WHIMPACT

Insights from the world's first Mobility-as-a-Service (MaaS) system

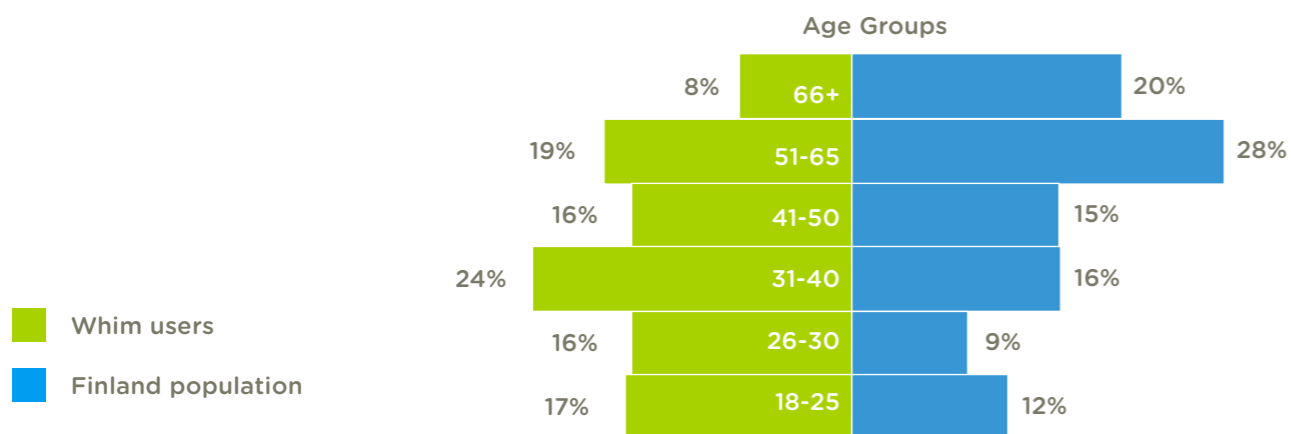RAMBØLL   Bright ideas. Sustainable change.

CONTENTS

EXECUTIVE SUMMARY

As the world continues to urbanize — and more people attempt to navigate within and between cities and their peripheries — so too continues the development of more efficient modes of transportation, new niches of transport modes and services, and a more intuitive integration of modes to simplify the trip-making process for users.

Perhaps most notably, changes are happening in the field of transportation due to the rapid application of technology. What has been a growing "menu" of discrete mobility options offered mostly by public agencies is now becoming a "spectrum" of mobility options; the differences between individual modes are blurring and mobility services are provided by a more complex mix of public and private operators. The most relevant combinations are now finding their way to the user based on their priorities, making mobility effortless and intuitive. This, ultimately, is the aim of Mobility-as-a-Service (MaaS), and the focus of this report.

Maas Global soft-launched its MaaS application "Whim" in Helsinki, Finland in late 2016, followed by a full launch in November 2017. The first ever MaaS operator interconnected many of the city's mobility options under one subscription and within a single app. With the Whim app, the user is able to combine, plan, and pay for public transport, taxi, car rental, car sharing and city bike trips. Thus, we are able to take a first look at any potential commonalities or differences in travel behaviour between Whim users and the typical urbanite, how users are spatially distributed, what kind of trips and trip-combinations they take, and any potential relationships with certain types of land-use. MaaS Global has invited Ramboll to study the 2018 Whim Data Set and share our findings in this white paper.

Age Groups

	Whim users	Finland population
66+	8%	20%
51-65	19%	28%
41-50	16%	15%
31-40	24%	16%
26-30	16%	9%
18-25	17%	12%

■ Whim users
■ Finland population

At this early stage in the life of MaaS and Whim, there are however a host of limitations to the available data set which restricts the framework of our analysis. Foremost among these is that the data reflect the first year of operations of the MaaS service. This means that the data are characterized by both a high growth-rate in users and being highly skewed towards early adopters. It is important to note that early adopters are nonetheless evenly represented across most age groups. Another important limitation is that during the sample period, new modal choices were added to the Whim service, thereby expanding the range of mobility options for customers but complicating the ability to normalize data sets for comparison purposes. For example, the option for car-sharing was not introduced until November 2018. To control these variations, our study focuses mostly on a combination of public transport, bicycle, taxi, and in some cases car rental trips.

Nonetheless, our analysis has resulted in several findings regarding the nature and preferences of early-adopters, and the development of the Whim service during its first year of operation which provides important insights on several of

the greatest concerns about MaaS – Will MaaS lead to a car-dependent city? Does MaaS steal ridership from public transport? Is MaaS only attractive to a niche group of urbanites? – none of which are identifiable in the first year of real-world MaaS user data. Municipal officials, city planners, public transport agencies, transport professionals, transport service providers, and many others can find benefit in these findings.

Taken with the noted limitations, there is much to glean from this first glimpse at the nature of MaaS and a substantial group of MaaS users in the real world, and much to share and discuss together. The data suggest that public transport is clearly the backbone of MaaS users' travel habits, MaaS users excel in multi-modality, and the MaaS platform is potentially facilitating first/last mile choices that lead to greater access to public transport. We find these insights encouraging, and hope you do too!

MOBILITY TRENDS

In 2018, over 50% of the world's population lived in urban areas. According to United Nations estimates, by 2050 this number will increase to 68%.

As the world continues to urbanize — and more people attempt to navigate within and between cities and their peripheries — so too continues the development of more efficient modes of transportation, new niches of transport modes and services, and a more intuitive integration of modes to simplify the trip-making process for users.

Perhaps most notably, changes are happening in the field of transportation due to the rapid application of technology. In recent years, discussions over the future of transportation have mostly focused on the headline-grabbing growth of electric and automated vehicles. Communities around the world — many of them struggling with chronic traffic jams, rampant air pollution, and high levels of traffic fatalities – have

slowly but surely been contemplating the prospects and impacts of zero-emission and self-driving vehicle fleets. These applications of technology are certainly promising, but they still involve an overdependence on cars and, more specifically, car ownership.

To combat a glut of privately-owned cars on already congested streets, public transportation infrastructure has become more prevalent in cities around the world, communities are attempting to better leverage human-powered mobility, and new, personalized services have emerged as well: shared cars, city bikes, and even city scooters, to mention a few. In some of the most enlightened places, a focus on holistic land use planning is effectively reducing trip distances and, subsequently, the impacts of transportation on quality of life.

What has been a growing "menu" of discrete mobility options offered mostly by public agencies is now becoming a "spectrum" of mobility options; the differences between individual modes are blurring and mobility services are provided by a more complex mix of public and private operators. This blurring also applies to what was once a clear dichotomy between car ownership and public transportation. Niche mobility services are incrementally bridging the gap that previously made public transportation inconvenient or impractical to households that already owned one or more cars, or that acted as a barrier to life without owning a car.

> " The differences between individual modes are blurring and mobility services are provided by a larger mix of public and private operators.

With this spectrum of mobility options, however, comes the confusion and complexity of navigating multiple alternatives, combinations of modes, competing services, separate accounts, a clutch of apps, etc. It is simply inconvenient or uneconomical to invest in multiple services; therefore, people often default to being a "driver", a "bicyclist", "taking the bus", etc. Yet, it doesn't have to be this way. When there is no sunk cost in a specific mode, when all of the options are conveniently combined in one place, when the most relevant combinations are presented to the user based on their priorities, mobility becomes effortless and intuitive. This, ultimately, is the aim of Mobility-as-a-Service (MaaS), and the focus of this report.

