

MOBILITY AS A SERVICE

EXPLORING THE OPPORTUNITY FOR
MOBILITY AS A SERVICE IN THE UK

July 2016



CATAPULT
Transport Systems

ABOUT THE TRANSPORT SYSTEMS CATAPULT

The Transport Systems Catapult is the UK's technology and innovation centre for Intelligent Mobility – the future of transport systems. We exist to drive UK global leadership in Intelligent Mobility, promoting sustained economic growth and wellbeing, through integrated, efficient and sustainable transport systems. Our vision is to create an environment that will make the UK a world leader in transport systems innovation.

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FOREWORD

Our research shows that travellers and other transport users increasingly view transport as a service which they want to buy when they need it. Our transport services need to better suit customers' circumstances and provide options that align with their lifestyles. One size fits all is no longer an option.

Dynamically updated and user-relevant information should be the norm, not an exception. This is evident in the way customers adopt services such as Uber. In the future, this trend will continue due to growth of urban populations and changing preferences of younger generations that care less about ownership and more about experiences. This trend will be especially evident when the car industry confronts an environment where customers prefer not to buy cars but instead require only occasional access to a vehicle and service – this represents a clear shift from an ownership model, to a service model.

The availability of data, processing power and the ubiquitous use of mobile phones have enabled travellers and their needs to be better understood. Passengers no longer need to collect and keep timetables to work out the most optimal connections between transport modes. There is a plethora of personalised apps designed to serve travellers - these apps deliver information in real-time to help avoid congestion and delays and enable the customer to choose a travel option according to the specific travel need.

Tailored travel options can be made possible - whether it is the fastest route, low-cost route, most direct route, most environmentally friendly, or most accessible service for persons with reduced mobility, or those travelling with children. This is all enabled by technological advancement, combined with the rise of new business models such as Mobility as a Service (MaaS).



STEVE YIANNI
CEO, Transport Systems Catapult

MaaS is a key focus area for the Transport Systems Catapult – it can help address our Intelligent Mobility Goals; this report moves us forward with our vision for supporting the delivery of Mobility as a Service in the UK.

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EXECUTIVE SUMMARY

Global interest in Mobility as a Service (MaaS) is growing and the concept is gaining the attention of the UK public and private sectors. MaaS offers an opportunity to improve how people and goods move, both from the perspective of the policy maker and for travellers themselves.

The Transport Systems Catapult has defined MaaS as using a digital interface to source and manage the provision of a transport related service(s) which meets the mobility requirements of a customer. This definition seeks to encapsulate the vision of a MaaS Provider offering their customer, any type of travel experience using any type of transport service, public or private. Innovation is expected to lead to new MaaS offers for the consumer; market conditions will shape which are made available.

There are two core strengths to the MaaS business model: servitisation, whereby the MaaS Provider creates a value proposition that comprises a 'bundle' of different mobility services; and Data Sharing, whereby the MaaS Provider shares data on the mobility needs of customers, to help Transport Operators improve their service.

To explore the enablers of MaaS growth, it is necessary to understand the relationships between the many stakeholders, technologies and capabilities that are involved in delivering MaaS. The use of a MaaS reference architecture is a useful starting point for understanding the stakeholder requirements and capabilities; there will be no one MaaS model that 'fits all'.

There are several trends that support future MaaS growth. Consumers are increasingly expecting their experiences in transport and other sectors, to be delivered as a 'service', and to get more value as a result. Technology change and the opening up of transport datasets has already added significant

value to travellers. Additionally changes in mobility consumption means greater adoption of new mobility models and this may lead to a move away from car ownership.

Evidence that MaaS growth requires policy intervention, may be found in the 'narrow' set of features available in current MaaS offerings. For example, although the taxi service apps have gained customers by offering some MaaS features e.g. easier transactions, they have not significantly improved multi-modal journeys. There are several reasons for this and barriers have been identified which may prevent the MaaS ecosystem from reaching its potential in the short-term.

As well as the potential benefits of MaaS, there is a risk that growth in MaaS could result in a number of negative consequences. A key question for policy makers is 'what type of MaaS do they want to see grow?' Our scenario analysis looked at two potential outcomes that could result from using different interventions. One outcome is the scenario where MaaS Providers offer consumers a service focussed on car vehicle transport e.g. taxi, carshare and rideshare services. The other outcome is a scenario where consumers are offered a fully multi-modal service. The MaaS growth scenarios identified in this report can be used to map potential pathways to achieving different MaaS outcomes.

Delivering MaaS presents a considerable scope of change for stakeholders in the MaaS ecosystem. Policy makers have an opportunity to shape how the MaaS marketplace grows. We have identified the following key findings that can be considered by policy makers when examining the MaaS opportunity:

MaaS COULD CHANGE OUR TRAVEL BEHAVIOUR

- The impact of MaaS is unknown. MaaS could result in more journeys and distances travelled by car or potentially less; it could support national and local transport policy or challenge it but further research is needed.
- MaaS offers the potential to address many of the transport challenges facing society by engaging new business models and technology – it offers policy makers an opportunity for achieving travel behaviour change and managing travel demand.

MaaS COULD CHANGE THE TRANSPORT SECTOR

- Existing transport operators face significant opportunities but also threats from MaaS growth. Transport operators may move away from a business to consumer model, to focussing on supplying transport capacity directly to MaaS Providers.
- MaaS has the potential to provide transport authorities with rich data to help them manage their transport systems and networks.

MaaS GROWTH COULD BENEFIT FROM POLICY INTERVENTION

- There are significant barriers that are preventing MaaS growth and policy interventions may be required to address them.
- The benefits of MaaS success are compelling and there are many potential pathways for policy makers to engage the private sector to achieve desired MaaS outcomes.
- MaaS value propositions can be developed to suit a range of target customers, however the private sector may develop business models that do not align with existing policy goals.

1. INTRODUCTION

Mobility as a Service (MaaS) provides new opportunities to improve customer travel choice and support greater efficiency in how our transport services are provided. The Transport Systems Catapult views MaaS as a significant opportunity to use Intelligent Mobility innovation to realise benefits for industry and travellers.

Global interest in MaaS is growing and the concept is gaining the attention of UK public and private sectors. MaaS, as a concept, is broader in scope than seeking to improve just one aspect of our travel experience, such as ticketing or journey planning information. Instead MaaS seeks to transform the way in which we choose how we travel from A to B and it provides an opportunity for policy makers to secure benefits for society.

PURPOSE OF THIS REPORT

The purpose of this report is to explore the opportunity MaaS offers UK, with a focus on the future role of transport policy. The report is designed to provide readers with an introduction to MaaS and highlight how policy could support MaaS growth.

Over 40 organisations representing a range of MaaS stakeholders from different sectors, industries and transport operators, were involved in developing the report's findings; stakeholder acknowledgement is provided at the end of the report.

This report is an output from the Transport Systems Catapult's programme to support MaaS development in the UK. The study was led by the Transport Systems Catapult and commissioned and supported by the Department for Transport (DfT).

STRUCTURE OF THIS REPORT

This report is structured as follows:

- Chapter 2 provides an introduction to the concept of MaaS and outlines its potential benefits.
- Chapter 3 describes the stakeholders in the MaaS ecosystem.
- Chapter 4 outlines the opportunities for further MaaS innovation.
- Chapter 5 highlights how MaaS aligns to existing policy areas.
- Chapter 6 looks at how the barriers to MaaS growth could be addressed.
- Chapter 7 considers potential strategies for achieving different MaaS outcomes.
- Chapter 8 provides a summary of the report's key findings.

2. WHAT IS MOBILITY AS A SERVICE?

MaaS is a new concept that offers consumers access to a range of vehicle types and journey experiences. MaaS may be perceived by travellers as a 'better choice' and may change how we currently travel. In the future the private car may not be perceived as such a popular choice for getting from A to B.

There is uncertainty as to how the MaaS marketplace will develop; MaaS offerings may take many forms and be marketed to different types of customer. Providing mobility using MaaS may result in consumers deciding they no longer need to own a car. It may also have other consequences, such as increasing the number of journeys or leading to mode-shift away from public transport.

This chapter describes what MaaS could look like from the perspective of the customer. It then identifies the stakeholders that are needed to deliver it and the benefits that MaaS could provide to different stakeholders.

DEFINING MaaS

Traditionally our mobility has been provided for by managing fleets of vehicles around networks, framed by strategic transport planning objectives. MaaS, as a service model, turns this on its head by putting the customer first and framing the mobility systems around customer preferences. MaaS offers an opportunity to improve how people and goods move, both from the perspective of the policy maker and for travellers themselves.

The ‘as a service’ business model that is integral to MaaS, is commonplace in many digital enterprises, for example, the IT sector’s success with ‘Software as a Service’. The term mobility is chosen instead of ‘transport’, because the service model is associated with understanding the ‘who?’ and ‘why?’ of customers’

mobility requirements and only then is the transport solution offered as the ‘how?’ In this way MaaS is seen as consumer-centric and MaaS Providers can match a mobility solution to an individual consumer need.

Consumers in many parts of the UK already make use of MaaS related services. These are associated with navigation, journey information, cashless payment as well as managed access to transport services including taxi, bus, rail and shared transport journeys. Figure 1 illustrates where the MaaS value proposition sits in terms of combining the services provided by transport modes. It also shows the capabilities associated with improving travellers’ customer experience.

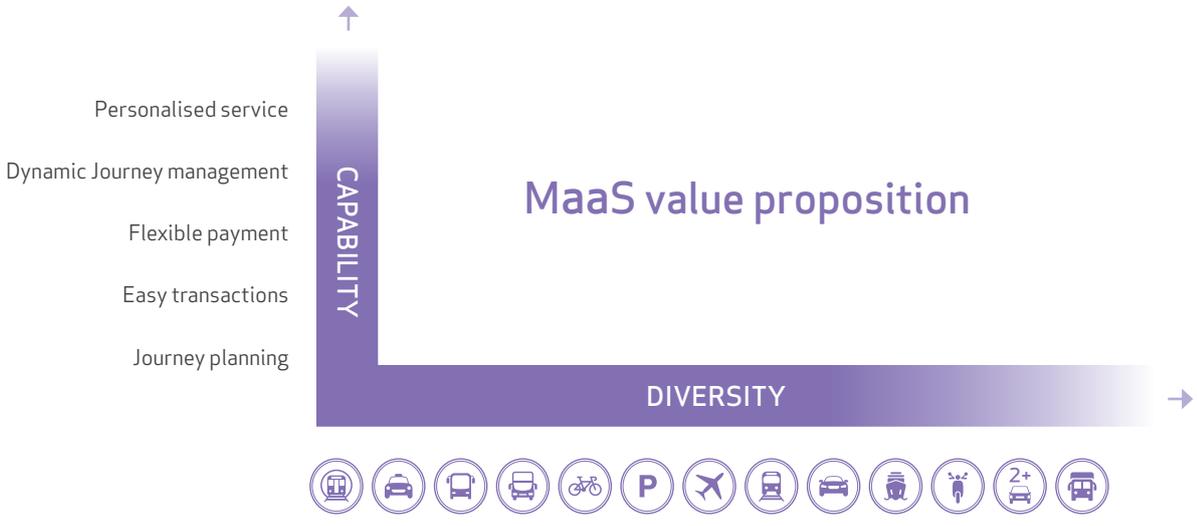


FIGURE 1: The opportunity for developing MaaS offers

Using the outputs from stakeholder workshops, the Transport Systems Catapult have defined the concept of MaaS as:

“ Using a digital interface to source and manage the provision of a transport related service(s) which meets the mobility requirements of a customer ”

This definition of MaaS encapsulates the ability for the service to offer any type of travel experience using any form of transport service, public or private.

Market conditions will shape the MaaS offerings made available on the market (reference Figure 2) and we expect that innovation in MaaS will result in consumers having a wide range of mobility services.

