The Future of Mobility: Trends That Will Shape the Mobility and Aviation Industry in the Future

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Contents

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Summary
- Digitalization is a gigatrend.
- Individualization, urbanization, ecology, globalization, new life, new work, security and mobility are eight megatrends to have on your watchlist.
- Autonomous vehicles, sustainable mobility and mobility sharing will reshape the mobility system.
- These trends have a global character, even if they are not pronounced everywhere at the same time with the same characteristics and the same magnitude.
- Be aware that these trends have a fundamental impact on supply and demand. Thus, introduce a culture of openness towards dynamic change and introduce uncertainty and curiosity as standard factors to embrace these trends.

Mobility is set to change in the future and this chapter maps these changes as well as the potential outcomes. It starts by exploring giga- and megatrends that will influence and shape the future of mobility. Technical innovations around autonomous vehicles, sustainability and mobility sharing will form part of the change in the mobility system. Although the shape and impact of these phenomena will differ across various geographical regions, they will have a global impact. The impact of these trends will shape the supply and demand sides of our economy. It is recommended that decision makers follow a culture of openness towards dynamic changes, which result from these trends. Furthermore, curiosity and uncertainty are standard factors that should be accounted for when working with these trends. This is not to be seen as an extensive list of trends, nor as a scientific piece on these trends. The chapter is rather based on our ongoing exchange with various societal, economical and political actors on these trends. It is a piece of opinion, which shall allow decision-makers to get curious about these trends, get involved in discussions on these trends, and/or exchange ideas and thoughts with their stake- and shareholders on this piece. It is further ought to be used as initial piece for long-term planning and thinking processes in for-profit and non-for-profic organizations.

1.1 Gigatrend Digitalization

1.1.1 Trend Management in General

Many researchers, scientists and also private institutes and companies are addressing the topic of the future and trying to analyse the effects of current trends for the future. Megatrends serve as early warning systems in corporate circles and highlight possible bottlenecks and shortages in life. They thus the future more plannable. This holistic view, with which we proceed to observe these deep currents of change, is not primarily technology-centred, but is always socio-technical, i.e. an evolutionary perspective on the interface of society and technology.

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Trend research is increasingly reaching its scientific limits. Only a few methods and standards have been developed yet which reliably describe the changes in systems. By combining quantitative methods (e.g., updating past developments through mathematical-statistical procedures) and qualitative methods (e.g., Delphi method, in-depth interviews, etc.), futurology does justice to the level of abstraction of a trend and the different knowledge types humans possess and are able to handle. Nassim Nicholas Taleb describes an essential limit of trend research in his book *The Black Swan* (2015). He shows that highly improbable events (called black swans) can occur, which are very difficult to measure and have a significant impact on the future of systems (e.g. earthquakes, economic and social revolutions, wars, etc.). The relevance of the factor of uncertainty has risen sharply as a result of scientific debate and the consideration of future or trend worlds. Trend research is thus currently in a paradox to explore the impossible to strengthen the validity of its own trend research.

1.1.2 Definition Gigatrend

Joseph. A. Schumpeter already assumed that in a cycle of at least 50 years, a trend will develop, which will then transform into the economy, ecology and society and thus influence the lives of all people on earth (Schumpeter, 2008).

The term *gigatrend* has been used very little in science and practice so far. The term *megatrend* strongly predominates. The term gigatrend merely describes the next higher prefix of the term megatrend. To put it simply, the word *giga* here means a "gigantic" change and the word mega a huge change in our society. When talking about a gigatrend in the following, this type of trend includes the following prerequisites:

- The trend must have an impact on all existing megatrends and other trend forms as well as on all areas of life, whereby this impact can be different.
- The trend is international and can be observed in all soecietal and economic systems.
- The trend has a half-life of at least 30 years.

Gigatrends, therefore, not only have an impact on all current megatrends but also on systems of industries or sectors due to their holistic nature. They considerably influence supply and demand and have different characteristics depending on the system, country and region.

Gigatrends are not intended to show what is already discernible today, but instead move on the borderline of what can be known and, through this level of abstraction, provide added value for the investigation of a future in more than 30 years, which is very difficult for people to imagine today (Kreuzer, 2003).

» Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution. It is, strictly speaking, a real factor in scientific research. (Einstein, 1931)

Gigatrends are to be distinguished, among other things, in their cycles and characteristics from megatrends (20–30 years), technology (15–20 years), society (10–15 years), consumption (5–10 years) and product trends (2–5 years).

1.1.3 The Gigatrend Digitalization

According to the Gartner Glossary (2020), *digitalization* is "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business."

» The digital revolution currently affects all areas of the economy and society and will have similar disruptive effects as the industrial revolution in the 19th century. (Zukunft Mobilität, 2016)

» Digitalization will be the main driver for the future of mobility. (Sommer, 2016)

What a few years ago was considered fictional, visionary thinking and represented the maximum level of abstraction, has now become everyday life: AI, the Internet of Things, Big Data, wearables and many other digital forms of products are influencing the future worldwide (Linden & Wittmer, 2018). The mobile, digital life will replace the classic computer. Digital products, such as smartphones, tablets or wearables, can be carried conveniently either directly on the body or in the trouser pocket. Humans and technology are growing together (more on this under connectivity). For Generation Z, it will be a crucial to be very mobile. A further development of information technology, sensor technology (Heinrich et al., 2015; Tille, 2016) and robotics (Haun, 2013; Molzow-Voit et al., 2016), as well as miniaturization of technical components, can be observed (Sánchez, 2008; Wiechert, 2015). The leaps in innovation are increasing as a result of advances in nanotechnology (targeted manipulation of matter at the atomic and molecular level) (Ahmed & Jackson, 2015; Schneider, 2016; Wolf & Freudenstein, 2015) and bionics (Küppers, 2015; Steinbuch & Gekeler, 2016) as well as the increasing semantics and intelligent algorithms up to a so-called Web 3.0 (Stachowicz-Stanusch & Wankel, 2016) or the much-discussed Industry 4.0 (Brettel et al., 2014; Lee et al., 2015). Besides, the technologies are networking with each other, which is leading to increasing consolidation effects in many industries and in some cases, across industries (Zukunftsstark, 2016). This is giving rise to new digital and internet-based business models that take computer support into different areas of life, new forms of communication and participation, increasing real-time information processing, and start-up and beta culture as models (Zukunftsstark, 2016). Through gamification (Mitzscherling, 2015; Wood & Reiners, 2015) and other applications, such as artificial intelligence, companies can change customer behaviour (Watson, 2014). The gigatrend of digitization will certainly, in the long term, lead to automation and technologization of the world of work, life and transportation. Digital and global subcultures are emerging, which also promote the digital participation of users from developing countries.

» Every part of the UK economy and our lives has been digitized – from how we shop and entertain ourselves to the way we travel to work and manage our health. (Vaizey, 2015)

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This often raises the question of the legal protection of both newly created and already existing generated data. Specifically, this concerns data, operational and, in the context of the digitalization of motion, vehicle safety (more on this in the megatrend of safety). According to experts, the right to privacy is an obsolete model. The increasing use of data will lead to a democratization of data in the future. The sub-trend of open-source redefines privacy. The individual is given more personal responsibility but also more freedom (Zukunftsinstitut, 2016). Thus, the democratization of public data also leads to the unleashing of private information. In the coming years, a new awareness of data rights will form and be reflected in socially sanctioned rules. However, this also leads to a demand for more transparency; with transparency becoming an increasingly important attribute of every economy and various public and private organizations (EY, 2016).

» The Internet of Everything is the connection of people, data, process and things. It is revolutionizing the way we do business, transforming communication, job creation, education and healthcare across the globe. (Chambers, 2014)

Computer-based avatars and brain-computer interfaces are the latest technologies (Diego-Mas & Alcaide-Marzal, 2015; Myers et al., 2016), which make the interface between products and humans even more fluid – whether by replacing the human with a machine (already commonplace in the industry today), an assistance function with avatars or only by better connecting the human brain to digital or material end products. The future of digitalization will certainly not depend on whether things are possible, but on whether people are willing to trust. This fact describes the failure factors to date of, for example, autonomous driving (more on this in the section on autonomous vehicles) or other fully autonomous products in the industry. Many expert opinions show that the entire world, all other trends, systems of industries and their value chains are fundamentally changed by digitization. Experts, therefore, no longer speak of digital industries, but of industries that operate in a digital world.

» We should no longer be talking about "digital marketing", but "marketing in a digital world". (Weed, 2015)

Moreover, the term digitalization also includes the connectivity of people and things. Connectivity refers to the organization of humanity in networks in the context of digitalization. Via new digital products, not only people but also machines communicate with each other. According to Evans (2011) of Cisco, around 50 billion "things" are connected to the Internet by 2020. The interaction of these systems is crucial. Everything is then interdependent. Connectivity, therefore, has not only a technical impact but also a social one. The partial trend towards Big Data (Fasel & Meier, 2016; Hu, 2016) and open source (Anthes, 2016; Watters & Layton, 2016) allows companies and administrative structures to the outside world (Deek & McHugh, 2008). It is driven by the demand for transparency, which is transforming society as a whole. Data should, thus, be freely accessible. Due to the new availability of data, increasing networking and communication between devices can be observed. This, in turn, is making the partial trend of connectivity increasingly dynamic.

Whether it is a home cinema, lighting, everyday objects such as the refrigerator or other types of terminal equipment, they can increasingly be used in networks with

other products. Digital and analogue realities are increasingly merging into a holistic one (Zukunftsinstitut, 2016). Life as a whole becomes more connected. Modern communication technologies give connectivity a breath-taking dynamic, where change, disruption and innovation are the results. New forms of national economies are emerging in the shape of new social, economic and collaborative communities. Through digital interface management, infrastructures can increasingly be networked and function, especially in the field of mobility, with intelligent contact points between hardware, software and humans. Vehicles will become parts of smart grids (Eberl, 2013; Mouftah & Erol-Kantarci, 2016; Stephens et al., 2015). Not only do they consume energy, but they also store energy or return it to the environment when required. Parked vehicles, for example, can act as interactive elements in urban space and interact with people (e.g. as city guides or through interactive advertising). The trunks and interiors of parked vehicles, for example, can be made accessible and thus usable.

» Infrastructure is already in place today. It is important how this infrastructure can be networked and used in a more digital way. (Beckmann, 2016)

The trend becomes more critical when one considers that there are different mobility requirements in different areas (urban, suburban and rural) and that different technologies or products are and will be attractive. One can certainly not fundamentally assume that explorations on the scale of the gigatrends will be made. However, one should sharpen the senses for such elementary changes in society and extend trend research through this giga level, also due to the cycle and the holistic view. To this end, this short report should provide added value, stimulate critical reflection and focus on future discussions.

Key Questions for Digitalization

- *What does digitalization really mean? What does it not mean?*
- *How can I use digitalization in a beneficial manner?*
- *Do we need digitalization for the sake of digitalizing or rather because of increasing efficiency or effectivity?*

1.2 Megatrends

» Megatrends (…are) large social, economic, political, and technological changes (…), they influence us for some time. (Naisbitt, 1982)

» A megatrend influences our social world view, it influences our values and our thinking. (weiterdenken.ch, 2010)

» Megatrends are the result of complex interactions between many different social, cultural, economic and technological systems. (Frick, 2016)

"[A megatrend] must play a role in ALL areas of life and show effects (economy, consumption, politics, everyday life, etc.). In principle, megatrends have a global character, even if they are not pronounced everywhere at the same time" (Horx, 2014). A megatrend has a fundamental impact on supply and demand and varies

Fig. 1.1 Illustration of the megatrends described in this chapter. (Author's own figure)

by country, industry and organization. The effect can have different characteristics in each case. If we speak of a megatrend in the following, this trend form has a half-life of at least 20 years.