> " When there is no sunk cost in a specific mode, all of the options are conveniently combined in one place, and the most relevant combinations are presented to the user based on their priorities, mobility becomes effortless and intuitive.

MOBILITY-AS-A-SERVICE

Mobility-as-a-Service (MaaS) enables the user to plan and buy trips from a suite of Transportation Service Providers (TSP) as packages offered by a MaaS Operator.

A variety of transport modes can be integrated into a single trip to best suit the customer's needs. Mobility services sold as packages can include, for example, an unlimited use of public transportation and a fixed number or price for taxi trips. The MAASiFiE project consortium (VTT Technical Research Centre of Finland, AustriaTech, and Chalmers University of Technology) define MaaS as "Multimodal and sustainable mobility services addressing customers' transport needs by integrating planning and payment on a one-stop-shop principle". MaaS Global defines

MaaS as "Anywhere anytime on a whim using all available assets smartly". It can be then said that MaaS comprises the following components: shared mobility, booking/ticketing and multimodal traveller information. Therefore, service providers focusing mainly on one or two modes are not considered as MaaS-operators. MaaS-operators offer access services to a variety of transportation modes from different service providers via one common mobility platform.

MaaS, in its simplest form, can serve as a clearinghouse for the mobility options in a community, just as travel websites have now prevailed to serve as a clearinghouse for airplane tickets, hotel bookings, and car rentals. In use, however, it may be that ease of access to a mix of modes changes the way people choose to move around. For example, MaaS could potentially serve as a platform for new mobility modes; new, more personalized mobility solutions could break down the barriers that inhibit users from trying new services, all the while reaching wider audiences when services are bundled together rather than merely accessible via an uncoordinated collection of discrete service providers.

MaaS also promises to better integrate other modes with public transportation, encourages people to consider different combinations of modes to move about their communities more efficiently, and challenges people to think of their mobility costs as a lump sum rather than an irregular account of disparate fares. On the other hand, fears prevail that MaaS will facilitate a "taxi culture", steal public transport ridership, and bankrupt traditional Transportation Service Providers (TSPs).

These competing concerns are all valid, and until recently could only be addressed in speculation, theoretical exercises, or statistically nominal evidence from very small sets of data gathered through limited pilot implementations. The field of MaaS operators is nevertheless growing, and pilots and limited demonstrations are becoming more prevalent as the concept gains traction. Although nascent, the combination of a multi-modal route-planner with cross-platform trip booking, payment, and ticketing is increasingly appearing in various forms around the world; Whim itself operates in several other metropolitan regions, such as in Birmingham in UK and Antwerpen in Belgium. However, there is arguably no place in the world where the concept of MaaS is more developed than in Helsinki, Finland.
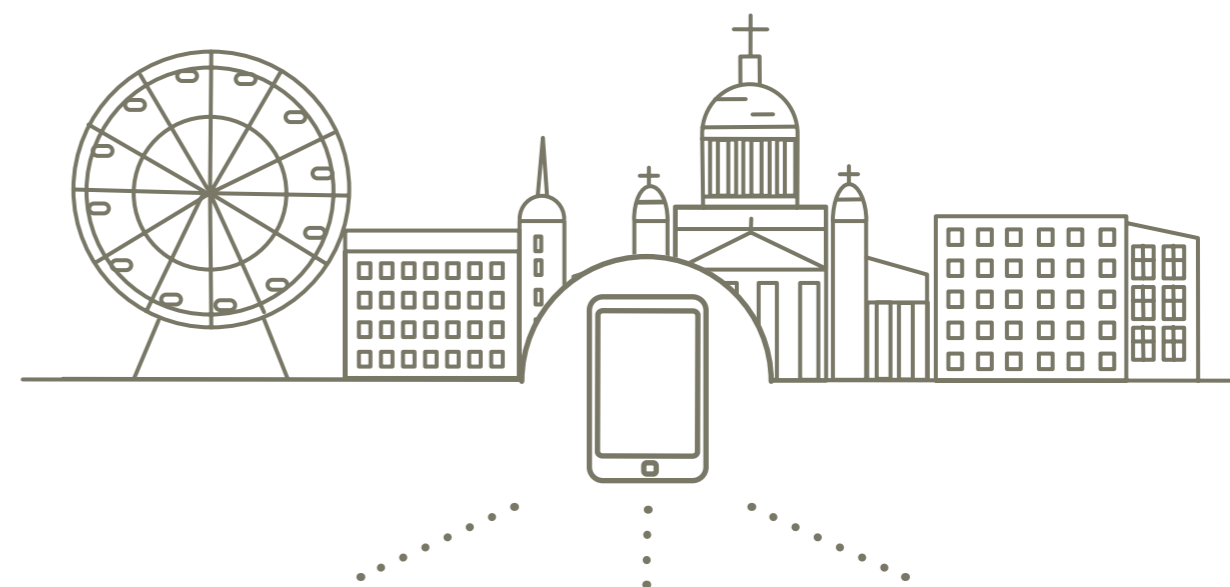
3.1

THE WHIM SERVICE IN HELSINKI

Maas Global soft-launched its MaaS application "Whim" in Helsinki, Finland in late 2016, followed by a full commercial launch in November 2017. In late 2018, the service had over 70 000 registered users. The first ever MaaS operator interconnected many of the city's mobility options under one subscription and within a single app. With the Whim app, the user is able to combine, plan, and pay for public transport, taxi, car rental, car sharing and city bike trips.

Three different service tiers exist: Whim to Go, Whim Urban and Whim Unlimited. The Whim to Go tier does not require a monthly subscription fee; rather, it provides pay-as-you-go access to available modes via the Whim App. Whim Urban is a

subscription package that includes an unlimited number of single tickets for public transportation at a slightly lower price than a monthly comparable Helsinki region travel card. Additionally, Helsinki City Bikes are included in the bundle during the summer season (April to October) and taxi fares are capped at 10 € when the trip distance is less than 5 km. Whim Unlimited is a subscription package that includes public transportation, city bikes, taxis, and rental cars on an unlimited basis with few limitations.

Whim Unlimited is an unprecedented mobility package and is thus difficult to compare to any known transportation system; the subscription is intentionally marketed and — at 499 € per

month — priced as an alternative to car ownership. The price of the Whim Urban is comparable to the standard Helsinki travel card with a few added benefits; a standard monthly public transport ticket within the Helsinki travel zone costs about 55 € versus the Whim Urban price of 49 €, which includes access to city bikes and capped taxi fares for shorter trips. The standard price for access to the city bike system is 30 € for the whole season (April to October). A standard monthly public transport ticket for the greater Helsinki region costs about 107 € versus the Whim Urban price of 99 €, which again includes access to city bikes and capped taxi fares for short trips.

