

Roland Berger

Focus

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Reconnecting the rural

Autonomous driving as a solution for non-urban mobility



Management summary

The current debate around autonomous driving tends to focus on its potential impact in cities. We think that the perspective should be broader: Self-driving vehicles could be the key to reconnecting the countryside, part of the mobility solution for people living in rural areas.

Rural populations are often isolated as a result of cuts in public transit, or difficulties accessing what services still exist. Besides offering major cost savings, using autonomous vehicles in rural public transit would reconnect these individuals to the wider world. The result would be a massive increase in their quality of life, with knock-on benefits for their psychological and physical wellbeing.

The case for making autonomous driving part of rural public transit has several elements. There are the social benefits, the economic benefits and the environmental benefits. But there are also the strategic benefits of using the rural setting, with its quieter roads and simpler traffic situation, as a testing ground for self-driving services. Companies can later transfer the invaluable experience that they gain in the countryside to the urban environment.

In this paper we examine how autonomous driving can form part of the solution for non-urban mobility. How it can help "reconnect the rural". We look at some of the projects currently underway around the world and imagine how the future of rural mobility could look. Finally, we make some practical recommendations to help operators exploit the opportunities and develop robust business cases going forward.

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Autonomous vehicles: Making the case for the countryside.

Current discussions about autonomous driving largely focus on its impact in urban settings. How will it contribute to mobility in today's cities? Could it be the key to reducing gridlock? Leaf through the pages of any automotive industry magazine, visit any online forum, and you might be forgiven for thinking that the only people who require mobility are wealthy urbanites who want to cut valuable minutes off their journey from work to home and back again.

We would like to suggest a different perspective. Autonomous vehicles can make a major contribution to mobility in the rural environment, too, reconnecting people who live in the countryside. The countryside offers automotive companies a uniquely valuable opportunity to develop their autonomous driving propositions in a rewarding market. At the same time, they can gain experience that they can later transfer to the urban environment, once the technology is mature and the business case has been fully defined.

Three customer groups would benefit in particular from public or semi-public transportation systems based on autonomous vehicles. The first is elderly people who are no longer able to drive but are not in a position to access traditional public transit. Second, we have people who are not yet of driving age living in areas where public transit has been reduced or perhaps never even existed in the first place. We include here schoolchildren, where a self-driving school bus with an adult minder on board could be an economical solution for accessing education. The third group is people with disabilities, those who cannot drive or who have difficulty accessing traditional public transit.

Of the three groups, the elderly currently form the focus of attention. Most countries have a rapidly aging population, with people aged 65 or over expected to more than double between 2015 and 2055, from 8.3 to 17 percent of the global population on average. Figures for individual countries are even more striking. For ex-

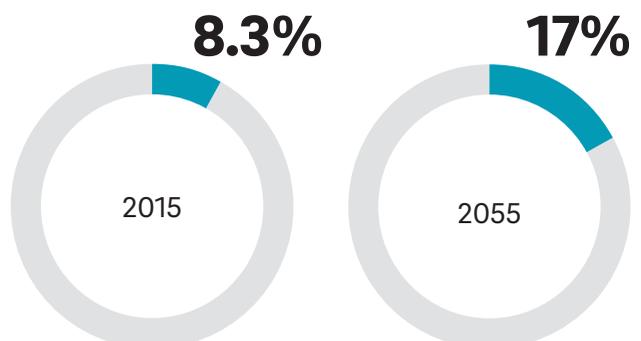
ample, the 65+ population is forecast to represent 30 to 35 percent of society in China, Singapore, Italy, Germany and South Korea in 2060, and perhaps as much as 40 percent in Japan. → **A**

Significantly, statistics show that the elderly make up a larger proportion of today's society in rural areas than in the countries as a whole. For example, Italy's 65+ population currently accounts for just under 22 percent of the total population, but makes up more than 25 percent of the rural population. In South Korea the share of elderly people living in the countryside is almost double that of the country taken as a whole. And in Japan, where more than a quarter of the population is aged 65+ today, the figure for rural areas is as high as 30 percent. Moreover, in the majority of countries, the proportion of older people living in rural areas is forecast to grow systematically over the coming years and decades. → **B**

For people living in the countryside, availability of transportation is key. Yet rural areas are very poorly covered by public transit networks, such as railroads and buses. This is often due to historical factors or the result

A: The future is gray.