The summary presented here is intended to provide a basis for discussion of the megatrends. It is important to note that the following list by no means covers all megatrends, but only those that have a central impact on future mobility. Therefore, the megatrend mobility is also listed separately at the beginning. Also, the megatrend of mobility will be given special attention in all megatrends. However, a compilation of megatrends, and therefore this chapter, is never final and conclusive. The megatrends examined in this chapter are shown in Fig. 1.1 (Frick, 2016).

However, there is one significant limitation to be made when it comes to the topic of megatrends. So-called wild cards (events not foreseeable in the future) are not to be considered here. Trends can develop into various extremes or be eliminated by the influence of other megatrends or other externalities.

» Anyone who thinks into the future must always take into account that everything will be different from what we think today. (Maas et al., 2015)

1.2.1 Individualization

Individualization describes the process of replacing industrial and social forms of life with post-industrial values of self-determination and self-realization. Decentralization is a decisive factor in this respect. The megatrend is developing as a result of an improved standard of living, extensive social security and new, digital ways of life and opportunities. There is a pluralism of lifestyles and the traditional family image is changing (see megatrend New Life). However, in this society, which is to be shaped freely by the individual, also known as a "multi-option society" (Cachelin, 2009; Heufers, 2015), there is also pressure for individuals to make decisions. This pressure to make decisions is changing values and attitudes and with them the economy, in which "do-it-yourself cultures"

(Reed, 2016; Suh et al., 2016) along with "free economies" (Andrews, 2013) are forming, and niche markets are established. Cultures of LOHAS (Helmke et al., 2016), LOVOS (McGouran & Prothero, 2016; Rich et al., 2016) and service clubs are emerging, which promote co-housing (Labit, 2015; Tummers, 2016) and strive for work-life balance (Maas et al., 2015). Social awareness, open-source, sharing, independence and renunciation as well as modesty, simplicity, voluntariness, hope and slowness define this new kind of "self-determination" (Maas et al., 2015, p. 63ff). Traditional restrictions and norms are overcome; class orders, caste systems and religions partly converge. Individualization processes are spreading worldwide and, thus, additionally promote multi-optionality. The trend towards sharing, for example, is closely linked to the megatrend of individualization. In the future, individualization can, therefore, make an essential contribution to increased mindfulness (Zukunftsinstitut, 2016). At the very least, however, it fundamentally changes interpersonal relationships (Sauter-Servaes, 2016; Schuldt, 2016).

As a result of this development, people are often "spoilt for choice" and sometimes find it challenging to deal with this heterogeneity and multiculturalism. Thus, they make irrational decisions. The result is that people look for orientation and support. The megatrend is thus also nurturing its opposite, with individualists seeking community or social groups to find more individual solutions. This corresponds more or less to the frequently used term "cocooning." Communities (real and virtual), shared flats and closed societies give the individual the security and safety needed through coaching.

Digitization dynamizes individualization and enables new forms of it. We can, for example, put together products ourselves via the Internet and thus tailor them to our individual needs. Schuldt (2016) describes mobility as a practice of individualization: "People want to be able to move freely and independently, to organize their lives flexibly." This has been observed for years, particularly in the area of mobility. New, multi-layered segments are emerging and are confronting government organizations and companies with the task of finding new, more individual solutions. Managers of companies with established business models have to adjust these old models to this trend and consider analyzing customer's demand and value drivers in more detail.

1.2.2 Urbanization

The United Nations (2015) estimates that by 2050 two thirds of the world's population will live in urban areas. The trend towards *urbanization* is already very distinct today. The degree of urbanization is particularly high in less developed countries (Ushakov, 2015). These urban centres are becoming engines of innovation in modern urban development, as planning often does not take place with existing infrastructures but with new, previously undeveloped infrastructures. The reason for this is the development problems of rural areas. But even in more developed countries, this megatrend – contrary to the expectations of many demographers – is unbroken (EY, 2016). On a global scale, urbanization has very different characteristics. These characteristics are broken down according to the economic and demographic bases of the countries (Watson, 2014).

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The cities of the future will be more diverse, networked, livable and in every respect "greener" than we have experienced for a long time (Eberl, 2013; Watson, 2014); they will become smart cities (Albino et al., 2015). This megatrend is also highly connected to the subsequently introduced megatrend of ecology, with people in well-developed countries seeking opportunities for the interconnection between digitalization, urbanization, and ecology for concepts of, e.g. urban farming. These future megacities are thus developing great innovation potential. The borders between town and rural areas are blurring. The cities of the future will be made more attractive through urban farming and through leisure activities, which are now also possible in the city (e.g. city golf). Urban spaces thus change the relationship to their inhabitants. Mobility and aviation customers, especially the younger generation, are therefore changing their behaviour already today and will do so in the future. Climate movements are just one of the many accelerators of this development.

» The fully networked city becomes an interactive marketplace for mobility customers. (Schönduwe, 2016)

These cities of the future are no longer just competing nationally, but must also strive and position themselves internationally for new industries and talented, mobile people. Cities must be more than just a centre of activity for their inhabitants. They must enhance the quality of life and thus contribute to the well-being, comfort, convenience, safety and satisfaction of the broadest possible range of needs. Particularly in the area of mobility and aviation, new technologies will increase the differences in urban and rural living. This requires the establishment of more efficient infrastructures to ensure sustainable urban life, but also the connectivity and accessibility of suburban areas.

However, the urban trend is also subject to multi-layered geographical-spatial, financial and ecological growth limits (Camagni et al., 2015; Dijkstra et al., 2015; Duncan & Wang, 2015). The impact of this development on mobility and quality of life in mega-cities is already taking on dramatic forms. Concepts for higher-level spatial planning must be introduced. If these complex solutions cannot be guaranteed across the board, or if the benefits of city life are minimized by new trends such as autonomous driving, the counter-trend towards more rural or suburban living will be reinforced. Rural regions become more attractive as a result of such new, digital developments, and urban sprawl occurs unless countermeasures are taken early on by spatial planning measures. These rural areas might be more accessible and reachable in the future, with mobility concepts being introduced on a rapid scale to foster rural living, working and commuting (for example through drones. To find out more about these new developments for rural mobility concepts, see the chapter on the megatrend *mobility*).

1.2.3 Ecology

Progressive global warming, a noticeable power shift, increasing pollutant emissions due to inefficient products, scarcity of raw materials and the increasing sensitization of people to environmental issues are making this megatrend more dynamic and

impactful. As a result of environmental problems, some of which are highly visible and measurable (Beijing, Stuttgart, Sao Paulo, etc.), rising food consumption and increasing consumption of energy and raw materials, especially in the rapidly growing emerging and developing countries, an increasing tightening of laws and market interventions can be observed - especially in urban areas. However, despite the sometimes apparent limitations and the increasing environmental awareness and sense of responsibility of people, especially in the automotive industry, there are still few dependencies in mobility behaviour due to significant pollutant emissions and sometimes enormously inefficient products, contrary to many expert opinions. Consumers often do not view this megatrend in a reflected and detached manner, but always in the context of economy, ecology and social commitment. This is right on the one hand, as this development shifts people's values towards the term LOHAS: Lifestyle of Health and Sustainability (Helmke et al., 2016; Pittner, 2014). Environmental protection, resource conservation, CO_2 reduction, corporate social responsibility and urban and vertical farming are, therefore, also fundamentally changing people's attitudes and values. On the other hand, there are still substantial differences in actual behaviour. In this context, science (mainly on sustainability issues) often speaks of the attitude-behaviour gap (Aschemann-Witzel & Niebuhr Aagaard, 2014; Caruana et al., 2016). Although customers feel a sense of responsibility based on ethics, values and attitudes, they still do not act on them due to economic and restrictive factors. For example, sustainability plays a minimal role in the choice of a mobility offer, since restrictive factors such as time and money predominate, and systematic misjudgements are made in the case of these inefficiencies.

It is noticeable that the customer thoroughly checks many products for their respective carbon footprint – "eco is in." This offers great potential for new technologies in the field of mobility, for example. The demand for post-fossil mobility is becoming increasingly popular as a result of the developments described above (Brake, 2009; Hehn, 2015; Knoflacher, 2013). Politics, societal actors and business must increasingly take this megatrend into account (Bilyk, 2015). In the context of other megatrends, the customer no longer wants to consume only in the classical sense but wants to control consumption himself due to his new, ecological values and attitudes. Digitalization and connectivity will ensure alternatives to the old throwaway society. New markets for environmental protection technologies and "fair trade" as well as concepts for saving resources and energy are emerging. In addition, there is an increasing demand for regional and seasonal products, and new business models are emerging in the area of recycling and by-product electricity use. For countries such as Switzerland, it will be valuable in the future to guarantee liberal electricity and energy markets, to "depoliticize" or privatize markets in order also to give new technologies and innovative solutions in the field of ecology a chance (possibly based on a measurable green premium), and to separate the market from the interests and behaviour of suppliers (Meister, 2013).

Attention

Be aware that introducing an ecological strategy or single products or services might backfire. Embrace this megatrend, create a culture of ecological relevance, empathi-

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cally care about this topic, not only for your marketing campaigns, and incorporate with main stakeholders or even outsiders to strategically tackle this megatrend for the long-term.

Key Questions for Ecology

- *What does ecology really mean? What does it not mean?*
- *How can I use the megatrend ecology for good in aviation without being criticized for greenwashing?*
- *Do we need ecology for the sake of an external push for environmental sustainability or because of increasing long-term competitive advantage instead?*
- *How can we use the megatrend of ecology to develop a culture of sustainability alongside long-term thinking and acting?*

1.2.4 Globalization

Supported by gigatrends such as digitalization and increasing automation, the dynamics of mobility are proliferating and becoming increasingly global. Migration movements of population groups and individuals can be observed worldwide. Contrary to numerous forecasts, this means that developing and newly industrializing countries will be able to participate more in world trade and, thus, in prosperity and economic growth (Eberl, 2013). The Internet, and in the future the Internet of Things, promotes a culture based on global challenges in a sometimes highly virtual space (Derven, 2016; Zaugg et al., 2015). Trade and innovation flows are changing. The influence of large emerging markets is increasing due to growing innovative power and positive social changes. Countries rich in raw material are developing a growing self-confidence and self-image (Eberl, 2013). Also, new technologies and speeds of travel, as well as the global spread of these factors, have led to a weakening of global production differences and a declining relevance of labour costs as a location factor (Lejpras, 2015). Many experts already speak of a multipolar world due to the megatrend globalization (De Keersmaeker, 2015; Dee, 2015). The role of the state and state organizations is changing (Fischer et al., 2016). Autonomy is being surrendered because of global interests and demands for transparency and participation.

In addition to economic factors, social factors are also playing an increasingly important role in this megatrend. The megatrend is changing education systems and consumption. Private life and relationships are changed via global mass media. Cultures change and converge. However, globalization affects not only urban but also rural areas. This does not necessarily mean that existing traditions will be dissolved. These are only made globally accessible and, thus, possibly more comprehensible.

Due to the pressure to legitimize established political and economic systems, a counter-trend towards more nationalization and the elaboration of local characteristics has emerged in the recent past. Covid-19 fostered this development even further. Experts speak of the increasing impotence of regional legislation. This can be observed mainly in regions that are highly dependent on other regions or show increasing competitive disadvantages. As a result of this development, remote areas are trying to detach themselves from the global challenges and reduce their dependence to become competitive again or to differentiate themselves from other regions or nations. Reshoring and nearshoring are just two of the many buzzwords in this context.

