JUNIPER RESEARCH + moovel

Exploring Mobility-as-a-Service (MaaS)

The New Era of Urban Mobility

Contents

Executive Summary

Defining Mobility-as-a-Service (MaaS)

Juniper and moovel define MaaS as: *'Urban transport solutions that are integrated into a single platform by which users can determine the best route and price across several end-to-end travel services and modes, according to real-time data such as traffic conditions, time of day and demand.'*

MaaS is also commonly referred to as *Transportation-as-a-Service* and *Mobility on Demand*.

Purpose of the Whitepaper

This publication will define and explain the concept of MaaS, alongside the vision of *Open Data*. It will demonstrate how MaaS will disrupt the smart city landscape, delivering a successful multi-modal mobility strategy covering transport and payments.

It will aim to clarify any technical or business challenges posed by MaaS, and steps required from stakeholders (ranging from transport, automobile, insurance and healthcare to energy sectors) to address any such issues.

The report will provide a blueprint for a successful MaaS deployment, identifying the different service layers and impact across multiple transport business areas. It will also provide recommendations to all stakeholders and a best practice guide for stakeholders.

In addition, the white paper will also demonstrate time and cost savings enabled by MaaS for citizens and businesses.

Key Report Findings

- MaaS will create new business models for the transport sector, enabled by the availability of rich data, and unify multiple platforms and businesses to improve transport planning and management.
- MaaS offers a significant opportunity to stakeholders to change travel behaviour and introduce new innovative business models such as dynamic and subscription pricing for multi-mode fare systems.
- However, the proliferation of MaaS will almost certainly be determined by changes, or lack thereof, in policy.
- Juniper anticipates that commuters travelling via MaaS will save, on average, 37% of the baseline journey time, calculated at 67 minutes per day for drivers and 61 minutes per day across all modes.
- As a by-product of MaaS enablement, their commute time is projected to fall to an average of 52 minutes per day.
- Meanwhile, for businesses, if one were to assume that all time saved was used for the purpose of business activity, the result would be an increase of $2.2 trillion in business productivity globally.
- Nevertheless, employees are unlikely to devote all this time to work activity; after all, there is life beyond work. An estimation that 33% of recovered time is used for business productivity would generate an additional $733 billion globally, purely from the implementation of MaaS.

1. The Rise of MaaS

1.1 Definition of MaaS

Based on the foundation of *Open Data*, the concept of MaaS is gaining popularity as a method of increasing public transit ridership and improving traffic on the road, thereby enhancing the quality of life for citizens. While MaaS is not a new concept, it is rather an evolution of customers' mobility requirements and pricing models.

MaaS improves the user experience and convenience by offering a single account or application to provide different mobility services ranging from public transport (for example rail and metro services) to rental, as well as ride sharing services (for example Uber, Lyft etc) and self-driving cars.

Juniper and moovel define MaaS as:

'Urban transport solutions that are integrated into a single platform by which users can determine the best route and price across several end-to-end travel services and modes, according to real-time data such as traffic conditions, time of day and demand.'

MaaS is also commonly referred to as *Transportation-as-a-Service* and *Mobility on Demand*. For the customer, MaaS will be offered in the form of an app, accessible at any time across many connected devices.

MaaS has the potential to create new business models for the transport sector, enabled by the availability of rich data, and unify multiple platforms and businesses to improve transport planning and management.

MaaS Example

Consider the multi-modal service experience below as observed by Zach:

Zach travels 19 miles (over 30kms) from the suburbs to his city office every morning. On a week day, it takes him around 60-75 minutes to drive to work due to commuter traffic on the New York roads. However, by accessing a MaaS service app, Zach is able to make his daily commute more convenient and accessible at a time he wants. Zach books an electric mini-bus sharing service from just outside his home to the nearest rail station (5 minutes) and commutes via train (25 minutes) to its final stop just 1.5 miles (2.4kms) outside his office location. Zach decides to book a ride sharing service, but then finds out about the road traffic congestion ahead so utilises a bike-sharing scheme to cycle the final 1.5 miles (2.4kms ~10mins) using the bike route. Zach saves around 20-35 minutes. Zach is presented with real-time prices based on a best fare calculation at each point of the dynamic journey management process. Once the trip has been completed, the MaaS app calculates the total cost and deducts it directly from his linked payment card or wallet.

While this is a very entry-level service offering based on a MaaS app, the opportunity exists to expand and offer related services benefitting both society and other stakeholders. For example, the app could further enable users to connect with other users to get points, exchange credits and compare fitness scores, as well as share commute timings and location. In addition, the app could be extended to integrate services such as loyalty and discount schemes from brands, vehicle trading services, and streaming services.

1.2 Stakeholder Objectives

The chart below highlights the various MaaS stakeholders. Each stakeholder will have an equally important part to play in the overall development of this new ecosystem. MaaS involves the use of public transit in a different way, therefore it is important that all stakeholders are in mutual agreement while defining policies and future business models; and is almost entirely dependent on legislation to ensure that it succeeds. Legislation, both in permitting certain business models and restricting certain business models, has the ability to shape the nature of MaaS. It is quite possible that the roles of these stakeholders including the likes of policy makers, transport authorities, ticketing providers, infrastructure vendors and others will evolve over the transition period to MaaS. In order for MaaS to succeed, these group of organisations will need to achieve the following set of individual objectives:

- **Conform to local/national laws and regulations:** Stakeholders need to ensure that emerging modalities meet local transportation policies and law. This means that authorities and policy makers, including regional and local public transit agencies, city councils and planners, will need to advance pilots, evolve transportation policy, plan for and implement budgets to spur investment.
- **Create a seamless mobility experience:** MaaS requires mobility to be more efficient, seamless and frictionless, covering ticketing, dynamic routing and pooling, as well as payments. This means there is opportunity for stakeholders, including operators, infrastructure and logistics providers, to come together and evolve from being simply mobility-enablers to become mobility managers in partnership with a MaaS provider.
- **Enabling MaaS technology:** The MaaS provider will be responsible for developing the technology platform that connects the various forms of modalities and sub-stakeholders in the transportation sector including, but not restricted to, on-demand/microtransit, public transit, ride share, taxis, parking and charging. This stakeholder group is responsible for creating a one-stop-shop for consumers, including pricing strategies, user experience/personalisation needs, and future incentives and promotions. The platform will need to manage varying mobility demand, providing back-office solutions which serve as control centres with various inputs from each mobility service provider.

