



CUBIC™ | Transportation Systems

Federal Submission

Inquiry into Automated Mass Transit Response to request for Submission

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SUBMITTED BY:

Cubic Transportation Systems (Australia) Pty Limited

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Table of Contents

1	Introduction	2
2	The Foundation for Automation	2
3	The Future of Mass Transit with Automation	3
4	Key Drivers	3
5	The Urban Layer	3
6	The Technology Layer	4
7	The Social Layer	5
8	Role of Government in delivering automation in mass transit	6
9	Conclusion	8

1 Introduction

When most people think about automation, they think of driverless cars. This is justified, given the widespread attention autonomous vehicles have gained in the media in recent years. However, when Cubic thinks of automation in land-based mass transit, we see it as more than just the introduction of autonomous vehicles, but as a wider mobility challenge facing governments around the world.

Rapid Urbanisation is a fact – more people are living in cities and their surrounding areas today than ever before. In fact, every week, three million more people move to cities around the world. By 2050, the urban community is expected to grow by 2.5 billion, which means that city dwellers will account for 66 percent of the world's population.

This rapid growth of the world's urban spaces has significant implications for city life. Congestion, particularly at peak travel times, has reached an all-time high. The statistics speak for themselves: In Australia, bumper-to-bumper traffic costs the economy \$16 billion each year in lost time and wasted fuel. In Sydney, one of Australia's most congested cities, drivers end up spending 4 days per year stuck in traffic jams.

Efficiently and effectively moving people around ever more crowded urban environments will require progress in understanding the current and predicted situation in the multimodal transport network and using this knowledge in real time to the benefit of the people using it and the authorities operating it. For example, this information can be communicated to travellers through a variety of channels allowing them to adjust their route or timing of their trip. Customers changing their journey can result in improved efficiency of the network and lessens traffic congestion which in turn leads to a reduced impact on the environment. Ultimately the number of traffic injuries and fatalities also decrease when travellers avoid congested and weather-affected areas.

This is automation of situational awareness on the transport network and using this information to improve journeys and make living in urban environments healthier for the residents.

2 The Foundation for Automation

Mobile, Big Data and the Internet of Things (IoT) are rapidly transforming our expectations about transport service delivery. In today's urban society, connectivity is expected to be almost ubiquitous. Here in Australia, smartphone penetration is expected to surpass 90% by the end of 2018. With new innovations coming about at a rapid pace, soon everyone will be plugged in and able to take advantage of tomorrow's digital economy. Analysts are predicting that the number of connected IoT devices worldwide could reach 200 billion by 2020. In 2017, nearly 60% of these IoT devices were installed in cities and were used in smart commercial buildings and in transportation.

All this connectivity creates enormous amounts of data and alongside it opportunities – ready to be harnessed, analysed and applied to improve operations, efficiency and quality of life in cities, as well as to help fuel further innovation. Recognising the value of this data, leaders in every sector, including transportation, need to start finding ways to remove barriers and utilise analytics to make the most of data insights. Machine learning and artificial intelligence are quickly becoming commonplace. Meanwhile consumers expect greater data responsibility, whilst data security and governance issues are gaining an increasing importance.

Creation of a platform which gives consolidated situational awareness of emerging issues and disruptions across an entire multimodal network in real time should be a focus of automation. This information can be communicated to travellers through a variety of channels, allowing them to adjust their route or timing of their trip.

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3 The Future of Mass Transit with Automation

Using this information to optimise the network requires new thinking about how journeys are made which has given rise to new terms gaining momentum with urban centres around the world. The concept of Mobility as a Service (MaaS) has entered the transportation consciousness. More often than not, it has been used in relation to travel that happens through a combination of public, private and shared transportation modes and as it is relatively new in concept, it also has varying definitions. For clarity, the definition of MaaS in this paper is a combination of public and private transportation services within a given regional environment that provides holistic, optimal and people-centred travel options, to enable end-to-end journeys paid for by the user as a single charge, and which aims to achieve key public equity objectives.

4 Key Drivers

To properly understand MaaS, we must look at what makes it applicable to today's transportation landscape. There are numerous complex drivers that can be observed around the world which make the conversation about MaaS highly relevant.