Share of population aged 65+.



Source: United Nations – Population division

of cuts made over recent decades. A 2013 study of accessibility carried out by the United Kingdom Department of Transport found that just 44 percent of people living in rural areas in the UK had "reasonable" access by public transit to key service locations such as schools, hospitals and food stores. This compared to 60 percent of people living in urban areas. In another study from 2012, just 49 percent of rural households in the UK had access to a regular bus service close by, compared to 96 percent of urban households.

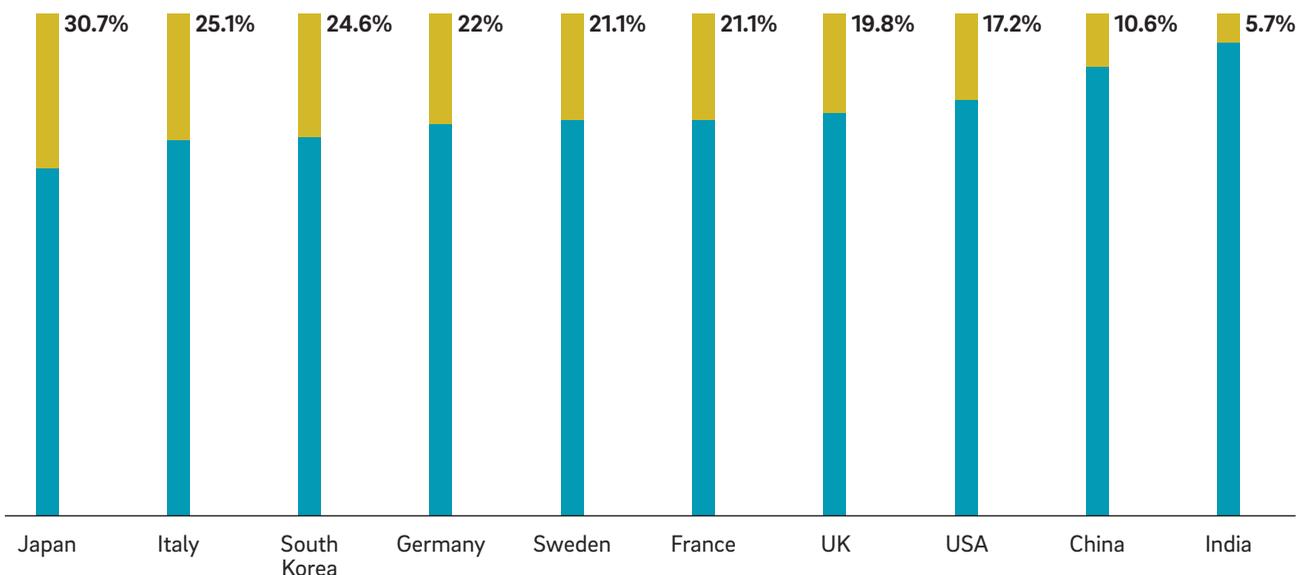
Most public transit systems have been functioning in almost permanent cost-reduction mode for some time

now. Public transportation very often depends on subsidies. In Germany, for instance, close to 25% percent of operating costs are subsidized, in Italy 40 percent. Few central governments currently plan to invest in public transit in sparsely populated areas, and some are actively disinvesting from these areas. The solutions put in place by local authorities or private players tend to be inefficient, mainly due to the labor costs for drivers. Japanese rural public transit is a case in point: For the equivalent of every EUR 1 earned in fares, the cost to the operator is around EUR 3.30. The need for a new approach to rural mobility is evident.

B: Country life.

Age distribution by country, rural population, 2015.

■ 65+ ■ 0-64



Source: United Nations – Population division

Big in Japan.

