas is expected to surpass 80% by 2050.

Urban population

Rural population

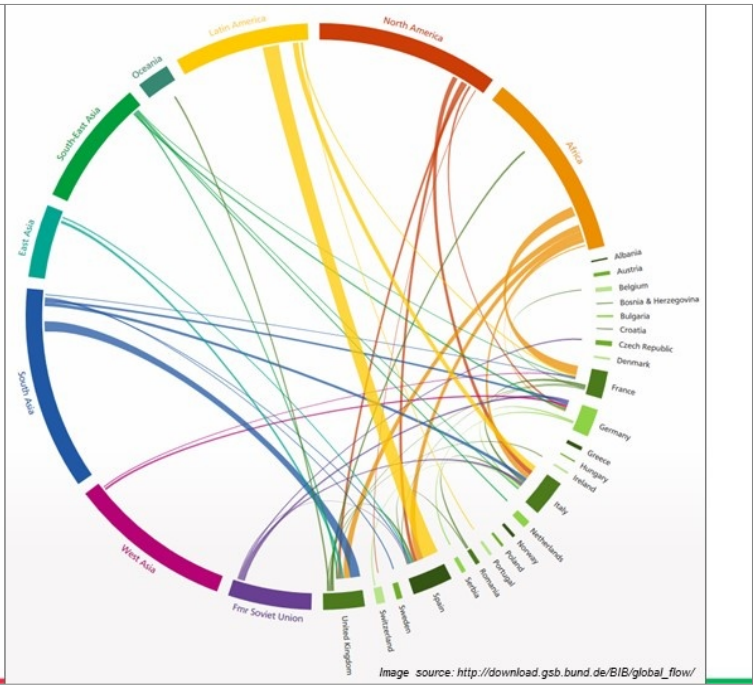


Image source: http://download.gsb.bund.de/BIB/global_flow/