TIER:	WHIM TO GO	WHIM URBAN	WHIM UNLIMITED
Subscription Fee:	0 €	49 € per month (99 € for extended Helsinki Region)	499 € per month
Includes:	• No monthly free • Pay as you go • Public Transport tickets, taxi rides, and rental cars can be all bought from Whim App	• Unlimited number of public transport tickets • All taxi trips within 5 km radius for max 10 € • Fixed 49 € daily rental car fee • Unlimited city bike trips up to 30 minutes at a time	• Unlimited number of public transport tickets • Unlimited number of taxi rides within 5 km radius • Unlimited rental car use • Free to use city bikes for 30 minutes at a time
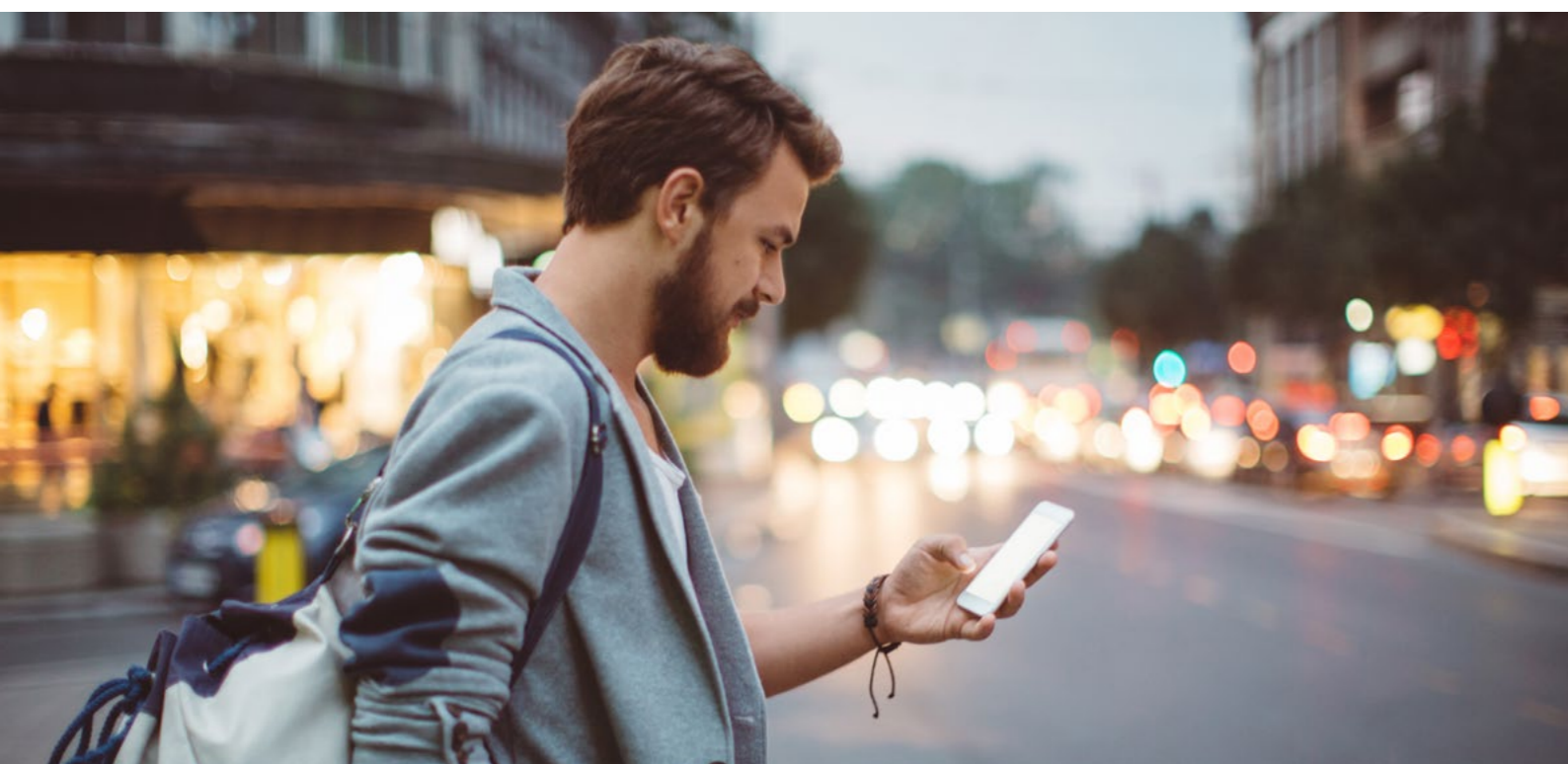
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AIMS OF THE STUDY

At the time of this publication, we submit that Whim is arguably the only fully-functional MaaS service in operation for at least one year. In this study, we are asked to review the first year's travel data (2018) provided by Maas Global, and compare it to other sources of travel data in Helsinki, where possible.

At the time of this publication, we submit that Whim is arguably the only fully-functional MaaS service in operation for at least one year. In this study, we are asked to review the first year's travel data (2018) provided by Maas Global, and compare it to other sources of travel data in Helsinki, where possible. Thus, we are able to take a first look at any potential commonalities or differences in travel behaviour between Whim users and the typical urbanite, how users are spatially distributed, what kind of trips and trip-combinations they take, and any potential relationships with certain types of land-use. In particular, a geographical-based study is made of the user characteristics of MaaS, to identify where and how the first adopters of MaaS-services usually travel.

This study is subsequently also the first of its kind; it is the first attempt to identify the impacts of MaaS in a real-world context with a large number of users. We are therefore able to review the data of the first year and begin to address some of the questions about MaaS, such as:

