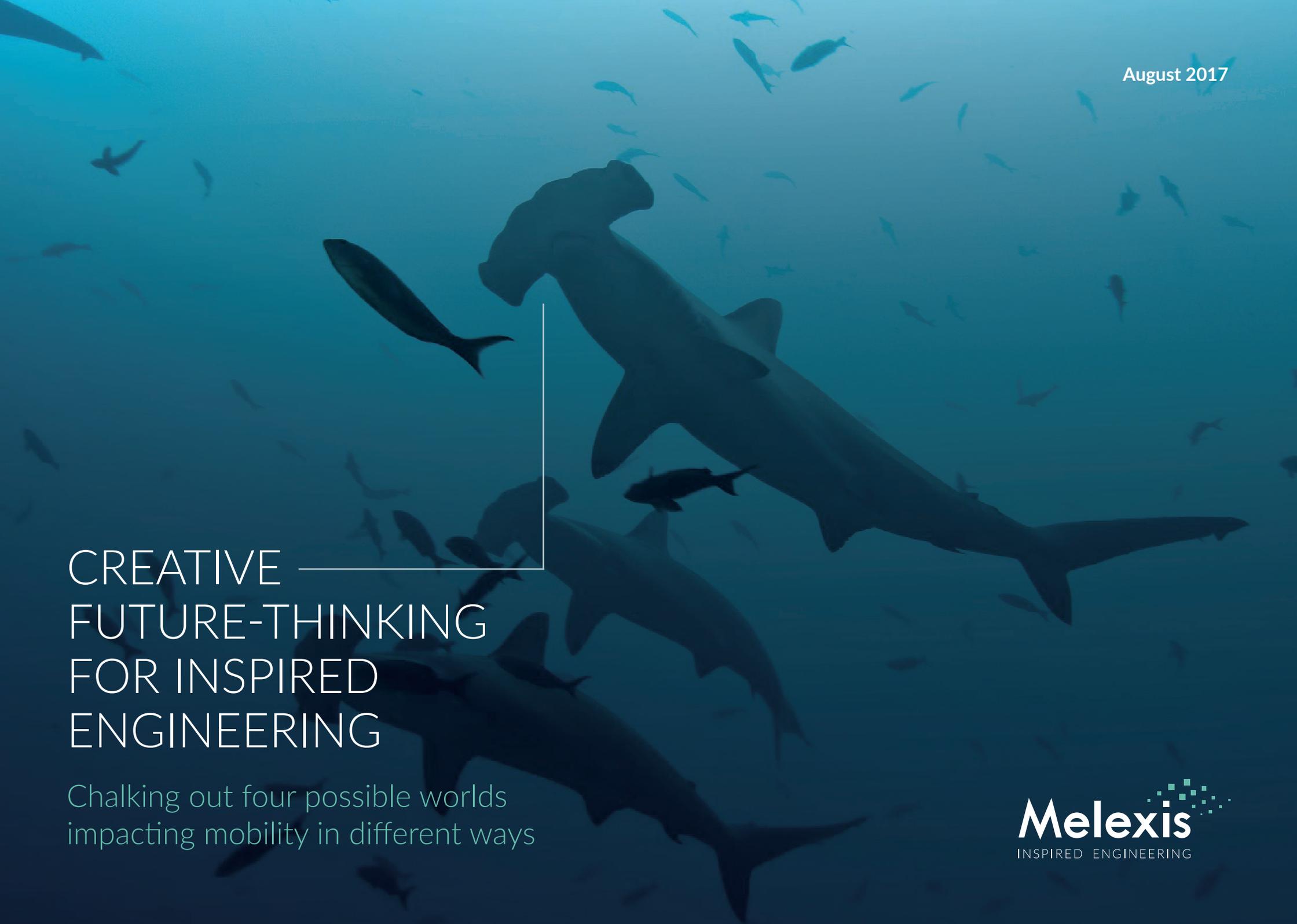


August 2017

An underwater scene with a large hammerhead shark in the center, surrounded by many smaller fish. The water is a deep blue color. A white L-shaped line is positioned to the right of the word 'CREATIVE' in the main title.