Figure 1: MaaS Stakeholders

Source: Juniper Research

1.3 The Open Data Vision

First pioneered by cities such as London, the concept of ***'open data'*** (that is, city performance data openly released for public consumption and driving innovation) is emerging as a key strategy for cities across the globe. Some cities, such as New York, for instance, have over 1,600 datasets on traffic performance, crime, air quality and others. The benefits of open data standards include:

- Equal access to affordable and innovative performance and operational data;
- Truly harnessing the value of real-time data and analytics that will enable an improved user experience and an integrated city planner view;
- Stimulating innovation via iterative development and unlocking new revenue streams and value to the customer such as dynamic, journey-based pricing;
- Addressing key challenges such as operational procedures, data ownership, licensing and monetisation in a transparent and collaborative way to fuel future innovation.

The most famous example of open data innovation is *Citymapper,*[i] which used real-time public transport and traffic information to enable citizens to determine the optimal route across the city at any given time. The company has now taken the open data concept further, with the launch of its Citymapper Smartbus service. This is the first bus service of its kind in the sense that its routes are not static, instead, they are determined by demand. At present, routes are identified using open data to determine underserved corridors. In future, this concept could feasibly transfer to incumbents to create a public transport system that is determined by real-time demand and has the potential to become more efficient.

While on-demand transport solutions already exist in the form of Uber, Lyft and so on, these do not solve any congestion issues in the city. In fact, given that in cities where such services operate their numbers are not regulated, the increase in vehicles roaming around the city in anticipation of fares may even lead to an increase in congestion. Meanwhile, these services function only as a single piece of the urban transport 'pie', offering users no visibility outside their walled garden.

Demand is particularly important here, as it will enable providers to increase the number of shared transport services. This will lead to an urban transport situation where price and availability are shaped by real-time information and will likely reduce congestion. This is not only due to the aforementioned increase in shared transport options but by the fact that transport services become more attractive to the customer versus personal vehicles.

If implemented correctly, MaaS has several primary advantages for policy makers, transportation, operations and logistics providers, and consumers:

- Consumers will be able to more effectively get to their destination, with advance information on modalities and pricing.
- Cities and transportation professionals will have more data to optimise decisions to improve policies, movement, city infrastructure and continue to innovate through public and private collaboration.
- Transportation options, management, planning, payments, mode options, and personalisation will become more efficient and accessible.

- Cities will become smarter through reduced congestion, pollution and cost savings, leading towards a happier and more sustainable infrastructure.
- Policy makers, urban planners, and transportation, operations, logistics providers and other stakeholders will be able to leverage the data to improve city planning processes and commuting times and experience.

Figure 2: MaaS Primary Advantages

Source: Juniper Research

1.4 Current State of Play

Alongside the emergence of a vast number of new and innovative digital services, to form what has been called 'the sharing economy', digital ticketing and the development of autonomous vehicles is driving the development of MaaS.

Source: Juniper Research

However, the proliferation of MaaS will almost certainly be determined by changes, or lack thereof, in policy. At present, most cities are focused on technologies (such as dynamically phased traffic lights and smart parking) that increase the average speed of vehicles in the city by virtue of more efficient management of the existing traffic volume.

Few cities, except for outliers such as Oslo and Singapore, aim to deliver solutions that render owning a private vehicle obsolete. Indeed, this view is nowhere more apparent than in North America, where the motor vehicle is a symbol of independence. However, the example of San Francisco, aiming to make the city less private vehicle dependent, shows that the situation is beginning to change.

While MaaS is largely viewed as a European concept at present, Juniper believes that interest will undoubtedly spread across to major cities in North America and Asia, particularly as driverless vehicles will push down private ownership levels in cities.

Indeed, for driverless vehicles to thrive (the aim now for many cities around the globe), the establishment of MaaS platforms will be critical, given they will first be used as a public transport solution as opposed to a private transport solution.

Case Study: San Francisco

San Francisco has taken a forward-looking approach to traffic management in the city and has developed a comprehensive strategy around the shift away from private transport.

The authorities believe that the key to underpinning this vision is in the direction of shared transport modes, with connected vehicles playing a fundamental role in enabling the development of MaaS offerings.

When MaaS is fully rolled out, the city envisions that cross-city journeys should take no longer than 20 minutes, while the on-demand nature of MaaS will ensure that the chosen transport mode will be available to the consumer within 2 minutes of booking.

San Francisco has thus set out a vision for a technology platform supporting an integrated service, allowing citizens to choose from a range of multi-modal options.