Lifestyle changes

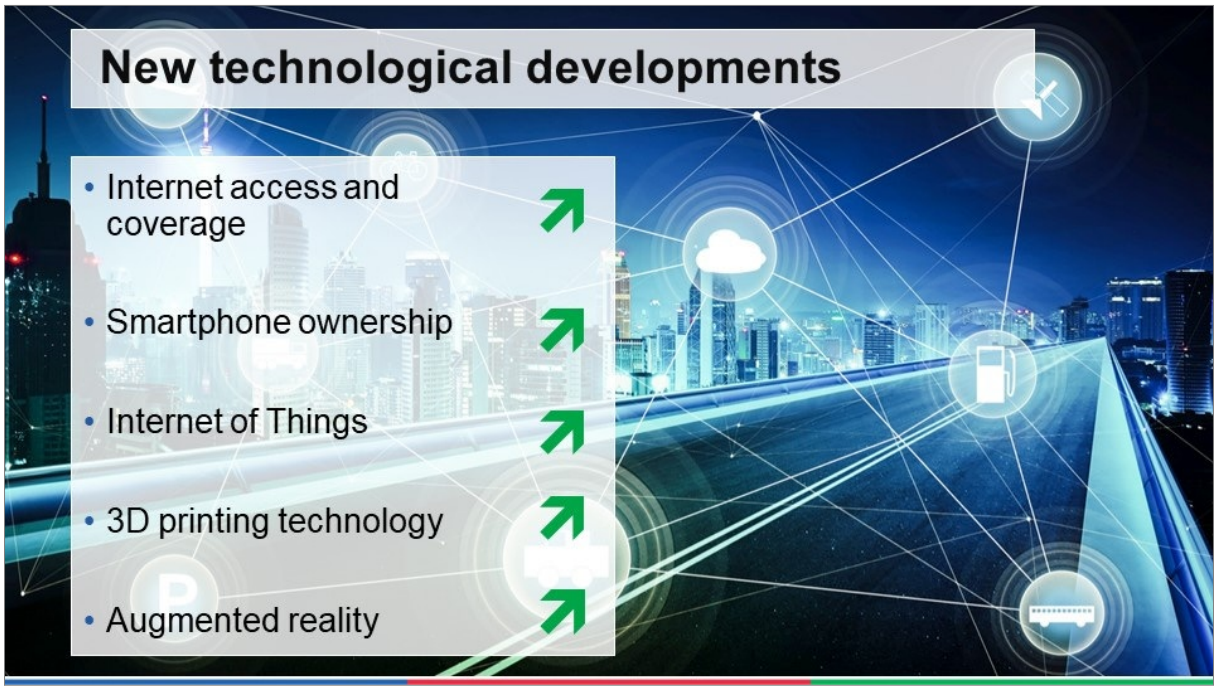
01 Somewheres vs. anywheres

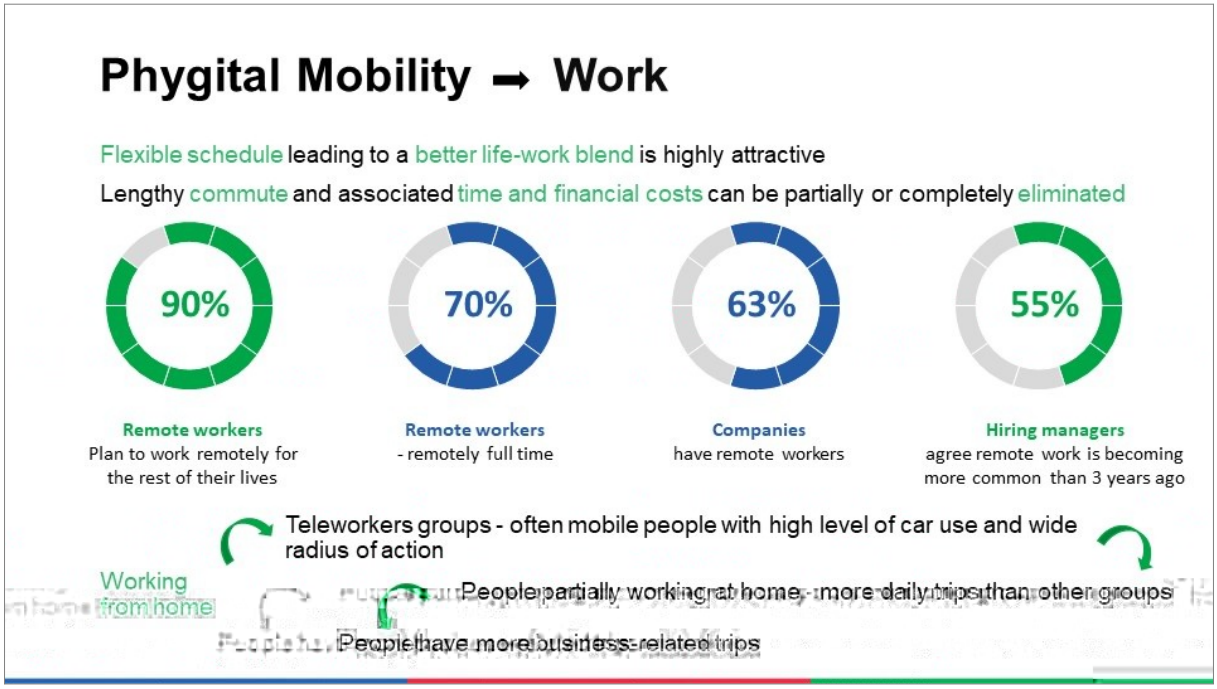
02 Increased percentage of disabled population