CREATIVE FUTURE-THINKING FOR INSPIRED ENGINEERING

Chalking out four possible worlds
impacting mobility in different ways

Melexis
INSPIRED ENGINEERING

Since the birth of the company in Belgium in 1988, Melexis has grown to over 1,400 employees in 19 sites, **all passionate about creating the future**. Because that's what we at Melexis stand for: creating the best imaginable future through inspired engineering. That vision, shared by everyone within the organization, has enabled us to grow.

Melexis is not a stand-alone organization, but is instead interwoven in the fabric of society. To be able to contribute to creating the best solutions, we must first understand what the future could possibly look like and which underlying aspects will determine it. How Melexis and the world around us could evolve, depends on the **interaction between five crucial factors: social, technological, economic, environmental and political** (also referred to as 'STEEP'). It is essential for every business to consider these external forces before making strategic decisions.

Between September 2016 and February 2017 we **interviewed a dozen executives** from inside and outside our company to gain insights into the external developments and their probable impact on the automotive industry. These interviews, together with an exhaustive literature study and internal workshops, formed the basis for the development of **four future scenarios**. We then examined what each scenario means for **mobility in 2030**.

This is the first time that Melexis has performed such extensive scenario analysis. The world is changing at an unprecedented speed, **making direction indicators increasingly necessary** in order to anticipate external changes sooner and identify potential blind spots. We sought to think beyond our own imagination and independently of our own experiences and beliefs. To make customer-driven innovation possible we need to understand the concerns of every citizen, in every future.

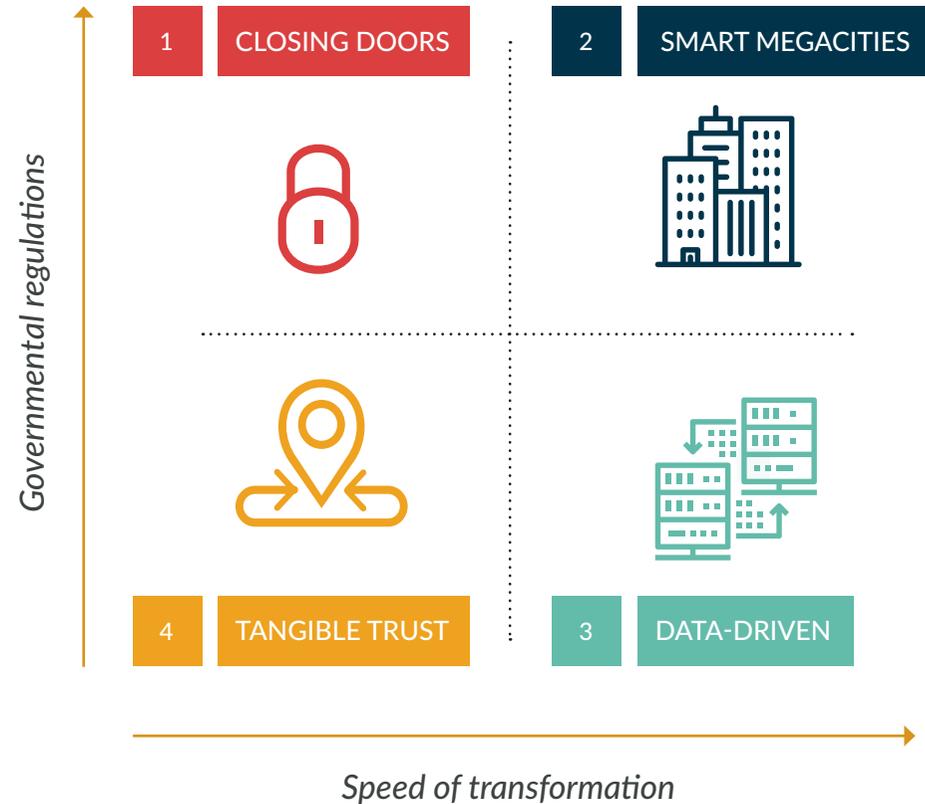
Outline of the four scenarios

Thinking about the future and developing foresight is no walk in the park. First of all, it is important to define the framework in which you want to highlight scenarios. We identified two differentiators as the labels for our axes:

1. What is the main driving force: governmental regulations or economic considerations?
2. What is the speed of transformation from products into services (as the indicator for technology adoption)?