The primary elements of this vision are:

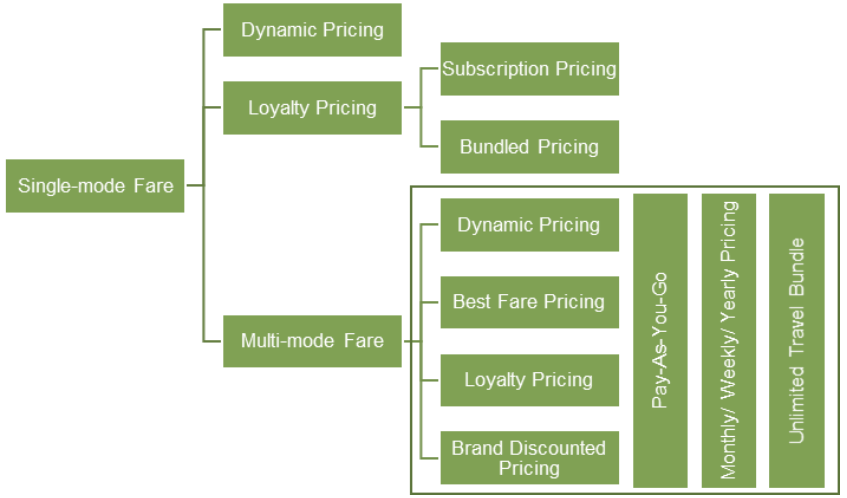
- Transportation as a Platform
- Transport as a Service.

1.5 Viewpoint: MaaS Market Opportunities & Trends

i. New Business & Service Opportunities

Consumers demand choice about how they use transportation services, whether private, public or shared, at a time and location convenient to them. They expect greater flexibility in not just the transport modes, but also in the pricing options available to them.

Figure 3: Pricing Model Evolution to MaaS



Source: Juniper Research

MaaS offers a significant opportunity for stakeholders to change travel behaviour and introduce new innovative business models such as dynamic and subscription pricing for multi-mode fare systems. In addition, service providers are able to offer incentives and usage-based pricing models that

can be sold on a pay-as-you-go basis, or as monthly/weekly/yearly subscription packages. These subscription packages can be incentivised by bundling in free ride sharing credit with Uber or car-rental minutes with car2go when commuting via public transit during rush hour. Indeed, subscription and monthly recurring charge models will become the foundation for MaaS.

In addition, individual pricing plans as customised by the user can also be offered, extending its availability to not just city-based transport services but also last-mile urban and cross-border services.

By pressing the idea that stakeholders make additional revenue and that users can help protect the environment (as well as receive an efficient on-demand service), MaaS services is expected to have significant uptake.

ii. Congestion & Health Management

Traffic volume is a growing concern, particularly in city environments. A high volume of traffic not only causes drivers annoyance, but congestion also contributes to:

- Economic losses through delays;
- Increased CO^2e (CO^2 equivalent) levels;
- Increased use of fuel;
- Greater concentration of vehicle exhaust emissions, contributing to the development of photochemical smog. The chemical compounds in this type of smog are known to have severe health risks, particularly for citizens who are suffering from, or are susceptible to, lung problems.

There are several factors that contribute to impaired traffic flow across a city, of which the number of vehicles on the road is undeniably the greatest factor. Elements such as poor road planning, poor traffic flow control and lack of information for drivers can also contribute to the development of congestion. TomTom, a global leader in navigation and transport management solution, highlighted the issue of heavy traffic in its Traffic Index 2017 report[ii], revealing that Mexico City drivers must, on average, spend 66% (up from 59% in 2016) more time getting to their destination than if there was no traffic on the roads. It must be understood that the only sure-fire method to reduce congestion in a city is to reduce the number of cars travelling on the streets. This is a policy, rather than a technology, issue and is something that cities are reluctant to address. In addition, MaaS will enable cities and corporations to cut down massively on any parking issues. In fact, there is an opportunity for businesses and councils to convert existing car parks into greener spaces for employees and citizens.

MaaS holds great prospects for green technologies. For example, most ride sharing services already offer greener alternatives to petrol and diesel vehicles. Whilst the focus has been on motorised, combustion-driven vehicles, there have been a number of ventures looking to utilise green forms of transport. These have included ideas such as the hiring and rental of electric cars, shared transport using electric vehicles as taxis and the promotion of bicycles through sharing mechanisms.

iii. Shared Services & the Development of Autonomous Vehicles

Developing a MaaS strategy will enable cities to address congestion and environmental issues by increasing public transport adoption, alongside increasing the number of shared cars amongst the public. Beyond using car sharing as a way to avoid the high costs of car ownership, those who

still prefer to own a vehicle could consider renting it out according to the very same principles, ie a form of vehicle crowdsourcing and a potential revenue stream for car owners. This will make car ownership more affordable in the light of increasing insurance premiums, taxes, fuel, maintenance and parking costs. For example, just like Airbnb for residential properties, there are services such as Turo[iii] that enable citizens to list their private cars for short-term rental services. This will become an integral part of the MaaS ecosystem.

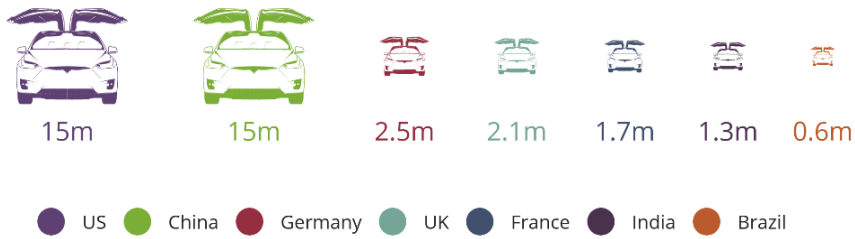
It is clear that the boundaries between private vehicle ownership, car-sharing and public car-sharing and rental fleets will increasingly become blurred.

Juniper estimates that the ride sharing transport industry will exceed $60 billion towards the end of 2021[iv]. Emerging regions will see the most rapid growth, in terms of driver revenues, as service providers seek to roll-out services to these regions.

In addition, there will be a further wave of disruption through the adoption of autonomous vehicles. Being able to call a driverless car on-demand could allow many people to dispense with the need to own a vehicle.

Whilst ride sharing companies will be eager to see autonomous cars roll-out to the general public, this is still a number of years away from becoming mainstream. There is also the challenge that car manufacturers will be concerned in the future as consumers increasingly feel less need to own their own vehicles, rather they can simply call a ride sharing autonomous vehicle to take them where they need to go. The fear is that this reduction in consumer car ownership will have an adverse impact on overall revenues.