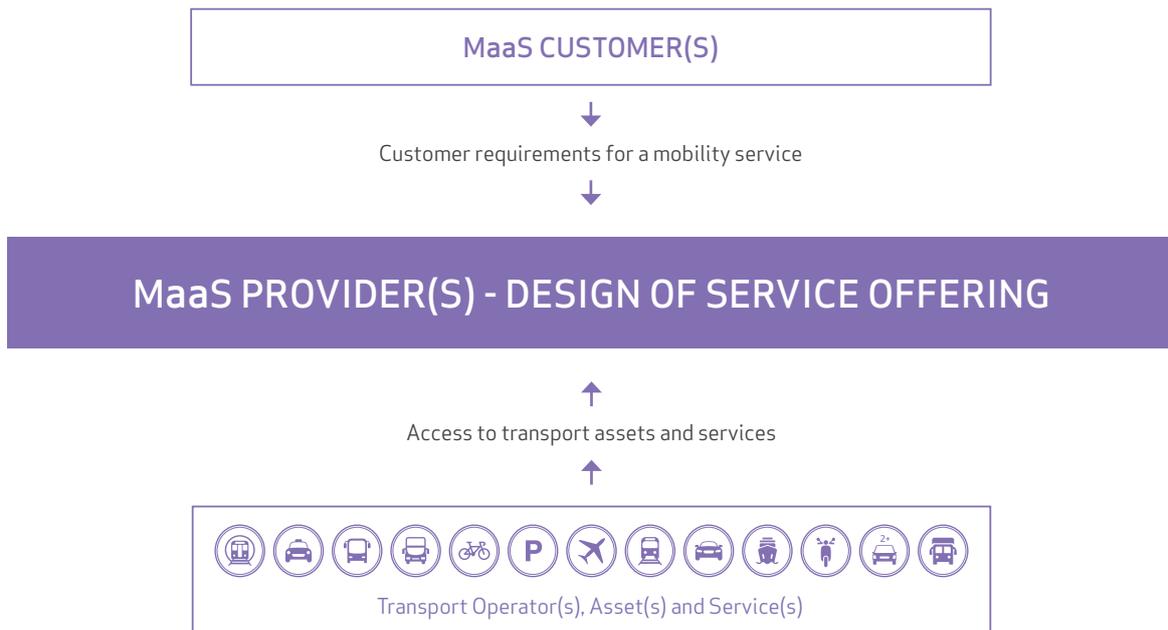
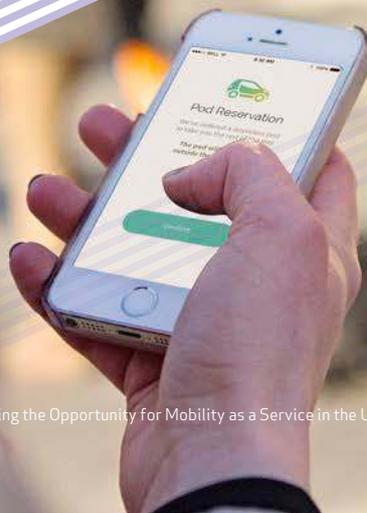


FIGURE 2: Developing the MaaS offering

As well as the choice of Transport Operator services that MaaS offers the consumer, research has identified a set of MaaS customer experience features that will be valued by the customer¹ (reference Table 1).

FEATURE	BENEFIT PERCEIVED BY THE CUSTOMER
Personalised Service	A personalised service that builds a relationship between the customer and the MaaS Provider, so that relevant travel choices can be anticipated and provided.
Ease of Transaction	The customer can conveniently access transport operator assets and services by using a range of devices, for example a smartphone, smartwatch, smartcard or bank card.
Ease of Payment	The customer can pay for their mobility to suit their needs - choice of pay-as-you-go, pre-pay or post-pay including the use of a monthly subscription model can be offered.
Dynamic Journey Management	The customer is provided with a dynamic journey management service that keeps the user informed in real-time if their journey expectations will need to change.
Journey Planning	A journey planning service allows a customer to plan their journey based on their personal preferences - for example, time, cost, comfort, convenience.

TABLE 1: Potential Customer Experience Features of MaaS



A DAY IN THE LIFE OF A MaaS CUSTOMER

Figure 3 provides a potential use case for a suburban family; it describes a scenario of how customers may derive value from MaaS.



Melinda is 35 years old and lives with her husband and two children in Tyldesley, a semi-rural area about 12 miles north-west from Manchester, where the most convenient transport mode option is the private vehicle. Melinda's household owns two cars. Her husband, Tom, uses one of the vehicles every day to commute to his workplace at Salford, which is 10 miles away and usually takes him a minimum of 35 minutes, but in some cases up to 60 minutes. Melinda uses their other vehicle to drop the children at school in Bolton and then drives back to Tyldesley to her workplace. Both Melinda and her husband suffer a lot of traffic problems when driving and decide they want a change.

Melinda's family subscribe to a MaaS offering in an attempt to make their daily travels less stressful. She first downloads the MaaS Provider's app to her and her husbands' smartphones, and opens their family account. During the registration, she answers a number of questions and the MaaS app offers her and her husband a 'Family Package'; which she finds very appealing. The package includes national rail, bus, on-demand mini-bus and bike sharing.

The next day, Melinda has a look at the options she has for taking the children to school. She types in the address of the school and sees that the MaaS operator offers an on-demand school bus that can pick her children up and take them straight to school. She hits 'submit' and can see the real-time location of the bus, its predicted arrival time, its registration plate and driver. The school bus arrives at her front door 15 minutes later. She uses the MaaS app to log that her children have boarded the bus. As Melinda saved time from not driving her children to school, she decides to have a pre-work coffee with her co-workers.

Melinda's husband Tom also plans his journey to work in the morning. He orders the mini-bus, which shortly arrives. As he boards the mini-bus the MaaS app starts counting the distance travelled. When the mini-bus arrives at the train station, Tom uses the MaaS app as a virtual ticket. Arriving at Salford, Tom receives a message that the route he was planning on taking with a bike is closed due to an accident and that he is better off walking an alternative route. He still gets to his office 15 minutes earlier than yesterday.

After a month of using MaaS, Melinda's family life has completely changed. They have sold Melinda's car and offer the other car for short term rental using the MaaS operator's website (community car club). In exchange Melinda's family gets credit in their MaaS account, which they use to buy mobility services. Due to the time they save on their daily commutes they now have more time to have family breakfasts and have saved money by selling their cars.

FIGURE 3: MaaS use case 'a day in the life'

WHO DEVELOPS THE MaaS OFFERING?

MaaS involves a range of different stakeholders, each of whom play an important part in developing and delivering the MaaS offering. These stakeholders form a MaaS ecosystem (reference Table 2).

STAKEHOLDER	ROLE
The Customer	Consumes the MaaS offer from the MaaS Provider.
The MaaS Provider	Designs and offers the MaaS value proposition to satisfy customer demand.
The Data Provider	Acts as a data broker to service the data and information sharing requirements of the Transport Operators and MaaS Provider.
The Transport Operator	Provides the transport assets and services including public and private transport, highway capacity, urban-realm assets such as car parking, electric vehicle charging points, and digital assets such as ITS infrastructure.

TABLE 2: Definition of stakeholder roles in the MaaS ecosystem

The Figure 4 illustrates the value that each of these actors provide to the MaaS ecosystem. Taken together, the stakeholders form a value chain that supports the delivery of MaaS, through the formation of a viable business model, enabled by digital services.

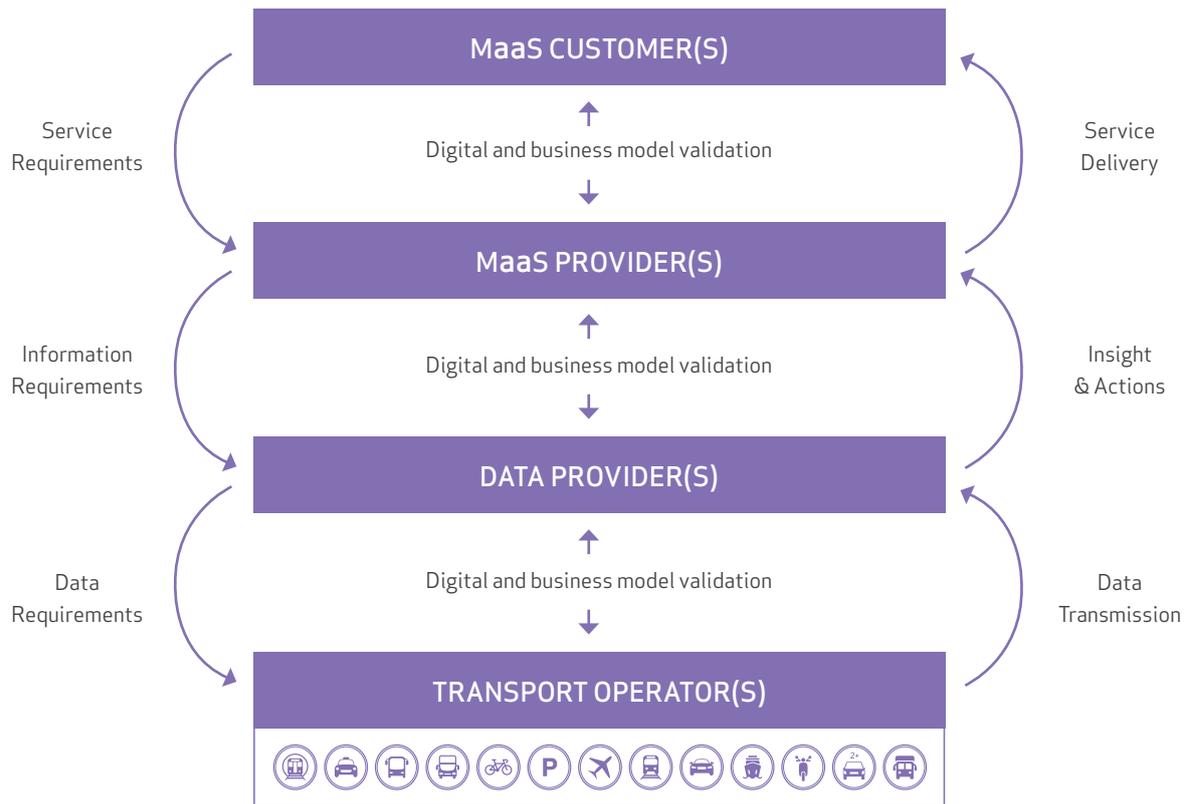


FIGURE 4: Simplified MaaS value chain

The extent to which enterprises fulfil one or more roles in the MaaS ecosystem, will be dependent on market conditions. There are many existing examples of businesses securing a position across the Transport Operator, Data Provider and MaaS Provider layers of the ecosystem. For example Uber's taxi based MaaS offering, or alternatively the Train Operating Companies and carshare enterprises that provide apps for their passengers' use. In contrast to occupying a 'full stack' within the MaaS ecosystem, there are examples of businesses focussing on a narrower set of capabilities, associated with one role; examples include travel information and journey planning apps.

THE CORE INNOVATION IN THE MaaS MODEL

The core innovation in MaaS is the ability for the MaaS Provider to aggregate Transport Operator services using a digital platform. The aggregator business model is well known in other sectors; one example in the retail sector is Amazon.com.

By fulfilling the position of an aggregator, MaaS could change the way the Transport Operators interface with their customers. There are two core strengths to the MaaS business model in this regard:

- **Servitisation:** whereby the MaaS Provider creates a value proposition that comprises a 'bundle' of different mobility services. This can create competition in the Transport Operator marketplace by incentivising Transport Operators to innovate to maintain or grow their market share.
- **Data Sharing:** whereby the MaaS Provider shares data on the mobility needs of customers, to help Transport Operators improve their service. Without the MaaS Provider, lack of co-operative competition between Transport Operators may prevent this type of innovation, especially where Transport Operators compete for the same customers.

A theoretical example to show how the servitisation and data sharing capabilities of MaaS may be used by the consumer is illustrated in Figure 5. This example illustrates the potential for a MaaS Provider to address their customer's lifestyle needs and by being successful in this, support behaviour change. In this example the gym organisation may be subsidising the taxi fare; the customer may only perceive the role of the MaaS Provider in terms of the MaaS 'deal' chosen.



FIGURE 5: Example of MaaS supporting a customer who wants to reduce Single Occupancy Vehicle use

THE BENEFITS OF MaaS

From a transport policy perspective, a strength of MaaS is its ability to secure a strong customer relationship with the traveller. This ability offers the potential to break some of the challenging societal dimensions that shape mobility demand. A mix of operational factors (e.g. school start times) and implicit social norms (e.g. presenteeism in the workplace) currently generate peak travel demand on transport networks and this often leads to traffic congestion. The potential for a MaaS Provider to manage the mobility needs of both workplaces and employees may support a reduction in peak hour travel demand.