FOUR SCENARIOS

Based on the above, we arrived at four possible future scenarios left:





SCENARIO 1, CLOSING DOORS

In this scenario geopolitical interests are the main driving force. In 2030 we live in a very multipolar world with several major regional power blocks. The increased nationalism and protectionist behavior has slowed down the economic growth. In this unstable society, there is high demand for old technologies along with military innovation. Where to work will be as important as what to work on.

Event: *In May 2017 President Trump reportedly criticized German automakers for selling millions of cars in the U.S., while U.S. automakers do not do nearly as well in Germany. This was not the first time the president attacked foreign countries, in a continuation of his election campaign's anti-trade rhetoric.¹*



SCENARIO 4, TANGIBLE TRUST

In this scenario we are talking about evolution, not revolution. In 2030, the world looks pretty similar to today but with a growing skepticism towards the impact of technology and thus also towards service-based mobility. People's living habits are changing only slowly and, together with the absence of a true (political/economic) power block, this produces a status quo. In the long term the power vacuum and the resulting turbulent decision-making will result in economic downturn.

Event: *In the month before Georgia repealed its generous \$5,000 tax credit on electric vehicles in July 2015, nearly 1,300 electric vehicles were sold. By August 2015 the market had collapsed, with just 97 cars sold that month⁴.*



SCENARIO 2, SMART MEGACITIES

In 2030 60% of the world population lives in urban areas². This has given cities the momentum to play a strong and proactive leadership role. Because greater population density has increased the need for environmentally friendly measures, the regulatory environment is heavily stimulating green technologies. The economic upturn has been delayed slightly due to the necessary investments in infrastructure, but the ultimate payback will result in flourishing city economies.

Event: *South Korea announced in 2002 it is building a \$35 billion city without cars. When completed by 2020, the district Songdo City will span 100 million square feet and will produce a third fewer greenhouse gases compared to another city of the same size.³*



SCENARIO 3, A DATA-DRIVEN SOCIETY

In 2030, the technology giants – such as Google, Facebook, Amazon, Apple and Microsoft – have blurred national boundaries and introduced new business models that we can't even imagine today. Data is the key to success and service-oriented thinking is the new gold. As ride-sharing and mobility-as-a-service find traction, the world's biggest companies are becoming even bigger.

Event: *Google is taking control of the scalability of its platform with Google Fiber, a service to provide broadband internet in the United States. The more people there are on the platform, the better its business becomes⁵.*

STEEP METHODOLOGY

In the following section, we will examine each of the scenarios from the angle of every STEEP factor.

Our analysis is visualized schematically to provide you with an at-a-glance overview of the necessary information and hence a useful reference for future decision-making.

NO SINGLE VERSION OF THE TRUTH

We have presented a very black-and-white outline of the future world in order to clearly illustrate the differences. In reality, however, the future world will almost certainly contain elements of multiple scenarios together with completely new elements that are currently still beyond our imagination.

<p>CLOSING DOORS</p> 	<p>Maslow's pyramid Safety is a key driver for decisions. There's no room left for fulfilling psychological or self-actualization needs.</p>	<p>"The news and information channels are highly regulated, so there are no surprises in this newspaper headline."</p>	<p>No. 1 The military is the top employer of the year (for the fifth time in a row), leading to a brain drain from other sectors.</p>	<p>Wealth gap between geographical regions Some trade blocks are wealthy, others are poor. As the borders are closed, immigration is illegal. Only the most privileged can move freely.</p>
<p>SMART MEGACITIES</p> 	<p>Where are you from? Barcelona, Shanghai, Cape Town... a person's identity is closely linked to their city and region.</p>	<p>"Today, January 1st 2030, 63% of people are living in cities. This is 3% more than originally predicted²."</p>	<p>41 The number of megacities with more than 10 million inhabitants⁶.</p>	<p>Wealth gap between rural and urban regions The cities are the place to be for glitter and glamour. In the countryside, there's less access to services.</p>
<p>A DATA-DRIVEN SOCIETY</p> 	<p>Mobility for peanuts Thanks to mobility-as-a-service the mobility prices have fallen and the doors of the world are open to everyone.</p>	<p>"Google University is recognized as most prestigious university worldwide."</p>	<p>2x The size of the digital universe doubles at least every two years⁷.</p>	<p>Wealth gap between educated and non-educated people Non-educated people run the risk of being left behind. There's a huge demand for people highly skilled in technology.</p>
<p>TANGIBLE TRUST</p> 	<p>Ownership is important Trust, safety and security concerns encourage private ownership. Above all, people prefer certainty.</p>	<p>"500,000 Belgians followed a re-education program in 2029."</p>	<p>\$30,000 The average price of a standard gasoline car⁸.</p>	<p>Wealth gap between capital able and non-capital able The access to capital is the main criteria for wealth. Today's differences between the haves and the have-nots will continue to increase up to 2030.</p>