1.2.5 New Life

1.2.5.1 Demographic Change

Due to the megatrend of globalization, also caused by migration, as well as due to the health trend (considered separately) and medical developments, a demographic change can be observed, especially in markets in Western Europe and North America. As a result of rising life expectancy worldwide (Watson, 2014) – according to United Nations forecasts, 9 billion people will already be living on Earth by 2043 (depending on the birth rate, wars, pandemics, accidents, etc.) – and due to the falling birth rate and population decline in general, an aging society emerged (Maas et al., 2015; Naumann et al., 2015). It can be observed that people are not only getting older but that developments or behaviour can also be observed across generations (Morgan & Kunkel, 2016). Experts refer to this as down aging, the process of stepping out of traditional-age roles (Beckmann, 2016; Dill & Keupp, 2015; Schuldt, 2016). Older people are simply no longer satisfied with classical everyday activities but want to reinvent themselves and realize their dreams in old age. Volunteering, working life and further education are the results. Age groups are blurring (Geithner et al., 2015). These new older generations are changing existing structures and creating new, different markets and more heterogeneous segments. Age no longer plays a decisive role in many decisions and is no longer a central differentiating factor for companies. Multigraphic CVs are the consequence.

This demographic development has a particularly significant impact on the area of mobility. The over-65s will account for a much larger share of the total mobility market in Western countries. These segments will have different mobility requirements or abilities to move within the mobility system. Experts even describe it as the most heterogeneous and complex segment in the mobility sector.

In addition to demographic change, an increase in population can be observed worldwide, despite the decline in births. Nevertheless, shortages of skilled labour and poverty among the elderly are evident in many regions. For many nations, the question is how this sub-trend can be financed and how these new needs and requirements can be met.

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Case: Ageing Airline Passengers

Although airlines are relatively good at catering for the needs of infants and children through the provision of colouring books, dedicated nanny services and food options, it is only recently that they have started to address the needs of older travellers systematically. Demographic aging has already become apparent and will increase rapidly in the coming decades. Older air travellers show different behaviour, beliefs, needs and values compared to younger travellers. In particular, they differ concerning their propensity to fly, travel purpose, destination choice, access modes, airport dwelling time, perception of the travel product and the use of airport facilities. This demographic has a particularly strong impact on airlines. The over-65s will account for a significantly larger share of the overall mobility market.

The physical and mental conditions of people change with age. Eyesight, hearing, and general physical health decline, mobility decreases, and mental changes such as anxiety may be potential side effects. These changes affect the business and operating model of airlines and the global transport system. Older travellers may be less agile, require mobility aids, take longer to board, are not familiar with automated systems and may find it difficult to lift bags into overhead lockers.

Also, in this context, it can be observed that people are not only getting older, but behavioural changes can also occur across generations. Experts refer to this as down aging, i.e. leaving traditional-age roles and changing traditional activities. The result is multigraphic CVs and travel characteristics. Older people are no longer satisfied with traditional everyday activities but want to reinvent and fulfil themselves. This results in changing behaviour, beliefs, needs, and values, for example, voluntary working, traveling more frequently and to a greater range of destinations. Age groups are becoming blurred. These older generations change existing structures and create new, different markets and more heterogeneous segments. Researchers and transport experts describe older travellers as the most heterogeneous and complex segment. They will have a significant impact on the business models of airlines, but also on the design of transport systems and the underlying infrastructure.

Stop and Think

Why is an understanding of aging important for airlines? What does the demographic change mean for my own business?

1.2.5.2 Gender Shift

In many regions and countries of the world, gender is increasingly losing its significance and social commitment. Contrary to many forecasts by experts, the change can also be observed in emerging and developing countries (Eberl, 2013; Otten & Wittkowske, 2014; Zukunftsinstitut, 2015). In the future, gender will no longer determine how a biography develops and what overarching gender role an individual assumes (Zukunftsstark, 2016). Career models dissolve; new cultures are formed (Blair-Loy et al., 2015). The increasing equality of men and women in

professional, private and social life creates enormous potential and disruptive changes in the economy and society of national economies.

This sub-trend, in turn, dynamizes the trend of individualization, as it enables more individuals to realize their own potential and satisfy individual needs. Millions of women from all over the world start their own businesses. Most of them do so because of the reason of possibility and less because of the aspect of necessity (EY, 2015). They, thus, provide new career opportunities. Female entrepreneurs also tend to expand. However, women are also increasingly striving for leadership positions, while men act as family organizers (Zukunftsstark, 2016). New and different family models are emerging, which places higher demands on the compatibility of family and career (more details in the chapter on the megatrend *new work*). The family thus plays a more significant role in general life. This also poses new challenges in the field of mobility. The changing needs and demands for mobility are developing an enormous potential for new business models and service structures, which are very different from today's offerings.

On the other hand, a trend towards single lifestyle has been observed for many years. Driven by the changing image of the family, almost 34% of all people in the United Kingdom already live alone (Watson, 2014). Due to the changed role of women in working and leisure life, marital alliances will no longer be decisive in the future.

Key Questions for Gender Shift

- *What does Gender Shift really mean? What does it not mean?*
- *How can I use the megatrend Gender Shift for my aviation organization?*
- *What are the benefits of a more gender-diverse culture in aviation?*
- *How can I, as an organization, benefit from a more gender-diverse culture?*

Case: Switzerland and Gender Diversity in Top Management Positions

Fifteen years ago, in Switzerland, only a few organizations had gender diversity on their agendas. At that time, the percentage of women on executive boards of the largest 100 companies in Switzerland was at 4%. Today, the quota is at 10%, which means that it has reached the double digits for the first time. Since 2010, the percentage of women on supervisory boards has even increased from 10% to 23%. The trend has remained consistent for years, which is why experts anticipate a 30% quota by 2024.

What one would not think of is that the public sector is paving the way in terms of gender diversity on the board level. The proportion of women employed as top executives in the public sector steadily rose by two percentage points and for the first time reached the 20% mark in 2020. The public sector confirmed its efforts of the previous year and again filled 38% of the vacancies in the top positions with a woman. The proportion of women in top positions is, therefore, twice as high as on executive boards of the private sector. The greater gender diversity in the public sec-

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tor is due to the better reconciliation of career and family. These aspects are vital to balance gender diversity.

Despite this, there is much room for improvement. Only 53% of the largest companies employ one or more women on executive boards. 47% of the companies still do not have one single woman on their executive board. In contrast, only 11% of the surveyed companies are without women on their strategic board – the supervisory board.

This case is based on the Schilling report of 2020 (Schilling, 2020).

1.2.5.3 Health

Due to rising standards of hygiene and living as well as the transparency of conflicts with food, work and consumption, a partial trend of New Life exists today. Growing health expenditure and increasing cost pressure in medicine can be observed (Zukunftsinstitut, 2015). Health is seen as a desirable goal, also because is offered more individually and technologically. Psychology and physiology are growing even closer together. This offers enormous potential for new medical services, as they are now seen less as a necessary means and more as a service for achieving general prosperity. Detoxing, self-tracking, wearables and other technological products for measuring the health of an individual are, therefore, in high demand (Bruno, 2015; Ernst, 2016; Neff & Nafus, 2016; Tiller, 2015; Zukunftsstark, 2016).

» Right now, we are struggling to realize what wearable technology is. It will not be just on the body, but in the body. (O'Reilly, 2014)

In this health society, the customer sees himself as a "health prosumer" (based on the term prosumer: the consumer who makes professional demands on a product). The marketing potential seems almost inexhaustible. This trend is also making itself felt in working life. Experts call this phenomenon "corporate health" (Moussu & Ohana, 2016; Schuldt, 2016).

However, the mobility market has not yet really become aware of this trend. Health offers, in combination with mobility offers, are the exception, although there would be an enormous synergy potential here, as the customer would feel this not only psychologically but also physically. Personalized genomics, regenerative medicine, remote monitoring, organ printing and user-generated medicine through medical data mining will lead to an additional dynamization of this trend (Watson, 2014). In the future, it will be possible to generate user-specific data, monitor it and treat it in a more personalized, resource- and cost-efficient manner.

» The digital world has been in a separate orbit from our medical cocoon, and it's time the boundaries be taken down. (Topol, 2014)

On the other hand, the shift in the focus of clinical pictures, the more important information and self-treatment of the customer and the emergence of ethical questions are creating new demands on the partial trend of health and medicine in general.

1.2.6 Knowledge Culture

Due to the increasing speed of innovation, growing technological change, new individualized concepts for lifelong learning, the globalization of educational opportunities and the worldwide increase in education and qualification levels, enabled the emergence of a knowldge culture. The demands on the type of competencies are changing. New competencies are in strong demand.

This trend will be reinforced by an increase in open access and open source solutions in the field of education (Eberl, 2013). Bionics, creativity and creation are increasingly promoting this trend (Maas et al., 2015). The liberalization of the education system leads to considerable potential for efficiency and innovation (Schellenbauer & Walser, 2013). There is an increasing number of educational opportunities. Besides, access to these new and more varied educational opportunities is increasing. Educational institutions act as multipliers. Through new technological educational opportunities (also due to the gigatrend digitalization), individuals are able to access knowledge more autonomously. Digital education is the key to success (Eberl, 2013).

» Think about learning and education with all the new tools that are being built. We are on the cusp of the acceleration of that and it's almost overwhelmingly good. (Schmidt, 2015)

This, in turn, supports the trend towards individualization. A culture is emerging around the knowledge and education of individuals in a society (Zukunftsstark, 2016). This development is further supported by new forms of work (see megatrend New Work) such as part-time work, homeoffice and third places (Maas et al., 2015). In turn, the future viability and competitiveness of individuals, societies and entire nations depend on the development of a knowledge culture (Schellenbauer, 2013).

On the other hand, there is also great danger in this. If individuals and societies do not succeed in establishing this knowledge culture, industries and societies will come under increasing pressure to be uncompetitive in the "war for talents" due to faster and more disruptive phases of change. For this reason, a gap in the level of education can be observed increasingly worldwide. Ghettoization, social inequality and two-tier societies are the result (Maas et al., 2015).

Attention
Really challenge and reflect your own thinking and your respective organizations'. Do not stick to the same mental models and rationales, but try to learn continuously. Foster different views from different people through open sources and open dialogue and develop into a learning organization or a learning individual.

Key Questions for Knowledge Culture

- *How can I use the megatrend knowledge culture for my aviation organization?*

- *What might be possible partners for my organizations to cooperate with to create a knowledge culture?*
- *How can I create a learning organization that benefits my employees and the capabilities of my organization in the long-run?*

1.2.7 New Work

The softening of the traditional image of the employee, the changing role of men and women and the automation of increasingly complex work tasks are creating a megatrend that can be described as a new way of working. Companies are faced with the challenge of combining concentrated work and increasing employee demands. They are increasingly being held responsible for solving social challenges. As a result, new and more open work structures and management concepts are developing, which result in more flexibility for employees. In recent years, the megatrend of digitalization has made it possible to develop new, intelligent production processes that increasingly relieve employees of physical labour. The megatrend of globalization is also fundamentally changing from an industrial to a knowledge and service society. Service, information and creative work form the foundation of modern economies. Different industries are growing together and are increasingly consolidated. Mobile working, autodidactic, new workplace designs as well as part-time work, home office and so-called third places are the characteristics of this new work. Creativity and identity are the critical skills required to manage the polarization of work content and quantity. New forms of mobility enable mobile workers to work and eliminate the need for a fixed job. It is not a scarcity that this trend promotes, but the complexity of the type of work that will challenge organizations in the future.

On the individual side, the megatrend new work is leading to an increasing merge of professional and private life. The professional world is taking on a new role in the life of an individual. Work-life balance, home office and flexible working hours are already standard today. Collaborative concepts and co-working allow the new, creative workers to exchange ideas and take on different jobs. This gives the employee the possibility (and sometimes just the feeling) of being self-employed, even though being employed. The boundaries between work, living and movement become relative. Work is changing and with it mobility as well. Leisure and work paths are becoming blurred, as is general leisure and working life.