Figure 4: Level 4/5 Autonomous Vehicles in Service (m), 2026



Source: Juniper Research[v]

However, while it is expected that while car ownership will go down due to the deployment of MaaS services using autonomous vehicles, the rate of car replacement and retirement will go up due to increased usage of these shared vehicles and this will to an extent offset any revenue loss for car manufacturers.

iv. Stakeholder Partnerships

There has been an increasing momentum to, and industry interest in, MaaS. Importantly, players within the ecosystem are collaborating with each other via partnerships; some organisations are actively becoming instrumental in creating an interface between transport operators, infrastructure providers and other industry players.

For example, the *MaaS Alliance*[vi] is a public-private partnership, of which moovel is a member, establishing a common approach to MaaS, driving

an open market for innovation and full deployment in Europe. In the US, moovel is a key partner in the Mobility on Demand (MOD) Sandbox Program alongside TriMet[vii] to help create an open platform for the integration of transit and shared-use mobility options.

Indeed, as discussed earlier, a successful MaaS approach requires an open data approach, whereby a specific dataset will enable stakeholders to analyse mobility conditions to determine where, and which, solutions will be the most appropriate to improve mobility use cases for customers at a specific point in time. This will enable these stakeholders to offer a 'minimum level' of services to customers. A lack of mutual co-operation and strategy will mean that it will become increasingly difficult for MaaS providers and other stakeholders to offer this expected 'minimum level' quality of service.

In addition, the development of innovative business models will depend on such stakeholder partnerships. A number of local bodies and private sector companies now understand this and encourage cross-industry and cross-sector collaborations. This will, in turn, drive policy and regulatory requirements.

v. Digital Ticketing Market Growth & Consumer Expectations

Digital transport ticketing is becoming more mature, with the number of transport operators committed to introducing new technologies to improve passenger expectations on the rise. The advances in technology, and the introduction of newer business models such as MaaS, mean that existing transport operators will witness a greater adoption in mobile ticketing, especially in the metro sector. The future of digital ticketing will depend on putting passengers in control, with intelligent transport networks driving future digital technologies and consumer adoption.

Juniper expects over 40 billion transport tickets to be bought via mobile and online means by the end of 2022.

Juniper's research[viii] found that more consumers prefer an end-to-end mobile ticketing process, with tickets purchased, delivered and validated using a mobile or an app; this is the fundamental principle of MaaS itself.

vi. Big Data & Analytics Technology Driver

Meanwhile, technology has disrupted transport ticketing and is currently driving remarkable growth. With the emergence of analytics platforms, real-time user relevant information and the ubiquity of mobile devices including smartphones and wearables, MaaS is becoming ever more relevant in the transport sector. With advances in technology, alongside the emergence of ride sharing services such as Uber and Lyft, consumers expect information on travel and booking services, anytime and anywhere.

This means that public transport is becoming more personal and dynamic, leading to newer business models such as real-time journey and fare management. In addition, integration of data analytics platforms has enabled brands and agencies to use consumer data to deliver operational and personalised services, as well as investigate new commercial opportunities based on the demographics of their audience. This has been a fundamental driver of MaaS. Delivery of an excellent transit experience also drives cross-selling and upselling opportunities based on the audience's personal preferences.

The increasing use of data means that ticketing providers and transit agencies are able to engage their target audience not just during a specific day or time of the travel, but at any time.

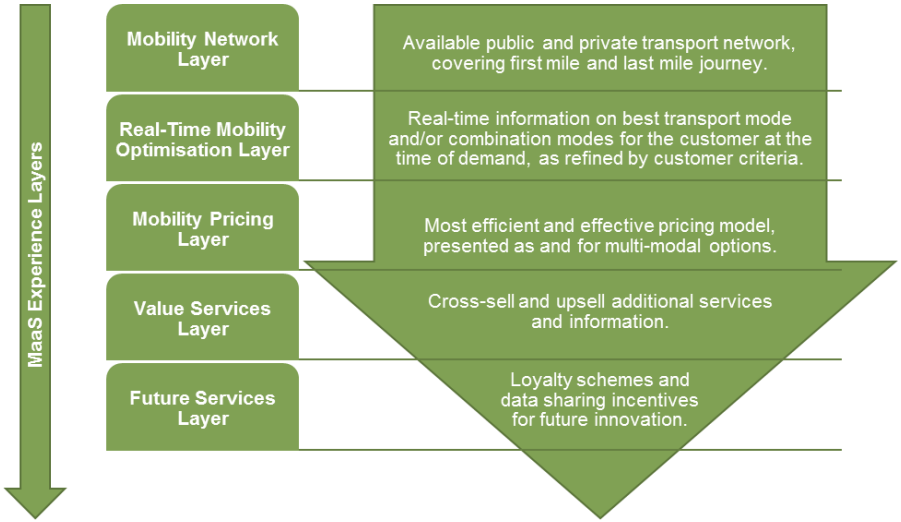
2. Future Vision: Blueprint for a MaaS Deployment

2.1 MaaS Deployment: Service Layers

In order to understand the MaaS value proposition, we have defined and mapped (overleaf) the different service layers in a MaaS model explored from a customer perspective. While this is not a technical framework, it essentially demonstrates the service layers that will shape future innovations that will offer a frictionless experience to the customers.