<p>CLOSING DOORS</p> 	<p>Regional boundaries Technologies are determined by locally available resources and strategic interest.</p>	<p>“Battle for cobalt claims hundreds of new victims in Congo.”</p>	<p>25% The demand for total primary energy is significantly higher than in 2020 (based on 2050 expectations)⁹.</p>	<p>Military tech Big investments in military technologies. Technology is strictly regulated.</p>
<p>SMART MEGACITIES</p> 	<p>Subsidized innovation An environment of regulatory stimulation drives adoption of key green technologies.</p>	<p>“Paris invests an extra €1.5 billion in transport infrastructure.”</p>	<p>6x Demand for lithium is 6x higher than in 2015¹⁰.</p>	<p>Mobility & pollution Strong focus on technology to solve local issues.</p>
<p>A DATA-DRIVEN SOCIETY</p> 	<p>Internet of Things Is the driver for new kinds of revenue streams and business models. Platform owners rule.</p>	<p>“AI powered diagnostics platforms reduce human errors in medicine by 50%.”</p>	<p>20,400 Thanks to car sharing, the annual mileage of cars has doubled in the space of 15 years (fewer empty seats)¹¹.</p>	<p>Appification & platformication Everything is available as-a-service. Data is the new gold and giving access to personal data is a new means of payment.</p>
<p>TANGIBLE TRUST</p> 	<p>Spreading distrust People feel that technology has not delivered what it promised. Safety, security and privacy are key words.</p>	<p>“2 billion medical records leaked in massive cyber-attack.”</p>	<p>0.5% The economy has slowed down because the human factor is not changing fast enough to truly adopt technology innovation.</p>	<p>No standard Different technologies operate in parallel.</p>

<p>CLOSING DOORS</p> 	<p>Broken supply chain Local organizations try to fulfill every element of the trade system, from energy to manufacturing.</p>	<p>“The chairman of the World Bank confirms its dissolution as from June 2031.”</p>	<p>↓ Limited global trade leads to minimum efficiency gains. Volatile financial flows with regular powerful shocks.</p>	<p>Robotics Investment in robotics to compensate for the loss of cheap labor in the Far East.</p>
<p>SMART MEGACITIES</p> 	<p>Sustainable growth Dislocations are part of the transition from unsustainable growth to green growth. Near-term demand leads to self-sustaining recovery¹².</p>	<p>“Beijing opens the largest 3D manufacturing plant in the world.”</p>	<p>↑ Broader investments in education, infrastructure and green technology lead to economic growth.</p>	<p>Renewables Shared platforms are a driver for further automation. The need for environmentally friendly measures increases the number of green solutions.</p>
<p>A DATA-DRIVEN SOCIETY</p> 	<p>Pac-Man A handful of gigantic players take most of the global market. Companies rival countries in terms of power.</p>	<p>“Loans.net borrows more money than all traditional banks combined.”</p>	<p>↑ Booming economy with many innovative service-based spin-offs. Driven by customer value.</p>	<p>Revolution New business models, such as shared platforms, are the key driver. Every single action is measured to be able to harvest the data.</p>
<p>TANGIBLE TRUST</p> 	<p>Consolidation wave The wave of consolidation will continue as it is one of the only ways to grow. High value in existing brands.</p>	<p>“Suez and China State Grid merge.”</p>	<p>→ Very low economic growth. The slow rate of technology adoption negatively affects the economy.</p>	<p>Industry 4.0 Lotsize 1 as a driver. Robotics make efficient product customization possible.</p>