As well as the benefits accrued by the MaaS Provider, the other stakeholders in the MaaS ecosystem (Transport Providers, Data Providers, Transport Operators and Customers) can gain from the opportunities that MaaS offers (reference Table 3).

	BENEFIT OF MaaS	OUTCOME
THE CUSTOMER (TRAVELLER)	MaaS provides additional value that supports customer lifestyle requirements.	Mobility expenditure channelled through the MaaS Provider, may provide cost savings for the customer.
	MaaS offers customers the ability to take part in the sharing economy, by sharing their transport assets e.g. car, cycle, motorcycle.	Reduced transport costs and potential to supplement income.
THE CUSTOMER (POLICY MAKER)	More efficient use of transport management tools and resources to meet the needs of citizens	More efficient use of transport management tools and resources to meet the needs of citizens.
	Potential to crowd-source traveller demand and willingness to pay for access to highway capacity. May also enable highway authorities to control how MaaS travellers access highway assets.	More effective policy making as a result of improved insight regarding traveller needs.
	Potential to support new mobility services and could support the redistribution of government mobility subsidy e.g. English National Concessionary Travel Scheme; MaaS customers could receive these funds directly from the Authority to then purchase MaaS.	Improvement to transport services in areas where market competition between Transport Operators is low and travel choice is restricted.
	Incentivised travel behaviour change can result in more sustainable travel patterns.	Transport policy goals are supported.
THE DATA PROVIDER	Provides the capability to manage data exchange with the Transport Operator and gives access to new markets for data brokerage services.	Additional revenues and market growth.
	Data analytics capabilities can support the design of the customer value proposition and gives access to new markets for data analytics.	Additional revenues and market growth.
THE TRANSPORT OPERATOR(S)	Enables travel behaviour change to secure passenger growth and access to new passenger markets.	Revenue growth opportunity from previously 'unreachable' customer markets.
	Creates potential for competition between engaged Transport Operators leading to improved levels of service offered by Transport Operators.	Greater market-share through successfully competing in the Transport Operator marketplace.

TABLE 3: Potential benefits of MaaS for stakeholders

3. THE MOBILITY AS A SERVICE ECOSYSTEM

To explore the enablers of MaaS growth, it is useful to understand the relationships between the many stakeholders, technologies and capabilities that are involved in growing MaaS in the UK.

This chapter illustrates how the MaaS ecosystem can be examined using a reference architecture. The MaaS reference architecture illustrates the building blocks of a conceptual MaaS system. It is used here to describe the requirements and capabilities of the different components of the system which could be supported to promote MaaS growth.

THE MaaS REFERENCE ARCHITECTURE

A MaaS reference architecture was developed using information collated via a literature review and the outputs from several stakeholder workshops. Each requirement was reviewed and linked to one of the following four 'capability' domains.

- **Consumer** – describes what various customer segments will value from using MaaS.
- **Business** – describes business drivers for risk and investment.
- **Technology and Information** – scoping the technology and data requirements needed to support MaaS.
- **Policy and Regulation** – scoping the policy areas that could enable MaaS.

Four 'actor' domains were identified for use in the reference architecture, to help understand the capabilities required to support MaaS:

- Customer(s)
- Transport Operator(s)
- Data Provider(s)
- MaaS Provider(s)

The MaaS reference architecture is illustrated in the Figure 6. Further stakeholder description is provided in the following sections.

The MaaS reference architecture demonstrates how the actors work within the following frameworks:

- **System Security:** to meet the needs of legislative requirements that cover ICT systems.
- **System Governance:** to deliver efficiency through good practice management of systems and manage relationships between the actors.
- **Business:** meets the requirements of investor stakeholders.
- **Policy and Regulation:** meets the requirements of local and national government.

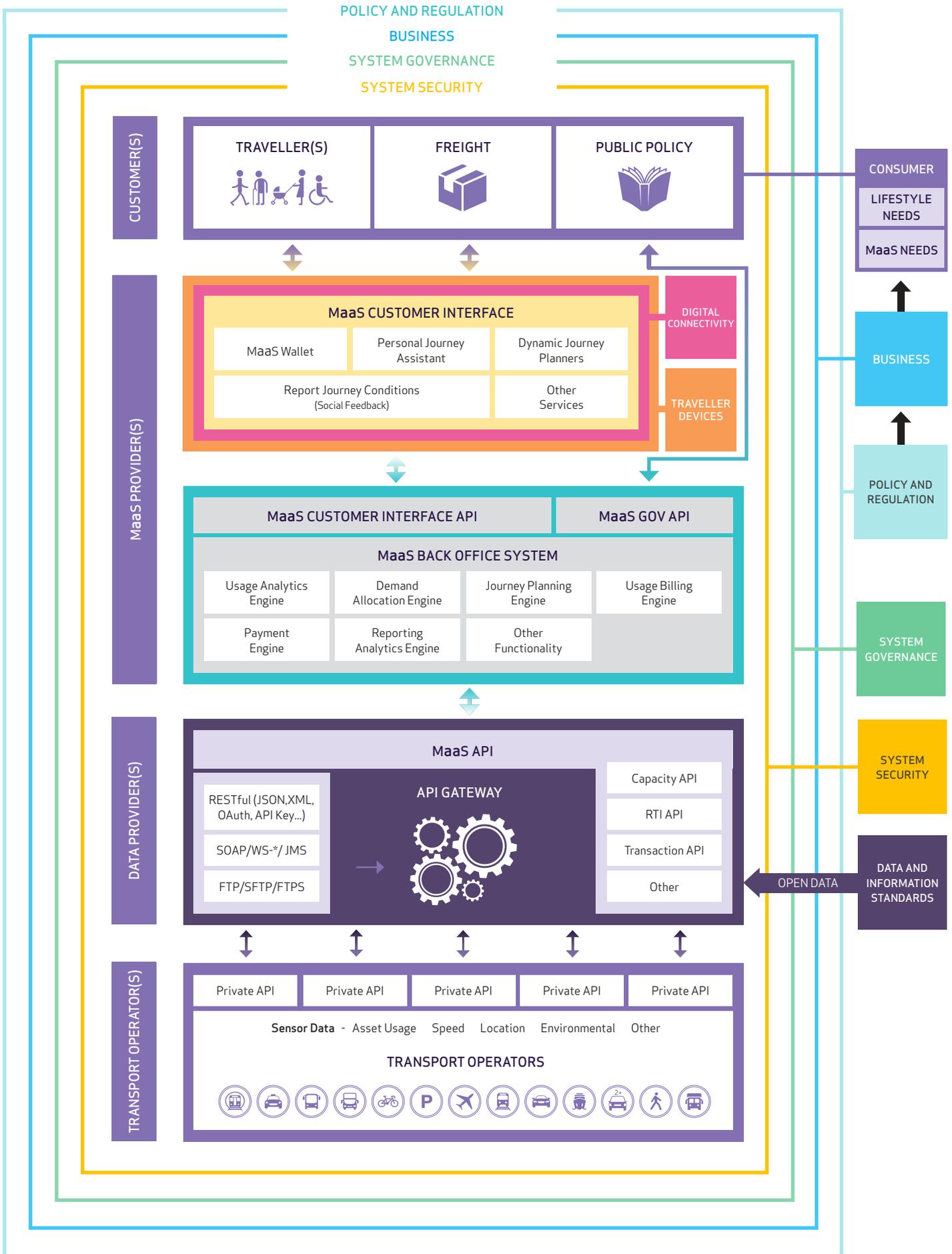


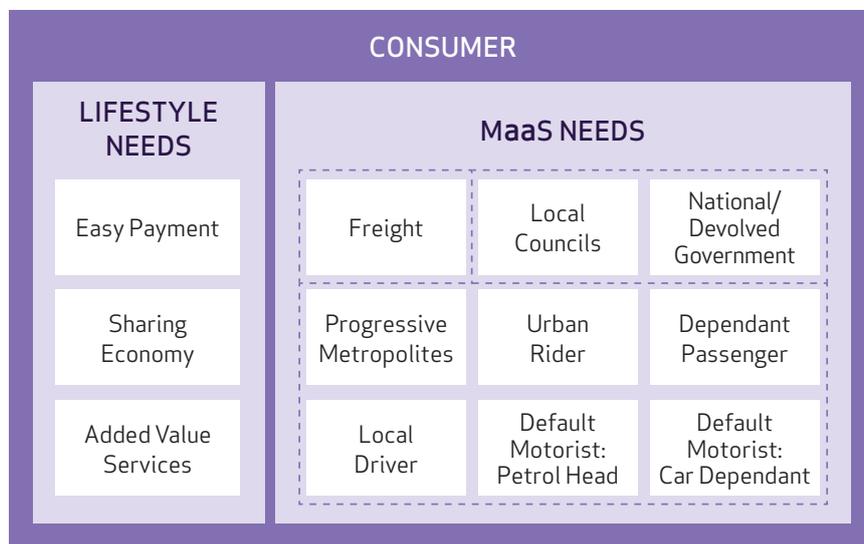
FIGURE 6: MaaS reference architecture

POLICY, BUSINESS AND THE CONSUMER RELATIONSHIPS

Shown on the right side of Figure 6, is the importance of 'market making', such that a MaaS value chain is supported. The black relationship arrows illustrate that benefits need to accrue across these three actors to create the value chain.

The requirements and capabilities relevant to these actors are described below. Stakeholder workshops were used to identify the needs of three target customer groups within the consumer domain; these needs will be designed for and exploited by, the MaaS Provider:

- **Travellers:** Six traveller types² have been identified e.g. the 'Urban Rider' to demonstrate the variation in personal mobility need.
- **Freight:** These are customers using MaaS to send and receive goods.
- **National and local government:** A key customer in terms of MaaS helping them achieve policy objectives and providing travel pattern insight. The public sector may also be a customer in terms of procuring specific MaaS capabilities.



As well as mobility needs, the following 'lifestyle' requirements that could be supported by MaaS were identified:

- 'Ease of payment' and multi-modal and real-time travel information.
- Value propositions that meet sharing economy needs e.g. carsharing and ridesharing.
- A number of other lifestyle 'added-value' propositions that may not be closely associated with mobility needs may be designed, for example media entertainment packages for use whilst travelling, or restaurant to home, food delivery.

Business requirements need to be understood and supported to create a robust MaaS marketplace. Business stakeholders also facilitate the needs of policy makers seeking to shape the way MaaS is delivered. Stakeholder workshops were used to uncover twelve capabilities and requirements that may affect the ability of business to deliver MaaS.

BUSINESS		
Cost Model	Product/Service Development	Customer Service
Business Plan	Funding	Piloting
Intellectual Property	Partner SLA/KPI	Risk
Market	Sharing Economy	Profit

The roles of policy and regulation are important as they can shape how MaaS meets the needs of society. Stakeholder workshops were used to uncover eighteen indicative policy areas that could be used to affect how MaaS is delivered.