Those drivers can be classified into three major 'layers' – of urban, technological, and social trends that influence the way we manage our cities, use our technology, and define who we are as consumers. Although the shifts taking place in each of the three layers occur independently of each other, what happens in one of them might influence and intensify transformations in the other? All of them raise important questions about the role that MaaS might play in helping alleviate some of the problems faced by modern urban spaces.

5 The Urban Layer

Some of the most striking changes that set the scene for the MaaS revolution are happening to our cities. As previously mentioned, rapid urbanisation is happening and is impacting on citizens. The growing demand for mobility puts a huge strain on the existing transportation infrastructure. At peak times it often outstrips capacity, whereas at other times of the day there is excess capacity. While there is some evidence that working patterns can be flexed, we are far from adequately shifting peak travel demand. New roads or rail lines are simply not built quickly enough; meanwhile the resources run dry. In many countries, including Australia, road infrastructure is financed by tax duties collected on gasoline. Yet, years of no tax increases, advancements in fuel efficiency, and the growing popularity of electric vehicles have limited traditional ways of financing road infrastructure. As more cars go farther on less fuel, governments and local authorities are searching for a funding mechanism that could not only continue to support the overall quality and safety of road services but also finance new, much needed roadway infrastructure projects. Currently considered solutions include raising the existing fuel tax, charging a flat fee for the use of electric vehicles, and introducing some sort of a mileage-based charge. Needless to say, none of those are popular with the general public.

Simply increasing capacity on roads and public transit are not straightforward solutions and definitely not ones that can be applied immediately – in most regions, building new roads and metro lines might

take years. Even China, which seems to be adding new rail lines at breakneck speeds (2400 kilometres of service lines have been built there since 2008), still struggles with capacity issues at peak times. Furthermore, building new service lines takes considerable capital and in recent years more public service agencies have faced shrinking allowances than budget increases. Today, several service lines, including evening and weekend bus routes in many American cities, are at risk of being cut due to the shortage of funds.

The continuous rise of urban populations is also bad news for the climate. Worsening air quality, particularly in larger cities, leads to a lowered standard of living and can cause serious health problems. According to the World Health Organisation, outdoor air pollution kills 2 million people every year and road traffic is one of the main culprits. In Australia, road transportation accounts for 86 percent of all greenhouse gas emissions, contributing to the poor quality of air in city centres and areas near roadways. The newest research points out that apart from health problems traditionally associated with air pollution, such as asthma and other respiratory issues, bad air quality can also increase the risk of diabetes and even obesity.

It is increasingly clear that our cities face multiple challenges. Half a century of worsening air quality, growing traffic and congestion, and deteriorating city infrastructure has undermined the urban spirit and led to a lower quality of life in city cores. If health prospects in cities are to improve, we will need to look for new energy sources, consider more fuel-efficient transportation, review regulation and effect a change in people's behaviour. MaaS, if well-planned and properly implemented, can be the remedy for many of those issues.

6 The Technology Layer

While several trends in the urban layer drive the conversation about the need for more automated mobility solutions forward, equally important shifts happening in the technology layer are changing our expectations about transportation service delivery in general. As previously stated, mobile, Big Data and the Internet of Things (IoT) have each transformed the way services are consumed today in a unique way. The transportation industry is no exception. All this connectivity creates enormous amounts of data – ready to be harnessed, analysed and applied to improve operations, efficiency and quality of life in cities, as well as drive further innovation.

On a more complex level, connectivity enables transit agencies to invest in vehicle-to-infrastructure (V2I) technology that helps vehicles and their drivers make better sense of their surroundings, analyse traffic and weather information, and make subsequent adjustments to the service, increasing its efficiency. Vehicle-to-vehicle (V2V) communication systems are also growing in popularity, helping reduce traffic accidents, improve overall safety on roads, and facilitate the sharing of real-time location data for the convenience of passengers. At the highest level, connectivity empowers the development of connected and autonomous vehicles (CVs and AVs). Numerous models of connected cars equipped with state-of-the-art technology have already been released by leading car manufacturers and technology companies, such as Ford, GM, and BMW, while more sophisticated cars with automated functions are released on the market every year. It is predicted that some 98 percent of vehicles will be connected to the Internet by 2020. By that time, they will share the road with nearly 10 million autonomous cars.