- Does MaaS have an impact on travel behaviour?
- Does MaaS correlate with urban development or impact the urban transport system?
- Are the intended benefits of the MaaS service accepted by users?
- Does MaaS encourage a car-dependent city?
- Does MaaS steal ridership from public transport?
- Is MaaS only attractive to a niche group of urbanites?
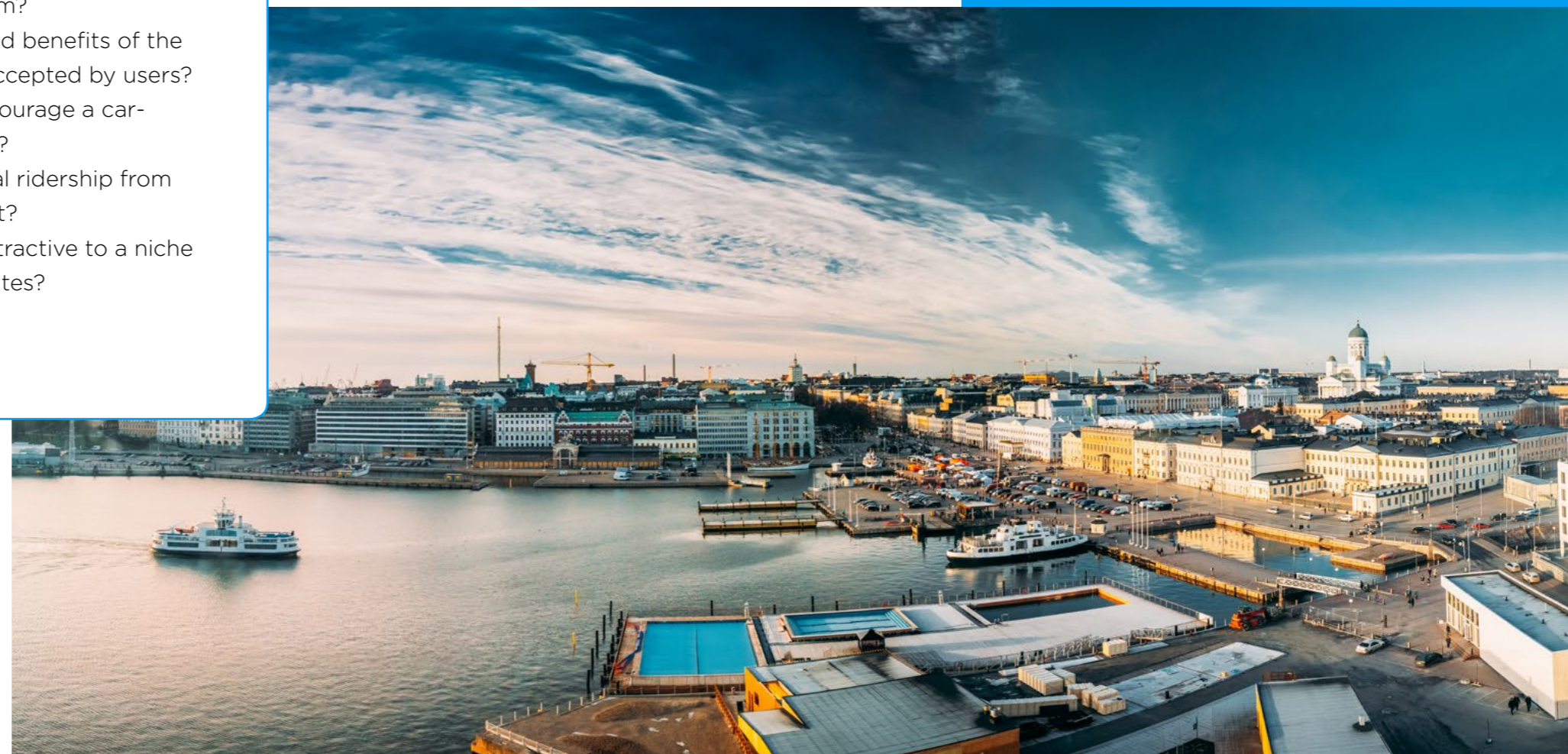
> **Is MaaS only attractive to a niche group of urbanites?**

METHODOLOGY

The Whim User Data Set is an excerpt from the daily business operations of MaaS Global's Whim service. The data set spans from 1 November 2017 to 31 December 2018, but for this study the data studied is the period of January 2018 to December 2018.

The rationale for this period is:
- to cover one full year; and,
- to exclude the first few months when there were fewer users.

From January 2018, trip data were significantly more predictable. The data contain information about trip origin zones, trip ticket types, ticket purchase times, and mode types. The data set delineates this information between the available service tiers. The anonymized data were provided by MaaS Global specifically for the purposes of evaluating the first full year of trip activity to be shared with the transportation community in this paper.

Our data analysis uses tools targeted to tabular and spatial data. Based on the research questions posed to the analysist, some answers were mined and calculated conditionally based on the given data. To address unknown latent parameters, statistical models were developed to suit the analysis context. This includes a polynomial regression model which was used to study the increase of the number of trips against time within the available spatial categories.

A key challenge for measuring the development and behaviour of the MaaS system is acquiring insight into the general travel behaviour of the population. Without this insight, one lacks a point of reference, or a benchmark, to which one can compare the observed behaviour of MaaS users. Among the reasons why it is challenging to acquire such a benchmark, is that few sources of data exist that could be used to accurately represent the benchmark. There are sources such as

the national Finnish Transport and Communications Agency 2016 National Travel Survey (National Travel Survey) and other questionnaire-based surveys; however, these are more suited to capture the overall travel behaviour of a large region, than to isolate local differences within a city region within a select sub-set of users and modes.

Capturing local differences is especially important because the MaaS concept is very new within Helsinki, and still very much in the growth phase of its operations. A rapidly growing user-base has yet to establish a mature pattern of usage within the area of operation. In other words, overall use characteristics will be highly volatile, and there is also likely to be large local differences that may be difficult to explain at this time. Analysing the development and use of MaaS therefore requires information on a spatial level which goes beyond that which is currently available. To overcome this data scarcity, we have attempted to combine the state-of-the-art regional transportation model and data from the national statistics agency to generate accessibility and transportation estimates for the various zones and districts in Helsinki that would be suitable to conduct these early comparisons to Whim user data.

The methodology for estimating accessibility is based on the approach used in the development of the LUTI model for Santander . This means that accessibility is estimated through combining the population's willingness to travel between the areas based on travel costs (the willingness represented by a probability) and the number of jobs within

the zones. In the analysis, we used estimated travel costs between the areas derived from the Helsinki Transportation Model (HTM). The different cost components included in the estimated costs of traveling between the zones with different modes are listed in the table.

A high accessibility value in a zone therefore means that one can reach more jobs with a given travel budget, while a low accessibility value means that one can reach fewer jobs with the same budget. In addition to accessibility measurements, we have also extracted estimated mode shares for each zone from the HTM. The estimated mode shares provide a signal similar to the accessibility measurements; however, while the accessibility measurements reflect the accessibility acquired from being in an area/zone based on the transportation network and the commercial land use of the surrounding area, the mode shares from the transportation model provide a measurement of the actual travel behaviour of the inhabitants of the zone.

The transportation estimates from the HTM thus provides a useful benchmark for the data as they signal the expected transportation behaviour of the areas derived from the combined effects of the area's accessibility and demographic profile.

To enable the comparison of Whim data to the accessibility estimates and transportation model estimates, we have performed a GIS-analysis using ArcGIS in which we take the zonal locations of each Whim trip event in the morning and evening rush-hours and merged these with the existing zonal structure of Helsinki which used in the transportation model. From this exercise we end up with a count of Whim trip events and a corresponding accessibility and transportation estimate for each zone. This merges the two data-sets into one comparable database which can be used to identify existing patterns in Whim usage, as well as how these patterns correlate to selected transportation attributes of those zones.

Mode Costs	Costs Components
Bicycle	Time Costs
Car	Time Costs Fuel Costs
Public Transport	Ticket Costs Transit time cost Waiting time cost Transfer time costs Access/ingress time costs