However, collective labour agreements, minimum wages and sector-specific wages have created inefficiency in many industrialized countries that limit this flexibility, liberal wage formation and new concepts (Schellenbauer, 2013).

1.2.8 Security

Due to the insecurity of society concerning uncertain events (described at the beginning as wild cards), new technologies and the usability of data as well as the vast and diverse demands on the state, military and sovereinty, a megatrend of security exists. This trend is caught in the dichotomy between monitoring or prevention and protection or precaution.

Many experts even call this a new culture of security, with the megatrend moving away from established structures and responsibilities. Due to the increased threat of cyberterrorism, natural disasters, data theft and forgeries, individuals are subjectively insecure and the complexity of the situation overburdens the state. For this reason, the state and public organizations will no longer play a central role in the security megatrend in the future. New technologies also result in an increase and change of type of safety issues, such as in the case of autonomous driving and flying. The new types of safety issues in this specific fields are issues of liability and vehicle safety. But also, in operational and data security, new questions arise in the context of security due to new and different final products and different interfaces (Eberl, 2013). In the future, there will generally be more regulation and incentive systems instead of hard regulation.

» In the digital era, privacy must be a priority. (Gore, 2013)

Due to increasing digitalization, connectivity, individualization and new demands about living and working, the understanding of security values is changing from superordinate organizations towards individual designs. In the context of mobility, for example, previous national efforts often neglected issues such as the intermodality of transport and overestimated safety issues. Experts argue that governmental organizations are only responsible for a framework and are guaranteed by regional institutions (private or state), some of which are highly adapted and individualized (Lyons & Davidson, 2016). In this new security world, people and companies are increasingly security and not just risk carriers because in the future security world, "nothing is private" (Watson, 2014). If the new security is not dynamic, adaptable, flexible and changeable, security can fundamentally no longer be guaranteed. Transparency plays a vital role in this process, to build trust with users and society.

» Trust is a serious problem; we have to get to a new level of transparency – only through radical transparency will we get to radical new levels of trust. (Benioff, 2015)

1.2.9 Mobility

» Economies, states and cultures have always depended on transport and the spatial exchange of people and goods for their existence, security and progress. For this reason, transport and its history form a fascinating cross-cutting theme with numerous far-reaching references, both within the historical sciences (political, economic, social, environmental and technological history) and within other sciences (geography, sociology, economics and ecology). (Merki, 2008)

Mobility:
No other term embodies the hopes, wishes, needs and problems of people and their impact on economic cycles. The term describes the movement, speed and agility of persons (origin in Latin: *mobilitas*). The term transport, in turn, describes the instrument with which mobility is perceived and executed.

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The forms of mobility today are at least as heterogeneous as the needs, lifestyles, work forms and networks of the mobility customers themselves (Hunecke, 2015). The mobility of the future, therefore, depends on many premises. Mobility stands for the freedom of movement of individuals (Weihrauch, 2014), strongly observable in times of the recent COVID-19 crisis. Since mobility is expressed in various areas of life (work, leisure, tourism, etc.), mobility has been characterized by a steady increase in demand and simultaneous acceleration (BFS, 2016). The volume of traffic and the number of trips per person will further increase in the future, experts say – especially in urban areas (ARE, 2016b) with transport modi being available in the future, such as urban air travel. In the future, home becomes a relative concept. Being mobile will become a social obligation and, thus, a matter of course for the customer (Zukunftsinstitut, 2016).

The value of mobility is changing in the perception of the customer precisely because many experts already describe mobility as a "commodity" or "basic supply." The megatrend mobility will also play a central role in everyday life of every individual in the future (Buckley et al., 2015). The car is still considered a general right of ownership today. Today, mobility also means activity, freedom, change and heterogeneity, both individually and socially. Future customers want even faster, more frequent, more, cheaper, safer and more female-friendly mobility (Wittmer & Linden, 2017). Soon already, mobility will increasingly unite working and living spaces. The needs become even more heterogeneous due to individual demands. Central mobility points (mobility hubs) are the key to an efficient, networked and mobile mobility lifestyle. The car is no longer just a status symbol and the central vehicle for everyday mobility but is being developed into an autonomous, high-tech data tool for the new, more mobile worker. Multimodality becomes even more system-critical and -important in the multi-option society that can be observed today. This also increases the search for possibilities to implement mobility requirements, rules, infrastructure and needs in an economical, comfortable, individual and ecological way. The consequence is that more and more areas of politics, business and society are being influenced and made dependent on the megatrend mobility. Mobility affects everyone and sometimes to a very considerable extent.

» In 2040, mobility will be greener, safer, more automated, multimodal, shared and individual. Mobility will thus become people-friendly, post-fossil and climate compatible. At the same time, mobility customers want 100% safety, punctuality and predictability as well as emission-free, eco-friendly, multimodal and time-independent services. (Linden & Wittmer, 2018)

Social change with new forms of living and working will further dynamize this megatrend. The increase of flows of people, goods and information on an international scale as well as growing tourism, changing interplay between different forms of mobility, mobility substitution through digitization, new logistics concepts and the emergence of horizontal mobility concepts are essential criteria for the relevance and nature of this megatrend (Zukunftsstark, 2016). The combination of social and environmental change combined with new technological possibilities has a major impact on the future of mobility. This is one of the reasons why the megatrend mobility is so dynamic and its development incredibly difficult to measure (Canzler & Wittowsky, 2016; Knie, 2016).

How can we react to this dynamic development, one might ask. The central challenge will be to eliminate inefficiencies in the mobility market and to make transport policy dependent on external costs such as congestion, noise, emissions, etc. (ARE, 2016a) to charge actual costs and promote the polluter-pays principle (Müller-Jentsch, 2013). One term that is particularly relevant is a controversial one: "mobility pricing" (Kryvobokov et al., 2015; Nash & Whitelegg, 2016; Pronello & Rappazzo, 2014). According to experts, it is also necessary to promote a rethink in the area of mobility (Knoflacher, 2013) to do justice to the digital mobility revolution (Canzler & Knie, 2016). Without this rethinking, the critics will grow in the following direction: "*Besides smaller innovations, it is above all the past that is being perpetuated: The sale of private cars remains at a high level, congestion hours are increasing, and the number of kilometers traveled and passengers on trains and buses are rising steadily. Although goods traffic on the last mile is becoming increasingly small, it is also continuing to grow.*"

1.2.9.1 Autonomous Vehicles

» The revolution in mobility comes with autonomous vehicles. And these are coming sooner than many experts suspect. (Thomsen, 2016)

» In 2040, autonomous vehicles will mundane. (Kelkar, 2016)

» Autnomous vehicles is the biggest revolution in the mobility industry since the invention of the car. (Röhrleef, 2016)

■■ Back to the Future:

Strictly following this motto, today's mobility players are trying to shape the future of the industry. They try to integrate phenomena observed in nature into intelligent, autonomous vehicles of the future (Watson, 2014). One of the most exiting examples for this is FESTO's Smart Bird, which is inspired by the herring gull. The ultralight flying model has state-of-the-art aerodynamics and agility, and is able to take off, fly and land without an additional drive. Vehicles of the future are to scan their surroundings with multi-layered sensory organs, communicate with other vehicles, act autonomously and also learn from past events.

Many researchers and experts, therefore, describe the introduction of fully autonomous vehicles in transport as a turning point for mobility as a whole. The potentials and effects of this sub-trend are very complex. Not only other modes of transport but also new ways of life and work of mobility customers depend very much on this sub-trend of mobility. Many megatrends, such as urbanization, ecology, globalization and security, can be suddenly changed or dynamized by this sub-trend. If autonomous vehicles are successfully introduced, the vehicles' system(s) exist mainly in acting as intermediaries between "automotive users" and third-party products. Thus, mobility vehicles will develop into data collectors and storage devices. These vehicles allow the provider to collect, analyse and use essential data and information to further improve their system, networks and resilience as well as understand customer needs. These customer needs can also change significantly through autonomous vehicles. The customer can be presented with new, more flexible and individual offers. The pyramid of needs can thus shift considerably. The autonomous vehicle eliminates both the price advantage of public transport and the flexibility advantage of MIV.

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Besides autonomous ground transportation, drones have been experiencing an immense push in recent years. When precisely the history of drones began depends on what exactly is considered to be a "drone." Both the first flight of an unmanned balloon in 1782 and the first quadcopter created in 1907 can be regarded as the beginning of the drone era. For many years, drones were developed and used mainly for military purposes. However, over the past 10 years, there has been a steady development towards commercial and private uses. The global drone market is expected to generate 43.1 billion USD in 2024, with growth projected to be at 16.8% CAGR (DroneII, 2019). Further, drones are set to disrupt different areas, from agriculture, arts and entertainment, to energy, logistics, real estate as well as mobility in more general. In many cases, it is expected that drones can carry out their mission independently without the intervention of a pilot, which makes the operation of drones very attractive from a technological and economic perspective. This automation of air mobility is expected to be implemented first for early use-cases, such as search and rescue, transport of medical goods or logistics, before even introduced in the passenger transport segment.

What drones clearly show is that the sub-trend of autonomous vehicles is mainly dependent on digital solutions, technological development in the entire mobility system and the provision of a network of intelligent infrastructures. Sommer (2016), for example, says that "autonomous vehicles will not be possible without digitalization." Nevertheless, for many experts, the question is only when and not whether this sub-trend will become a reality:

However, the smart vehicle of the future must increasingly be embedded in its environment to increase safety, ecology and connectivity. Today, due to the lack of implementation of these aspects, there is often speculation about public acceptance of such vehicles. If the public does not trust these products due to safety or other aspects, this sub-trend will only be observed as a selective phenomenon or utopia. However, if acceptance can be guaranteed, this will have "fundamental effects on the way people understand mobility" (Thomsen, 2016).

? Key Questions for Autonomous Vehicles

- *What do autonomous vehicles really mean for the system of mobility?*
- *How do autonomous vehicles change customers' perception?*
- *How do autonomous vehicles change the way the mobility industry will function?*
- *What are showstoppers for autonomous vehicles and what and when are tipping points for them?*
- *What do new technologies, such as drones, mean for my business in the long-term?*

1.2.9.2Sustainable Mobility

- **e-Mobility**

» The crisis in the automotive industry is putting on the agenda what has long been a certainty: The departure from oil is drawing nearer and with it the need to further develop our current form of mobility and make it fit for the future. (Brake, 2009)

The environmental discussions in politics and society are omnipresent and inevitable. In current discussions, the electric car seems to be a promising way to reduce emissions and allow environmentally friendly driving in the future. Although this sounds promis-

ing and there is a lot of media interest in it, the handling and the high acquisition costs prevent many people from seriously considering the purchase of an electric car. It still frequently fails to be integrated into the existing mobility concept of many companies, regions and mobility ecosystems. Furthermore, the negative energy balance of the manufacturers as well as the need of and impact on natural resources. At present, customers do not yet have sufficient confidence in the technology. They doubt that the range is sufficient to meet their needs and think that not enough charging stations are available yet (Henkel et al., 2015). However, fundamental issues of the automotive industry, such as the VW exhaust gas scandal, clearly show the advantages of regenerative drives. Therefore, despite the relatively adverse developments in electric mobility today, many researchers consider the trend towards post-fossil drives to be inevitable (Augenstein, 2015; Monheim, 2012). At the latest when the internalization of external costs (noise, congestion, emissions, etc.) (ARE, 2016a), which many experts have called for becomes a reality, the price of non-electromobility mobility will increase significantly and lead to an efficiency disadvantage (cost-benefit) compared to electromobility - also called green premium. Many of these external costs can be minimized and, in some cases, even eliminated by electric vehicles. Many experts, therefore, conclude that price parity will be achieved soon:

- Price parity will be achieved by 2022 at the latest. (Randall, 2016; Wenzel, 2016)
- We will have almost exclusively electric mobility, with a few exceptions that will not get away from fossil fuels until then (gravity, infrastructure). (Weiss, 2016)

Also, laws and regulations provide this sub-trend towards mobility with a critical framework in which it can develop further. The state must inevitably promote post-fossil transport to achieve its sustainability goals. E-bikes already demonstrate very well today the enormous impact that an electric motor can have on mobility in general (see also e-load wheel). The mindset of humans will inevitably adapt (Gebauer et al., 2016).

