

Mobility as a Service:

Early implementations in the UK

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Abstract

Mobility as a Service, MaaS, has been developing at a pace across Europe. While engaged in an InnovateUK project, MotionHub, to implement a MaaS scheme in a municipality in the South East England, the authors began to ask two fundamental questions; what is MaaS and to what extent is it materialising in the UK. From the experience of MotionHub, it is clear that UK implementations would be slow.

Combining a number of web-based services and amalgamating their financial transactions is relatively straightforward. However, introducing the potential for public transport ticketing as well raises additional security, scale and financial constraints. Motion Hub has engaged with major players and regulators across the public transport industry. In its latter stages project was rolled out to the public. The various individual services became available from the single website via one membership application and the use of a single card.

Other MaaS styled initiatives have been reviewed and it appears that there are just five other MaaS projects being trialled concurrently with MotionHub that provide journey planning and single point ticket purchase for multimodal journeys. A number of other initiatives provide just some aspects of MaaS.

The project has also reviewed customer perceptions, suitability of various types of town to MaaS initiatives and the varying enthusiasm amongst local government officials. From these reviews it is clear that the MaaS uptake will be slow.

However, reflecting on the theoretical discussions about MaaS, there appears to be a significant gap between theory and practice. In particular of the claimed benefits of decongestion and reduced pollution seem to be some way off in the future. This is not a criticism of MotionHub and the other implementations, some of which are substantial investments. It is acknowledgement that the goal of seamless adaptive travel is an extremely ambitious one.

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Introduction

Outline of the transport problem

The problems on 21st Century roads in the developed world can be summarised as congestion and with it pollution, travelling times, highway growth, EV charging infrastructure and parking.

Solutions that have been tried around the world are enhanced forms of public transport, car sharing and bike sharing. More recently work has gone on in the fields of Autonomous vehicles and Mobility as a Service.

Mobility as a Service, MaaS, can be defined succinctly as a mobility distribution model that delivers users' transport needs through a single interface of a service provider (Hietanen, 2014). The technology is emphasised by identifying the similarity with telecommunications (Cox N.C.J., 2015) and the idea that service be integrated through internet connections.

The MaaS Service is seen also as a Mobility Aggregator that seamlessly combines a number of transportation modes so allowing the user to plan a journey and purchase all the parts through a single payment via a smartphone app (Holmberg P.-E., 2016, CIVITAS, 2016). The actual services themselves may well be framed around the user's preferences through collaborative customisation and personalisation (Hietanen, 2014, Kamagianni M., 2017).

Early studies have identified the need for any MaaS scheme to be recognised as an added value service and be measured by its quality of service (Ambrosino G, 2016) and the need

for designers to take on board the geographical, cultural and climate differences without losing focus on the people (Ison, 2016). Giesecke has set out a four step model for MaaS:(Giesecke R, 2016).

- The transport offer needs to be clearly specified. It should be applicable to both short and long distances using a variety of means in a smart way.
- The end users need to be able to save costs whilst experiencing an improved level of convenience in terms of accessibility, directness and comfort.
- MaaS needs to include existing offers such as public transport, car and bike sharing and taxi services on demand. IT linkage is of most importance. Availability of real time data and traffic control allows operators to implement modal preferences online
- MaaS needs to be as sustainable as possible - in both the environmental sense it reduce congestions and improve air quality and in the economic sense. It must add value with a reduced income from users (2018).

Jittrapirom (2017) adds the degree of personalisation as a design differentiator between competing schemes.

Background to the MotionHub Project

This paper has developed out of an InnovateUK project run from 2016 to 2018 in the East of England. MotionHub was set up as a demonstration of Mobility as a Service. From its feasibility study in 2014 four specific four specific learning points were taken forward into the Motion Hub project. (Fenner, 2014).The first was single card access. Whilst there might be a number of different services making up the Mobility-as-a-Service offering at MotionHub, the user would need to be aware of a single provider, requiring a single transaction.

Secondly the level of detail embodied in the feasibility study set the criteria for selecting a suitable software supplier to work on the MotionHub website and back office. Of particular importance was the need to integrate a set of disparate web based services, the most complex of these being those associated with public transport.

Thirdly, there was a clear need for much wider stakeholder involvement. Hence the Transport Systems catapult was asked to join the Motion Hub Consortium. The final point was that the software would need to have a degree of flexibility so that the progress of the development could be staged and modified to compensate for other constraints.