Cost component of modes

5.1

LIMITATIONS

While the insights provided in this report offer a first glance at the user habits and trip characteristics of a real-world MaaS system, there are a host to challenges to the available data identified that must be clearly stated and shared with the reader. These challenges, while limiting the depth to which inferences can be made from the current data set, do not categorically prevent some early insights from being made. Moreover, they point to opportunities to improve the outcome of future assessments. Nonetheless, limitations do exist. These are listed and explained more in detail in Appendix 1.
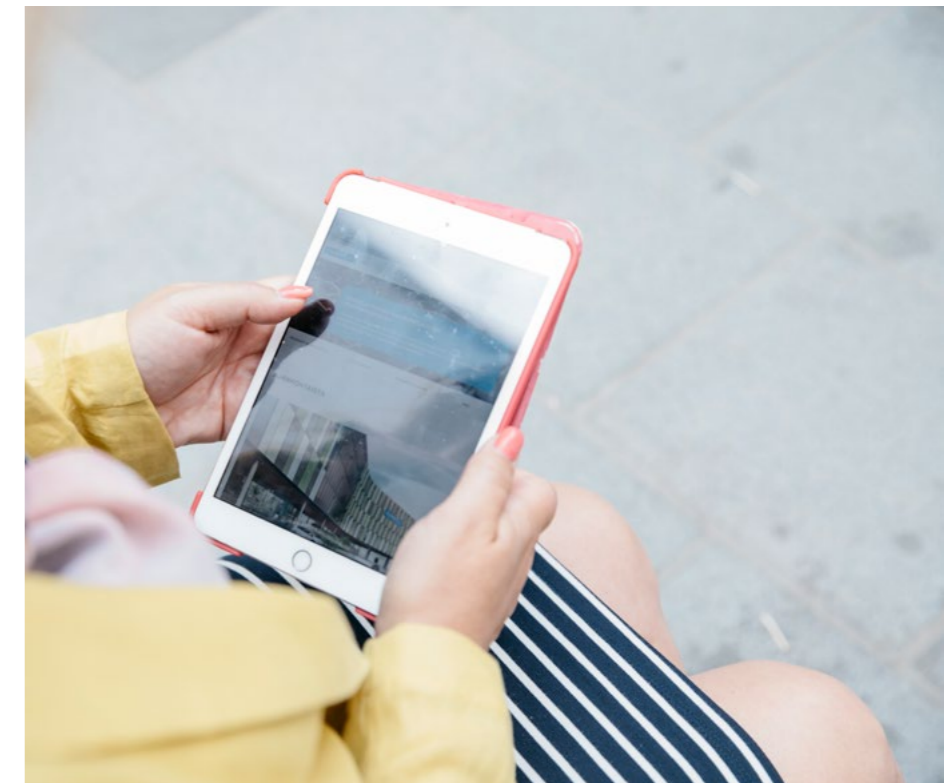
The spatial relationships between the datasets is visualized by maps in which the accessibility and transportation estimates are represented by color-gradient backgrounds, and Whim trips as to-scale columns. In the maps, the range of transportation estimates and accessibilities are categorized from lowest to highest, in which each category is defined by the natural shifts in the data-set as estimated by the GIS-software.

To further compare Whim-users against the typical Helsinki resident, a selected control group was carefully defined to best match with Whim-users' characteristics. The comparison is done against the average, but for some occasions the missing modal shares were estimated for Whim users from a more specifically defined control group. In other words, Whim data have been normalized for comparison purposes with Helsinki resident data from the Helsinki Region Transportation's Travel behavior survey (Travel behavior survey).

> " These challenges, while limiting the depth to which inferences can be made from the current data set, do not categorically prevent some early insights from being made.

6

DATA PRIVACY

The following text is a summary of the data privacy and security measures practiced by MaaS Global with respect to the Whim data set:

Maas Global uses industry standard security mechanisms to protect the collected personal data. All collected personal data is stored in protected databases located behind a firewall and with both physical and software-based access controls provided by our Hosting Provider. The payment providers are PCI-DSS Level 1 certified. The personal data is pseudonymised and encrypted. A process for regularly testing, assessing and evaluating the effectiveness of technical and organisational measures are used for ensuring the security of the processing.

For more information about Whim's data privacy and security measures, please visit the website at:
**https://Whimapp.com/privacy/**

7

HELSINKI'S TRANSPORTATION SYSTEM

A brief description of Helsinki's transportation system is provided below:

- The metropolitan area of Helsinki is serviced by 290 bus lines, 14 commuter train lines, 11 tram lines, two metro lines and 2 ferry lines.

- 375 million passengers were recorded in 2017 with 25 000 daily departures.

- 25% of trips made in Helsinki are by public transportation. Bicycling, walking, and public transportation together are responsible for 62% of all trips. Car trips (drivers and passengers) are responsible for 36% of trips in Helsinki.

- At the end of 2017, the metro system was expanded into the neighbouring municipality of Espoo to the west, with a further westward extension planned in coming years.

- The modern city bike program is approximately two years old.

- Bicycle infrastructure is already well developed and constantly upgraded.

- Taxi deregulation was introduced in the summer of 2018, making ride hailing services such as Uber legal.

To aid in the spatial comparison of trip behaviour, we have identified a list of neighbourhoods that may represent differences in access to transport, demographics, and development density.

5.KM

Helsinki Rail and Metro Lines

N
W E
S

Kartverket, Geovekst og kommuner - Geodata AS
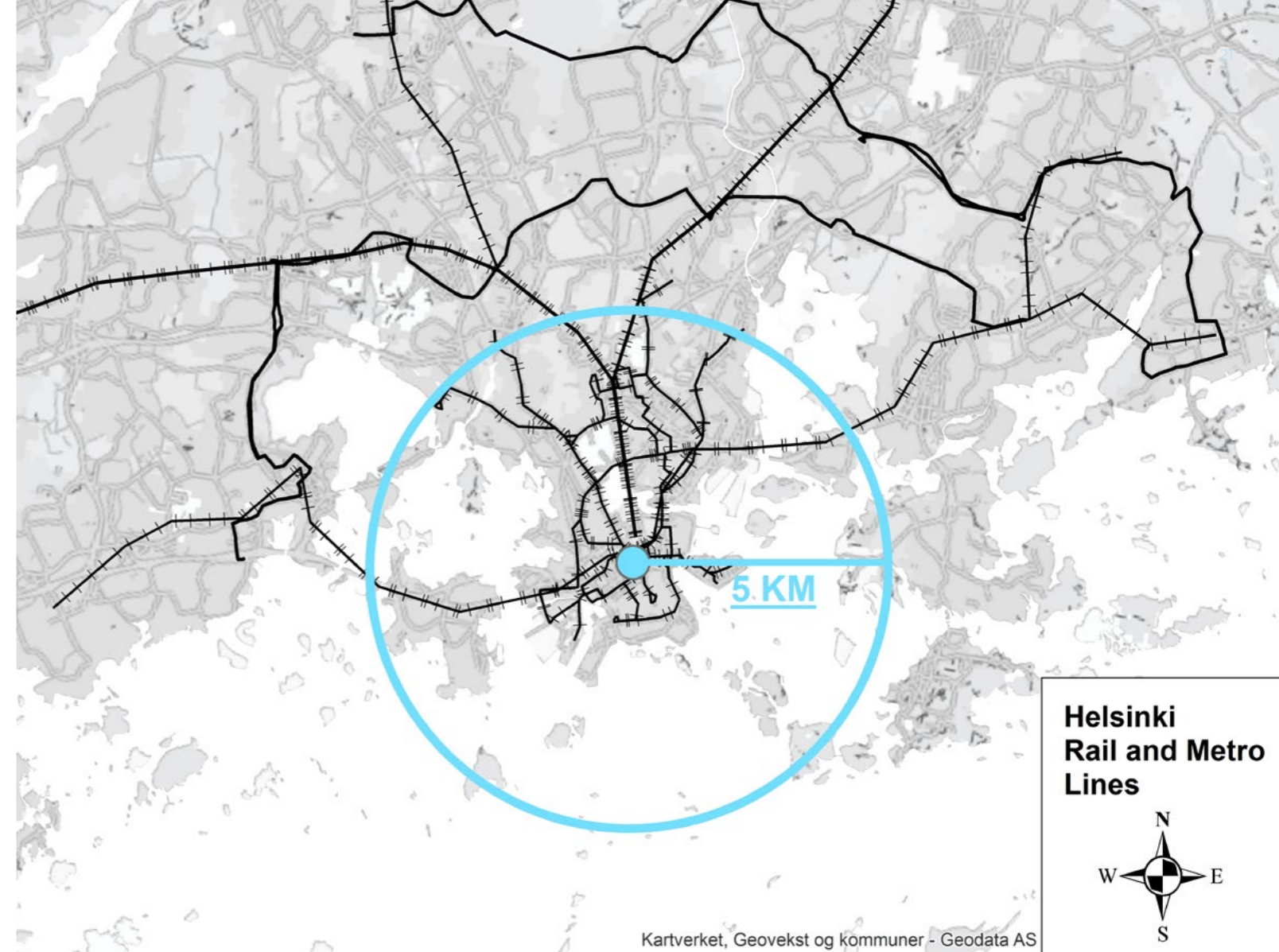
Trunk lines in Helsinki Metropolitan region