Very exciting is also the combination of different mobility sub-trends, such as a combination of sustainable mobility and autonomous vehicles. A ground-breaking field is, e.g. eVTOLs (an acronym for electric vertical take-off and landing vehicles). eVTOLs highlight the incredible promise and progress of electric and hybrid-electric powered vertical take-off and landing aircraft, focusing on non-helicopter VTOL aircraft large enough to carry passengers without conventional helicopter flight controls. They are said to change regional air mobility, inter-city travel, city-countryside as well as countryside-countryside and, most importantly, urban air mobility. There are more than 500 concepts worldwide working on a solution to integrate autonomous and electric vehicles into airspace, mostly for urban centres with highly congested road traffic and with rotor-lift or wing-lift technologies. The market for eVTOLs could amount to $1.5 trillion by 2040 (Morgan Stanley Research, 2019).

However, the challenges of eVTOL companies are often not given adequate attention in the media. The VTOL pioneers act “in a largely and so-far unregulated and non-certified space. It is unclear if there will ever be a product achieving economic viability and social acceptance - despite billions of dollars being invested in this sphere already and several SPAC-deals being concluded in 2021 alone. Air travel is highly regulated, and aircraft are required to be authority-certified for passenger safety. Also,

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main issues to be solved are in the area of infrastructure, technological development, safety, social acceptance, economic viability, and emissions of these aircraft. Even if a concept could be technologically, ecologically, socially, and economically successful, regulators might not allow its widespread use, due to regulatory and/or safety concerns.

Further, a main disclaimer for eVTOLs needs to be made here. One needs to highlight that there might be radical innovation from a technical development standpoint; they might disrupt the helicopter market and they might be a valid addition to the already existing transport modi, but they will always serve a small niche in the broader mobility system.

Key Questions for e-Mobility

- *What does e-Mobility really mean for the larger system of mobility?*
- *What is the real impact of e-Mobility on the system of mobility?*
- *How do autonomous vehicles change customers' perception?*
- *How do autonomous vehicles change the way the mobility industry will operate?*
- *What are showstoppers for e-Mobility?*

Case: Dufour Aerospace as an eVTOL Manufacturer

Dufour Aerospace is an eVTOL start-up, based in Visp, Switzerland. Thomas Pfammatter and Dominique Steffen, both aerospace experts, started working on an electric aerobatic aircraft, the aEro1, in 2016 (Dufour Aerospace, 2016). Building on this experience, they founded Dufour Aerospace in 2017 with Jasmine Kent to further explore the possibility of electric aviation. So far, most work has been done remotely by the leadership team or outsourced as project work. They have raised 2.2 million CHF in funding until March 2019 and raised another 10 million CHF to develop and produce the aEro 3.

The leadership team of Dufour Aerospace consists of Thomas Pfammatter, co-founder and CEO, Dominique Steffen, co-founder, Jasmine Kent, co-founder and CTO, and Damian Hischier, chief test pilot and head of certification. They are the core team with the vision and the motivation to develop and market the aEro 3, a 7-seater version of their tilt-wing eVTOL concept. The current goal is to first introduce the aEro 3 as an emergency medical service (EMS) aircraft, because such a use case will most likely face the least resistance from the public and can provide a solid cost advantage, compared to traditional helicopter emergency services. The company is cooperating with academic institutes in Switzerland to refine their concepts. So far, Dufour Aerospace has worked on three concepts. The aEro1 was their first electric acrobatic aircraft that first flew in 2016 as proof of concept for electric aviation (Dufour Aerospace, 2016). The aEro2 concept was designed as an eVTOL and was the original concept Dufour Aerospace planned to bring to market, based on their understanding of the certification requirements at the time. Due to the regulation "Special Condition for Small Category VTOL Aircraft" (EASA, 2020), this focus shifted as all passenger-carrying eVTOLs up to the weight limit of 3175 kg are treated equally under the regulation. Therefore, it makes sense to directly develop a passenger aircraft with more seats instead of developing a two-seater with a much more limited scope of application. Dufour Aerospace aims to develop the aEro3, while testing with a half-sized aEro2

prototype, that could potentially become a cargo drone, and simultaneously looking to develop the aEro1 into a standardized product to be manufactured on a small scale.

Dufour Aerospace is approaching the development of products with a strategically planned phased approach, hoping to stay as lean as possible and utilize their time and products efficiently to develop the capabilities to be a successful eVTOL manufacturer. This approach is a mirror of the eVTOL concept selection, trying to reduce the risk and cost whilst positioning themselves as an early follower, hoping to leave the majority of development and certification costs to the pioneers, entering with a mature product in an already established market.

Nevertheless, success is uncertain as many factors are beyond Dufour Aerospace's control, and its assumptions might be faulty. The eVTOL market may develop quicker, technologies might be more successful than anticipated, business models might diverge and the willingness of the EMS market to adopt eVTOLs over helicopters may be lower than expected. Also, the acceptance of society and the public of eVTOLs on an autonomous basis might be slower than expected. Additionally, Dufour Aerospace might be outpaced by competitors, such as Joby, Lilium, Volocopter and others, which have far-exceeded Dufours' funding amounts and are far-ahead in terms of certification and public sentiment.

1.2.9.3 Sustainable Aviation

Climate change and increasing air pollution are among the most significant challenges facing humanity in the coming years and decades. One industry that is increasingly appearing in the spotlight of public debate on reducing greenhouse gas emissions is the mobility industry, with specific emphasis on the aviation industry in recent months and years. Why is this so? Commercial aviation is responsible for about 2% of global carbon emissions. Reducing these emissions is a serious global challenge for the aviation system and every player involved. In 2009, IATA put in place an ambitious and robust carbon emissions strategy, which targets a four-pillar action plan: (1) improved technology, including the deployment of sustainable low-carbon fuels, (2) more efficient aircraft operations, (3) infrastructure improvements, including modernized air traffic management systems and (4) a single global market-based measure, to fill the remaining emissions gap (IATA, 2020a).

Further, by establishing a multilateral approach to the "Carbon Offsetting and Reduction Scheme for International Aviation" (short CORSIA) in 2016 at the General Assembly of ICAO, the industry tries to stabilize and reduce emissions from international aviation continuously. CORSIA's obligations have already started. As of 1 January 2019, all carriers are required to report their CO_2 emissions on an annual basis, whereas they have to compensate for a part of their CO_2 emissions by purchasing and cancelling CO_2 emission units as of 2021.

Today, the substantial societal and political call for more sustainable travel has already resulted in the first movements, such as "flight shame," which regard flying as one of the top environmental sins and therefore call for renunciation. Despite and maybe even because of the unprecedented industry crisis brought by

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COVID-19, aviation players reconfirmed their commitment to their global environment strategy (IATA, 2020b). Thus, the commitment, also established through CORSIA, is yet more critical than ever before. Combating climate change remains a top priority. Cutting CO_2 emissions by half by 2050 with innovative technologies, sustainable aviation fuel and improved operations and infrastructure will be a considerable challenge, but also an immense opportunity for aviation players to position themselves as leaders in this critical but relevant area for society and politics.

Since the social and political pressures on the industry will continue to grow in the future, sustainability and the path to it are currently at the top of the strategic agenda for all players of the aviation system. In addition to numerous measures that can be implemented in the short term, a complete transformation is needed in the long term in addition to pollutant-neutral and sustainable flight services. For example, airlines need to rethink their business models (Rossy et al., 2019) and look for opportunities to embrace sustainable aviation. One solution might be a controversially discussed topic of eco-labels (Wittmer et al., 2019). Even if the necessary technologies are not yet available, players of the aviation system are well-advised to plan the transformation process as early as possible, to define a roadmap and milestones, and to plan the required resources as well as the internal change management.

Key Questions for Sustainable Aviation

- *What are the main concerns of society and politics when it comes to sustainable aviation?*
- *What might be hidden agendas of stakeholders that demand sustainable aviation and how do I cope with that?*
- *What is my long-term plan for sustainable aviation?*
- *How can I sense and use the strong societal and political call for sustainable aviation to develop a long-term competitive advantage for my organization?*

1.2.9.4 Mobility Sharing

» Sharing is good, and with digital technology, sharing is easy. (Stallman, 2012)

Due to the emergence of "peak car use" in numerous countries, a trend toward less ownership can be observed. This might be due to cars not being used 96% of the time. They are one of the most expensive goods that private households own. This makes cars incredibly inefficient, not to mention that in some cities up to 30% of the area is dedicated to car infrastructure. Sharing could reduce this inefficiency to a smaller extent. "Using instead of owning" is the motto of this sub-trend of mobility. Through the trend of mobility sharing, it is possible to combine public and private mobility offers even better. The development of membership figures for such sharing offerings is rising by 600% in some cases (e.g. China), with a nationwide increase observable for years. Bike, ride and especially car sharing are the characteristics of mobility sharing today (Laporte et al., 2015; Shaheen, 2016). The sharing concept is clearly on the advance: 20% of all car routes worldwide today

run via Uber. A study by Deloitte (2015) has shown that 55% of Swiss consumers will purchase a sharing service in the next 12 months. Also, in aviation, many exciting start-ups popped up in recent years, such as WeeShare, Wingly, Simplyfly, to name only a few.

Travis Kalanick, the former CEO of Uber, even described sharing as "the future of human-driven transportation." If two or more people share a car, total mobility costs are reduced. For example, there is one fewer car on the roads, which can reduce emissions. An study by APTA of 2016 came to the same conclusion:

» The more people use shared modes, the more likely they are to use public transit, own fewer cars, and spend less on transportation overall. (APTA, 2016)

Today, mobility sharing fails going mainstream already passing the first hurdle: actual testing and first-using vehicles. Mobility sharing is mainly used based on recommendations from friends and acquaintances. However, since there are still relatively few experiences and offers, many models fail already due to the lack of awareness of these models. Though, the dynamics of the sub-trend and new offers could increasingly accelerate it in the short term. The problem today is that the sharing models are still too little integrated into the existing infrastructure and receive little legal support. Despite this, there are some promising examples, also in niches of the mobility industry, which serve as appetizers for more innovative ways of sharing instead of owning in the future (see Case Fractional Aircraft below).

Further, megatrends such as urbanization, digitization and ecology, but also spatial boundaries, are making the partial trend of mobility sharing increasingly dynamic (González, 2015). It is, therefore, not only a trend with an urban impact but also an essential basis for rural and suburban areas to participate in modern life. For many experts and researchers, it is therefore already taken for granted. For the future, however, the development of attitudes and values and, thus, the mobility behaviour of mobility customers will continue to be neccessary to boost its acceleration.