During the feasibility stage the following partners and suppliers were identified; first the project partners, E-Car Club Ltd, Southend on Sea Borough Council, EValu8 Transport Innovations Limited (activity and staff subsequently moved to UH Ventures Limited), HourBike and Transport Systems Catapult.

Implementation of the virtual infrastructure of MotionHUb, the website heart.

To realise the aims of Motion Hub, it was necessary to bring together a number of independent operations and present them to the user through one unified web and mobile portal with an increased level of system functionality. Each of the constituent operations, eCarClub, Hourbike, EV charging network and elements of public transport can be accessed

independently via their own website. These elements can be seen in figure 4 together with route planning and behaviour change.

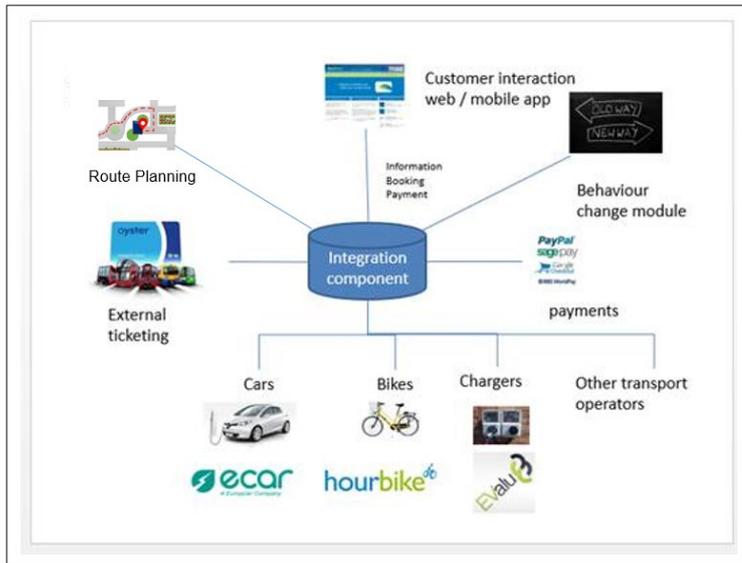


Figure 1 Early conception of Motion Hub structure

The figure briefly illustrates the software development objectives of the project. These are to provide:

1. An integrated journey planner, containing public transport and hub items
2. An overarching booking platform to enable all parts of journey to be booked from a single site
3. Implementation of an active 'Mobility as a Service' (MaaS) trial involving public users.
4. Inclusion of Behavioural Change incentives to encourage sustainable transport use
5. Tests of business models to evaluate effective approaches

Not only are the constituent parts independent operations but each has its own membership scheme, booking process and payment handling process. MotionHub, eCar and Hourbike are at least project partners so co-operation is mandated through a clear legal collaboration agreement. All the other operators must be treated as totally separate businesses trading with MotionHub. There are two other layers of regulatory complexity that have to be built into MotionHub. Users are passing personal information into the MotionHub portal. This places obligations on all the partners to comply with the regulations on handling confidential personal data. The implementation of the European Union's General Data Protection Regulation, GDPR, (EU, 2018) did not add the design complexity. It simply meant that the partners and the MotionHub project had to make explicit statements confirming their own compliance.

The passing of online payments between organisations is not only a regulatory issue but also one of secure communication between differing systems. Setting up a complete payment handling system which could take payments for tickets and ensure those tickets were available or delivered whilst being was a valid intention but actually financially and practically beyond the scope of this relatively small project. Such systems require significant through put to achieve economically viable costings. The final implementation of Motion Hub uses a combination of methods.

The immediate and local conclusions from the practical parts of the Motion Hub project were that major operators were extremely cautious engaging with an early experimental MaaS project; consumers were unwilling to change and so would need strong incentives; a high profile partners would be better able to promote to a wider audience; these projects do need local or national government backing; any imbalance in scale of partners can be a problem.

The Wider issues

Before moving to exploit the MotionHub initiative by promoting it to other towns or cities, it was important to understand the MaaS scene in the UK and the reception that MaaS in general was receiving. In parallel with the project's practical implementation of a trial MaaS scheme, a brief survey was made of other schemes or initiatives taking place simultaneously in the UK. In addition the Transport System Catapult, a partner in the MotionHub project developed an exploitation plan for taking MotionHub forward. Whilst the majority of this plan is confidential to the project partners, there are three general learning points which would be of general interest to the MaaS community.