Japan realized early on the potential of autonomous driving for transforming rural mobility. Indeed, experts at Roland Berger believe that the solutions the Japanese government is currently pursuing show the way for central and local authorities in other countries.

An estimated 13 percent of the Japanese population – around 17 million people – have unsatisfactory mobility due to a lack of public transit coverage or difficulty accessing transportation services. Six million of these citizens have limited access to shopping to provide for their daily needs. Lack of mobility is a source of significant inconvenience for individuals and has a substantial negative impact on local economies.

In an attempt to address this problem, some bodies have introduced their own transportation systems. For example, non-profit organizations are cooperating with hospitals and supermarkets to run local buses, and customers in certain depopulated areas can use shopping buses to travel to hospitals and other public facilities, too.

The problem with such solutions is that they are costly. This is due in particular to the associated labor costs. Indeed, in some depopulated areas it can be almost impossible to recruit drivers. Autonomous driving could be a real game changer here. It represents a way to support mobility-impaired people in their day-to-day lives and enhance their general satisfaction, at the same time as reducing the costs of public transit and stimulating local economies.

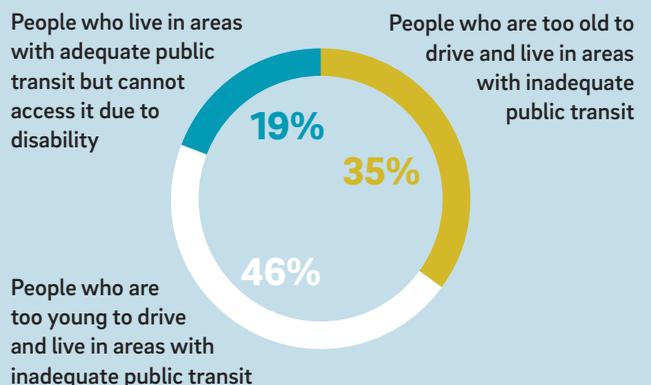
The Japanese government is aware of this huge opportunity, and keen to seize it. Prime Minister Shinzo Abe stated publicly in February 2017 that "we will aim to address labor shortages in rural areas and help people with mobility difficulties by introducing automated driving that does not need human drivers by 2020." For the government, the main driver behind this policy is the desire to tackle the problems of mobility-impaired people, alongside traditional factors such as increasing safety and reducing traffic volumes.

A number of initiatives in Japan are looking into this area. SB Drive Corp. – a joint venture between SoftBank and Advanced Smart Mobility Co. Ltd. – is currently

engaged in a government-backed project to trial autonomous buses in several local areas in Nagano, Fukuoka and Tottori. The self-driving vehicles, which can carry 11 or more passengers at speeds in excess of 20 km/h, are based on the existing Hino Liesse step-floor minibus and use cameras to recognize traffic lanes and obstacles, as well as featuring radars and control units for steering and acceleration. SB Drive Corp. expects to introduce self-driving vehicles in local bus networks by 2020, focusing particularly on routes that currently run at a loss.

Another project currently underway involves using a combination of roads and former railroad lines in rural areas. The vehicles operating on the road would be manually driven, while those on the railroad lines would be self-driving, enabling lane control and vehicle "platooning", in which a lead vehicle sets the speed and direction for a convoy of vehicles that communicate with it and mirror its movements closely. Exploiting the former railroad lines would, of course, have significant cost advantages. The project has already been trialed in Ibaraki Prefecture and is expected to be expanded to other regions in the near future.

17 million Japanese citizens have limited mobility (2015)



Source: Roland Berger

Interview with Gunnar Heipp.



Photo: SWMM/MVG

GUNNAR HEIPP

Director of the Strategic Planning Department at Stadtwerke Muenchen GmbH (Munich City Utilities)¹ and former Chair of the Sustainable Development Commission at the Brussels-based International Association of Public Transport (UITP).

ROLAND BERGER: As an expert working inside the industry, what do you see as the key challenge facing public transportation in rural areas?