Key Questions for Mobility Sharing

- *What are main aspects that need to be introduced to enable mobility sharing?*
- *What are the pitfalls of a mobility sharing concept?*
- *How do mobility sharing concepts change the way the mobility industry will operate?*

Case: Mobility as a Service and MaaS Global with Its Whim-App

Mobility-as-a-Service (MaaS) describes a shift away from personally owned modes of transportation towards mobility provided as a service. This is enabled by combining transportation services from public and private transportation providers through a unified gateway that creates and manages the trip, which users can pay for with a

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single account. Users can pay per trip or a monthly fee for a limited distance. The key concept behind MaaS is to offer travellers mobility solutions based on their travel needs. Travel planning typically begins with a journey planner. For example, a journey planner can show that the user can get from one destination to another by using a train/bus combination. The user can then choose their preferred trip based on cost, time and convenience. At that point, any necessary bookings (e.g. calling a taxi, reserving a seat on a long-distance train) would be performed as a unit. It is expected that this service should allow roaming, that is, the same end-user app should work in different cities, without the user needing to become familiar with a new app or to sign up to new services.

MaaS has many benefits that can improve ridership habits, transit network efficiency and societies that adopt MaaS as a viable means of transportation. MaaS could decrease costs to the user, improve utilization of MaaS transit providers, reduce city congestion as more users adopt MaaS as a primary source of transit and reduce emissions as more users rely on public transit component, autonomous vehicles in a MaaS network. MaaS equally has many benefits for the business world – understanding the total cost of business mobility could help travel decision-makers in the corporate world save hundreds of thousands. By analysing data and costs attributed to "business mobility" (e.g. vehicle rental costs, fuel costs, parking charges, train ticket admin fees and even the time taken to book a journey), businesses can make informed decisions about travel policy, fleet management and expense claims. Business MaaS companies such as Mobilleo suggest that in journey planning alone, it can take up to nine steps before a simple travel arrangement is booked.

Maas Global soft-launched its MaaS application Whim in Helsinki, Finland, in late 2016, followed by a full launch in November 2017. The first-ever MaaS operator interconnected many of the city's mobility options under one subscription and within a single app. With the Whim app, the user can combine, plan and pay for public transport, taxi, car rental, car sharing and city bike trips. The data of a study by Ramboll in 2018 on MaaS Global suggests that public transport is the backbone of MaaS users' travel habits, MaaS users excel in multi-modality and the MaaS platform is potentially facilitating first/last mile choices that lead to greater access to public transport. As MaaS lets users access alternative modes more quickly when they need to, it may attract those users who are thinking of either buying a car or give up a car. MaaS, therefore, allows a more holistic use of the existing transportation system. MaaS is, therefore, not changing the transport system itself; rather, it facilitates more effective and inclusive use of the existing one.

Through MaaS platforms, such as Whim, users can access a variety of different transport modes, which covers an individual's mobility needs. Platforms not only could combine the different modes but also could be the "distribution channel" for new mobility services. This has been the case in other industries, such as new content creators in social media, shopkeepers in internet retail and so on.

Case: The Fractional Aircraft

Today, many business travellers are criticized for taking a private jet or leasing a jet to travel for short business meetings. Most probably, you will never justify the cost of a business jet by how much you save in airline tickets. It comes down to how much the value of time and the opportunity to take trips that you could not otherwise is, as well as how important it is to run on your own schedule. Further, business jets reduce the lack of stress, being able to work or relax, meet with associates in privacy and the feeling of freedom from the misery of mega hubs. What price is that worth? Whether to acquire a business jet often comes down to an act of faith – an entrepreneurial rather than a spreadsheet decision. Fractional aircraft is a novel compromise, used by many managers, athletes or generally busy or luxury-seeking people today.

Fractional aircraft is a collective term for fractional ownership of aircraft where multiple owners share the costs of purchasing, leasing and operating an aircraft. There are already several commercial programs for fractionally owning a large aircraft, such as NetJets, Flexjet, PlaneSense and AirSprint, to name only a few. With fractional aircraft, customers (or "owners") buy a share of an aircraft, rather than an entire one. The price is pro-rated from the market price of a full aircraft. Owners then have guaranteed access (the magnitude of usage depends on the model) to that aircraft or a similar one in the operators' fleet – with as little as 4 hours' notice in some models. Fractional owners pay a monthly maintenance fee and a pay-per-use hourly operating fee. Usually, the latter is charged only when an owner or guest is on board, not when the plane is flying to a pick-up point or returning to its home base after completing a flight. Owners have access to the full fleet of aircraft and may upgrade or downgrade for specific flights when they need to. At the end of the contract, the owner can sell his or her share either back to the company or to another owner waiting for a position, though most companies charge a re-marketing fee to do this. In most cases, typically, after 5 years, you have a guaranteed buy-back of your capital asset at "fair market value."

After 20 years of fractional ownership, it is unclear if the model works in its current form. The original fractional model anticipated selling planes in 1/4 fractions, rather than the 1/16 or 1/32 fractions that have emerged recently. Each additional partial owner creates more demand and scheduling complexity for each plane, particularly during peak periods, such as holiday seasons. Further, the theory that a growing customer base will reduce empty-legs has proven limited. While there have been some improvements, the best-case "floor" of empty traffic is still above 20% of total traffic. The worst-case for new operators can approach 50%. One strategic boost has been the introduction of efficiency incentives to align client behaviour with operating efficiency better. Some companies have resisted these programs: if fractional's appeal is the simplification of flight, that appeal is reduced when accompanied by a host of individual pricing adjustments and incentive programs. Despite this marketing challenge, cost concerns have resulted in numerous efficiency-driven

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programs, while many models still struggle to offer cost-efficient ways of fractional aircraft.

The case shows that such niche mobility sharing models are exciting but challenging. These models might offer customers innovative solutions that increase variability and options. At the same time, flexibility and individualism challenge such models – true for many sharing models in the sector of mobility and especially in air travel today.

1.3 Summary

In recent years, one can observe a hype in trend research. Many researchers and scientists are addressing this topic and trying to analyse the effects of today's trends for the future. Megatrends should make the future more predictable due to their long-term nature and overarching effects. In the course of the work at the Center for Aviation Competence at the University of St. Gallen (CFAC-HSG), it was found through empirical work that one central trend fundamentally influences all megatrends, i.e. *digitalization*. This is why one can refer to digitalization as so-called gigatrend.

In this chapter, we discussed the gigatrend and eight other megatrends, always emphasising their relation and importance for the mobility and aviation industry. Through our dedicated work on the matter and intense exchange with experts, we found that the megatrends *individualization*, *urbanization*, *ecology*, *globalization*, *new life*, *new work* and *security*, in turn, also have a substantial impact on mobility and the aviation industry in specific. Also, we identified three central sub-trends for the the megatrend *mobility*: autonomous vehicles, sustainable mobility and mobility sharing. We described the gigatrend and each of these mega- and sub-trends briefly and highlighted their impact on mobility and the aviation industry.

This chapter is ought to ensure a discussion of the criteria for planning the future of mobility and the aviation industry and, at the same time, to show the dependence of mobility and aviation on various external factors of the environment, influenced by trends that are already possible to be sensed today. Further, it is not to be seen as an extensive list of trends, nor as a scientific piece on these trends. Hence, the chapter could be a first starting point for a strategic exercise or planning process.

Hint

A transformation towards embracing these trends will not happen overnight. Introduce a culture of openness towards dynamic change and introduce uncertainty and curiosity as standard factors. This will take time. But be aware of the immense power of being a role model as management team and introduce quick wins to increase motivation and commitment to the topic.

Key Questions Overall

- *What do these specific mobility trends mean for my organization?*
- *How can I use these mobility trends to shape my own organization in the long run?*
- *How can I sense developments, like the ones described above, continuously to do proper long-term planning?*
- *How can I personally and proactively shape the future that was described above?*
- *What role do we, as an aviation organization, play in the future described above?*

Key Questions for Digitalization

- *What does digitalization really mean? What does it not mean?*
- *How can I use digitalization for good?*
- *Do we need digitalization for the sake of digitalizing or rather because of increasing efficiency or effectively?*

Key Questions for Ecology

- *What does ecology really mean? What does it not mean?*
- *How can I use the megatrend ecology for good in aviation without being criticized for greenwashing?*
- *Do we need ecology for the sake of an external push for environmental sustainability or instead because of increasing long-term competitive advantage?*
- *How can we use the megatrend of ecology to develop a culture of sustainability and long-term thinking and acting?*

Key Questions for Gender Shift

- *What does gender shift really mean? What does it not mean?*
- *How can I use the megatrend gender shift for my aviation organization?*
- *What are the benefits of a more gender-diverse culture in aviation?*
- *How can I, as an organization, benefit from a more gender-diverse culture?*

Key Questions for Knowledge Culture

- *How can I use the megatrend knowledge culture for my aviation organization?*
- *What might be possible partners for my organizations to cooperate with to create a knowledge culture?*
- *How can I create a learning organization that benefits my employees and the capabilities of my organization in the long run?*

Key Questions for Autonomous Vehicles

- *What do autonomous vehicles really mean for the system of mobility?*
- *How do autonomous vehicles change how customers perceive mobility?*
- *How do autonomous vehicles change the way the mobility industry will function?*
- *What are showstoppers for autonomous vehicles?*
- *What do technologies, such as drones, mean for my business in the long term?*

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Key Questions for e-Mobility

- *What does e-Mobility really mean for the system of mobility?*
- *What is the real impact of e-Mobility on the system of mobility?*
- *How do autonomous vehicles change how customers perceive mobility?*
- *How do autonomous vehicles change the way the mobility industry will operate?*
- *What are showstoppers for e-Mobility?*

Key Questions for Sustainable Aviation

- *What are the main concerns of society and politics when it comes to sustainable aviation?*
- *What might be hidden agendas of stakeholders that demand sustainable aviation and how do I cope with that?*
- *What is my long-term plan for sustainable aviation?*
- *How can I sense and use the strong societal and political call for sustainable aviation to develop a long-term competitive advantage for my organization?*

Key Questions for Mobility Sharing

- *What are main aspects that need to be introduced to enable mobility sharing?*
- *What are the pitfalls of a mobility sharing concept?*
- *How do mobility sharing concepts change the way the mobility industry will operate?*

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Literature

Ahmed, W., & Jackson, M. J. (2015). *Emerging nanotechnologies for manufacturing* (2nd ed.). William Andrew.

Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. *Journal of Urban Technology, 22*(1), 1–19. https://doi.org/10.1080/10630732.2014.942092

Andrews, D. C. (2013). Ownership-usage dichotomy and the human element in Newman's freeconomy. *The Vanderbilt Law Review, 66*, 179.

Anthes, G. (2016). Open source software no longer optional. *Communications of the ACM, 59*(8), 15–17. https://doi.org/10.1145/2949684

APTA. (2016). *Shared-use mobility: Shared mobility and the transformation of public transit*. In A. P. T. Association (Ed.).

ARE. (2016a). *Externe Kosten und Nutzen des Verkehrs in der Schweiz: Strassen-, Schienen-, Luft- und Schiffsverkehr 2010 bis 2012*.