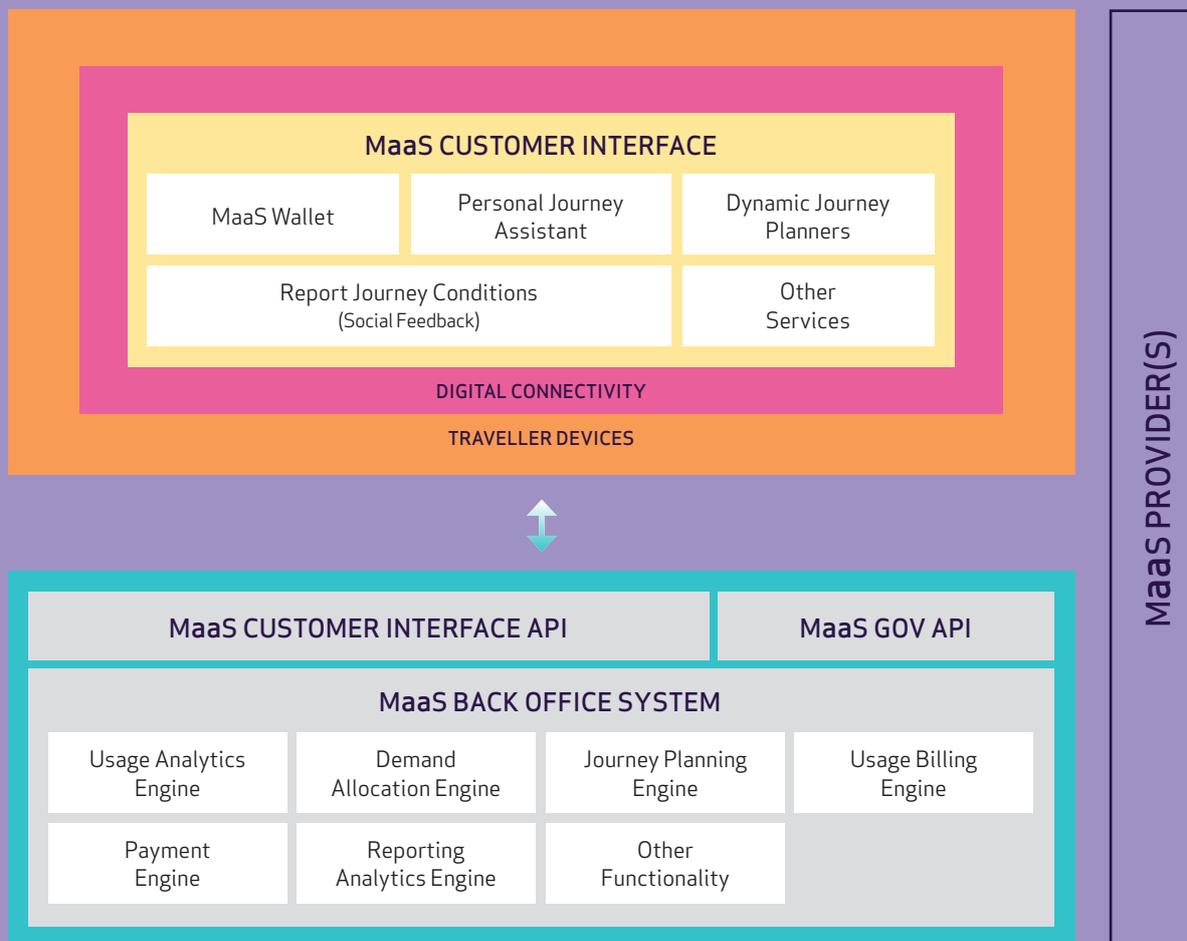
These policy areas can be made effective through political leadership tactics such as regulation, incentivising, negotiation, facilitation and collaboration.

POLICY AND REGULATION		
Local MaaS Regulation	Open Data/Open Source Policy	Tax Relief for Workplaces
MaaS Procurement Framework	Fiscal Savings	Buses Bill
MaaS Provider Licensing	Long Term MaaS Government Policy	Unions
MaaS Funding	Tax Relief for Travellers	Mobility Operators Licensing
Ticket Reselling Regulation	Social Inclusion Policy	Passenger Rights Regulation
Highway Regulation	Employee Rights	Investor Incentives

TRANSPORT OPERATOR, DATA PROVIDER AND MaaS PROVIDER RELATIONSHIPS

At the centre of the architecture are the actors that make MaaS feasible, tangible and visible in terms of its technical functionality e.g. transport services and data transfer, and its outputs e.g. the customer facing MaaS interface and its features.

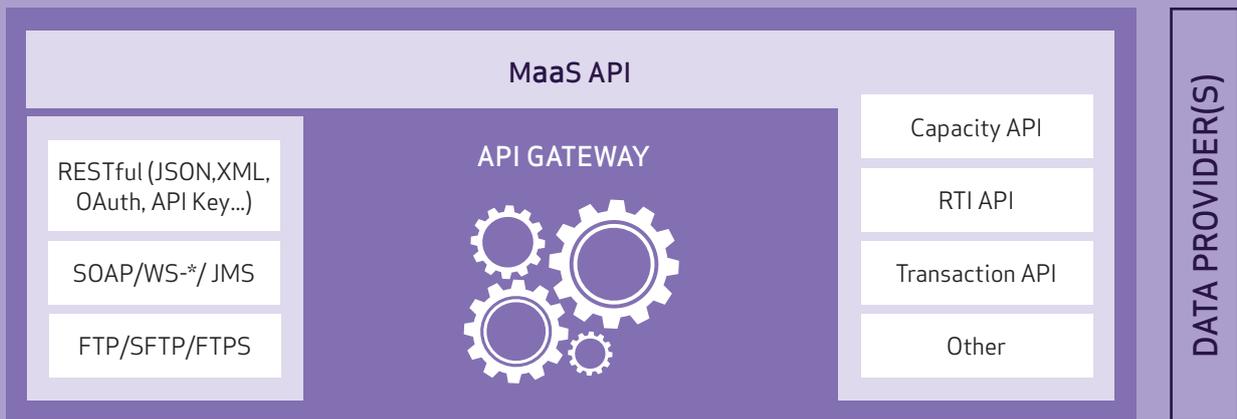
The requirements and capabilities relevant to the MaaS Provider, Data Provider and Transport Operator are described below.



The MaaS Provider develops a customer interface that will be provided through an appropriate device (notably a smartphone app in the short term).

The Customer Interface provides the communication link with the customer and supplies a range of features that support the value proposition. These features may include providing the customer with the ability to purchase mobility, receive personalised and contextualised information on which to make real-time travel decisions and allow customers to provide feedback to the MaaS Provider. The Customer Interface may provide additional benefits to meet other lifestyle requirements.

Data flow between the Customer Interface and the Back Office System is enabled. This can provide journey planning, transaction and payment, billing and usage information. Intelligence designed for the customer is made accessible via the Customer Interface. In the case of the customer being the local highway authority, this could be via an appropriate reporting ITS 'dashboard'.



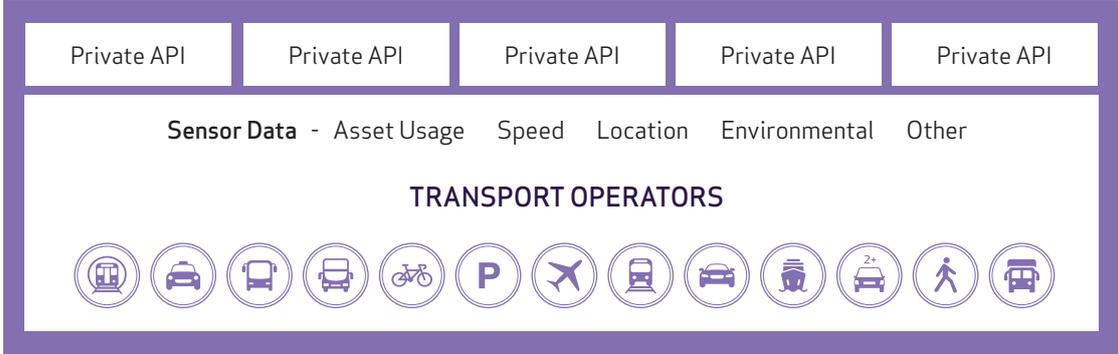
The Data Provider offers data and analytics capabilities. This includes processing, repackaging and publishing data from a range of sources including open data and private data.

The data sources will vary depending on the requirements of the MaaS Provider but are likely to include the following:

- the available route(s)
- data on where customers can access / egress Transport Operator assets and services
- pricing information
- MaaS customer transaction validation
- real time asset/vehicle position
- asset characteristics
- asset usage by customers

The Transport Operators provide capacity and access to mobility assets. Transport Operators can include traditional public transport operators, airlines, highway authority assets, freight carriers, parking operators, electric vehicle charging infrastructure owners and petrol filling station owners. Individual citizens who wish to share their own vehicles by offering them as a service through the MaaS Provider are also considered with this category.

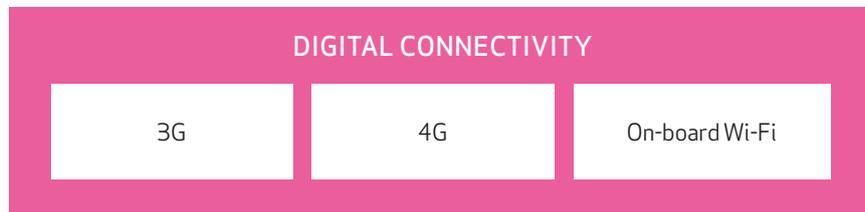
The Transport Operators share (via API) data collected from a range of sources, including potentially crowdsourcing activities. Transport Operators may choose to install sensors to meet the requirements of the Data Provider and MaaS Provider.



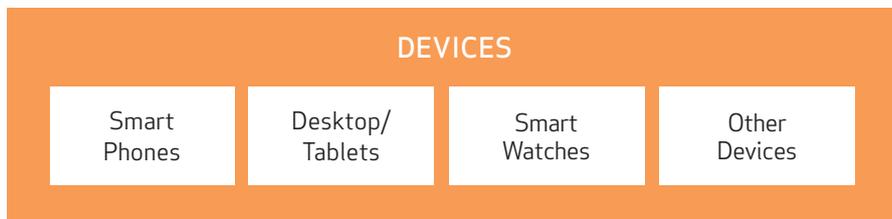
TECHNOLOGY AND INFORMATION RELATIONSHIPS

On the right of the architecture are the digital actors, which are central to the growth of the digital economy and provide the technological foundation without which the MaaS innovation will be constrained. These digital actors are managed through ICT industry proven methodologies for System Governance and System Security, against which MaaS should operate.

Internet connectivity is central to any MaaS solution as it enables information to flow to consumers in real-time. 3G/4G and Wi-Fi are just some of the connectivity capabilities that will support MaaS growth but other types of digital connectivity should also be considered. The geographical coverage of digital connectivity is a key enabler of MaaS.



In the short term the customer-facing component of a MaaS solution is assumed to be the MaaS Customer app. In order to ensure that all consumers can be serviced, the app will need to function across a range of popular devices such as smart phones, tablets and smart watches.



A number of mobility related data standards and specifications exist. These standards are openly available and have been used by the national and international transport industry to ensure interoperability across systems.

The MaaS reference architecture highlights a number of these standards as well as several openly accessible data APIs. It is envisaged that open data will be processed by the Data Provider to support the needs of the MaaS Provider.

DATA AND INFORMATION STANDARDS		
Bus	Cycle	Stations
TransXChange	CycleNetXhange	NaPTAN
Localities	Train	Multimodal
NPTG	NRE	TFL Unified API
Other Data		
Journey Planning	Transport	Transport
JourneyWeb	CEN	ISO
Smart Payment	Road	Transport
Various	Datex II	UTMC
Other Standards		

4. OPPORTUNITIES FOR MaaS INNOVATION

MaaS is an example of a service business model that is supported by the growth in smartphone penetration. It is a digital, data driven service that uses a number of technology capabilities that are associated with Intelligent Mobility innovation.

The consumer market supports the digital requirements of MaaS: a recent study shows that 57% of respondents would not mind sharing their personal data in order to get a better transport service and approximately half of smartphone users already consider the smartphone as essential to their travel experience³.

The UK marketplace for MaaS is estimated as being worth £billions per year⁴. MaaS has the potential to make a significant contribution to the UK service sector, by generating jobs and economic growth. This growth will be driven by new business opportunities that will support our mobility and lifestyle needs.

Although there are a number of challenges that may constrain MaaS innovation, we anticipate that private sector investment will continue to support a MaaS marketplace.

This chapter considers the opportunities facing MaaS investors and some of the challenges facing innovation in the market.

DRIVERS OF INVESTMENT IN MaaS INNOVATION

The average household spend on mobility is over £300/month⁵. This is a large market for MaaS investors to exploit. Growth of MaaS could cause the redistribution of current mobility expenditure or generate new expenditure from consumers demanding new services associated with their mobility needs.

Figure 7 illustrates the addressable value pools associated with private and public sector spend on mobility assets and services in the UK; MaaS can affect all of these value pools that are considered to be worth £billions to the economy. The global market for MaaS is estimated to be in the £trillions⁶.