GUNNAR HEIPP: There are many different challenges: low-density populations, the distance from built-up areas and railroad stations, shrinking populations, an aging society, decentralized schools and retail outlets... the list goes on and on. The result is longer travel distances in rural areas than urban areas, without the critical mass required to create new solutions. On top of that, municipal budgets are being cut on an almost continual basis. In Germany, public transit in rural areas is heavily subsidized by regional authorities, sometimes by as much as 80-90 percent. These subsidies mainly target schoolchildren, which often means that timetables are reduced to morning and late afternoon services. That leaves the rest of the population dependent on their own vehicles for most of their mobility needs.

Do you see any possible solutions? What options are currently under discussion?

Solutions tend to vary depending on local priorities and financial resources. Most local authorities currently maintain a minimum bus service, even at great cost, for the morning and afternoon peak hours, leaving the rest of the day and evening with mostly no service at all. At the same time we are beginning to see discussions about on-demand shuttles that operate as and when customers call for them. Some regions have developed apps to help citizens use whatever public transit still exists. Car-pooling solutions between members of the public are increasingly popular.

So there is cause for optimism?

Well, the problem is that these are piecemeal efforts – small-scale, fragmented discussions and projects. A global perspective is lacking. We need a political debate about the future of public transit in rural areas. What

1 At the time of this interview

are the public's expectations? What solutions are available? Are we really serious about creating services for all, or simply resigned to further cutbacks?

What about autonomous vehicles? Would they improve the situation? To what extent do local authorities see them as a potential solution?

The reason I am excited about autonomous vehicles is that they could realistically form an important part of the solution. Managed fleets of shared autonomous vehicles – once we have overcome the technical difficulties – would be an enormous help in rural areas. They would cut operating costs while improving service quality. In addition, they could be tailored to customer needs in terms of timetables and destinations. Ride-sharing is a first step in this direction, and we see how popular that is. Of course, autonomous vehicles are not with us yet. But we are beginning to see local areas allocating funds to research and development activities related to them.

Activities such as...?

Most activity is currently taking place in large urban areas. In Munich, for example, we are discussing the launch of a major project together with industry partners and universities to establish a common vision for mobility. If realized, the project will cover such issues as the role of autonomous driving in future mobility, creating a robust legal and market framework, piloting on-demand services and public acceptance for driverless vehicles. But developing such projects is highly complex.

Where does the complexity stem from?

Well, it's because we are talking about an area that does not yet exist – an area where we do not yet know the full implications, or how to measure them. Autonomous technology presents us with many challenges. Just think of the infrastructure issues, for instance. This is where

"We need a political debate about the future of public transit in rural areas"

rural areas represent a great place for trials: The complexity is lower and you can run your pilot and learn from the results before bringing autonomous driving to urban contexts. Such projects are actually happening at the moment, but because they are taking place in rural areas they are less visible, making them less impactful for cities and the big car manufacturers.

Should the state get involved?

Absolutely. This is clearly an issue for European governments – certainly in Germany and even more so in countries such as Italy, France, Spain and in Scandinavia, where population densities outside large cities are even lower than in Germany. Both local and federal governments have a role to play in shaping the future, whether it is through creating a suitable regulatory framework, providing or facilitating financing, or driving development efforts. The work must be focused and goal-driven, not technology-driven. Even where it is clear that projects will ultimately deliver lower costs and greater efficiency, companies require major support and investment.

Live long and prosper.

Autonomous vehicles offer more than just cost savings.

For autonomous vehicles in public transit to enjoy true popularity with local or national governments, they need a solid business case behind them. New vehicles of this type have higher associated costs for technology and maintenance. But we estimate that the savings on labor costs for drivers will easily offset this extra cost burden. Indeed, employing autonomous vehicles for the entire mobility chain could even lead to public transit services running at a profit.