> " The metropolitan area of Helsinki is serviced by 290 bus lines, 14 commuter train lines, 11 tram lines, two metro lines and 2 ferry lines.

FINLAND

Helsinki

Suutarila

Pakila

Munkkiniemi

Pasila

Arabia

Herttoniemi

Töölö

Kallio

Lauttasaari

Kluuvi
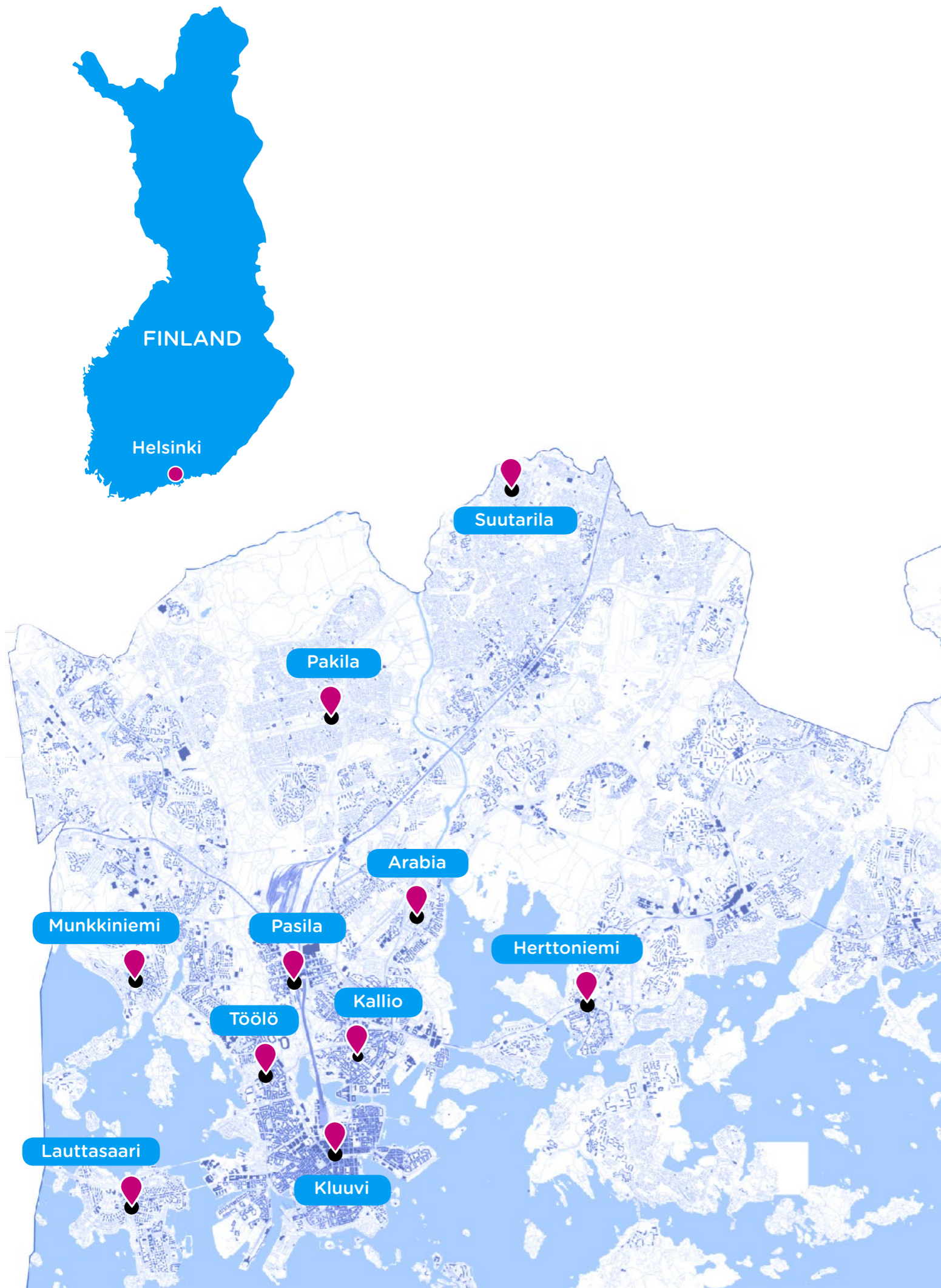
DESCRIPTION OF THE DIFFERENT ZONES:

SUUTARILA
13km from city centre, Suutarila is a relatively car-dependent area with a large amount of detached housing. Also, no rail-connections exist here; it is serviced by bus lines only.

PAKILA
Predominantly detached housing, Pakila does not have a rail connection, but is situated adjacent to one of the busiest road sections in Finland.

MUNKKINIEMI
Serviced by its own tram line into the city center, Munkkiniemi is nonetheless a moderately car-dependent district. It was mainly built in the first half of 20th century, with two distinct types of housing: apartments and detached homes.

PASILA
The busiest train station in Finland and a major transportation hub is located in Pasila. Virtually every train departing and arriving to Helsinki stops here. Pasila is a major job center, accommodating government offices, many company offices, and other organizations. Addition, a short walk from the station is the ice hockey arena and exhibition center, as well as some housing as well.

ARABIA
Home for multiple cultural centers and educational universities, Arabia is also a relatively new housing district. It is serviced by two tram lines and lies at the border of the city bike operating area.

HERTTONIEMI
Six kilometers from the city centre, Herttoniemi is one of the oldest suburbs in Helsinki. It is serviced by metro, and consists mostly of apartments and some light industry.

TÖÖLÖ
Traditionally considered as a more expensive neighbourhood very close to the city center, it's well-kept building stock was built mostly between 1910 and 1930. Töölö has larger apartments and family sizes than for example Kallio, but compared to today's standards it is still quite small. Töölö is serviced by many bus and tram lines.

KALLIO
The former working class area is now the densest populated square kilometre in Finland. Many single-room apartments, trendy cafés and bars, and small businesses can be found in this area. Kallio is serviced by tram, bus, and metro.

LAUTTASAARI
In recent years, housing prices have rapidly increased in Lauttasaari, due to a newly built metro station, close proximity to city centre, and large outdoor areas along the seaside. Industries have slowly moved away as the share of housing and neighbourhood businesses increase in the area. It is serviced by both metro and bus.