<p>CLOSING DOORS</p> 	<p>Very diverse approach Regions fall back on the natural resources they have. No international climate agreements.</p>	<p>“Eco-terrorists ‘Blue Cloud’ attacked the Dakota Access Pipeline for the second time this month.”</p>	<p>50%-80% Rich regional blocks will run for 50% on internal combustion engines (ICEs), poor blocks up to 80%¹³.</p>	 <p>Paris Climate Agreement targets not met</p>
<p>SMART MEGACITIES</p> 	<p>Sense of urgency World leaders, policymakers and businesses address the climate challenge as the largest common threat.</p>	<p>“Sao Paulo has successfully completed its annual CO₂ scrubbing.”</p>	<p>0% Pure ICEs in passenger cars have dropped to virtually zero by 2030. The majority are electric vehicles (EVs)¹³.</p>	 <p>Paris Climate Agreement targets are met</p>
<p>A DATA-DRIVEN SOCIETY</p> 	<p>Green gold The investments in greener technology are economically driven. Therefore, not all industries are equally environmental friendly. Rapidly changing transport sector.</p>	<p>“Companies increase investment in green technology after recent floods.”</p>	<p>10% There are 10% ICEs left in 2030. Hybrid vehicles have 50% market share, EVs 40%¹³.</p>	 <p>Paris Climate Agreement targets are just met or just missed</p>
<p>TANGIBLE TRUST</p> 	<p>No long-term thinking Due to the sputtering economy there’s no budget to invest. The evolution towards more sustainability is moving too slowly.</p>	<p>“After ten years of political discussions, citizens demand a referendum about the construction of the LifeSafe dam.”</p>	<p>55% More than half of all cars are ICEs. Hybrid vehicles have 35% market share, EVs 10%¹³.</p>	 <p>Paris Climate Agreement targets not met</p>

<p>CLOSING DOORS</p> 	<p>Closed system The market is highly regulated and company or technology transfers are not easily allowed.</p>	<p>“Europe prohibits the export of tomatoes.”</p>	<p>Proactive & top-down Politics = driving force, with strong leadership and regional focus.</p>	<p>Favoritism Trade blocks give more benefits to local companies.</p>
<p>SMART MEGACITIES</p> 	<p>Local decision-making Decisions can be made more quickly and pushed more strongly as less compromise is needed. Increased tensions with rural politics.</p>	<p>“California ignores federal advice and makes license plates for EVs free as of February 2030.”</p>	<p>Proactive & bottom-up Politics = driving force, but the politicians can only be successful by being the citizens’ voice.</p>	<p>Machiavellistic facet Politics is a way to make the city livable. Politics is not a goal in itself. Left-wing, progressive policymaking.</p>
<p>A DATA-DRIVEN SOCIETY</p> 	<p>Reverse lobbying Countries attract companies through lobbying. This creates open borders for better trade.</p>	<p>“G20 questioned by C10, the consortium of the most important companies.”</p>	<p>Reactive & low power Economy = driving force. Governments are too slow in adapting legislation.</p>	<p>Money, money, money The big companies have more funds at their disposal than countries themselves.</p>
<p>TANGIBLE TRUST</p> 	<p>Political vacuum As issues remain unsolved by traditional politics, new political players are entering the arena.</p>	<p>“The government praises the latest Apple product, but warns on privacy matters.”</p>	<p>Reactive & medium power The economy = driving force, but with a lack of a real ruler.</p>	<p>PPPs Public-private partnerships for (infrastructure) investments are more likely.</p>

What does this mean for mobility in 2030?