The 'driverless revolution' is already happening on the streets of Pittsburgh, Pennsylvania; London, United Kingdom; and Tokyo, Japan, where self-driving cars are being tested in pilot programs. The Boston Consulting Group estimates that by 2025, the driverless car market will be worth \$42 billion. Many expect self-driving cars will be the answer to the transportation industry's multiple problems. Car manufacturers hope mainly electric AVs will be better for the environment. City planners anticipate that

driverless cars will transform urban spaces by eliminating the need for parking in city centres. Others expect that self-driving cars will help address the issues of congestion, decrease traffic and improve mobility options for entire generations. Self-driving cars are intended to make our streets safer, while platoons of self-driving trucks are supposed to cut down carbon dioxide emissions and improve efficiency. Whether or not those ambitions will be realised remains to be seen and should be debated now. Certainly, fleets of autonomous vehicles may help address some of the problems faced by modern urban spaces, but only when they form part of a bigger picture. MaaS might provide just the right context for the autonomous vehicles to thrive.

But smart cars will not be the only vehicles that hope to dominate the streets in years to come. The rapid acceleration of e-commerce and m-commerce has fuelled the rise of online shopping and new business models, giving birth to an entire army of vehicles, delivering people and goods in high-frequency, low-density trips. E-commerce sales have nearly doubled in the past five years to \$450 billion, accounting for 8.4 percent of all retail sales. According to transportation analysts, they will reach 17 percent within five years, and due to e-commerce being likely to support longer transportation distances and shorter delivery cycles, focusing shipments more on individual items, it increases demand for road space and parking, contributing to traffic, congestion and for now, also pollution. Uber alone offers a number of different services depending on location: UberRush, UberEats – even the somewhat controversial UberPuppies.

In the U.K., the company is already eyeing the country's £7.1 billion courier market. In Europe, bike-delivery services are booming, particularly in the fast food delivery market, where a number of popular services, including Deliveroo, JustEat and Delivery Hero, are competing for customers. They won't disappear anytime soon; McKinsey estimates that the largest five companies in the sector globally have a combined valuation of more than €10 billion.

On top of encouraging on-demand services, e-commerce pushes transportation toward more precise pick-up and delivery times. Amazon is a pioneer in the United States, with the Amazon Prime Now service promising delivery within the hour. In 2016, this retail giant accounted for 43 percent of all online purchases in the United States. There is talk of the company is considering building its own fleet of autonomous pods, focused solely on delivering packages and groceries more quickly and efficiently. Traditional delivery trucks might soon be jostling for road space with fleets of autonomous vehicles, realising high-frequency, short-term road occupancy and on-demand deliveries.

This, of course, is bad news for our cities, pushing city authorities and local governments to look for innovative solutions that can deal with the challenges brought about by the technological revolution of the 21st century. MaaS must form part of their considerations.

7 The Social Layer

Both the urban and technology layers are forcing city authorities, technologists and transit operators to rethink how future transportation services might need to be delivered. Meanwhile, the social layer is redefining consumption itself.

Many have tried to name the recent socio-economic shift that has reinvented how and what we consume. Some called it the “sharing” economy, the “gig” economy or the “application” economy. Others named it the “access” economy or the “on-demand” economy. All of these terms boil down to one simple truth: We now live in a world where consumer demand, rather than any other driver, determines the delivery of services; where usage trumps possession; access rather than ownership is king, and where consumers' immediate needs can be satisfied with the tap of an app. This new economy currently attracts more than 22.4 million consumers annually and transportation is its second

biggest category. Thanks to companies like Lyft and Uber, it claims more than 7.3 million monthly consumers and \$5.6 billion in annual spending.

At the heart of this new economy sits a markedly different way of matching supply and demand and a deep understanding of a trend called 'collaborative consumption'. In simple terms, collaborative consumption uses the power of the Internet to reinvent traditional market behaviours, such as buying renting and lending, through the use of technology.

All of these shifts are encouraging the growth of personalised, flexible, and sometimes informal mobility services. From obvious examples such as Uber to smaller, "micro transit" providers, the idea of on-demand transit has captivated transportation for good. Today Uber operates in 83 countries and 674 cities across the world, while micro transit services, such as New York's dollar vans, are popping up across America almost daily. For many the arrival of on-demand transit services has made life easier and has also made transit more accessible and flexible.

People from across the social spectrum use shared modes of transportation, but there is compelling evidence which suggests that certain generations, such as Millennials and Generation Z, are particularly prone to making the most of shared mobility. In the last ten years, the number of people under 35 with a driver's license has decreased by six percent. According to The Economist, car sharing will reduce car ownership at an estimated rate of one shared vehicle replacing 15 owned vehicles.