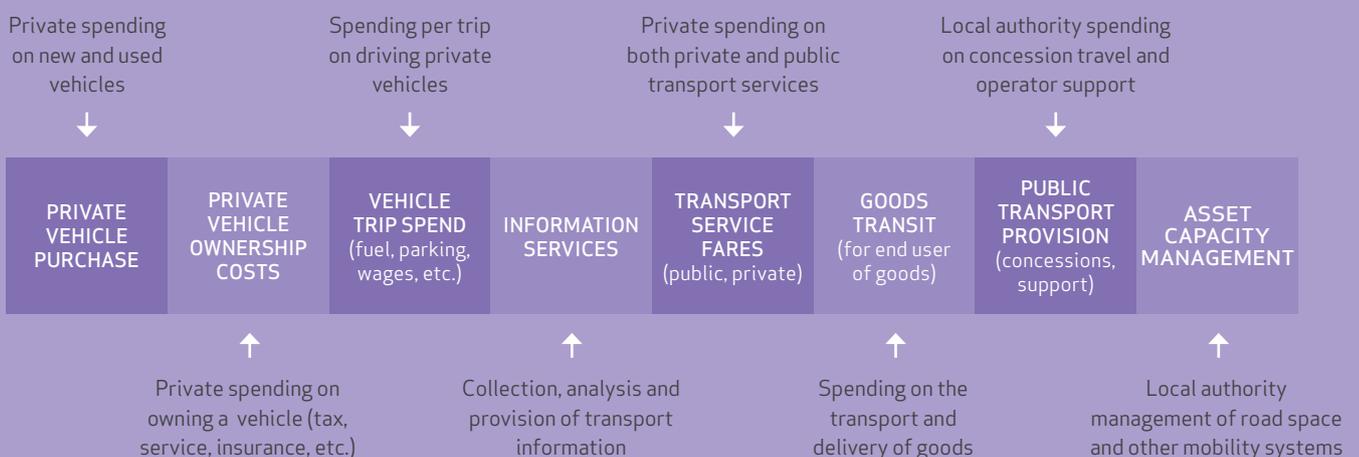


FIGURE 7: Value pools associated with MaaS

A key opportunity for MaaS Providers to attract customers is to remove the pain points that travellers face during their journeys. There are many types of frustrations faced by different types of travellers, these are summarised in the Table 4⁷. A recent survey suggested that 75% of journeys have pain points and that there are 4.3billion journeys where parking is an issue. In terms of public transport users, 20% consider the lack of personal space is a problem⁸. Each pain point and issue represents an opportunity for MaaS Providers to offer a solution to attract customers.

	PROGRESSIVE METROPOLITES	URBAN RIDER	LOCAL DRIVER	DEPENDANT PASSENGER	DEFAULT MOTORIST
TRAVELLER FRUSTRATIONS	<ul style="list-style-type: none"> • Affordability • Late trains and buses • Rush hour • Parking • Reliable data connectivity 	<ul style="list-style-type: none"> • Buses take too long • Need more bus routes • Taxis are expensive • Lack of flexibility 	<ul style="list-style-type: none"> • Lack of practical public transport • Long journeys • Rush hour traffic • Expensive parking • Public transport inflexibility 	<ul style="list-style-type: none"> • Unavailability of drivers • Unreliable buses • Lack of bus routes • Walking long distances • Lack of support during journey • Lack of flexibility 	<ul style="list-style-type: none"> • Rush hour traffic • Cost of fuel • Parking • Wasting time • Delays

TABLE 4: Traveller Needs personae and their travel frustrations

As well as the MaaS Providers selling a service that addresses the above pain points, there are two further areas that could be exploited to gain MaaS customer revenues⁹:

- enhancing the customer’s end-to-end travel experience by supporting them at every stage of the journey.
- enabling better lifestyles by managing the customer’s need to travel as 31% (19billion) journeys would not have been started, if alternative means were available.

Looking at which parts of the consumer market are likely to be the early adopters of MaaS offers, there is emerging evidence that consumer demand from the millennials generation, is growing¹⁰, for example:

- 43% expect to be provided with transportation options based on their immediate preferences (e.g. routes for good weather, bad weather, most cost efficient, etc.)
- 38% want lifestyle information (e.g. weather, social media, travel, etc.) via one interface.
- 36% want information to enable their lifestyle (e.g. retail, events, other commuters’ social network profiles, etc.)

For a significant proportion of the consumer market, the ability for MaaS Providers to offer value propositions that are more attractive to consumers, may be challenging. However, given the size of the mobility market and diversity in consumer travel requirements, there is significant potential for the MaaS Provider to attract customers (reference Figure 8).

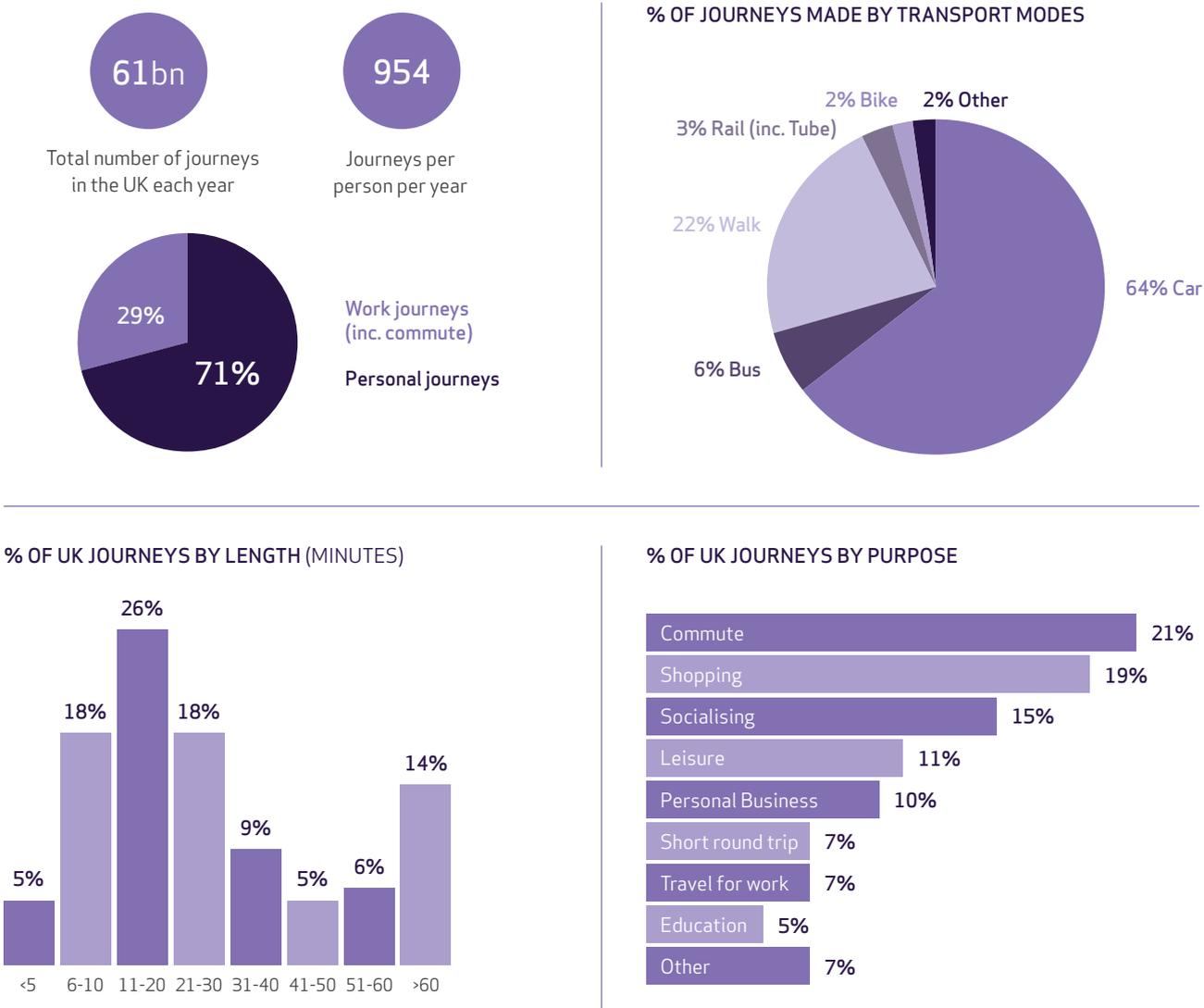


FIGURE 8: Diversity of journeys in the mobility marketplace

Given the dominance of consumer demand for car travel, automotive OEMs are considering how they can innovate using MaaS. There have been recent acquisitions of a number carshare companies that provide shared mobility¹¹ and consumer preferences for ‘access over ownership’ models may become more widespread.

The efforts of the automotive OEMs and public transport operators to provide MaaS may be complemented by new entrants from outside the transport sector. For example, telecoms, retail and media organisations with a strong track record in service provision and access to a large customer base may invest in MaaS.

MaaS Global

MaaS Global serves as an operator between transport services providers, users and third parties. It will combine all the existing transport services into a single mobile application on the 'single-ticket principle' and offer personalised transport plans tailored to customer needs.



“ We are driving innovation in every part of our business to be both a product and mobility company – and, ultimately, to change the way the world moves just as our founder Henry Ford did 111 years ago. ”

TRENDS SUPPORTING MaaS GROWTH

There are several trends that may support MaaS growth, these can be summarised into three main themes:

1. Consumer expectations: consumers are increasingly expecting their experiences in transport and other sectors to be delivered as a 'service' and are looking to get more value as a result.
2. Technology change: the opening up of transport datasets has already added significant value to travellers in terms of new applications. As a result of the Internet of Things, transport data will become more pervasive. Combining big data with new autonomous transport systems will enable opportunities to innovate and refine MaaS offerings.
3. Changes in mobility consumption: younger people, who are the most likely to adopt new mobility models, are increasingly deciding to not own cars. Transport authorities are looking to new technology platforms to help them manage the use of their assets.

Further context on the above trends is provided in Table 5.

	TREND	DESCRIPTION
CONSUMER EXPECTATIONS	Better interchange is expected by consumers	Interchanges between transport modes are significant pain points ¹² . There is an increasing focus on the whole journey experience and for better interchange for travellers ¹³ .
	Demand for the Sharing Economy is growing	The carsharing market is predicted to have a compound annual growth rate of 23% between 2013 and 2025 ¹⁴ .
	Demand for the 'as a service' Economy is growing	The growth of service-based platforms in other sectors has been strong in recent years, with industry analysts predicting further growth. Notable examples include Spotify, Netflix, and Amazon Prime. The fact that many cars are parked for over 90% of the time ¹⁵ may provide an opportunity for the 'as a service' model to offer consumers better value than offered by the car ownership model.
TECHNOLOGY CHANGE	Information Ubiquity	The availability of transport data as 'open data' has already delivered significant value, estimated at £58 million in London alone ¹⁶ . Internet of Things may accelerate the growth of the data pool that can be exploited by MaaS.
	Automation	Autonomous vehicles are expected to become increasingly common. Such vehicles could be integrated into MaaS and offered to customers as a service.
	Appetite of Early Adopters	Driven by a desire to be first to market and facilitated by enhanced connectivity and lower barriers to access, platform developers are offering their products to market at beta and pre-beta stages. This is fuelling early adoption of new services by specific customer segments and this can support the fast growth of new MaaS value propositions.
MOBILITY CONSUMPTION	Demand for car ownership	Whilst vehicle ownership is still dominant, attitudes to car ownership are shifting. In the UK, this is particularly pronounced amongst younger people, where the percentage of under 20s owning a driving licence has decreased by 40% since 1995 ¹⁷ .
	Congestion Crunch	In the UK, road traffic is forecast to grow between 19% and 55% by 2040 from a 2010 base ¹⁸ . Population growth may exacerbate congestion in the future.
	Urbanisation	An increasing proportion of the global population is living in urban areas – currently estimated at 53% of the global population. MaaS capabilities in the UK could be exported internationally to support these urban mobility challenges.

TABLE 5: Summary of key trends supporting MaaS

EARLY STAGE RISKS FOR MaaS INVESTMENT

A key risk facing MaaS investment, is that there are few examples of profitable MaaS-style business models, operating at scale. For instance, early mobility experiments in Helsinki have not achieved desired financial results despite their popularity¹⁹. As the MaaS concept is still relatively new to consumers and the market is still in breakout stage, some degree of experimentation (and failure of business models) can be expected.

A significant risk to market innovation is the power of the Transport Operator incumbents. These stakeholders may show indifference to supporting MaaS growth if it means a change to long-established business models. However, attitudes to innovation are beginning to shift in the transport sector as there is evidence that new mobility models can lead to the increased use of public transport²⁰.