ARE. (2016b). *Verkehrsentwicklung bis 2040: Deutlich mehr Personen und Güter auf Schiene und Strasse*. Bundesamt für Raumentwicklung (ARE).
Aschemann-Witzel, J., & Niebuhr Aagaard, E. M. (2014). Elaborating on the attitude-behaviour gap regarding organic products: young Danish consumers and in-store food choice. *International Journal of Consumer Studies, 38*(5), 550–558. https://doi.org/10.1111/ijcs.12115
Augenstein, K. (2015). Analysing the potential for sustainable e-mobility – The case of Germany. *Environmental Innovation and Societal Transitions, 14*, 101–115. https://doi.org/10.1016/j.eist.2014.05.002
Beckmann, J. (2016). *Megatrends und Mobilität/Interviewer: E. Linden*.
Benioff, M. R. (2015). *In tech we trust and the future of the digital economy*. Paper presented at the World Economic Forum, Davos.
BFS. (2016). *Mobilität und Verkehr: Taschenstatistik 2016*. BFS.
Bilyk, B. (2015). *Vereinbarkeit von Ökonomie und Ökologie: Eine Analyse des Wertschöpfungspotenzials nachhaltiger Maßnahmen*. Diplomica Verlag.
Blair-Loy, M., Hochschild, A., Pugh, A. J., Williams, J. C., & Hartmann, H. (2015). Stability and transformation in gender, work, and family: Insights from the second shift for the next quarter century. *Community, Work and Family, 18*(4), 435–454. https://doi.org/10.1080/13668803.2015.1080664
Brake, M. (2009). *Mobilität im regenerativen Zeitalter: Was bewegt uns nach dem Öl?* Heise Zeitschriften Verlag.
Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014). How virtualization, decentralization and network building change the manufacturing landscape: An industry 4.0 perspective. *International Journal of Mechanical, Industrial Science and Engineering, 8*(1), 37–44.
Bruno, T. (2015). *Wearable technology. Elektronische Daten. smart watches to Google Glass for libraries*. Rowman & Littlefield.
Buckley, R., Gretzel, U., Seott, D., Weaver, D., & Becken, S. (2015). Tourism megatrends. *Tourism Recreation Research, 40*(1), 59.
Cachelin, J. L. (2009). *Management in der Multioptionsgesellschaft*. Universität St. Gallen/Gabler.
Camagni, R., Capello, R., & Caragliu, A. (2015). The rise of second-rank cities: What role for agglomeration economies? *European Planning Studies, 23*(6), 1069.
Canzler, W., & Knie, A. (2016). *Die digitale Mobilitätsrevolution: vom Ende des Verkehrs, wie wir ihn kannten*. Oekom Verlag.
Canzler, W., & Wittowsky, D. (2016). The impact of Germany's "Energiewende" on the transport sector – Unsolved problems and conflicts. *Utilities Policy, 41*, 246–251. https://doi.org/10.1016/j.jup.2016.02.011
Caruana, R., Carrington, M., & Chatzidakis, A. (2016). "Beyond the attitude-behaviour gap: Novel perspectives in consumer ethics": Introduction to the thematic symposium. *Journal of Business Ethics, 136*(2), 215–218. https://doi.org/10.1007/s10551-014-2444-9
Chambers, J. (2014). Are you ready for the Internet of everything? *Global Agenda – Hyperconnectivity – Innovation*. Retrieved July, 2016, from https://www.weforum.org/agenda/2014/01/are-you-ready-for-the-internet-of-everything/
De Keersmaeker, G. (2015). *Multipolar myths and unipolar fantasies [Elektronische Ressource]/ Goedele de Keersmaeker*. Egmont – Royal Institute for International Relations.
Dee, M. (2015). *The European Union in a multipolar world: world trade, global governance and the case of the WTO*. Palgrave Pivot.
Deek, F. P., & McHugh, J. A. (2008). *Open source: Technology and policy*. Cambridge University Press.
Deloitte. (2015). Sharing economy: Teile und verdiene! Wo steht die Schweiz?
Derven, M. (2016). Four drivers to enhance global virtual teams. *Industrial and Commercial Training, 48*(1), 1–8. https://doi.org/10.1108/ICT-08-2015-0056
Diego-Mas, J. A., & Alcaide-Marzal, J. (2015). A computer based system to design expressive avatars. *Computers in Human Behavior, 44*, 1–11. https://doi.org/10.1016/j.chb.2014.11.027
Dijkstra, L., Garcilazo, E., & McCann, P. (2015). The effects of the global financial crisis on European regions and cities. *Journal of Economic Geography, 15*(5), 935–949. http://joeg.oxfordjournals.org/content/by/year

Dill, H., & Keupp, H. (2015). *Der Alterskraftunternehmer: Ambivalenzen und Potentiale eines neuen Altersbildes in der flexiblen Arbeitswelt*. transcript Verlag.
DroneII. (2019). *Drone market report 2019–2024.* Retrieved from https://www.droneii.com/
Dufour Aerospace. (2016). *Hamilton aEro 1*.
Duncan, R., & Wang, X. (2015). *The impact of urbanisation on economic growth*. Asia Pacific Press.
EASA. (2020). *Special condition for VTOL and means of compliance*. https://www.easa.europa.eu/document-library/product-certification-consultations/special-condition-vtol
Eberl, U. (2013). *Zukunft 2050: Wie wir schon heute die Zukunft erfinden*. Beltz & Gelberg.
Einstein, A. (1931). *Cosmic religion and other opinions and aphorisms*. Covici-Friede.
Ernst, C.-P. H. (2016). *The drivers of wearable device usage: Practice and perspectives*. Springer.
Evans, D. (2011). *The internet of things: How the next evolution of the internet is changing everything*. In Cisco (Ed.). Cisco Systems.
EY. (2015). *Making sense of a world in motion*. EY.
EY. (2016). *The upside of disruption: Megatrends shaping 2016 and beyond*. EY.
Fasel, D., & Meier, A. (2016). *Big data. Grundlagen, Systeme und Nutzungspotenziale*. Springer Fachmedien Wiesbaden.
Fischer, S., Lange, D., Kleinschmidt, M., & Fischer, F. (2016). *Globalisierung und Politische Bildung: Eine didaktische Untersuchung zur Wahrnehmung und Bewertung der Globalisierung*. Springer VS.
Frick, K. (2016). *Megatrends – Pläne für eine unplanbare Welt*. Retrieved August, 2016, from http://www.gdi.ch/de/Think-Tank/Studien/Megatrends-Plaene-fuer-eine-unplanbare-Welt
Gartner. (2020). *Digitalization*. Retrieved June, 2020, from https://www.gartner.com/en/information-technology/glossary/digitalization
Gebauer, F., Vilimek, R., Keinath, A., & Carbon, C.-C. (2016). Changing attitudes towards e-mobility by actively elaborating fast-charging technology. *Technological Forecasting & Social Change, 106*, 31–36. https://doi.org/10.1016/j.techfore.2016.02.006
Geithner, S., Gühne, M., & Schirmer, F. (2015). *Der demografische Wandel als Herausforderung für das Personal- und Organisationsmanagement: Demographic change: Challenges for managing human resources and organizations – Results of a survey*. Saechsische Landesbibliothek- Staats- und Universitaetsbibliothek Dresden.
González, M. A. P. (2015). The shared mobility, emerging system derived from collaborative and digital economy. *Revista de Obras Publicas, 162*(3566), 33–40.
Gore, A. (2013). *In digital era, privacy must be a priority*. Retrieved August, 2016, from https://twitter.com/algore/status/342455655057211393?lang=de
Haun, M. (2013). *Handbuch Robotik. Elektronische Daten. Programmieren und Einsatz intelligenter Roboter* (2. Aufl). Springer Berlin Heidelberg.
Hehn, N. (2015). *Postfossile Stadtentwicklung. Rechts- und Steuerungsprobleme einer Umsetzung kommunaler Energiewende- und Klimaschutzkonzepte im Rahmen der Stadtplanung*. Metropolis Verlag.
Heinrich, B., Linke, P., & Glöckler, M. (2015). *Grundlagen Automatisierung. Elektronische Daten. Sensorik, Regelung, Steuerung*. Springer Fachmedien Wiesbaden.
Helmke, S., Scherberich, J. U., & Uebel, M. (2016). *LOHAS-marketing. Elektronische Daten. Strategie – Instrumente – Praxisbeispiele*. Springer Fachmedien Wiesbaden.
Henkel, S., Tomczak, T., Henkel, S., & Hauner, C. (2015). *Mobilität aus Kundensicht. Elektronische Daten. Wie Kunden ihren Mobilitätsbedarf decken und über das Mobilitätsangebot denken*. Springer Fachmedien Wiesbaden.
Heufers, P. (2015). *Biographien gestalten durch lebenslange Lernprozesse. Rekonstruktionen berufsbiographischer Orientierungsmuster*. Springer Fachmedien Wiesbaden.
Horx, M. (2014). *Trend-Definitionen: Megatrends*. Retrieved 2016, from http://www.horx.com/Zukunftsforschung/2-03.aspx
Hu, F. (2016). *Big data. Storage, sharing, and security*. CRC Press.
Hunecke, M. (2015). *Mobilitätsverhalten verstehen und verändern. psychologische Beiträge zur interdisziplinären Mobilitätsforschung*. Springer VS.
IATA. (2020a). *Climate change*. From IATA https://www.iata.org/en/programs/environment/climate-change/
IATA. (2020b). *Environment*. From IATA https://www.iata.org/en/programs/environment/

Kelkar, O. (2016). *Selbstverständlichkeit Digitalisierung*. Paper presented at the Mobilität 2040, Zürich.
Knie, A. (2016). *Megatrends und Mobilität/Interviewer: E. Linden*.
Knoflacher, H. (2013). *Zurück zur Mobilität! Anstöße zum Umdenken*. C. Ueberreuter Verlag.
Kreuzer, F. (2003). *Gigatrends: Erkunden der Zukunft unserer Lebenswelt* (F. M. Kreuzer, Wolfgang; Schaumayer, Maria Ed.). Böhlau Verlag.
Kryvobokov, M., Mercier, A., Bonnafous, A., & Bouf, D. (2015). Urban simulation with alternative road pricing scenarios. *Case Studies on Transport Policy, 3*(2), 196–205. https://doi.org/10.1016/j.cstp.2015.02.001
Küppers, E. W. U. (2015). *Systemische Bionik: Impulse für eine nachhaltige gesellschaftliche Weiterentwicklung*. Springer Vieweg.
Labit, A. (2015). Self-managed co-housing in the context of an ageing population in Europe. *Urban Research & Practice, 8*(1), 32–45. https://doi.org/10.1080/17535069.2015.1011425
Laporte, G., Meunier, F., & Wolfler Calvo, R. (2015). Shared mobility systems. *4OR, 13*(4), 341–360. https://doi.org/10.1007/s10288-015-0301-z
Lee, J., Bagheri, B., & Kao, H.-A. (2015). A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems. *Manufacturing Letters, 3*, 18–23. https://doi.org/10.1016/j.mfglet.2014.12.001
Lejpras, A. (2015). Knowledge, location, and internationalization: Empirical evidence for manufacturing SMEs. *Economics of Innovation & New Technology, 24*(8), 734–754. https://doi.org/10.1080/10438599.2014.997460
Linden, E., & Wittmer, A. (2018). *Zukunft Mobilität-Gigatrend Digitalisierung*.
Lyons, G., & Davidson, C. (2016). Guidance for transport planning and policymaking in the face of an uncertain future. *Transportation Research Part A, 88*, 104–116. https://doi.org/10.1016/j.tra.2016.03.012
Maas, P., Cachelin, J.-L., & Bühler, P. (2015). *2050: Megatrends: Alltagswelten, Zukunftsmärkte*. Institut für Versicherungswirtschaft.
McGouran, C., & Prothero, A. (2016). Enacted voluntary simplicity – Exploring the consequences of requesting consumers to intentionally consume less. *European Journal of Marketing, 50*(1/2), 189–212. https://doi.org/10.1108/EJM-09-2013-0521
Meister, U. (2013). Funktionierende Märkte statt politische Pläne im Energiesektor. In G. Schwarz & U. Meister (Eds.), *Ideen für die Schweiz. 44 Chancen, die Zukunft zu gewinnen – NZZ Libro* (2. Aufl). Verlag Neue Zürcher Zeitung.
Merki, C. M. (2008). *Verkehrsgeschichte und Mobilität*. Stuttgart UTB GmbH.
Mitzscherling, L. (2015). *Gamification: Gamifizierte Apps und Kundenbindung im Mobile Commerce*. Tectum Wissenschaftsverlag.
Molzow-Voit, F., Quandt, M., Freitag, M., & Spöttl, G. (2016). *Robotik in der Logistik. Elektronische Daten. Qualifizierung für Fachkräfte und Entscheider* (1. Aufl). Springer Fachmedien Wiesbaden.
Monheim, H. (2012). Mobilität 2112. Perspektiven für einen effizienten Verkehr. In E. A. Grandits (Ed.), *2112 – die Welt in 100 Jahren*. Olms.
Morgan, L. A., & Kunkel, S. (2016). *Aging, society, and the life course* (5th ed.). Springer Publishing Company.
Morgan Stanley Research. (2019). *Are flying cars preparing for takeoff?*
Mouftah, H. T., & Erol-Kantarci, M. (2016). *Smart grid: Networking, data management, and business models*. CRC Press.
Moussu, C., & Ohana, S. (2016). Do leveraged firms underinvest in corporate social responsibility? Evidence from health and safety programs in U.S. firms. *Journal of Business Ethics, 135*(4), 715–729. https://doi.org/10.1007/s10551-014-2493-0
Müller-Jentsch, D. (2013). Grundzüge einer zukunftsfähigen Verkehrspolitik. In G. Schwarz & U. Meister (Eds.), *Ideen für die Schweiz. 44 Chancen, die Zukunft zu gewinnen – NZZ Libro* (2. Aufl). Verlag Neue Zürcher Zeitung.
Myers, C. E., Kostek, J. A., Ekeh, B., Sanchez, R., Ebanks-Williams, Y., Krusznis, A. L., et al. (2016). Watch what I do, not what I say I do: Computer-based avatars to assess behavioral inhibition, a vulnerability factor for anxiety disorders. *Computers in Human Behavior, 55*(Part B), 804–816. https://doi.org/10.1016/j.chb.2015.07.067