- Mobility Network Layer: Customers are able to choose their preferred mode of transport, from point A to B, by selecting between public, private, shared, or a combination of the 3.
- Real-Time Mobility Optimisation Layer: Customers are then able to view available travel modes including total duration for travel from point A to B, based on real-time information including taxi or ride share availability, traffic conditions, bus or train delays and any other disruptions.
- Mobility Pricing Layer: Customers are able to select the preferred payment option, based on usage or subscription plans.
- Value Services Layer: Opportunity for MaaS provider to innovate and offer related or other vertical services; for example providing offers to nearest retail outlets or restaurants, suggest meetings points and other location-based services.
- Future Services Layer: This provides opportunities for service providers and the customer. It enables loyalty schemes and discounts for customers and provides the opportunity to present them with user data-based service plans and other services including advertising and paid-for information display. In addition, it is possible to use customer data to innovate future business models, as well as delivering credits and discounts for promoting continued usage.

Figure 5: MaaS Service Layers



Source: Juniper Research

2.2 Impact Assessment

MaaS will have a significant level of impact across a number of transport service areas including ticketing, payment, journey planning, customer management, and operations.

We have summarised the impact of MaaS on transport services below.

Table 6: Transport Services Areas Impacted by MaaS

Impact Areas	Impact Scenario	Timescale
Service Offerings	Availability of rich data and the use of analytics platform will deliver improved customer churn and relationships that will translate into personalised offerings. This will also enable tracking of customer usage of products and engage continued innovation.	Now
Payment Mechanisms	All transactions and payments can be made easily and conveniently via a single mode of payment, across multiple devices.	Now
Journey Planning & Management	Real-time information on traffic delays, weather, roadworks etc to offer better journey planning and management for commuters. This will enable significant time, cost and emissions savings.	Now
Next Level Personalisation & Customer Recognition	Using beacons, other sensors, mobile location check-in and cameras to provide a better, personalised service across every mode of transport.	Longer Term
Reduce Operational Cost	Improved management tools and resources to reduce operational cost for all stakeholders.	Near Future

Source: Juniper Research

2.3 Creating a Frictionless Experience

For MaaS services to come together and offer an end-to-end mobility service, there are specific logistical challenges.

i. Pain Point 1: Technology Level

Technology is critical in delivering a frictionless experience for commuters. Creating a single platform on which MaaS technology can be placed is vital to the ecosystem development; most likely this will be in the form of an app. This model will speed up the initial development and enable rapid expansion into other areas and integration of other services, once use cases and technologies become apparent.

However, from a consumer perspective, technology should not be implemented for the sake of providing a digital app-based experience. There must be a clear goal of what is intended to be achieved, especially in terms of delivering a seamless service-level experience between different transport modes. This means that in terms of ticketing, a full-mode integrated service offering will be required and, in terms of payment, choice (for example between card and a mobile wallet payment) will become critical. In addition, customers expect the technology to be available across all their devices; ie smartphones, tablets, smartwatches, and personal computers.

Furthermore, the deployment of 5G cellular services will increase efficiency in terms of data utilisation and sharing amongst stakeholders as well as the customer. In turn, this will also provide stakeholders an opportunity to innovate further. Whilst the demand for faster connectivity, from local bodies and councils is likely to be strong, high implementation costs will remain a deterrent in many instances in the near future.

Combining real-time data, analytics, sensors and management software will enable service providers to establish a smart mobility platform.

ii. Pain Point 2: Business Model Level

Meanwhile, from a B2C business model perspective, the MaaS provider should be able to present the customer with a flexible and affordable pricing model that will differentiate itself from existing service models to drive customers to use MaaS services.

However, changes to pricing models present themselves as the biggest challenge to enforcing consumer behavioural changes. Consequently, this will require putting a mobility strategy in place that considers the pricing evolution model from single mode to multi-mode. Clear identification of public versus private transport options, weighed against real-time cross-modal availability, offering first and last mile transport connectivity will become the winner.

iii. Pain Point 3: City Level

Addressing MaaS at a city level requires transport authorities and governments to further explore the following key elements.

- Traffic Management: Congestion is a common issue and affects public services, such as emergency response, as well as bus and tram transport systems, with the potential to cause delays. Overall, delays may result in revenue loss for businesses. Sensor deployments are crucial to gather data regarding real-time traffic volumes. Traditionally, this has involved the deployment of induction-loop sensors, which need to be embedded in the road itself, further disrupting traffic; other solutions also include overhead cameras, overhead infra-red or microwave sensors.
- Public Transport Management: A timely service is seen as important in consumer satisfaction and is a common KPI (Key Performance Indicator) for operators of such services. Increasingly, initiatives to equip buses with positioning technology to better inform customers of arrival times at a stop will become increasingly common, while fuel efficiency is also of rising importance.
- Payment Infrastructure: This is concerned with the payment system associated with transport and will include ticketing systems for public transport as well as shared transport. A necessary platform to manage all payment methods across all transport modes will remain a critical requirement. Parking payment requirements built in on a city-level basis is also required for a sustainable payment infrastructure policy.

These factors are critical in delivering a frictionless experience for commuters.

iv. Pain Point 4: Policy & Regulation Level

Currently, there is an absence of national frameworks defining both the need for, and the overall direction of, MaaS' role in a smart city. Government organisations and legislators, at a state- or a council-level, need to begin work on implementing trials and pilot policies to enable a smooth migration to future MaaS service deployments. This will require setting aside the funding needed for infrastructure investments or upgrades (minimal), as well as creating rules and regulation with regard to operating conditions, city planning, transport policies, alongside data sharing. In short, policies and regulation will drive future innovation, not just in terms of technology but also consumer benefits, including consumer productivity, travel and traffic management, safety, urban planning and a cleaner environment.

v. Pain Point 5: Security Level

The importance of cybersecurity cannot be overstated, given the fact that citizens' data, as well as critical infrastructure, are attractive targets for cybercriminals.

It is critical that identifying and addressing key risks and cybersecurity strategies affecting key layers in the MaaS ecosystem is at the forefront of player vision.

MaaS will undoubtedly gather citizen data in some form or another. As this data becomes richer, the need to ensure that data security and privacy breaches are minimised will require further expertise. Stakeholders, primarily government and city authorities, will need to explicitly address the issue of data privacy and security.