The status quo, in which traditional vehicles are used for all parts of the mobility chain, generates huge losses, primarily due to labor costs. Replacing traditional vehicles with self-driving vehicles on existing routes – running autonomous vehicles from bus stop to bus stop along established routes, for example – would already deliver a significant cost saving. But going one step further in the rural context and combining autonomous driving along established routes with autonomous vehicles for "last-mile services"² would deliver the same cost savings and additionally enable operators to charge higher prices for the full service. The result? A bottom line firmly in the black. → **D**

Increasing personal mobility in rural areas would also have a knock-on effect for the economy in general. At the moment, many rural areas find themselves caught up in a negative cycle: Rural residents are less able to access public transit, leading to destinations earning less revenue, resulting in them having less financial resources to invest. This leads to less income for local government and less investment in local areas and transportation services. And so the cycle continues. → **C**

Autonomous vehicles can take this negative cycle and turn it on its head. Public transit services are improved, making rural residents more mobile, leading to

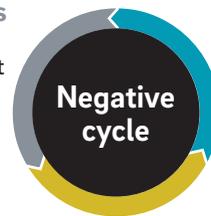
more money spent at local destinations, which then have the resources to improve their attractiveness. Extra revenue is generated for local governments, which are now in a position to invest more in local regions. The result is a positive cycle, ultimately reviving the economy of rural areas and beyond.

C: From negative to positive.

The power of autonomous vehicles.

Rural dwellers

- Limited access to public transit
- Less frequent travel



Destinations

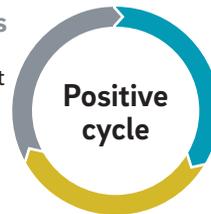
- Fewer customers/visitors
- Less revenue
- Limited resources for improving attractiveness

Local government

- Local areas become less desirable for residents/tourists
- Less income
- Limited resources for improving infrastructure, including public transit

Rural dwellers

- Better access to public transit
- More frequent travel



Destinations

- More customers/visitors
- More revenue
- Increased resources for further improving attractiveness

Local government

- Local areas become more desirable for residents/tourists
- More income
- Increased resources for further improving infrastructure, including public transit

² Last-mile services: moving passengers between their homes and transportation hubs such as bus or railroad stations, or moving goods from hubs such as warehouses to customers' homes.

Impact on health and happiness

But the story doesn't end there. The economic benefits of autonomous driving in rural areas are only part of the picture. Increased mobility, especially for people in isolated areas or with mobility issues related to age or ability, has a direct impact on personal health and happiness. Numerous studies have shown that quality of life is directly correlated to connecting with other people and membership of a community. A study in 2012 by the United Kingdom's Surgeon General, for example, showed that free bus passes had a positive impact on the health of senior citizens, as they immediately took the opportunity to travel more, leading to more walking and exercise overall.

Similarly, a UK study reported in 2014 on a network of knitting groups for seniors in Norfolk, England. Over the course of a year, the investigating team monitored requests to establish groups, data from new members, visitors to events, talks given and reviews by existing members. They found that more than being an opportunity to practice a craft, the knitting clubs improved seniors' mental health by reducing rural social isolation and increasing integration into communities. They were seen as an attractive and accessible activity by diverse community groups seeking support, and were instrumental to the self-esteem of vulnerable individuals who were empowered to give back to their communities in a way that utilized their skills and assets. For example, of the members interviewed, 74 percent had joined for the purpose of social contact, 86 percent had made new friends from joining, 79 percent felt that they were using their skills to benefit others, 55 percent reported feeling happier, and 14 percent were able to describe how being part of the community had contributed to improvements in their health.

With obesity and other health issues on the rise in all Western countries, maintaining personal mobility into old age is very much a hot topic. Digital communi-

cation technology improves connectivity, and of course such technology has a cost advantage over physically moving people. But these communication tools are just that – tools – and no replacement for actual face-to-face meetings. Digital solutions can offer partial solutions for people with mobility issues, but autonomous driving can improve people's health and offer real added value to individuals' lives.

A wide range of benefits

In fact, self-driving vehicles, used as part of public transit solutions, offer benefits across a number of different dimensions. There are environmental benefits arising from transporting larger numbers of people in a highly efficient manner. There is the fact that being able to move from your home safely, conveniently and economically is a source of happiness in itself, as well as a way to get you to your destination. There is the added stimulation and fulfillment that people enjoy during the time spent at their destinations. There is an improved safety net for emergency situations. And overall, there is an increased amount of movement within society, encouraging encounters, collaborations and ultimately a rich social economy.