03 Trading place and the rise of the "progressive province"

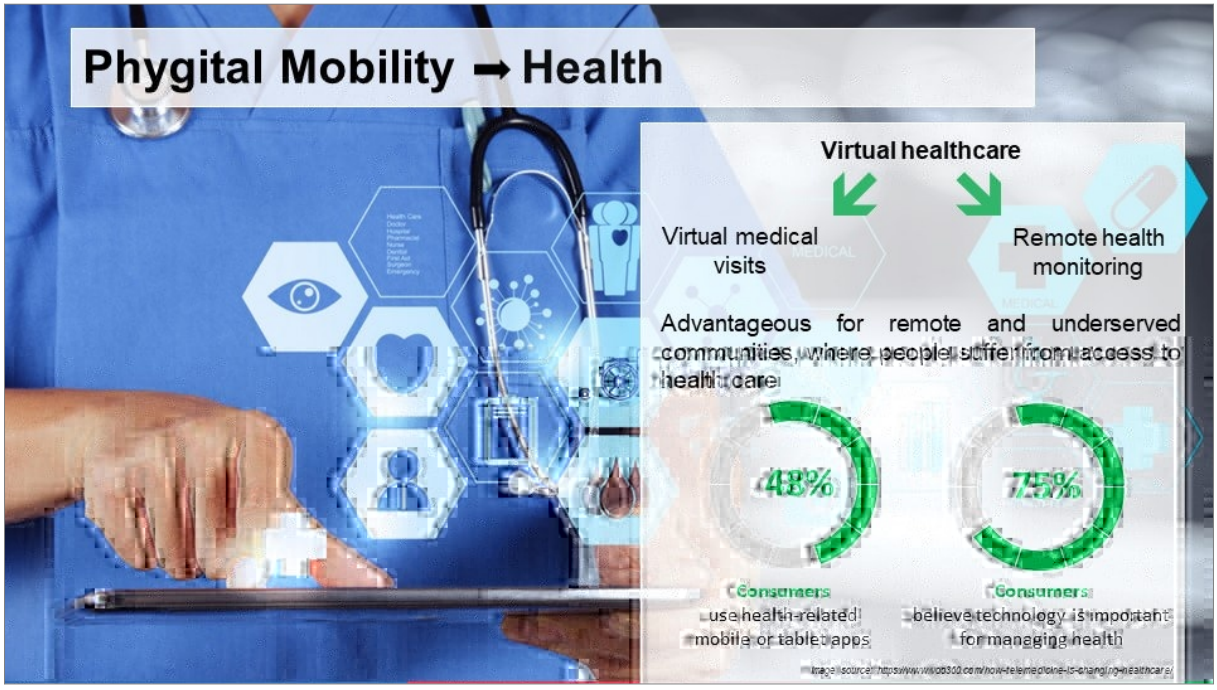
04 Micro-mobility

05 Uncoupled society






Phygital Mobility ➡ Shopping
More comfortable, less time consuming, increasingly attractive for consumers
Online shopping is increasing
Decrease in consumers and business revenue for physical shops
Street space re-allocation needed to support the future urban logistics
Virtual shopping does not remove an equivalent amount of retail traffic.
Virtual shopping generates additional logistic demand.
ups
Worldwide Services


Phygital Mobility ➡ Health
Virtual healthcare
Virtual medical visits
Remote health monitoring
Advantageous for remote and underserved communities where people suffer from access to health care
48%
Consumers use health-related mobile or tablet apps
75%
Consumers believe technology is important for managing health

Phygital Mobility ➡ Social

Substitution effect on physical mobility – leading to a decrease in travel (stronger)

Enhancement effect on physical mobility – leading to more travel due to telecommunications use (weaker)

Supplement travel – increasing levels of access and social participation without increasing levels of travel

Redistribute travel – changing either the time of day or locations for travel

Enrich travel – travel time being used fruitfully ('positive utility')

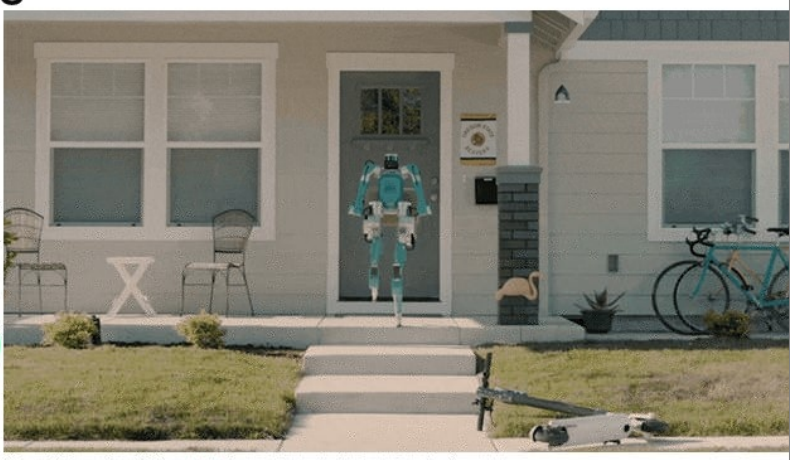
Overall **increases number of trips and trip distance** – substitutes non-motorized short trips with longer distance motorized ones

Future logistics

- Logistics demand for road space is likely to grow;
- Demand will be concentrated, especially, to cities and towns;
- 3D printing is considered a breakthrough technology, but not close to replacing mass production

Shift to electrical logistic vehicles

Demand for additional charging capacity at the road-side



New, highly autonomous technologies for urban deliveries are being developed.

Autonomous vehicles – future potential

The future impact is difficult to project, it ranges between 2 main scenarios: positive effect and negative effect.