2.4 Recommendations to Address Pain Points

i. Collaboration Needed

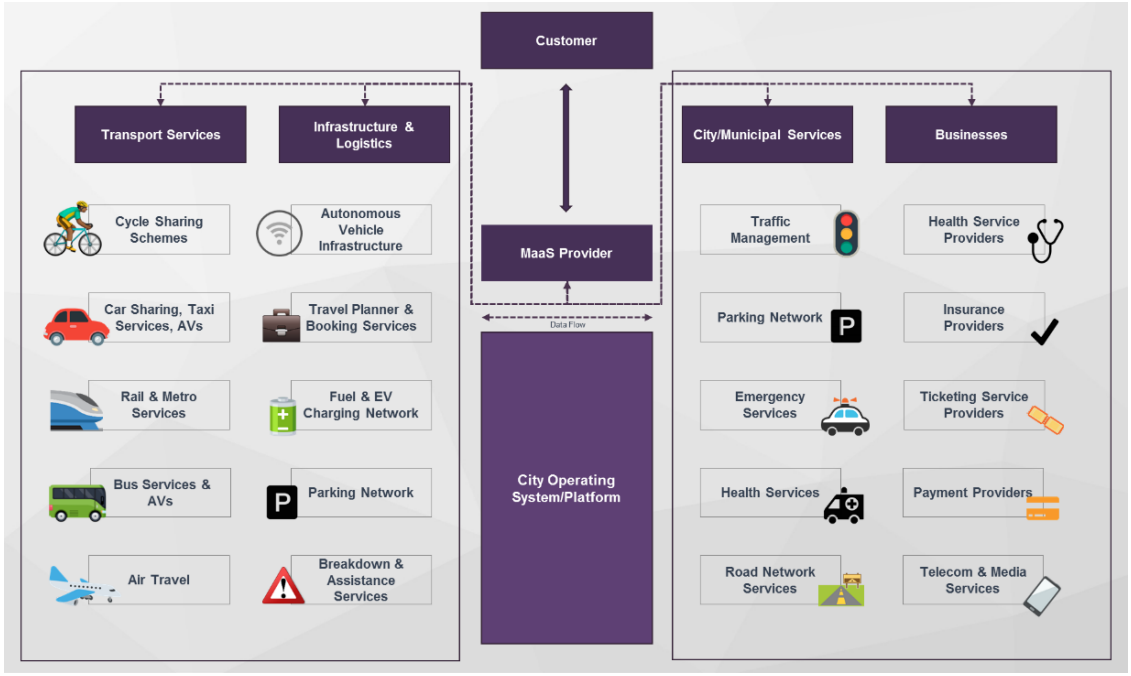
The ability to integrate data across several urban transport solution providers via stakeholder collaboration and information sharing will drive the development of MaaS initiatives in the future.

Juniper recommends that collaboration on a public authority and departmental level needs to be complemented by industry-specific strategic partnerships with technology partners and service providers alike.

These will form the basis for next generation urban transport services and will fundamentally transform the delivery model for public, on-demand, hire and private transport services.

The MaaS ecosystem will need to evolve into a highly successful value chain where private and public companies will be better positioned to innovate and offer customers the best services possible.

Figure 7: Collaboration Supporting MaaS Ecosystem



Source: Juniper Research

ii. MaaS Regulation & Policy

Municipal agencies will ultimately determine the manner in which projects are initiated, but rolled out approaches may be perceived as ignoring the needs of citizens in favour of business investment; technology for technology's sake.

Meanwhile, bottom-up methods have their own issues in terms of scaling, investment and meeting the needs of the whole population, as opposed to a subset. In addition, regulation is needed to address future business models and the issue of *'who owns the customer?'*.

iii. Open Data Policy & Security

Driven by an *Open Data* policy, unlocking ecosystems to a wide pool of developers will lead to more innovative services; mobile app stores are a case in point here.

City authorities and municipal corporations should encourage innovation and interest from a wide range of stakeholders, partners and developers through hosting events such as conferences, pilot programmes and technology sessions like hackathons.

In addition, they need to make sure any security strategies are implemented as *'Security by Design'.* This means that security at every layer is accounted for; ie from establishing trust in one's supplier to code development and cloud deployments.

Careful security planning should evaluate each of these layers in terms of risk to the business, and take appropriate action for that level of risk.

iv. Pricing Models & Payment Integration

In addition, stakeholders must come together to define a workable business model that suits all parties; clearly, this affects ticketing as one payment application.

A business model that has had positive responses from the mobile payment ecosystem is one in which the MaaS provider retains ownership of the pricing model and manage the relationship with the transport service providers and subsidise the sale to the end-user. However, in cases where there is the potential availability of multiple competing service providers (for example, Uber vs Lyft) there is the possibility that, in some markets, this will need to be settled via a bidding process, especially when there is strict regulation involved.

Experienced MaaS providers will need to focus initially on defining a contractual framework document detailing the minimum set of requirements for service providers to interface with others. In addition, if there is the possibility of revenue sharing involved, then this will require some attention and progress.

2.5 Best Practice Guide for Stakeholders from moovel

Source: moovel Group

3. What Does MaaS Mean: For Citizens & Businesses

3.1 Methodology & Assumptions

Juniper has estimated the benefit of MaaS proliferation on the basis that MaaS is not only fully available in major cities, but that the benefits resulting from route and service optimisation are according to a 'best case scenario'.

This efficiency, such as being able to route intelligently to avoid congestion, alongside the fact that private transport modes are expected to fall as a result of high-quality transport services, is expected to realise time savings, cost savings as well as business productivity gains. Here, we examine to the extent of those potential gains.

The main basis for MaaS-derived gains was sourced from results published through simulated and real-world results from shared transport solutions, such as those conducted by the ITF (International Transport Forum)[ix].