MaaS projects across the UK

First the other UK projects. These twelve were chosen from high profile publicity and also from appearances at Smarter Travel 2017, held in October at Milton Keynes Arena. The selection was based on whether project made a contribution in one or more of the following areas: journey planner, integrated ticket/ payment, app/web, user incentives, subscription/membership, modes of transport, personalisation/user preferences and the logging of user activity.

iMove

iMove is a EU funded project operating in Berlin, Gothenburg, Manchester and Turin. Each city has a MaaS initiative running which is used as a "Living Lab" so that the iMOVE project can potentially accelerate the deployment and unlock the scalability of MaaS schemes in Europe. Transport for Greater Manchester, TfGM, is leading the UK contribution.

City Mapper

A good transport planning app, built for the real world of commuters and their daily needs. Live in 39 cities, including London. Using mobility data from its app, City Mapper runs its own responsive transport services and on-demand fleet management. A cross between bus and taxi offering shared rides across gaps in public service provision according to live demand. (<https://citymapper.com/london>)

Whim

MaaS Global's Whim launched across Birmingham, West Midlands. The Whim app, in conjunction with the Swift travel card, delivers smarter transport solutions that provide customers travel options for less than the average monthly cost of running a car. The app integrates journey planning, reservations, payments and subscriptions. Commuters using Whim access buses, trams, taxis and hire cars, either as part of a monthly fee or on pay-as-you-go. In addition the scheme rewards users for greener, healthier options such as walking more and having car-free days (<https://whimapp.com/uk/>)

TripGo

Combined journey planning tool using local public transit (bus, train, ferry, tram, subway, metro, rail) with private and other transport such as taxi, cabs, ride share, shuttle services, car routes and car sharing, motorbike, cycle routes, bike sharing and walking. TripGo delivers results in real-time: Up-to-the minute information on predicted departure/arrival times, GPS locations and service alerts. It supports ticket bookings by providing operators and their contact numbers. It can be integrated with a user's diary. (<https://skedgo.com/home/tripgo/>)

London Transport planner

Focused on London but integrates bus and train services across Great Britain, although outside London, it struggles to link to destinations. (<https://tfl.gov.uk/plan-a-journey/>)

CAPITALS (Collaborative and AdaPtive Integrated Transport Across Land and Sea)

The CAPITALS project aims to develop innovative and scalable multi-modal transport applications, services and business models to support more efficient, greener and safer movement of goods and people across end-to-end land/sea transport. The partnership is made up of a multidisciplinary team of 15 organisations comprising industrial, governmental, and academic and logistics operators. Funded by Innovate UK. (<https://gtr.ukri.org/projects?ref=102618>)

Motionhub: A UK MaaS solution pilot

Motionhub combines electric car club, bike and e-bike hire from single 'hub' locations, accessible with a single membership. These provide first/last mile transport options available from a digital platform which also offers train, bus and other local transport options. The demonstrator project is delivered in Southend-on Sea. visitors can have full journey planning, information and booking mechanism for their journeys. The project is funded by Innovate UK. (<https://landormaaS.blog/2017/09/18/case-study-the-motionhub-project/>)

iTravel

The project team brings together the experience and talent of Visual Atoms, iGeolise and the University of Surrey to develop iTravel, a smartphone-based interactive travel assistant. iTravel bridges the gap between textual/map-based navigation and visual navigation by seamlessly combining end-to-end multi-modal real-time journey routing with visual routing and checkpoints, and augmented data. The project is funded by Innovate UK. (<https://gtr.ukri.org/projects?ref=102811>)

NaviGoGo: Scotland's first MaaS platform

Scotland's first Mobility as a Service (MaaS) web application was piloted in Dundee and Fife in autumn 2017 with 16-25 year olds. 'NaviGoGo' has sought to solve many of the transport issues that young people face and provide a real alternative to owning a car. Co-designed by young people for young people, NaviGoGo is a service aiming to revolutionise travel for 16-25 year olds. NaviGoGo offers streamlined and personalised information, payment and fulfilment for buses, trains, taxis, walking, car clubs and bike schemes – all in one single hub. (<https://navigogo.co.uk/about>)