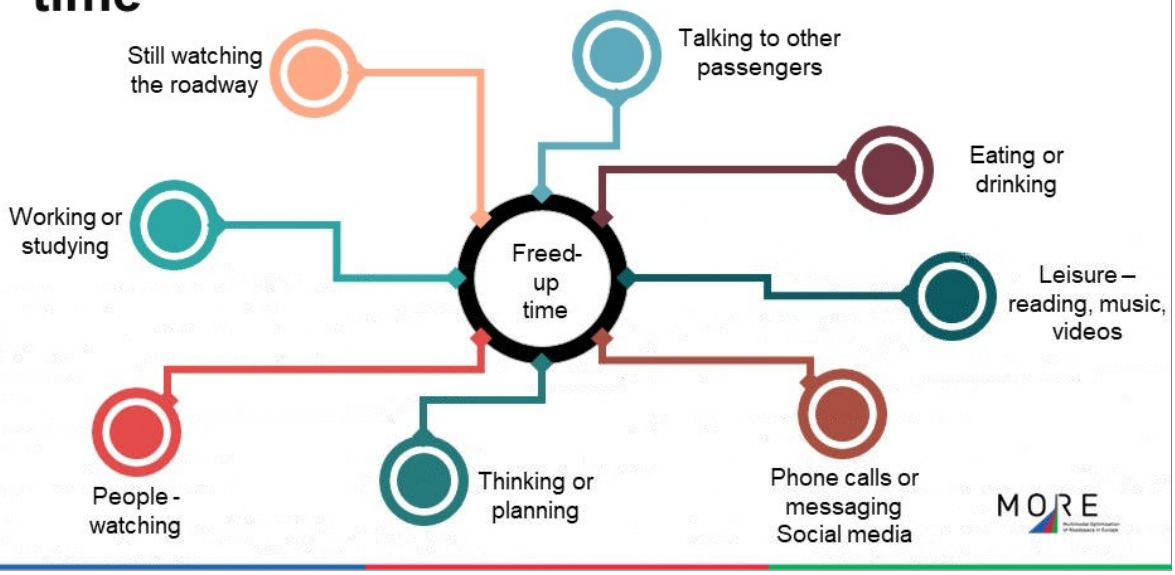
Active involvement of national and local administration makes a significant difference for generating positive impact.

Potential benefits for cities and users:

- More travel options;
- Less traffic congestion – if supported by policy;
- Improved road safety;
- Improved urban landscape;
- More efficient public transport;
- An increase in convenience and optimization of trips;
- Lower overall costs;
- Reduced emission levels (GHG) – if supported by policy;
- Behavioral change from ownership to sharing;

Images sources: https://gastopowerjournal.com/markets/item/9162-automation-of-electric-vehicles-may-halve-energy-demand-in-transport, https://www.theatlantic.com/technology/archive/2018/01/black-workers-and-the-driverless-bus/550535/

Autonomous vehicles – using the travel time



Future business models

The future of mobility is characterized by a shared, connected, highly automated and electrified transport system, providing comfortable, door-to-door and schedule-less travel.

Potential threats :

X

- Sharing services attract all categories of user groups
- Competition between public and private operators
- Integration between different operators is needed to provide
- Lack of precedence for regulating the services and developing public – private cooperation and integration

Benefits for cities and users:

✓

- Attractive alternative to private car use
- Reduction of number of vehicles on the road, car ownership and GHG emissions
- User oriented services for door-to-door travel
- Opportunity to support behavioral shift through incentives
- Potential to reduce operating costs and user costs

Images sources: http://www.bcr-ego.ro/, Lime – phone app

Future stakeholder engagement practices

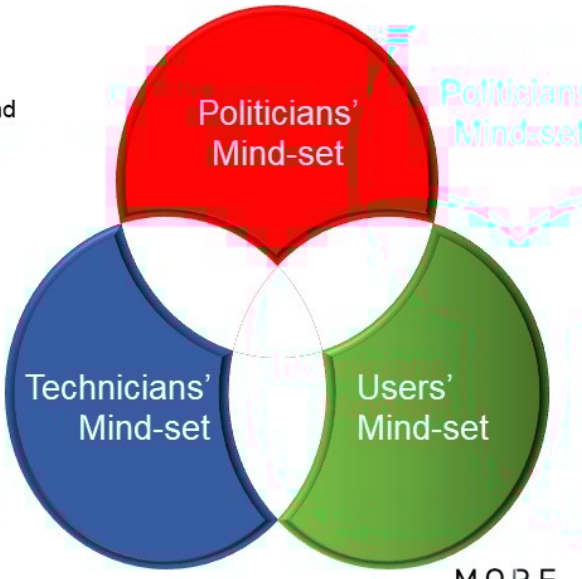
Augmented and virtual reality have the potential to bring new stakeholder engagement practices:

- **VR platforms** which allow users to meet and interact (under research at Facebook)
- **AR boardroom and office tools** enable a more interactive virtual working space reducing need to travel to public consultations
- **AR** can be used for **visualisation of urban and building design**, by walking through the future development.

Future governance

Public administrations need to be pro-active and manage change

1. Future professionals mind-sets:
   - More transparency
   - Cooperative mind-sets
   - Sharing not owning
   - High digital literacy – intuitive technology
   - Phygital experiences



Future Users' Needs

Future needs						
More attractive public spaces	●	●	●	●		● ●
Better integration of mobility services - seamless mobility	●	●	●			
Updated regulation to include alternative/emerging mobility services	●	●	●	●		● ●
Increased safety during travel	●	●	●	●	●	
Increased cybersecurity for mobility services and devices			●	●	●	
Adaptive, on demand mobility services	●	●	●	●		
Public space allocated for short term parking for delivery vehicles					●	● ●
Regulations for low air space			●		●	● ●
Pro-active mobility planning	●	●	●	●	●	● ●