Today the change in the consumer mindset driven by the on-demand economy is apparent. The transportation industry must recognise it is facing a new generation of users: affluent, tech-savvy, environmentally conscious and used to the immediacy of services. These are consumers who like to make informed decisions, and expect quick action, convenience and choice. For those of us who fall into that category, the vision of MaaS propagated by the private sector is indeed an attractive offer. On the other hand, we must not forget that effective future transportation should serve all, rather than leave behind those who might not be digitally savvy, the elderly and the disabled. For them, the demand-driven, technologically complex and profit-motivated mobility services won't bring any answers, again underlining the need for a careful reflection on the nature of future MaaS solutions.

8 Role of Government in delivering automation in mass transit

The idea of MaaS as an exclusively private-industry-led initiative is slowly retiring. Many of the considerations about the drivers of MaaS, its benefits, challenges and objectives, point to a similar conclusion: public MaaS transit, and by extension, the government, can and should play a central role in MaaS discussions and in its implementation. But what exactly should that role be? How far should governments go in regulating future mobility solutions?

On the one hand, if a city takes complete ownership of MaaS delivery, then it can control and regulate the services that are provided under MaaS and influence the development of the multi-modal environment. That's beneficial for many reasons – it gives cities control and a say over how public assets such as roads, walkways and parking lots are used, it enables them to ensure mobility services in the city serve the wider interest of the public, and it helps them protect those consumers who might be left behind by the rapid growth of on-demand mobility services or a host of other social disadvantages. Because the city or the agency needs to consider the impact of the service provision on the city as a whole and on the environment, only through control and regulation can it provide a mechanism for delivering MaaS in a way that supports the wider city objectives.

On the other hand, regulation can be rigid and oftentimes slow to adopt. Imposing strict regulatory systems for the provision and operation of new mobility services might slow the pace of change and slow innovation. Over-regulating mobility may even discourage private providers and new players from

entering the market, thus taking away opportunities for better mobility services from citizens and slowing the much-needed transformation of urban spaces. Leaving the market to sort itself out is also not desirable because private companies would develop urban transportation solutions according to their own wishes, serving a narrow customer base and doing so without regard for the wider city or regional mobility goals. It is also unlikely that private organisations would put both optimisation of mobility for the individual and the entire transportation network ahead of their own corporate gain.

In order to achieve desirable outcomes, city authorities will need to pitch regulation at the right level and send the right policy signals to the private sector. They will need to create a level playing field for mobility providers, which encourages (but not maximises) competition, as well as collaboration, and participation from the private sector, while keeping consumers' best interest in mind.

There are some responsibilities that we believe should not be outsourced or contracted out by government. Those include regulation, policy, planning, environmental protection, funding, revenue collection, subsidisation and distribution, and security. Affordable and sustainable transportation is critical to the economic vitality of a city and a region. Transportation of people and goods is a major component of the economy, accounting for a significant part of the Gross Domestic Product (GDP) each year. This is a responsibility that cannot be outsourced to a third party. Equally, the government must ensure social equity and inclusion, neither of which can be guaranteed by leaving things to the free market model. The economics and subsidisation of infrastructure development, maintenance and funding must also be coordinated by government policy to ensure the optimum use of space and funds. In addition to economic and pricing policy, there are also many other standards related to safety, security and other critical topics that the government is already responsible for managing and best placed to do so. The core technology platforms needed for MaaS – a single account, multi-modal journey planning and congestion management platforms – are best specified, procured and managed by the government, and potentially, by extension, by transit agencies, since they already have similar systems in place, even if the capital and operating cost of these platforms is recovered via varying business models from both public and private mobility operators, either before or after the investment. Finally, we believe governments are also best placed to own the customer relationship and provide the needed data protection and 'best interest' assurances to the public.

However, there are also those elements of MaaS that can and perhaps should be contracted out to create an environment where innovation thrives. Those include the operational aspects of mobility services, the development and maintenance of infrastructure and technology, and even the performance of government responsibilities (e.g., congestion management control rooms). To ensure best results for MaaS, government bodies should, at the minimum, set the scene for MaaS implementation, bringing all the various stakeholders to the table. They should help define the vision for MaaS in a given region, set common objectives for the said region, and agree the metrics by which success will be measured. They should also encourage and promote investment, while ensuring that the new transportation environment doesn't compromise the safety or security of consumers, and make sure any mobility efforts are aligned with broader social equity goals. As a general rule, governments should play the role of responsible and encouraging guardians: stepping in and correcting the course when necessary but allowing cities to arrive at their own solutions without a negative impact on innovation.