Smart Routing: Smarter door to door: a new public transport experience

Smart Routing has developed an end-to-end real-time public transport journey planning service for the passenger, and offering new analytical insight tooling and reduced operational overheads to the industry. The project has delivered an innovative decentralised architecture that shifts multimodal routing away from cloud servers to the users smartphone device and create new data aggregation and analytics capabilities via the oneTransport platform that can be used to create new industry insights and real-time travel guidance. The project was funded by Innovate UK. (<http://digitalbirmingham.co.uk/project/smartrouting/>)

Trav.ly: The Smarter Transport Solution

Smarter Travel Solutions (STS) is an integrated transport project to bring the entire management and completion of multimodal journeys under one umbrella across the West Yorkshire region. The STS team have combined data, built a business model and delivered a robust ticketing system for the 17 bus operators and rail operators in Leeds. The project integrates Journey planning, Booking and payment, In-journey and post-journey information and entertainment and Journey history using existing and planned public transport routes, smartcard and ticketing solutions and private transport sector (taxis, car clubs, etc). (<https://www.trav.ly/>)

Active and sustainable travel for hard-to-reach sectors

The Smarter Choices, Smarter Places (SCSP) programme supports behaviour change initiatives to increase active and sustainable travel. It is administered by Paths for All on behalf of Transport Scotland, and aims to make walking and cycling a mode of choice for short local journeys. It also encourages other forms of sustainable choices such as public transport use and car share. Now in its third year, the Programme allocates funds to local authorities across Scotland. £5 million has been made available to local authorities each year, with awards match-funded by at least 50%. Each authority develops packages of measures that are tailored to distinct communities or target audiences, and these are implemented by the end of each financial year. (<https://www.pathsforall.org.uk/pfa/get-involved/smarter-choices-smarter-places-fund.html>)

A table showing the perceived comparison across the twelve projects is located in the appendix. Of the twelve projects listed only five provided key characteristics of journey planning and ticketing. (CAPITALS was omitted as it is dealing with an altogether wider scenario than any of the others.) A shorter summary table is included here. Beyond the five highlighted, it is worth mentioning the key features of the next three. City Mapper operates in a number of places and from its amassed journey data it identifies gaps in provision and operates its own on demand bus service. Tripgo does not offer booking but does provide the contact details to facilitate independent booking. The thinking in London seems to be that with the size of the city and the regulated public transport provision accessible by Oyster card, MaaS would be an over complication and not add value to travellers.

Project	Journey Planner	Integrated ticket/ payment	App / Web	User incentives	Modes of Transport	Personalisation/ user preferences	Log user activity
iMOVE (Manchester)	yes	yes			Multimodal		Yes, for later analysis
Whim (B'Ham and West Midlands)	yes	yes	App	Rewards greener, healthier options	Multimodal		yes

Motionhub (Southend)	yes	yes	app	yes	Multimodal	no	yes
NaviGoGo: Scotland's first MaaS platform	yes	yes	web	points	Multimodal	Tailored to user's profile	yes
Trav.ly (Leeds)	yes	yes	app	-	Multimodal	-	-
City Mapper (London and various)	yes	no	App & Web	no	Multimodal	none	Logs A-B journeys to find holes in provision
TripGo (International)	Yes	Support for ticket bookings,	App & Web	no	Multimodal	diary alerts, e.g. "Time to leave".	no
London Transport planner	Yes	no	App	none	Multimodal	walking limits and step free access	no

Table 1 Summary of key MaaS initiatives in UK

Understanding the challenges

Working partly within the Motion Hub project, but combining with other related projects, the Transport Systems Catapult has engaged with demand side (or consumer) using focus group discussions and then specifically with representatives of local authorities in order to understand the challenges to be faced in the exploitation process. The focus groups aimed to uncover:

- Existing travel needs, current mobility choices, problems encountered and solutions expected
- Perceptions of value related to different ways of traveling
- What the core of an attractive MaaS-type offering might be
- Identify which groups of people are most likely to take-up these types of offering

Four types of traveller were recruited, based on existing research suggesting a high need for MaaS-type solutions and therefore high likelihood of take-up.

1. Younger Travellers - 18-24 year olds, mix of students and employed, none personally owning a car
2. Older Travellers – 65+, mostly retired, mix of those with and those without regular access to a car
3. Reluctant Drivers – Drivers who prefer (emotional reasons) to travel less by car if viable alternatives exist
4. Progressive Drivers – Drivers who would consider (logical reasons) less travel by car/ give up second family car if alternatives exist.