D: Back to black.

Indexed business case for different scenarios (current revenue = 100).

SCENARIO 1

Business as usual

Huge losses due to cost of drivers

SCENARIO 2

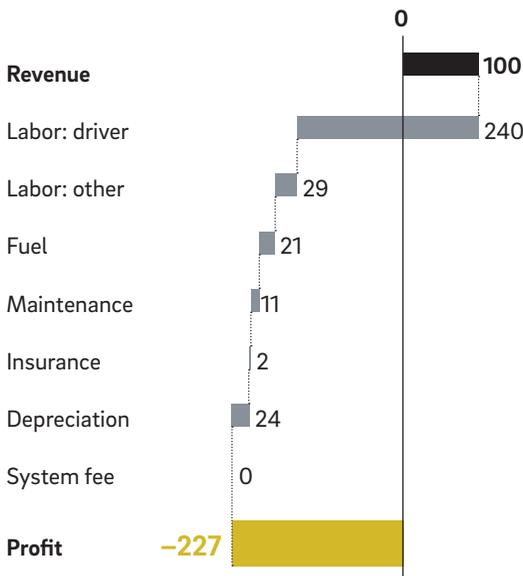
Autonomous vehicles on traditional routes

Massive cost reduction

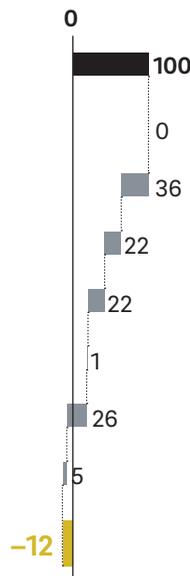
SCENARIO 3

Autonomous vehicles for traditional routes and last-mile services

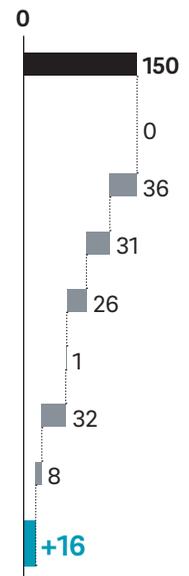
Profit due to increased fare revenues and greater utilization of public transit services



-227%



-12%



+10%

Take the pod! Tomorrow's world today.

Autonomous driving has a wide range of practical applications in rural environments. Let us take a glance at what tomorrow's world might look like.

Cuts to public transit have led to a situation today in which rural dwellers often find themselves isolated and unable to access local services such as hospitals, government offices, public facilities and stores. Their only option is to use their own vehicles, either for the whole journey or the last mile. For many, this is not possible due to age or disability.

In our imagined tomorrow's world, autonomous vehicles have breathed new life into rural communities. Self-driving buses will run on major routes, linking transportation hubs, hospitals, shopping malls, local government offices and residential areas. Autonomous pods or self-driving taxis will provide last-mile services to users' doorsteps. Citizens will be reconnected and reintegrated into their communities, with all the benefits for health and happiness that entails.

How close are we to tomorrow's world today?

Japan currently leads the way in the development of autonomous driving solutions for rural public transit (see page 7). France also has a number of initiatives in place to develop alternative mobility solutions in rural areas, which could eventually be combined with autonomous vehicles. On-demand transport solutions are already common. In the rural area of Mayenne in northwest France, for example, local residents can use the services of Petit Pégase, a network of 14 regular, on-demand transit lines with a fleet of nine-seat vehicles, plus services dedicated to school transportation, covering the entire area. Other regions are promoting car-sharing and ride-sharing by adapting infrastructure and even developing joint schemes between different areas, such as the Ardèche and Drôme départements in the south of France.

What might a typical day in the life of a self-driving pod look like?