We are committed to being a market-leading public transport business with long-term growth prospects based on high-quality services and investment in innovation.

Stagecoach Group

Linked to the power of the incumbents are the risks associated with access to data and sharing of data. Whilst much work has been undertaken by Government to open up datasets, many datasets in the transport environment remain proprietary. This is a challenge for MaaS Providers wishing to utilise such data to provide a service platform²¹.

It is not known if MaaS will change the travel behaviour of citizens. If change results in negative consequences, for example changes to the accessibility of transport services, there is a risk that policy interventions will be used to address market failure. A further policy related risk that could affect markets is that UK MaaS policies may be required to align with emerging MaaS Policy from the EU²².

Our mission statement is 'Transportation as reliable as running water, everywhere, for everyone.'

Uber Technologies

5. MaaS AND TRANSPORT POLICY

The need to manage the impacts of mobility will remain a key focus for policy makers given the vital role that transport plays in our society and across our communities.

This chapter reviews how MaaS aligns to Department for Transport policy goals and how it could support other public sector policy developed by National and Local Government. It then considers some of the potential risks of MaaS growth that may need to be addressed by policy makers.

MaaS ALIGNMENT TO DEPARTMENT FOR TRANSPORT POLICY

The Department for Transport's (DfT) aim is to '...support the transport network that helps the UK's businesses and gets people and goods travelling around the country'. MaaS is considered to offer an opportunity to support the DfT's high-level policy commitments, namely: Boosting economic growth and opportunity, Building a One Nation Britain, Improving journeys, and Safe, Secure and Sustainable Transport.

The DfT's Single Departmental Plan (SPD) 2015-2020 outlines the progress made in supporting the Department's high-level policy commitments. The SPD's commitments cross a range of transport sector delivery areas and illustrate DfT's engagement in many initiatives that support the development of MaaS, albeit without explicit reference to MaaS (reference Table 6).

POLICY APPROACH	POLICY COMMITMENT	IMPACT ON MaaS DELIVERY
Getting the regulatory framework right	Deliver savings to businesses by cutting red tape and further deregulating the transport sector.	Private sector investment in MaaS innovation can be de-risked by regulation.
	Consult business on adapting regulation for innovation in the transport sector as part of our commitment to produce an innovation plan.	
Supporting the UK transport sector	Increase DfT procurement spend through small businesses.	SMEs currently operate within the MaaS supply chain and may benefit from further investment through DfT procurement.
Devolving powers	Be a key partner in delivering devolution deals and wider devolution.	Devolving responsibility to the regional local government authority level can support the pace and diversity of MaaS innovation.
	Reform the bus market.	Buses are an important asset to support mobility – the reform to the bus market can be designed to support MaaS.
	Establish Transport for the North as a statutory body with statutory duties to produce a long-term transport strategy for the North.	These regions is currently progressing MaaS innovation to support its Intelligent Mobility aspirations.
	Work in partnership with Midlands Connect to transform connectivity in the Midlands.	
Rolling out new technology and innovation on our transport networks	Supporting ticketing innovation.	Flexible ticketing and MaaS ‘transaction’ capabilities are a key area for further innovation in MaaS.
	Invest millions of pounds in fitting out trains with new Wi-Fi equipment.	Digital connectivity capabilities are a key area for further innovation in MaaS.
	Improve mobile phone signals to benefit passengers on trains.	
	Continue to roll out smart motorway technology and prepare our road infrastructure for the vehicle technologies of the future.	Intelligent Transport Systems (ITS) ‘smart’ technology and Connected and Autonomous Vehicles are key enablers of MaaS.
Supporting wider government objectives to protect the environment and public health	Ensure transport plays its part in delivering the government’s climate change obligations.	MaaS offers a new opportunity for policy makers to capture value from adjusting the consumer preferences to support a range of DfT and wider government objectives.
	Contribute to delivery of the national air quality plan.	

TABLE 6: DfT Policy and how it aligns to MaaS

MaaS ALIGNMENT WITH WIDER GOVERNMENT DEPARTMENT POLICY

As well as the ability of MaaS to directly support the objectives of DfT, the following Government Departments were identified through the study's workshops, as also potentially benefiting from the MaaS opportunity:

- Department of Health:
 - To support active lifestyle objectives – through engaging the travel behaviour change capabilities of MaaS.
 - Improving patient and NHS transport – through engaging with MaaS Providers to provide mobility for NHS related transport demand.
 - Reducing respiratory and air quality related health issues – through engaging with MaaS Providers to manage travel patterns in areas with poor air quality.
- Department for Business, Innovation and Skills:
 - Supporting innovation and growth, particularly in the sharing economy – through contributing to MaaS customer choice.
 - Supporting new markets for Connected and Autonomous Vehicles (CAV) – through using MaaS to manage CAV mobility supply.

Further research is required to examine the potential for cross-government collaboration on MaaS policy development.

MaaS CAN SUPPORT LOCAL GOVERNMENT POLICY

In line with the Government's devolution agenda, Regional and Local Authorities are empowered to innovate around the MaaS concept to deliver local policy benefits. A number of Authorities are already starting to deliver MaaS by developing strategies and designing real-life MaaS trials. Several MaaS trials with consumers are being developed through Innovate UK funding²³. These initial steps are important ones and help provide insight as to where policy changes may support MaaS growth.

From the Highway Authority perspective, a number of ways MaaS may support different policy areas were identified using stakeholder workshops:

- **Development Planning** - through the ability of MaaS to reduce the traffic impacts of new developments.
- **Social cohesion** - through MaaS facilitating the sharing economy, particularly through ridesharing and carsharing.
- **Partnership working** - the ability of MaaS to create new ways for authorities to work with their transport supply-chain.
- **Traffic Management** - the ability for MaaS to enable highway authorities to create a regulated market for allocating road space to the MaaS Providers who best meet highway authority requirements.

IS MaaS A RISK FOR POLICY MAKERS?

As well as the potential for MaaS to offer benefits to a range of stakeholders, there is a risk that MaaS growth could result in unintended negative impacts. These may include the greater use of car based transport, an increase in transport related carbon emissions, and a reduction in demand for public transport services. Additionally, in the longer term, the business models of existing transport operators may be forced to change and this could impact those employed in the passenger transport sector.

There is insufficient evidence available to appraise how MaaS growth will support the broad range of policy objectives held by Government, from social inclusion to economic growth. However, to design effective policy interventions, policy makers will benefit from engaging with the MaaS ecosystem to build a strong understanding of its economic, social and environmental costs and benefits.

There is a challenging balance to be found between developing policy that catalyses the MaaS marketplace, and at the same time planning for any negative impacts of MaaS should they occur.



6. HOW POLICY CAN SUPPORT MaaS GROWTH

MaaS has the potential to benefit policy makers and it aligns with existing transport policy goals. We have identified a number of ways policy makers can support MaaS growth. Without policy intervention, we believe that MaaS growth will be constrained.

This chapter considers the short-term barriers to MaaS growth and identifies policy interventions that could address them. It then reviews a number of future MaaS related policy challenges that may be considered by policy makers in the longer term, to shape MaaS growth.

THE BARRIERS TO MaaS GROWTH AND POTENTIAL INTERVENTIONS

Evidence that MaaS growth needs policy intervention, can be seen in the 'narrow' set of features provided by current MaaS offerings. For example, although several taxi service apps have gained customers by offering some of the features of MaaS such as easier transactions, they have not had an equivalent success in offering similar levels of service, for multi-modal journeys.

Our stakeholder workshops identified a number of barriers which may prevent the MaaS ecosystem from reaching its potential. The Figure 9 illustrates where these barriers exist in the MaaS ecosystem.

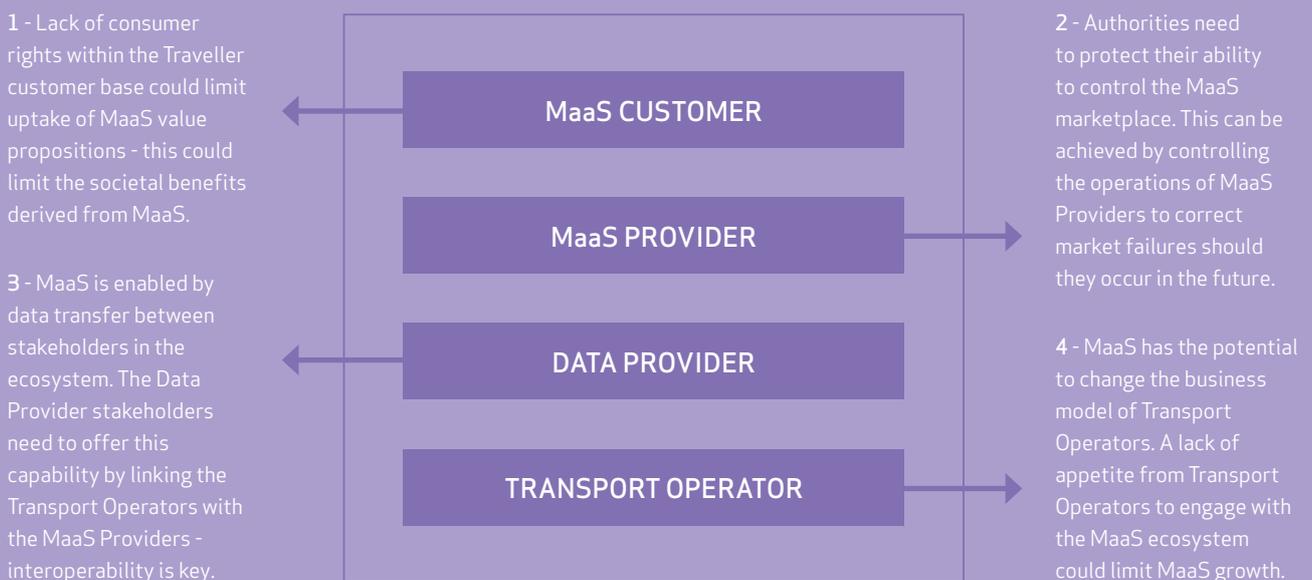


FIGURE 9: Barriers to MaaS growth in the ecosystem

We have identified potential policy interventions that could address the above barriers. The Table 7 references these against each actor in the MaaS ecosystem and provides the rationale for each intervention.

ACTOR	BARRIER	POLICY INTERVENTION RATIONALE AND GOAL
MaaS CUSTOMER	1(a) – Consumer Protection (ability to switch between MaaS Providers)	<p>The EU General Data Protection Regulation comes into force in 2018 and will include supporting “the right to data portability”. From a UK Government perspective, relevant Authorities should be empowered to enforce this requirement.</p> <p>The right to data portability can prevent anti-competitive outcomes that can occur if consumers perceive switching between MaaS Providers as being inconvenient. Without data portability, the rich insight e.g. traveller preference data which is used to personalise a MaaS Provider’s service for the customer, may not be transferred to a new MaaS Provider and will therefore have to be ‘relearned’.</p> <p>There are parallels with the Current Account Switch Service (CASS) that was backed by Government and designed to improve how the retail banking sector supported customers who wished to change their banking service provider.</p> <p>The goal of this policy intervention is to create a competitive MaaS Provider marketplace which supports innovation and greater value for consumers.</p>
	1(b) – Consumer Protection (right to service quality from the MaaS Provider)	<p>With the emergence of MaaS, consumers may enter into contracts with MaaS Providers for various mobility service levels (or value proposition ‘bundles’). The greater the financial commitment made by a MaaS customer, the greater the importance of protecting their consumer rights, should the MaaS Provider fail to honour their service level agreement.</p> <p>It is anticipated that the current commitments to customer service (for example Train Operating Company’s ‘delay repay’ schemes) will be adopted by MaaS Providers. However regulatory oversight can help ensure success in this area, particularly where a bundled service of multiple travel modes is purchased involving multiple transport operators to deliver an ‘end-to-end journey’ service level agreement for the customer.</p> <p>The goal of this policy intervention is to incentivise consumers to purchase services from MaaS Providers by limiting the risk of financial loss.</p>
MaaS PROVIDER	2 – Inability for Authorities address potential future market failures in the MaaS ecosystem	<p>The ability for policy makers to realise the MaaS vision, will be dependent on how they address market failure that could develop in the MaaS ecosystem. Policy such as licensing which is targeted at the MaaS Provider, may offer a level of control over the multiple stakeholders involved in other parts of the MaaS ecosystem. An alternative approach would be to support an accreditation programme for MaaS Providers (similar to ENCAP which seeks to highlight the best performing vehicles in terms of safety rating).</p> <p>The goal of this policy intervention is to enable effective control by Authorities over the MaaS ecosystem.</p>
DATA PROVIDER	3 – Lack of interoperability between the Data Provider and other stakeholders in the ecosystem	<p>Interoperability describes the extent to which the systems, infrastructure and devices used in the MaaS ecosystem, can exchange and interpret data.</p> <p>Policy makers can support the interoperability capabilities of the Data Provider stakeholders using a range of policy interventions including setting standards for data sharing and supporting effective collaboration between stakeholders.</p> <p>The goal of this policy intervention is to support the interoperability capabilities of the MaaS Providers.</p>
TRANSPORT OPERATOR	4(a) – Lack of appetite from Transport Operators to adjust their business model	<p>MaaS could change the relationship between the Transport Operator stakeholders and their customers by changing their business model from a Business to Consumer model to a Business to Business model as they support the servitisation requirements of the MaaS Provider.</p> <p>Policy makers can facilitate the engagement of Transport Operators with the MaaS opportunity using a range of interventions such as public transport service franchising regulations.</p> <p>The goal of this policy intervention is to successfully engage Transport Operators so that they benefit from the MaaS value chain.</p>
	4(b) – Lack of ability to provide the data requirements of the MaaS Provider	<p>MaaS Providers will require information on different attributes of the Transport Operator’s service e.g. customer transaction validation, real time vehicle position and vehicle asset characteristics.</p> <p>Each of the data requirements may require investment in new systems to be installed by Transport Operators. Policy makers may wish to incentivise investment in this area.</p> <p>The goal of this policy intervention is to support the Transport Operators in fulfilling the data and interoperability requirements of the MaaS Providers.</p>