KLUUVI
Is situated in the heart of Helsinki's city centre. The Area consist mostly workplaces, shops, and other services. It is serviced by tram, metro, and bus.

	Walking	Bicycle	PT	Car (Driver)	Car (Passenger)
Kluuvi	6	14	65	13	2
Töölö	56	10	23	8	3
Kallio	34	10	34	17	4
Pasila	9	9	51	27	5
Lauttasaari	33	7	31	22	6
Munkkiniemi	32	8	28	25	7
Suutarila	20	5	22	42	11
Arabia	22	7	29	34	9
Herttoniemi	28	6	34	25	7
Pakila	21	5	24	39	11
Average	27	9	36	23	6
Helsinki average	30	7	25	27	9

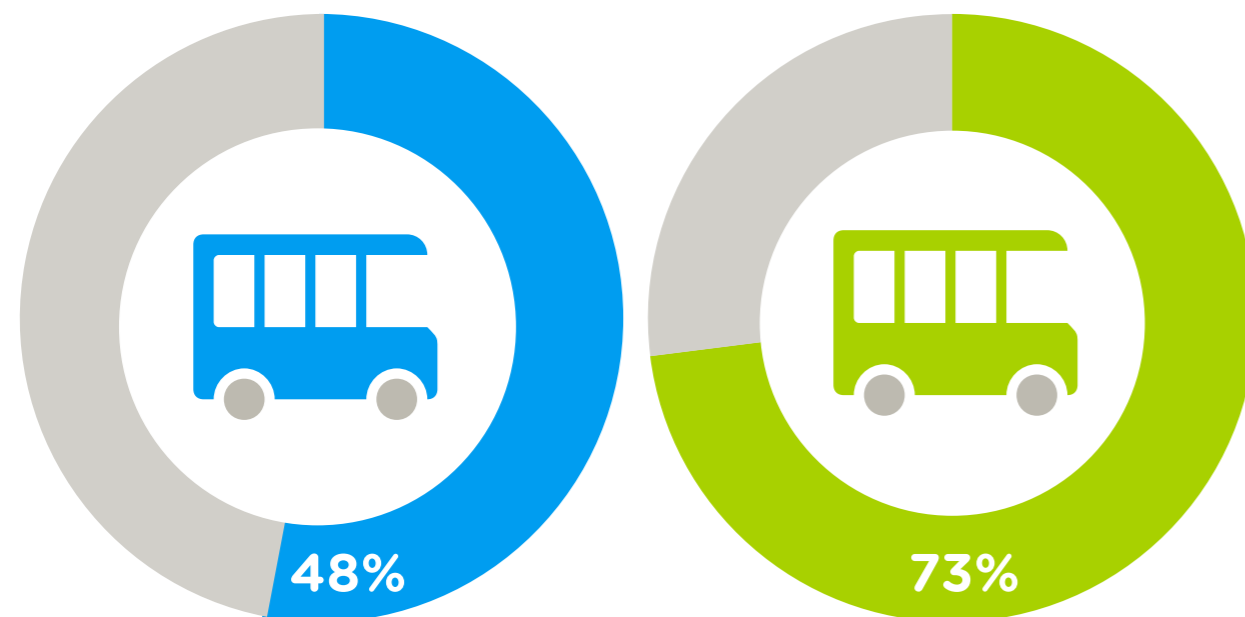Modal share in Helsinki (%)

8

KEY INSIGHTS

In this section, we represent the most relevant initial findings of our assessment of the Whim data set, as well as some comparisons to generally available travel data from the Helsinki region.

The presentation on the following pages is in infographic format to make each individual finding useful on its own as well as within the context of this report. In summary, this assessment has identified the following initial findings.

The areas further studied are chosen to represent the typical Helsinki resident's travel behaviour. According to the National Travel Survey, on average walking, cycling, and public transportation compose up to 62% of the trips in Helsinki. In chosen areas, this number is slightly higher at 72%. But as these areas are very different by the nature of their primary mode of transportation, we consider this as a reasonably useful depiction of variations in Helsinki. While places such as Pakila and Suutarila represent car-dependent housing districts, others such as Töölö and Kallio represent the highest density neighbourhoods where walking, bicycling and public transportation are much more common.

8.1

MAAS USERS RIDE PUBLIC TRANSPORTATION MORE THAN THEIR HELSINKI COUNTERPARTS

48%

73%

■ PT Modal share in Helsinki 48%

■ PT Modal share with Whim 73%*

*Whim data have been normalized for comparison purposes with Helsinki residents in the Travel behavior survey
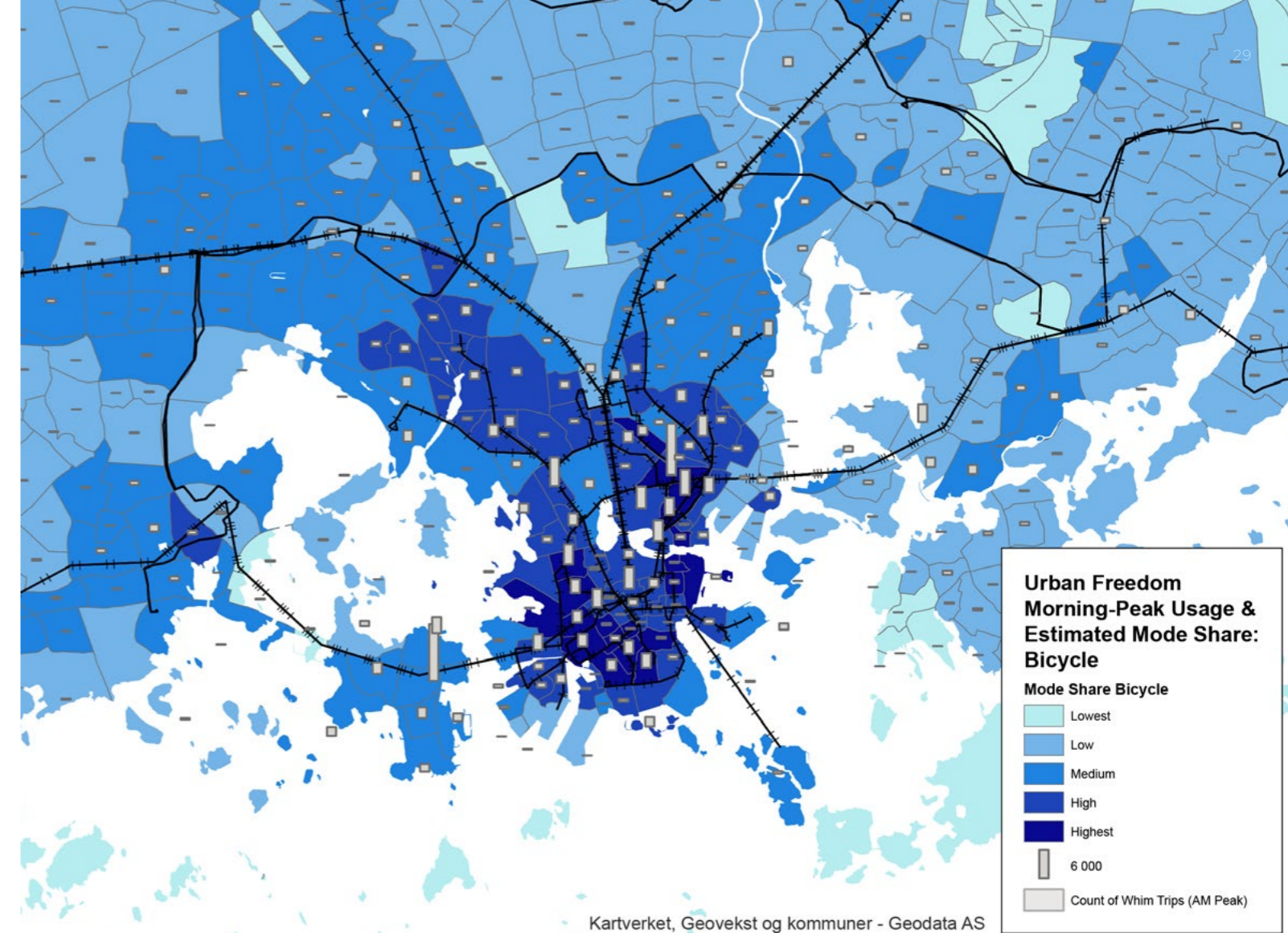
Approximately 48% of all trips by Helsinki residents with similar demographics are made by public transportation. Whim users ride public transportation significantly more, at 73% of all trips. In other words, MaaS users are more likely to ride public transportation than their Helsinki counterparts. To make this comparison, the corresponding user subset is excerpted from the data and the missing modal shares for Whim users have been matched to the Travel behavior survey's data.