Four focus groups of one and a half hours were conducted in each of the three locations, a rural town, Norwich, a more dynamic university town, Bristol, and a post-industrial town, Sheffield. The detailed outputs and findings from these focus groups are commercially confidential and so excluded from this paper, but the more general learning points are presented here.

The first general point relates to selection of target towns or cities. The views across the focus groups provide a perceived state of transport by location. The research showed that 'place' (and its determinants) is very important to understand where the most consumer demand would exist. Appreciating the importance of the quality of transport services, the

physical connectivity between origins and destinations and the attitudes to changing travel behaviour is a key requirements for understanding propensity for MaaS usage.

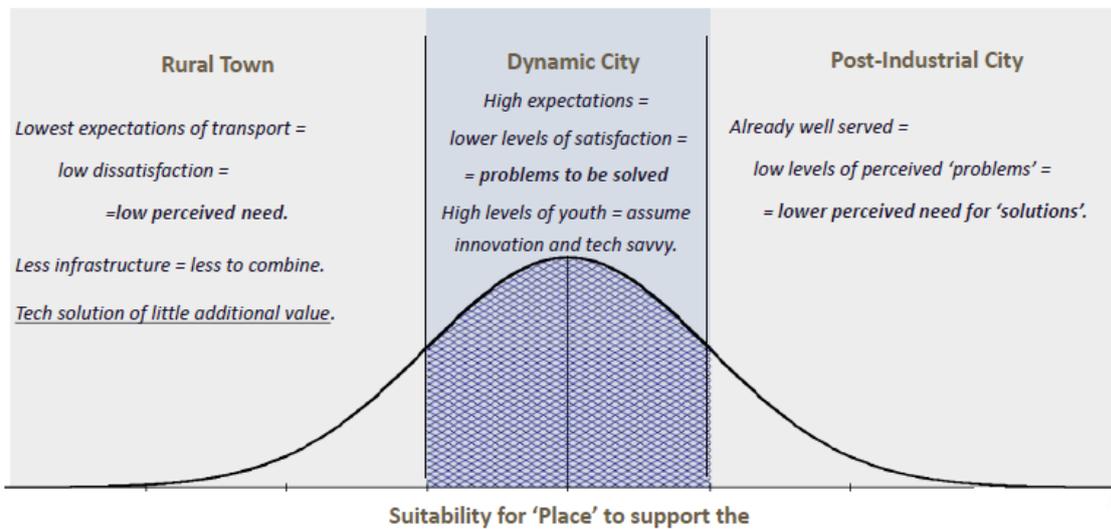


Figure 2 The importance of Place (Source TSC market research)

The second learning point was that travellers need to explore and understand the value proposition in stages. It appears that in general they do not want “everything at once” from the MaaS value proposition. Very few are willing to commit to or pay for something they don't quite understand or believe is possible. It is hard for many consumers to really understand the power of data and what a digitally enabled transport system could achieve in terms of a better customer experience. This means a staged roll out of MaaS features will be essential to 'bring the traveller along with us'.

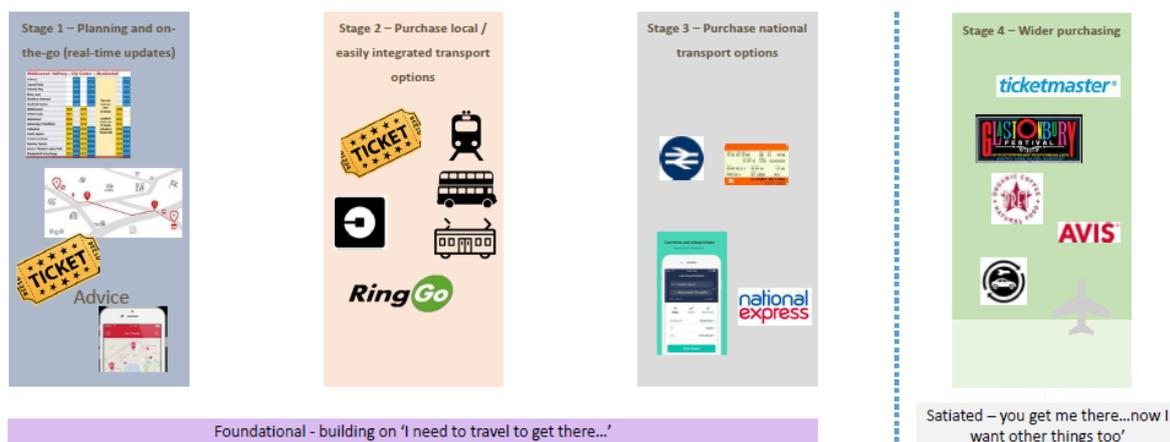


Figure 3 The travellers' journey to acceptance (TSC market research)