There likely won't be a 'one-fits-all' approach to MaaS planning and implementation. Depending on the market, country, region or city, varying levels of government regulation and control might be needed to successfully deliver MaaS that serves the public good. In some places public transit agencies themselves might deliver a MaaS system, in others they might allow private players to take ownership of particular projects, or they might simply retain strategic control over a system delivered entirely by a third party or a mix thereof. In Europe, where the mobility market is arguably more advanced and developed, and where transit modes are already well established and popular, it is likely that the third

scenario will become the main model for MaaS adoption. As more public authorities move beyond their conventional role of infrastructure providers and become enablers and promoters of mobility services delivered by private companies, we will see a more open MaaS market, with major partnerships between government agencies and technology companies, as is already happening in Hamburg, Germany; Manchester, U.K.; Stockholm, Sweden, and many other European cities.

In Australia, where the private car still dominates as the main mode of transportation, the MaaS model might be more regulated and more inclined toward careful control of a mix of private and public mobility solutions with an emphasis placed on the use of public transit. Ultimately, the level of market freedom will depend on the set of unique circumstances of a city or a region – each will need to determine the extent to which local government should be involved in the journey toward better mobility. The key to success will lie in ensuring that conversations about MaaS are happening in collaboration with transit agencies, city authorities and private players, and with social equity in mind.

9 Conclusion

More and more cities are starting to explore improved automation and the integration of public and private transportation networks. Some are testing the waters with early integrations. Recent examples include Sydney's Opal card integration with the Manly Fast Ferries, the launch of LA's TAP-integrated Metro bike-share system or Atlanta's MARTA link-up with Lyft and Uber. These partnerships demonstrate the first attempts at integrated MaaS and start to seed the idea that combined mobility is truly an option in the traveling public's mind.

Private mobility providers are also starting to recognise that they cannot combat urban challenges alone and that MaaS cannot happen with public transit as an afterthought. Both Uber and Lyft are keen to work with public transit to bring MaaS to the general public together. After all, the majority of their income comes from base fares with limited mileage journeys – in Paris, France, 65 percent of Uber trips start or end within 700 feet of a metro station. While alternative transit services can offer riders convenience and on-demand travel options, they will never be able to reduce congestion or improve travel in the city alone, especially since in the U.S. ride-hailing apps don't serve the same purpose as public transit. For now, they are more often used for social trips than everyday commuting. In Boston, for instance, only 15 percent of all Uber and Lyft trips account for the rush hour commute. However, when private companies become partners in regional MaaS schemes alongside local transit providers, their role can start to evolve.

Shifts on the urban, technological and social layers will continue to change our cities and our ideas about transportation. In the coming years, we will witness a growth in bespoke transit services and an increase in on-demand solutions that aim to address the first and last mile connectivity problems and get people on to the first node of the public transport system. We will see greater consolidation of accounts and users will be able to quickly find optimum solutions for themselves based on personal preferences for travel options. The individual mobility providers will focus less on complete ownership of individual users, and more on the ability to aggregate and link their customers to other mobility providers to deliver holistic solutions. Finally, we will see an increase in utilisation of public transit, as early adopters take to the MaaS offerings. The service variety will then broaden as the customer base broadens.

The relationship between regulation and innovation is a difficult one and will continue to pose challenges on the road to MaaS implementation. As governments and city authorities move from regulating transportation as a sector to regulating transportation as a service, they will need to think carefully about the role they can play in the MaaS discussions, recognising the balance of priorities in

the new transportation mix and acting as facilitators of partnerships, enablers of innovation and guardians of cities' and the public's interests.

We have no doubt that MaaS is a great candidate to help solve the challenges brought about by the shift in consumer preferences and empower cities to cater to a new type of citizen. As our society becomes more mobile, transit agencies across the country need to invest in automation to provide a more people-centred mobility paradigm, so that they can play an active role in the transformation of our transportation networks and city spaces, rather than let the MaaS revolution unfold inefficiently before their eyes.