TABLE 7: Policy interventions to address barriers to MaaS growth

FUTURE CHALLENGES FOR POLICY MAKERS

In the longer term, a number of other policy interventions may be required to address currently unanticipated market failures of MaaS. The study's consultation process with stakeholders, raised a wide range of complex questions that policy makers may consider as the MaaS marketplace matures. The questions provided through the consultation, have been matched to DfT's high-level policy goals but many can be considered at the regional and local government policy level.

BOOSTING ECONOMIC GROWTH AND OPPORTUNITY

Will MaaS be supported by stronger use of Open Data principles?

Will MaaS be used to provide more effective use of mobility capacity and to optimise investment in transport systems?

What is the right balance between fare payer and taxpayer investment, to release the economic benefits of MaaS?

SAFE, SECURE, SUSTAINABLE

To what extent can policy makers rely on citizens to only choose MaaS services that are safe?

Can MaaS offer an opportunity for the transport sector to achieve its carbon and other sustainability targets?

How will policy on Low Emission Vehicles be used to influence the choices of MaaS providers?

IMPROVING JOURNEYS

Will MaaS investment deliver against social inclusion, equality and accessibility policy objectives?

Should the quality of the MaaS customer experience be managed?

Will network capacity e.g. highway capacity be managed so as to support MaaS delivery?

EFFICIENCY AND TRANSFORMATION

Will MaaS pilots be supported through provision of funding?

Will knowledge sharing between stakeholders be facilitated to support MaaS growth?

How much should investment in MaaS capabilities be the responsibility of the private sector?

Will public transport franchising strategies to support the MaaS opportunity?

Will MaaS be acknowledged as an optimal long term solution to the 'predict and provide' challenge?

Will the benefits of MaaS be promoted to the consumer to foster public acceptance?

Will the Devolution Agenda stimulate greater efficiency in MaaS innovation?

How will the ability of MaaS to achieve cross-sector policy goals be managed?

Each of the above questions represents a challenge for transport policy makers and the way in which they are addressed will be dependent on building a greater understanding of the impacts of MaaS over time.

TABLE 8: Future challenges for UK MaaS Policy Makers

7. STRATEGIC CHOICES FOR MaaS GROWTH

If the stakeholders we consulted are proved correct, MaaS will have a significant impact on both our travel patterns and on the business models of our existing Transport Operators. The opportunities to be gained from technology advancement, the emergence of new MaaS business models and the devolution agenda, can be embraced by policy makers to support MaaS growth.

To realise these opportunities, policy makers must acknowledge the constraints of our current regulatory systems which limit how fast policy can react to changing market conditions. They must also consider how to optimise the effectiveness of their policy interventions to achieve the right outcomes.

This chapter uses scenario analysis to offer a high-level review of different strategies that policy makers could use to support MaaS growth and shape its outcomes.



POTENTIAL MaaS GROWTH SCENARIOS – CONSTRAINED AND HIGH GROWTH

To support further analysis, we have identified two MaaS growth scenarios against which different outcomes can be considered by policy makers:

- **Constrained growth:** this scenario is characterised by marginal changes to MaaS related policy. It is characterised by devolved responsibility for delivery of MaaS, through the devolution agenda. Low levels of MaaS growth will result from the funding of MaaS pilots and through public sector procurement of specified MaaS ‘solutions’ from private sector providers.
- **High growth:** this strategy is characterised by a highly interventionist policy approach led by Government. The strategy will engage regional and local government. Local Highway Authorities will become a key stakeholder in supporting MaaS growth. All of the policy interventions that address MaaS barriers are delivered and this results in a resilient world class MaaS ecosystem that engages consumers from across society. We have identified two potential strategies that policy makers could take to achieve this level of MaaS growth:
 - **A private sector ‘partner’ focus:** whereby policy makers collaborate with specific private sector stakeholders to understand their requirements for building MaaS business models. This will involve addressing the barriers to MaaS growth using a targeted mix of national and regional policy intervention. Policy makers will target resources where there is a demonstrable need. For example, to enable MaaS Providers in a specific city to sell public transport capacity provided by local Bus and Rail operators. There would be a highly iterative and data driven approach to policy making, to ensure policy interventions remain effective.
 - **A ‘whole ecosystem’ focus:** this approach is characterised by policy makers taking a strong lead in creating a highly competitive and robust marketplace at all levels of the MaaS ecosystem. This supply-led focus would require significantly more resource than the ‘private sector partner focus’ approach. For example, nationally all transport operators would be made ‘MaaS ready’ and a highly competitive market in the Data Provider and MaaS Provider levels of the ecosystem would be supported. The objective would be to build a MaaS ecosystem from first principles to ensure that MaaS supports as many cross departmental goals as possible e.g. job creation and active lifestyles. This would be achieved through cross-departmental collaboration and central government would be at the centre of the MaaS industry and a key stakeholder in its ongoing success.

The above scenarios are illustrated in Figure 10 which illustrates the policy interventions that could be used by policy makers to shape how MaaS grows.



FIGURE 10: Potential policy interventions used to achieve different MaaS growth scenarios

In the high growth scenarios, the private sector is considered to start launching a range of different MaaS value propositions, extending from direct mobility services, to wider lifestyle services overtime.

POTENTIAL OUTCOMES FROM MaaS GROWTH

A key question for policy makers is ‘what type of MaaS’ do they want to see offered and used by consumers? Our analysis identified two potential outcomes that could result as the MaaS marketplace matures. Of course in reality there is likely to be a range of different outcomes that face policy makers.

One outcome is the scenario where MaaS Providers offer consumers a service focused on car vehicle transport e.g. taxi, carshare and rideshare. The other outcome is a scenario where consumers are offered a fully multi-modal service that involves the use of passenger service vehicles, and other traditional public transport modes, as well as the services offered in the ‘car focus’ scenario. It is considered that the multi-modal scenario addresses many of the Intelligent Mobility (IM) challenges identified in the Figure 11; we refer to this scenario as the ‘IM’ vision scenario.

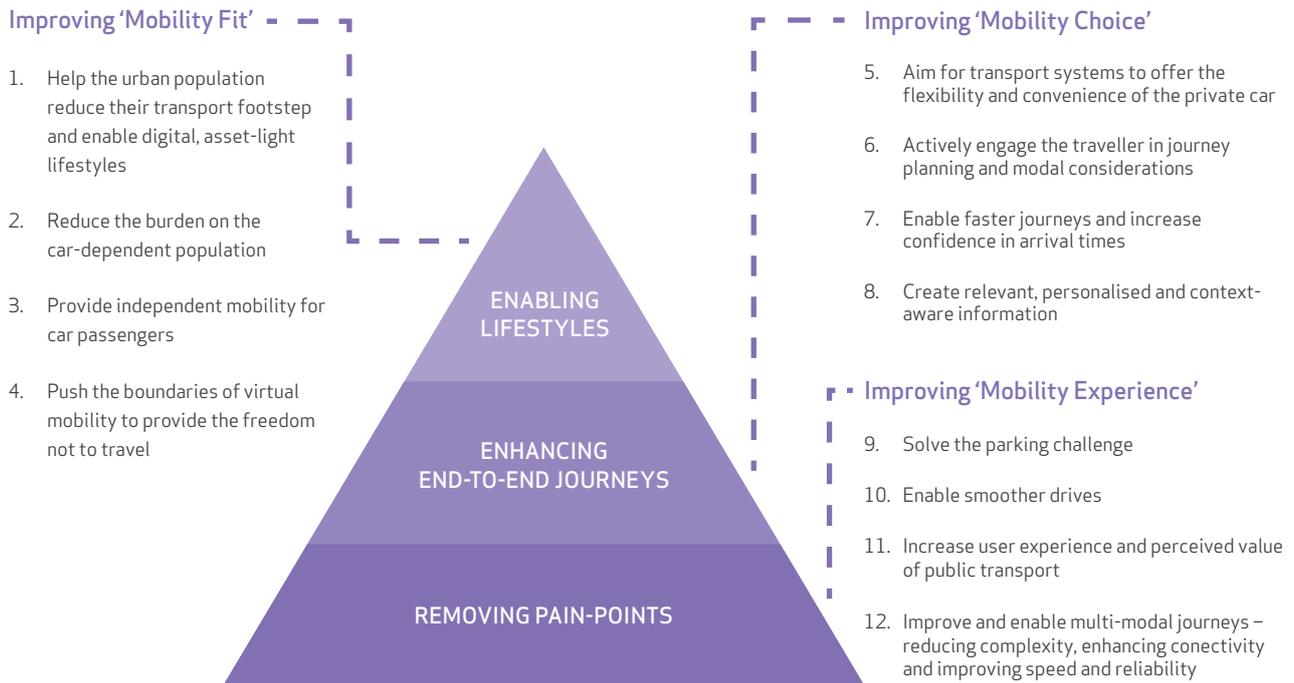


FIGURE 11: The Traveller Needs Capability Challenges

The Figure 12 illustrates how the diversity in MaaS value propositions will need to increase to address the IM challenges.

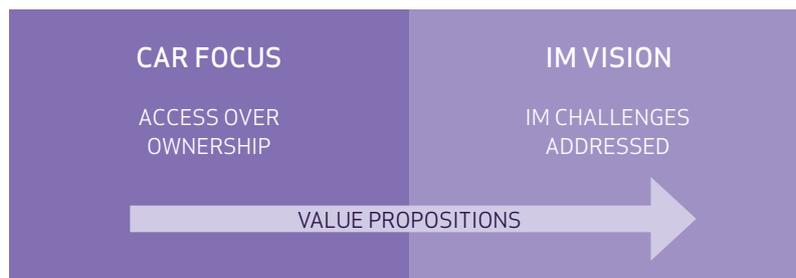


FIGURE 12: Car focus and Intelligent Mobility vision outcomes

POTENTIAL PATHWAYS FOR ACHIEVING MaaS OUTCOMES

The MaaS growth scenarios can be used to map potential pathways to achieving MaaS growth outcomes. The Figure 13 illustrates our assessment; a description of each of the five growth pathways (A to E) is provided.