The Local Authorities are important stakeholders. The third learning point confirms anecdotal evidence from previous related projects. TSC has engaged with many of the stakeholders in this market and the table below provides some high level analysis of three different levels of MaaS readiness from a strategic perspective.

The table is based on feedback on MaaS provided by 46 English local authorities. Those interviewed were employed in a variety of transport roles and at differing levels of seniority. Not all were decision makers but the feedback gives a good flavour of their authorities' stance and progress on MaaS. The relative size of each grouping is approximate as based on a small number of interviews. However, it is clear that those authorities looking strategically at MaaS are in a minority.

MaaS 'level'	Size *	Activity completed	Future plans
3	10%	Multiple mobility services offered e.g. car club, car share, electric bike scheme Feasibility and pilot studies ongoing Single ticketing platform Openness to available technologies	Developing strategy to include MaaS and CAV Consider policy implications Consider commercial model – need to operate responsibly Alignment to broader LA objectives
2	20%	Mobility services offered e.g. bike hire, shuttle bus, car club, dockless bikes Apps in place although these offer journey planning and transport information Joined MaaS Global Alliance	Consider DRT e.g. Arriva Click pilot Moving to contactless Investigating CAV
1	35%	Discussions and consideration	Waiting to see how market unfolds
0	35%	Interest but minimal activity	Unsure

Figure 4 Spread of Local Authority opinion (TSC research)

Conclusions

In close co-operation with a municipality, the MotionHub project has been able to install the physical components of a rounded MaaS proposition. Use of these different transport operations has been integrated into one website with its equivalent mobile app.

For a relatively small project, it has been demonstrated that it is possible to provide a service where the complete journey can be booked and paid for at a single point. In doing so, the project revealed the difficulties associated with combining the financial processes of a number of operators and in particular with the integration into the major transport operators.

Looking at the wider picture in terms of other initiatives across the UK and a deeper look at the traveller and the local authority players, the initial conclusions have been expanded.

MaaS and the utilisation of mass data present challenges difficult challenges to many travellers and to the decision makers within local government. The major operators, conscious of their brands, their markets and their business demands are also wary of engaging. It will take time for these new ideas to gain traction.

Although different groups of consumers will react differently, most will need time to accept new modes of transport, so messages and incentives must be strong and obvious. Having well-known companies or supporters with high profiles will be important.

Local and national government, like consumers have to be brought on side. It was clear in the interviews that only a small proportion of relevant local government officials have as yet bought into the MaaS concept.

Mention has already been made of the fears about the vulnerability of business to working in a co-operative environment. A second part of this is that within a MaaS project the commercial partners may be of differing scale and that can add to the fears about being overshadowed.

Choosing new towns or cities into which to expand a MaaS project is not an issue of geography and population. The market research has exposed a greater depth of challenge. A new site needs to be one where a large percentage of the population are not satisfied with current public transport provision and seriously expect something better. Areas of greater satisfaction and low expectation seem less commercially attractive.

An important conclusion from this part of the work is that future implementations may be better managed when integrating down from the large to the smaller operators rather than from the directly from an external app provider, but this will require further investigation.

Having begun the MotionHub project by installing new on-street hardware, it should not have been surprising that the legal processes, the civil engineering and the electrical hook-ups each brought their own delays. Consequently the actual launch of MotionHub has been nearer to the end of the funded project. The system is now working and users are engaging, but the MotionHub will need to run for a longer period in order to attract consistent users. Again, the project has become aware that promoting the service to the large customer base of the train operator is likely to be more successful than promotions solely from the project partners. The municipality's contribution to promotion to the Southend community has been enthusiastic. The installations have been completed, the cars and bikes are available, the website is functioning and the people of Southend are beginning to make use of the service. It is right here to acknowledge the input from the residents and workers in Southend who are voluntarily making use of MotionHub and so are providing the data to enable further analysis. The accumulation of data over time will be important for all the MaaS initiatives mentioned in this paper.