In the morning, the pod picks people up from their homes and takes them to transportation hubs, such as a

Imagine a world in which autonomous vehicles have breathed new life into rural communities. Citizens will be reconnected and reintegrated into their communities, with all the benefit for health and happiness that entails.

bus or railroad station. In the afternoon it takes passengers to hospital, supermarkets and the like, on demand. Come evening it is back moving people from hubs to their homes. In between rides, the pod's interior is "refreshed" as and when necessary – a clean-up service and any minor maintenance that can be provided by a taxi driver, say, or a retired local resident. At the end of a busy day, the pod then goes to a central workshop for maintenance, repair, charging, software updates and so on.

Opportunities in rural mobility: A framework for stakeholders.

We believe that autonomous driving in rural areas will create enormous opportunities for stakeholders, be they automotive companies, local authorities, national governments or others.

The countryside offers perfect conditions for trying out innovative technology and road-testing new business models. When exploiting these manifold opportunities, however, players must remember that the rural context differs in key respects from its urban counterpart. We look at some of those differences below.

If self-driving vehicles are to become widespread in rural areas, business models will need to be tailored to local regions. For example, fare structures for passengers should be flexible, based on the number of vehicles, the quality of the services and the length of the journey. Operators will need to forecast the number and types of users by looking at geographical areas, times and weather conditions. Businesspeople will want to travel home from business districts in the evening, for example, and the number of passengers in residential areas will increase if it starts raining. Similarly, operators will need to identify which models of vehicle are preferred by users and which of these will be profitable. A clear, fully specified detailed business case is the only way to ensure profitability.

The business cases will also differ fundamentally between urban and rural environments. In urban areas, experts are forecasting higher levels of profitability as there is great demand and passengers are willing to pay more for services. Balancing this out will be the need for operators to invest in a large number of vehicles in order to meet passengers' needs instantly. In rural areas, where population density is much lower, demand will be lower and passengers will be more price-sensitive. However, those passengers will also be less demanding: In many cases they may not need to travel at a specific time of day, and they will be happier to wait for the operator to meet their needs.

The needs of rural and urban users that need to be met differ at a very basic level. In the countryside, autonomous driving will improve the quality of life of mobility-impaired people by enabling them to connect with

their community. In the city, by contrast, autonomous driving will offer busy urbanites shorter traveling times from home to work or vice versa, say.

Differences also apply to infrastructure and local conditions on the road. The state of rural roads will need to be improved, with clear white lines to guide vehicles and good telecommunications connections. City roads will require less investment. However, testing on public roads in the countryside will be easier than in cities due to the low traffic and population density. In the city, more advanced technology will likely be needed.

We would suggest piloting projects in rural areas before moving into the urban environment. On country roads, the traffic situation is simpler than in cities and it will be easier for players to build consumer confidence and acceptance for the new technology. Penetration will speed up as a result. Players can then take that experience and apply it in cities, always remembering that they will need to adjust their business model in line with the different demand and infrastructure. Partnerships and collaborations will be the name of the game here, enabling the provision of total mobility solutions and the full exploitation of transportation synergies.

We believe that autonomous driving in rural areas represents a great opportunity for businesses to try out future models, and for governments to bring real benefits to rural populations in terms of their mobility. Autonomous vehicles for public transit in rural areas, unlike the more widely discussed urban robocab services, represent a valuable first step for testing the whole idea of self-driving services. The countryside provides a perfect setting, simpler than the urban environment, for testing models and then adjusting them for use in cities. Now is the moment for stakeholders to start developing models for reconnecting the rural. The benefits for individuals, for businesses and for government will quickly be apparent to all.

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WE WELCOME YOUR QUESTIONS, COMMENTS AND SUGGESTIONS

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Navigating Complexity

Roland Berger has been helping its clients to manage change for half a century. Looking forward to the next 50 years, we are committed to supporting our clients as they face the next frontier. To us, this means navigating the complexities that define our times. We help our clients devise and implement responsive strategies essential to lasting success.

Automotive Disruption MADE by RB

We believe that the combination of four dimensions (Mobility, Autonomous driving, Digital and Electrification, or MADE) is likely to trigger a major disruption in the automotive industry over the next 15 years. In 2017, we brought together our experts from all around the world to try to make this new future and its implications more concrete, and to best support the key decision makers of the automotive industry.



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