CLOSING DOORS

The government is pushing car ownership for the middle class since the automotive industry is seen as an important motor for the economy. Public transport is growing in urbanizations, mainly in the poorer areas. Traditional cars with ICEs are the norm in the US and Europe, but not so in Asia where electric vehicles do well. By stimulating EVs the Chinese government has killed two birds with one stone: the country no longer depends on the European car makers, plus it profits from local lithium stocks. The cleaner air is a nice added benefit. The demand for cars remains stable, but the total addressable market may decline depending on the geographical region. Innovation is difficult as the military now employs most of the intellectuals. Besides, the transfer of technologies is heavily regulated and there are countless trade secrets to protect. The value of the car is mainly in the mechanics, which are of course locally produced by local brands.



SMART MEGACITIES

Citizens no longer want to live in highly polluted cities so local councils are favoring clean technologies by, for example, introducing a waiting time for registration of polluting cars or creating separate EV driving lanes. There are convenient, innovative kinds of public transport everywhere in the cities, with a good interaction between the different transport types. Cars are still part of the street scene, but most of them are electric, have fuel cells or are hybrids. Electric batteries are cheap and every city has ample charging infrastructure, so why should consumers still invest in ICEs? In fact, why should they own a car at all unless they're living in the countryside? There are plenty of ride-sharing initiatives and a car's appearance in 2030 is heavily commoditized. Meanwhile, there is a lot of innovation in terms of smart infrastructure so the era of the autonomous car (level 4) is steadily nearing.

What does this mean for mobility in 2030?



TANGIBLE TRUST

Due to a lack of clear regulatory intervention the cost of EVs remains high. Besides that, no organization is willing to invest in the charging infrastructure. Therefore, ICEs still account for the majority of the market, followed by hybrids and a small 10% for EVs, under the influence of legislation. As population increases, the number of cars increases too. Although car-sharing initiatives are growing, they mainly take market share from taxi companies and public transport. As most cars are privately owned and the individualization trend continues, features that build brand strength are gaining in value. Innovation is ongoing in ADAS technology as safety and security is a big concern, but high-speed automated driving is not accepted by the public. Innovative tech companies find it difficult to sustain their exponential growth, but the traditional car manufacturers are succeeding. The market is more consolidated than before, but the value is still in the hardware.



A DATA-DRIVEN SOCIETY

Since battery prices have dropped drastically, EVs are proving to be the most economical option. EVs are still more expensive in terms of purchase price, but given that mobility has become a service that is of lesser importance. The EV offers a better total cost of ownership (TCO) over its lifespan since there are fewer moving parts and the cars are more robust. And, to be blunt, the car itself has become a side issue. Data is the new gold. Therefore, transport is virtually free because people 'pay' by giving access to their data. People highly skilled in artificial intelligence (AI) are working for the world's biggest companies, which paves the way for fully autonomous cars (level 5). The market is in the hands of new technology players and innovative service-based businesses, who have been massively investing in apps since hardware turned into a commoditized platform owned by some non-traditional market players. They maintain partnerships with diverse parties because the value lies in the upselling of data.

Conclusion

'The new age of protectionism: Trump's attack on Germany and the global economy'¹⁴, 'Sixt CEO hints at car-sharing merger talks between BMW and Daimler'¹⁵, 'Gov. Jerry Brown on the Paris climate change accord: Trump is AWOL but California is on the field, ready for battle'¹⁶, 'Amazon and WhatsApp falling short over privacy, says pressure group'¹⁷, 'Xi Jinping's grip is tightening on China - But will it strangle the economy?'¹⁸ these are just some of the real headlines over recent months, each pointing to different directions in which the world could move.

Some analysts say we are at a turning point in history. In the midst of the turmoil, it's difficult to say how big the change will be. Will the economic system change radically or will we revert to a time of strong geopolitical systems? There are too many questions to answer today, but there's no doubt that we are living in volatile times.

Volatility is something that businesses prefer to avoid, and the automotive industry is no exception. With its relatively long R&D cycles and lead times, strategic decisions have to be made a considerable time in advance.

This creative future-thinking exercise is a first step towards mapping out a particular direction. Unlike these black-and-white potential scenarios, the solutions will not be so clear-cut. Therefore our advice is to take an incremental approach and draw up a flexible plan. The individual pieces should all help to build up a picture – heading in the chosen direction – but none of them should be such a big bet that your business topples if things turn out differently than expected.

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