The whole of this work fits squarely within one of the UK Government's Four Grand Challenges in its Industrial Strategy (Department for Business, 2017). The Mobility Challenge includes "We will look for opportunities to improve customers' experience, drive efficiency and enable people to move around more freely".

It is worthwhile at the end of these conclusions to revisit an earlier definition of MaaS. In their paper discussing the various definitions and their limitations, Jittrapirom's group (Jittrapirom P, 2017) provides an optimistic and forward looking definition that stresses the major reasons for embarking on any MaaS project.

"A well-functioning MaaS application can reduce stress on over-utilized segments of the transit network by shifting demand from affected parts of the network to less crowded modes of transit, as consumers take into account quality and comfort as major decision factors when considering public transit. MaaS can also help local governments achieve goals related to traffic congestion and pollution by providing consumers with stronger incentives in the form of optimized trips to use fewer private vehicles and more public/shared modes of transportation. While this has the obvious benefit of improving the overall transit network, it would also improve and expand local relationships with public transit agencies to further innovate on top of MaaS. Additionally, it would increase consumer investment in the public/private transit network instead of in private vehicles, which would reduce consumers' stress of the first mile/last mile problem, increase direct revenue for transit agencies, and even increase the economic benefit generated from consumer investment in local, private shared transit offerings."

Jittrapirom P (2017)

The use of "reduced stress", "shifting demand", effects on "congestion and pollution", "increase in revenue" and "increased economic benefit" point to the gains that might be accrued should the not insignificant challenges be met.

Recommendations and further work.

The most important next step is to accumulate actual usage data and analyse performance. As the MotionHub is rolled out to other sites, the analysis will become a key development tool. This is true of all the initiatives discussed in this paper.

Appendix

Project	Journey Planner	Integrated ticket/ payment	App / Web	User incentives	Subscription/membership	Modes of Transport	Personalisation/user preferences	Log user activity
iMOVE (Manchester)	<i>yes</i>	<i>yes</i>				Tram, bus, on-demand bus, car share, car hire, cycle share, taxi		<i>Yes, for later analysis</i>
City Mapper	<i>Yes, multimodal</i>	<i>No,</i>	<i>App & Web</i>	<i>No</i>	<i>none</i>	Bus, cycle, tube,rail, Uber (launches app), Gett (launches app), Black Bus, ferry, tram, Smart Ride.	<i>none</i>	<i>Logs A-B journeys to find holes in provision</i>
Whim	<i>Yes, by mode</i>	<i>Yes</i>	<i>App</i>	<i>Rewards for greener, healthier options</i>	<i>monthly contracts and pay-as-you-go</i>	Bus, taxi, walking, car hire, bike share.		<i>yes</i>

TripGo	Yes	Support for ticket bookings, e.g. operators and contact numbers.	App & Web	no	no	Public Transport (coaches), taxi, Uber/BlaBlaCar, myDriver car/Car Rental, motorbike, bike sharing, walking	Integrates with user's diary to provide alerts, e.g. "Time to leave".	no
London Transport planner	Yes	no	App	none	Includes Oyster card	Bus, tube, National Rail, DLR, London Overground, TFL Rail, River Bus, tram, Emirates Airline, coach, cycling, walking	Yes e.g. walking limits and step free access	no
CAPITALS (Collaborative and AdaPtive Integrated Transport Across Land and Sea)								
Motionhub: A UK MaaS solution pilot	yes	yes	app	yes	mixed	Train, car share, cycle share	no	yes
iTravel	Visually enhanced	no	app	-	-	Multimodal	-	-
NaviGoGo: Scotland's first MaaS platform	yes	yes	web	points	-	Multimodal	<i>Tailored to user's profile</i>	yes
Smart Routing: Smarter door to door: a new public transport experience	yes	no	app	-	-	Public Transport	Tailored to requirements	yes
Trav.ly: The Smarter Transport Solution	yes	yes	app	-	-	Public Transport, taxis and car share	-	-

Active and sustainable travel for hard-to-reach sectors	<i>no</i>	<i>no</i>	<i>no</i>	<i>Local campaigns/incentives</i>		<i>Walking cycling, car share, public transport</i>	-	-
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