Other relevant data were collected from the EEA (European Environment Agency)[x] to assess vehicle occupancy rates and TomTom[xi] to gather a map of congestion levels. Other indicators were gathered from Juniper's internal database trackers, maintained through research publications such as Consumer Connected Cars: Applications, Telematics & V2V 2017-2022[xii] and Smart Cities: Strategies & Forecasts in Energy, Transport & Lighting 2017-2022[xiii].

The first step was to establish a baseline *where no MaaS services are available*. Applying a scenario where MaaS is fully available then enables calculations as to the potential gains.

3.2 Quantifying the MaaS Experience for Commuters: Time Savings

According to a study by the ITF, MaaS has the potential to reduce congestion by 37%. Taking this into account alongside anticipated city modal shifts as a result of falling private vehicle ownership:

Juniper anticipates that commuters travelling via MaaS will save, on average, 37% of the baseline journey time, calculated at 67 minutes per day for drivers and 61 minutes per day across all modes.

Not unexpectedly, commuters who shift from private vehicle use to MaaS will see their average commute time fall to 34 minutes per day owing to congestion avoidance and high vehicle occupancy rates.

These benefits will not only fall to MaaS users, however, as some commuters will still prefer to travel using their own private transport. Presently, there is no data directly related to the transport industry that allows us to make an assumption as to how many commuters that will be; nevertheless, there are parallels in other industries from which we can base assumptions.

For instance, the IFPI's analysis of music industry revenues highlights that, despite the music streaming (ie non-ownership) business model being established and affordable, consumers continue to demand music ownership in the form of downloads and physical media. This demand has now settled, at roughly 20% of the industry.

Essentially, this means that some drivers will continue to own, and use their cars to drive to work: as a by-product of MaaS enablement, their commute time is projected to fall to an average of 52 minutes per day.

3.3 Quantifying the MaaS Experience for General Public: Time Savings

Trips that are made other than for the purposes of commuting are, more often than not, made when traffic conditions are not at their peak, therefore congestion levels tend to be much lower.

Meanwhile, modal shares shift towards increasing use of public transport services as the day progresses, while private vehicle use drops. In essence, this means that the potential for MaaS to reduce journey times by virtue of avoiding congestion is much less pronounced than it is during commuter 'rush hours'.

Nevertheless, Juniper has found that across some 312 annual weekend trips (assuming 1.5 made per weekend), MaaS will realise some 13 hours' saving annually from the effective baseline 41 minutes required to travel a 15 mile (24km) route. During weekdays, an increase in trade traffic comes into play.

Over 198 annual trips across the city for the purposes of leisure, shopping and so on, each trip via MaaS will save citizens an average of 2 minutes over the baseline, realising an annual saving of close to 8 hours.

3.4 Quantifying the MaaS Experience for Businesses: Impact on Productivity

Time savings for commuters through adoption of MaaS will undoubtedly realise benefits for businesses.

Indeed, the simple fact that employees will waste less time in congestion means that they can arrive at work earlier, or indeed, in the case of shared, driverless vehicles, use their travel time more productively than manning a gridlocked motor vehicle.

If one were to assume that all time saved was used for the purpose of business activity, the result would be an increase of $2.2 trillion in business productivity globally.

Nevertheless, employees are unlikely to devote all this time to work activity; after all, there is life beyond work. An estimation that 33% of the recovered time is used for business productivity would generate an additional $733 billion globally, purely from the implementation of MaaS.

4. MaaS Leadership: moovel

i. Background

As a subsidiary of Daimler AG, moovel's vision is a planet without traffic jams and its mission is to transform cities by providing the most convenient and sustainable mobility solutions. moovel helps advance Mobility-as-a-Service (MaaS) solutions, making cities smarter. moovel is working on MaaS operating system for urban mobility that offers access to suitable mobility options and paves the way for a future with autonomous vehicles.

The moovel Group GmbH has more than 5 million users in Germany and the US. In the first half of 2018, almost 13 million transactions were made through moovel's apps.

ii. Campaign Experience

a) Germany

moovel acts as a partner to cities, transport associations and customers. moovel is represented in the German market by the moovel app, moovel Transit and on-demand. The moovel mobility app combines local public transport, the car-sharing provider car2go as well as mytaxi, rental bicycles and Deutsche Bahn. Most services can be booked and paid for simply and directly via the moovel app. With the moovel transit product portfolio, the moovel Group offers white label solutions for transport associations and companies around the world. In addition, moovel on-demand is a ride sharing service, which was piloted in Stuttgart starting in December 2017 and Karlsruhe for the IT-Trans Conference. The initial pilot of on-demand service in Stuttgart led to a successful launch in June 2018. moovel Group's headquarters is located in Stuttgart, with offices in Berlin and Hamburg.

b) North America

In the US, moovel North America, with headquarters in Portland, Oregon, provides cities and transit agencies with moovel transit and on-demand platforms. moovel North America is the market leader in mobile ticketing solutions for public transit agencies.

iii. Service Portfolio: moovel's Mobility-as-a-Service Platform

The moovel platform offers a suite of white-labelled mobile ticketing and payment solutions for the most innovative public transit authorities worldwide.

The platform consists of the following products:

a) Mobility App

moovel's Mobility App allows consumers to search, book and pay for transit as they run to catch their ride. The white-labelled app includes several powerful features such as trip planning, next time arrivals, multimodal integrations, innovative payment options including Apple and Google Pay; it leverages contactless technologies including NFC (Near-field Communication), Bluetooth and QR codes.

*b) Rider Web**

Consumers can also purchase and manage fares through Rider Web, a transit agency-branded eCommerce website.