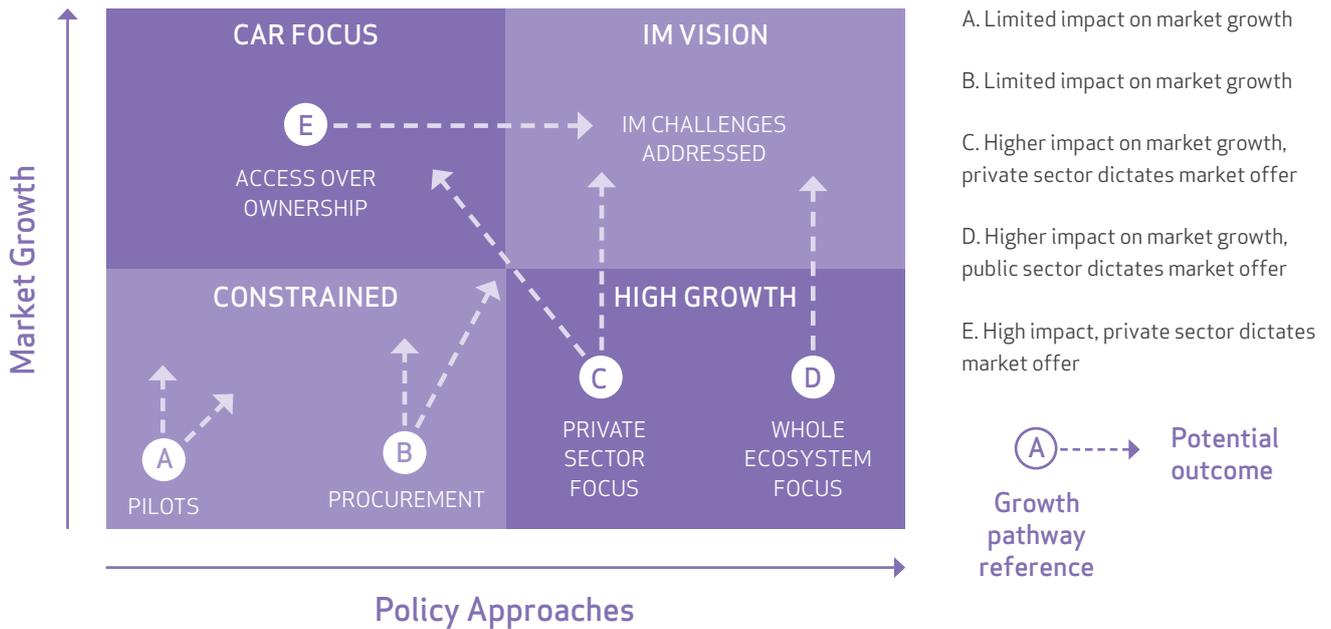
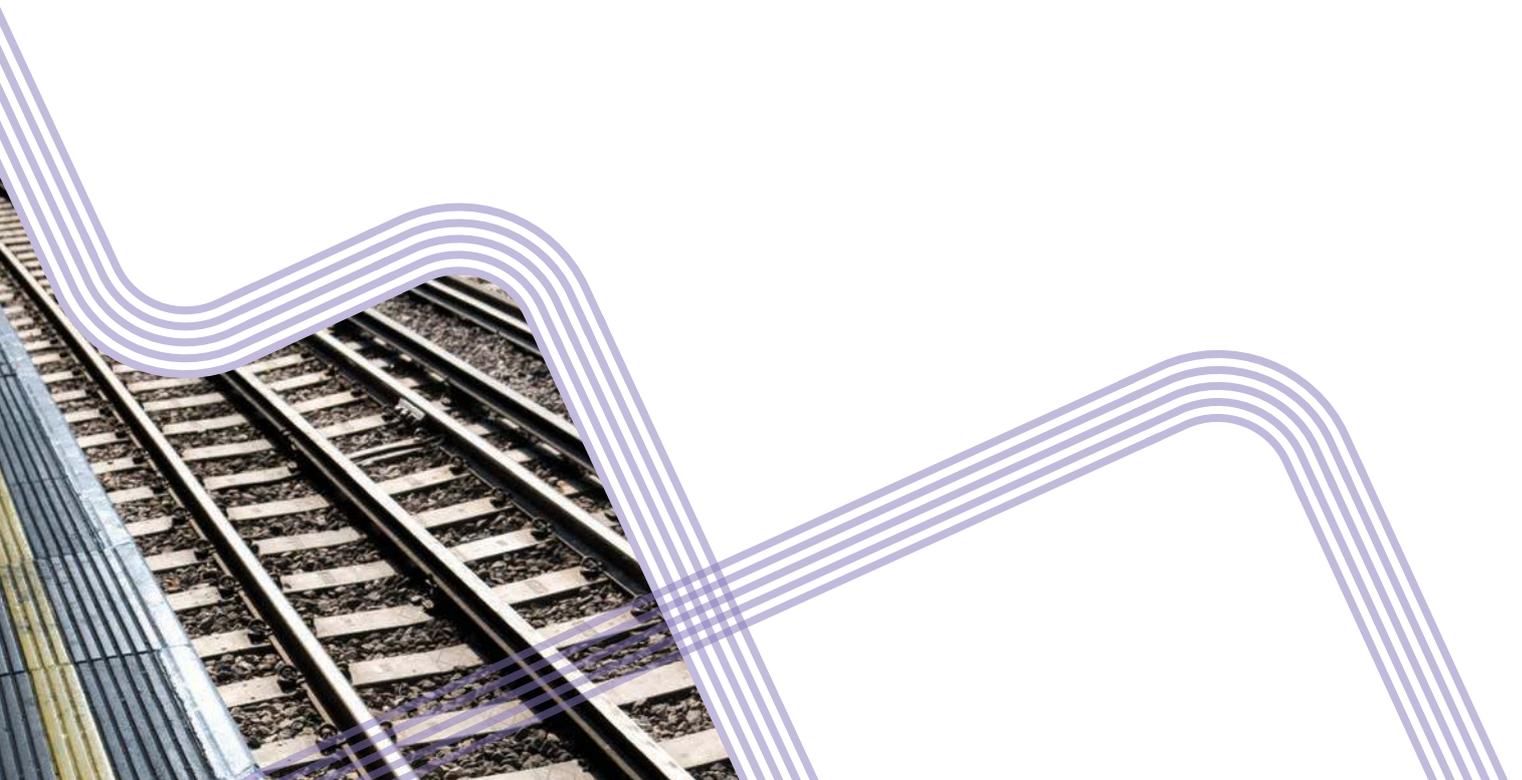


FIGURE 13: Potential growth pathways from different policy approaches



THE CONSTRAINED GROWTH SCENARIO

MaaS pilots and MaaS procurement are central to the success of this scenario. The use of pilots to support incremental growth is represented by **Point A** where it is assumed that high levels of consumer uptake are not attained. However, the value in pilots will be to de-risk future MaaS investment through testing MaaS technology and business model requirements and examining how they can scale. Pilots will help stakeholders develop shared mobility and multi-modal value propositions and support a greater understanding of customer adoption rates. Collaborative working relationships between the private and public sector are fostered.

Point B in the Figure 13 illustrates the potential value of effective MaaS procurement. This could take the form of a Local Authority procuring a MaaS 'solution' from a private sector provider. It is assumed that authorities will seek to engage the MaaS ecosystem so that public transport remains central to the solution to support transport policy objectives e.g. reduction in traffic congestion. Using procurement to grow MaaS will be challenging for the funder. They risk contract 'lock-in' following procurement and there is a lack of future market insight and uncertainty over the resilience of tendered MaaS business models. Additionally, there are challenges to incentivising the MaaS supplier to innovate within the contracted service period. Open innovation approaches can help address this risk to a degree, but procured MaaS solutions may prevent new entrants from competing in the market to bring greater choice to consumers.

THE HIGH GROWTH SCENARIO

Looking at the High Growth scenario, **Point C** represents the ability for policy makers to grow MaaS by supporting the private sector. A range of car vehicle based MaaS solutions, or a more balanced value proposition that includes public transport services for consumers will be provided. The ability for policy makers to be agile and effective in how they attract private sector investment whilst also meeting the objectives of their MaaS vision is a key challenge. This scenario would result in MaaS happening at a national and regional level using private sector investment.

Point D represents the aspiration of policy makers to achieve the MaaS Intelligent Mobility (IM) vision by taking a strong lead on developing all parts of the MaaS value chain. This scenario is considered to be more effective than using pilots or procurement to support the MaaS marketplace. However, it may only be as effective as the private sector scenario (**Point C**), in terms of attracting customers to use MaaS.

Point E illustrates the potential for the private sector to lead MaaS growth so that it achieves the 'Intelligent Mobility' vision from a starting point of 'car focus'. In this scenario, businesses build on their near-term shared mobility value propositions to offer consumers greater levels of multi-modality for a wide range of journeys. This could be a result of shared mobility services reaching a critical mass, so that multi-vehicle households begin reducing the number of cars they own. Other households may sell their car and choose to travel solely using MaaS.

8. SUMMARY OF KEY FINDINGS

Global interest in Mobility as a Service (MaaS) is growing and the concept is gaining the attention of the UK public and private sectors. MaaS offers an opportunity to improve how people and goods move, both from the perspective of the policy maker and for travellers themselves.

We have defined MaaS as using a digital interface to source and manage the provision of a transport related service(s) which meets the mobility requirements of a customer. This definition seeks to encapsulate the vision of a MaaS Provider offering any type of travel experience using any type of transport service, public or private. Innovation is expected to lead to new MaaS offers for the consumer. Market conditions will shape which MaaS offers are made available.

Delivering MaaS presents a considerable scope of change for stakeholders in the MaaS ecosystem. Policy makers have an opportunity to shape how the MaaS marketplace grows. We have identified the following key findings that can be considered by policy makers when examining the MaaS opportunity:

MaaS could change our travel behaviour

- The impact of MaaS is unknown. MaaS could result in more journeys and distances travelled by car, or potentially less; it could support national and local transport policy or challenge it – further research is needed.
- MaaS offers the potential to address many of the transport challenges facing society by engaging new business models and technology – it offers policy makers an opportunity for achieving travel behaviour change and managing travel demand.

MaaS could change the transport sector

- Existing transport operators face significant opportunities but also threats from MaaS growth. Transport operators may move away from a business to consumer model, to focusing on supplying transport capacity directly to MaaS Providers.
- MaaS has the potential to provide transport authorities with rich data to help optimise how they manage transport systems and networks.

MaaS growth could benefit from policy intervention

- There are significant barriers that are preventing MaaS growth and policy interventions may be required to address them.
- The benefits of MaaS success are compelling and there are many potential pathways for policy makers to engage the private sector, to achieve desired MaaS outcomes.
- MaaS value propositions can be developed to suit a range of target customers, however the private sector may develop business models that do not align with existing policy goals.

GLOSSARY

API (Application Programme Interface): A set of procedures and tools for building software applications that interact with the features or data of another application or operating system.

Bundle: A set of services sold together to increase value to the consumer that adds value as a supplement to the original service.

Carshare: The practice of sharing access to and use of a car vehicle for travel purposes.

CAV (Connected and Autonomous Vehicles): Connected vehicles use communication technology to interact with the driver, other cars on the road, the infrastructure and the 'Cloud' and autonomous vehicles are self-driving.

Devolution Agenda: A proposal for the strengthening of local government to improve local economies and public services.

DfT (Department for Transport): Responsible for transport network and transport issues in the UK.

Ecosystem: A complex system or network of interconnected components.

ENCAP (The European New Car Assessment Programme): A five-star safety system applied to testing the safety of European cars.

Innovate UK: The UK's innovation agency that collaborates with companies and people to drive scientific and technological innovation.

Intelligent Mobility: Using technology and data to create connections between people, places and goods across all modes of transport.

ITS (Intelligent Transport Systems): The interaction of Information Technology and Telecommunications to enable information to be used by the public and through private administration, that is applied to transport.

Multi-modal: A combination of the use of different modes of transport in one trip.

MaaS Provider: Stakeholder that designs and offers the MaaS value proposition.

Data Provider Acts: Stakeholder that acts as a data broker.

Transport Operator: Stakeholder that provides transport assets and services.

OEM (Original Equipment Manufacturer): This is a company that makes products that are used as parts in another company's product.

Reference Architecture: A reference model that describes the division of capabilities and functions within in a system.

Rideshare: The act of people sharing transportation to reduce the number of vehicles used.

Customer Segment: Referring to a particular section of a wide customer base that has been divided based on characteristics such as age or gender.

Servitisation: The idea of aggregating products or services that adds value as a supplement to the original product or service.

Sharing economy: A model of peer-to-peer sharing to access a range of goods and services.

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