Naisbitt, J. (1982). *Megatrends: Ten new directions transforming our lives*. Megatrends.
Nash, C., & Whitelegg, J. (2016). Key research themes on regulation, pricing, and sustainable urban mobility. *International Journal of Sustainable Transportation, 10*(1), 33–39. https://doi.org/10.1080/15568318.2013.821006
Naumann, E., Hess, M., & Steinkopf, L. (2015). Die Alterung der Gesellschaft und der Generationenkonflikt in Europa. *Aging Societies and Intergenerational Conflict in Europe, 44*(6), 426–446.
Neff, G., & Nafus, D. (2016). *Self-tracking*. The MIT Press.
O'Reilly, D. (2014). *Mobile world congress*. Paper presented at the Mobile World Congress, Barcelona.
Otten, M., & Wittkowske, S. (2014). *Mobilität für die Zukunft: interdisziplinäre und (fach-)didaktische Herausforderungen*. Bertelsmann.
Pittner, M. (2014). *Strategische Kommunikation für LOHAS. Elektronische Daten. Nachhaltigkeitsorientierte Dialoggruppen im Lebensmitteleinzelhandel*. Springer Fachmedien Wiesbaden.
Pronello, C., & Rappazzo, V. (2014). Road pricing: How people perceive a hypothetical introduction. The case of Lyon. *Transport Policy, 36*, 192–205. https://doi.org/10.1016/j.tranpol.2014.08.005
Randall, T. (2016). *Here's how electric cars will cause the next oil crisis: A shift is under way that will lead to widespread adoption of EVs in the next decade*. Retrieved from http://www.bloomberg.com/features/2016-ev-oil-crisis/
Reed, S. D. (2016). Women, work, and revolution: A do-it-yourself practice. *Design and Culture, 8*(1), 27–54. https://doi.org/10.1080/17547075.2016.1142337
Rich, S. A., Hanna, S., & Wright, B. J. (2016). Simply satisfied: The role of psychological need satisfaction in the life satisfaction of voluntary simplifiers. *Journal of Happiness Studies, 18*, 89–105. https://doi.org/10.1007/s10902-016-9718-0
Röhrleef, M. (2016). *Megatrends und Mobilität/Interviewer: E. Linden*.
Rossy, J., Wittmer, A., & Linden, E. (2019). *Rethinking airline business models* (Vol. 14). Dike Verlag AG.
Sánchez, Y. (2008). *Nanophilologie – fraktale Miniaturisierung*. Max Niemeyer Verlag.
Sauter-Servaes, T. (2016). *Megatrends und Mobilität/Interviewer: E. Linden*.
Schellenbauer, P. (2013). Liberale Arbeitsmärkte trotz protektionistischer Versuchungen. In G. Schwarz & U. Meister (Eds.), *Ideen für die Schweiz. 44 Chancen, die Zukunft zu gewinnen – NZZ Libro* (2. Aufl). Verlag Neue Zürcher Zeitung.
Schellenbauer, P., & Walser, R. (2013). Wahlfreiheit und Benutzerfinanzierung in der Bildung. In G. Schwarz & U. Meister (Eds.), *Ideen für die Schweiz. 44 Chancen, die Zukunft zu gewinnen – NZZ Libro* (2. Aufl). Verlag Neue Zürcher Zeitung.
Schilling, G. (2020). *Schillingreport 2020: Transparency at the top*. The Executive and Supervisory Boards of the largest Swiss Companies and the Public Sector.
Schmidt, E. (2015). *In tech we trust and the future of the digital economy*. Paper presented at the World Economic Forum, Davos, Switzerland.
Schneider, C. (2016). *Licht in der Welt der Nanotechnologie: Ein verständlicher Einstieg in die Grundlagen und Anwendungen* (Vol. 1). Springer Spektrum.
Schönduwe, R. (2016). *Die Zukunft der urbanen Mobilität*. Paper presented at the Mobilität 2040, Zürich.
Schuldt, C. (2016). *Megatrends und Mobilität/Interviewer: E. Linden*.
Schumpeter, J. A. (2008). *Konjunkturzyklen: eine theoretische, historische und statistische Analyse des kapitalistischen Prozesses*. Vandenhoeck & Ruprecht.
Shaheen, S. A. (2016). Shared mobility innovations and the sharing economy. *Transport Policy*. https://doi.org/10.1016/j.tranpol.2016.01.008
Sommer, C. (2016). *Megatrends und Mobilität/Interviewer: E. Linden*.
Stachowicz-Stanusch, A., & Wankel, C. (2016). *Emerging web 3.0/semantic web applications in higher education: Growing personalization and wider interconnections in learning*. Information Age Publishing.

Stallman, R. (2012). *Technology should help us share, not constrain us*. Retrieved July, 2016, from https://www.theguardian.com/technology/2012/apr/17/sharing-ebooks-richard-stallman
Steinbuch, R., & Gekeler, S. (2016). *Bionic optimization in structural design: Stochastically based methods to improve the performance of parts and assemblies*. Springer.
Stephens, J. C., Wilson, E. J., & Peterson, T. R. (2015). *Smart grid (r)evolution. Electric power struggles*. Cambridge University Press.
Suh, D. H., Khachatryan, H., & Guan, Z. (2016). Why do we adopt environmentally friendly lawn care? Evidence from do-it-yourself consumers. *Applied Economics, 48*(25–27), 2550–2561. http://www.tandfonline.com/loi/raec20
Taleb, N. N. (2015). *Der schwarze Schwan: die Macht höchst unwahrscheinlicher Ereignisse*. Albrecht Knaus Verlag.
Thomsen, L. (2016). *Megatrends und Mobilität/Interviewer: E. Linden*.
Tille, T. (2016). *Automobil-Sensorik. Ausgewählte Sensorprinzipien und deren automobile Anwendung*. Springer Berlin Heidelberg.
Tiller, N. (2015). Detoxing: fact or fallacy? *Peak Performance*, (346), 10.
Topol, E. (2014). The wireless revolution hits medicine: Eric Topol talks about the upheaval that's coming as the digitization of health care meets the smartphone/Interviewer: R. Winslow. *The Wall Street Journal*. http://www.wsj.com/.
Tummers, L. (2016). The re-emergence of self-managed co-housing in Europe: A critical review of co-housing research. *Urban Studies* (Sage Publications, Ltd.), *53*(10), 2023–2040. https://doi.org/10.1177/0042098015586696
United Nations. (2015). *World population prospects: The 2015 revision, key findings and advance tables. ESA/P/WP.241*. In Department of Economic and Social Affairs, United Nations, Population Division (Ed.).
Ushakov, D. S. (2015). *Urbanization and migration as factors affecting global economic development*. Information Science Reference.
Vaizey, E. (2015). *UK Digital Strategy – the next frontier in our digital revolution. Digital Economy Minister Ed Vaizey on how Government is seeking ideas from public and industry on the UK's digital strategy*. Retrieved August, 2016, from https://www.gov.uk/government/news/uk-digital-strategy-the-next-frontier-in-our-digital-revolution
Watson, R. (2014). *50 Schlüsselideen der Zukunft*. Springer Spektrum.
Watters, P. A., & Layton, R. (2016). *Automating open source intelligence: Algorithms for OSINT*. Syngress.
Weed, K. (2015). *We should no longer be talking about "digital marketing", but "marketing in a digital world"*. Retrieved July, 2016, from https://twitter.com/keithweed/status/654302819185467393
Weihrauch, S. (2014). Entwicklung von den Verkehrs- und Mobilitätserziehung an Schulen in der Bundesrepublik Deutschland anhand von bildungspolitischen Empfehlungen. In M. Otten & S. Wittkowske (Eds.), *Mobilität für die Zukunft: interdisziplinäre und (fach-)didaktische Herausforderungen*. Bertelsmann.
Weiss, H. (2016). *Megatrends und Mobilität/Interviewer: E. Linden*.
weiterdenken.ch. (2010). *Was ist eigentlich ein Megatrend?* Retrieved 2016, from https://weiterdenken.ch/2010/10/20/was-ist-eigentlich-ein-megatrend/
Wenzel, E. (2016). *Wie wir morgen leben und unterwegs sein werden*. Paper presented at the Mobilität 2040, Zürich.
Wiechert, W. (2015). *Miniaturisierung, Automatisierung, Digitalisierung in der Biotechnologie*. Germany, Europe.
Wittmer, A., & Linden, E. (2017). *Zukunft Mobilität: Szenarien für das System Mobilität und Bedürfnisse der Mobilitätskunden im Jahr 2040 in der Schweiz*.
Wittmer, A., Linden, E., & Dorizzi, F. (2019). *Eco-labels and their influence on consumers' decision making in the aviation sector*.
Wolf, E. L., & Freudenstein, R. (2015). *Nanophysik und Nanotechnologie: eine Einführung in die Konzepte der Nanowissenschaften*. Wiley-VCH.

Wood, L. C., & Reiners, T. (2015). *Gamification in education and business*. Springer.
Zaugg, H., Davies, R., Parkinson, A., & Magleby, S. (2015). Best practices for using global virtual teams. *TechTrends, 59*(4), 87–95.
Zukunft-Mobilität. (2016). *Digitalisierung des Verkehrs*. Retrieved November, 2016, from http://www.zukunft-mobilitaet.ch/themen/digitalisierung-des-verkehrs
Zukunftsinstitut. (2015). *Die Megatrend-Map*. Retrieved 2016, from https://www.zukunftsinstitut.de/artikel/die-megatrend-map/
Zukunftsinstitut. (2016). *Megatrend Mobilität*. Retrieved 2016, from https://www.zukunftsinstitut.de/dossier/megatrend-mobilitaet/
Zukunftsstark. (2016). *Diese 16 Megatrends werden unsere Zukunft maßgeblich beeinflussen*. Retrieved from http://www.zukunftsstark.org/megatrends/