*c) TOMS (Transaction and Operations Management System)**

TOMS is an intuitive analytics system and customer support tool that communicates with in-system devices and external vendor systems to put business intelligence at an administrator's fingertips. TOMS gives transit agencies the ability to easily manage a diverse range of services, including accounts, orders, ticketing and real-time reporting.

*d) Inspector App**

Instant inspection and validation of mobile tickets from any mobile device, the Inspector App gives fare enforcement personnel a reliable and easy-to-use handheld tool to verify payment.

*e) Fare Connect**

Fare Connect is moovel's hardware agnostic contactless validation platform that allows agencies to implement fare validation systems by accepting and validating mobile fares. Powered by moovel's pioneering EDK (Embedded Software Development Kit), Fare Connect redirects engineering staff from burdensome software development cycles to work that grows the core business.

*f) FareShare**

moovel FareShare is a configurable system for transit agencies, universities and businesses to offer transportation benefits, reduced fares and discounted tickets. The easy-to-use application can be extended to third parties to quickly manage, track and distribute fares to eligible riders; increasing ridership and creating new revenue channels for the local community.

g) On-demand

Urban mobility is on the cusp of a fundamental change and public transportation agencies are under pressure to respond to changing customer needs, improving service quality, and increasing operational efficiencies. On-demand mobility and microtransit services complement the existing public transit system to supplement underserved rounds and are used to adapt to ever changing customer needs.

- moovel's on-demand solution provides public transportation agencies with a tool to implement their own on-demand mobility solution or microtransit service. These tools are built to help solve ever-changing market needs, improve customer experience and overall ridership and support first and last mile services.
- moovel's on-demand platform includes 3 integrated and intuitive elements: a Rider App to search and book rides; a Driver App providing map-based (GPS) turn-by-turn navigation for on-demand drivers showing pick-up and drop-off locations of the riders; the Operator Dashboard, a cloud-based back-office solution providing a live overview of on-demand services, including fleet administration tools, shift planning, reports, incident handling, trip overview, delays and more.

h) moovel app

Search, book and pay for rides with a single app. The moovel app is the first app in the world where you can simply book and pay for car2go, mytaxi and Deutsche Bahn in a single experience.

**Only available in North America.*

MaaS Case Study: KVV App

In May 2017, moovel partnered with the KVV (Karlsruhe Transport Authority) to launch the 'KVV.mobil powered by moovel' app.

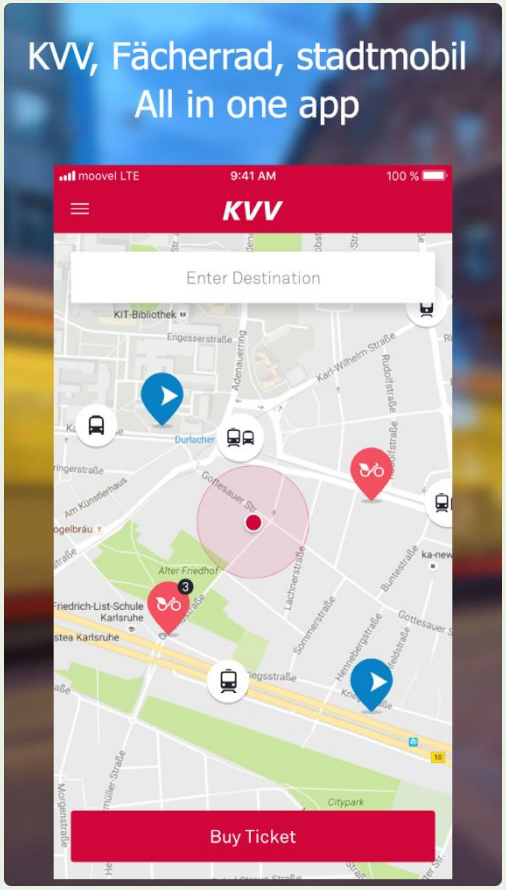
The app displays connections and departure times of buses, trains and trams at all 1,900 stops in the KVV area, as well as available rental bicycles from regional bike-sharing provider Fächerrad, a service by Nextbike.

Timetable bus, train and tram information is provided in real-time, putting information about delays or cancellations at users' fingertips. Whether bus, light rail, tram or bicycle, tickets and bicycles can be booked and paid for directly in the app, providing a complete user experience. Additionally, single ride, all day and group tickets are provided in the app.

At the IT-TRANS conference in 2018, moovel and KVV piloted a new, integrated microtransit service in the KVV.mobil app, powered by moovel, as an additional mobility option for conference attendees. The service comprised of 10 Mercedes-Benz V-Class sedans that could be flexibly booked for free using the app KVV.mobil powered by moovel. If multiple people wanted to take a similar route, the app's algorithm pooled the requests so that the passengers were able to share a single shuttle, which is known as pooling.

> 'The intelligent linking of mobility services will lead to entirely new transport concepts. We are developing innovative solutions for future mobility,' explained Karlsruhe's Mayor Dr Frank Mentrup.

'This pilot project between the moovel Group and KVV, which is already a driving force for sustainable mobility in Karlsruhe, underscores the city's commitment to help shape mobility transformation as a central IT and business location," says Mentrup.



Endnotes

[i] https://citymapper.com/

[ii] https://www.tomtom.com/en_gb/trafficindex/

[iii] https://turo.com/

[iv] https://www.juniperresearch.com/researchstore/innovation-disruption/sharing-economy/sharing-economy-opportunities-impacts-disrupto

[v] https://www.juniperresearch.com/researchstore/iot-m2m/autonomous-vehicles/adas-adoption-regulation

[vi] https://maas-alliance.eu/

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[ix] https://www.itf-oecd.org/

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[xii] https://www.juniperresearch.com/researchstore/iot-m2m/consumer-connected-cars/applications-telematics-v2v

[xiii] https://www.juniperresearch.com/researchstore/iot-m2m/smart-cities/strategies-forecasts-in-energy-transport-lighting