Whim trips do not fully represent the overall modal share of the user, since it only counts for trips made via the Whim-app. Walking, bicycle trips (with privately owned bicycles), travelling as a passenger in a car, etc. are not included in the data. To estimate the overall public transport modal share, the missing modal shares are excerpted from the corresponding user subset in the Travel behaviour survey. Even though the modal share of public transportation is higher, when comparing the normalized Whim data against the Travel behaviour survey, there is little to no indication that the total amount of trips by Whim users would significantly deviate from the average. Assuming the overall trip average is close to 3 trips, this gives a public transportation modal share of 73%.

8.2

MAAS USERS ARE MULTIMODALISTS

Whim users combine taxis **3x** more often with public transport compared to the typical Helsinki resident

Urban Freedom Morning-Peak Usage & Estimated Mode Share: Bicycle

Mode Share Bicycle

- Lowest
- Low
- Medium
- High
- Highest

6 000

Count of Whim Trips (AM Peak)

Kartverket, Geovekst og kommuner - Geodata AS

Typically in Helsinki, 3% of all taxi trips are made in combination with public transportation trips. With Whim, 9% of all taxi trips are made either 20 minutes before or within 30 minutes after a public transportation trip. In addition, there is a clear rise in density of bike trips before and after the public transportation trip. These findings suggest that Whim users are avid multimodalists, using both bicycles and taxis to solve the first/last mile problem.

Multimodality is also apparent on the spatial dimension. To illustrate this, the map depicts the total count of Whim morning rush hour trips (bars) together with the bicycle mode share for each area estimated by the Helsinki transportation model (background color). Whim morning period trips are significantly higher in the areas estimated to have high or highest usage of bicycles. This implies that early adopters of MaaS are those who desire to use public transport in combination with bicycling. While the time series is too short to determine with an accurate degree of significance whether or not this tendency is stationary, it does coincide nicely with the other patterns of relationships between public transport and bicycling found in the Whim data.
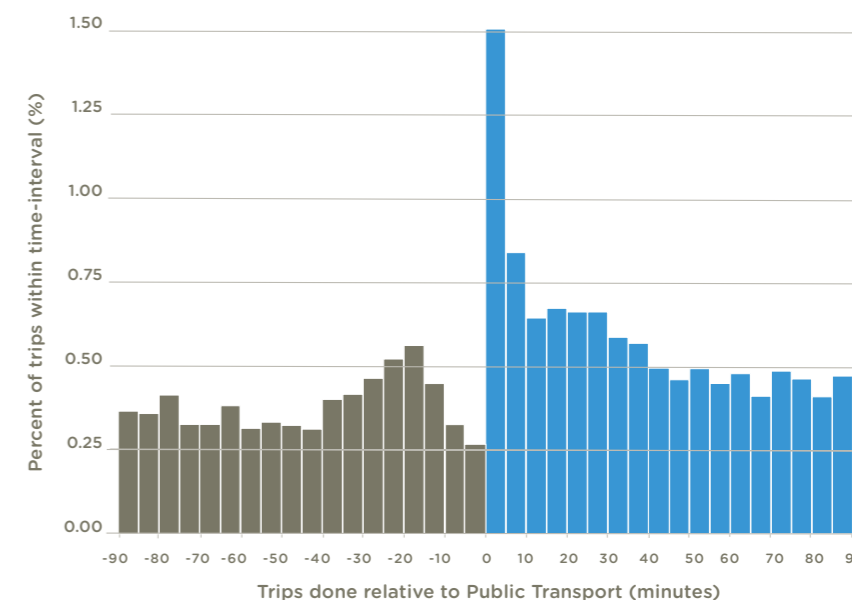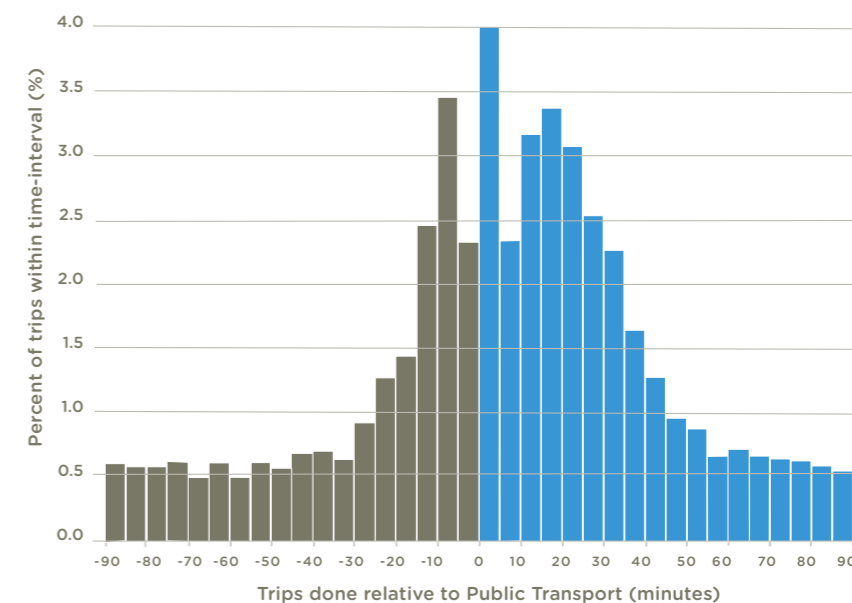
8.3

MAAS HELPS SOLVE THE FIRST/LAST MILE PROBLEM

12%

of bike trips are taken within 30 minutes before PT trip
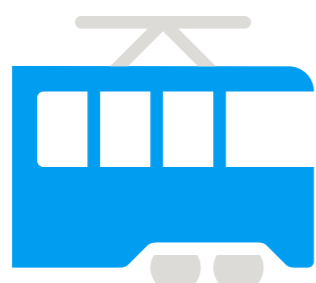
30%

of bike trips happen within 90 minutes after PT trip

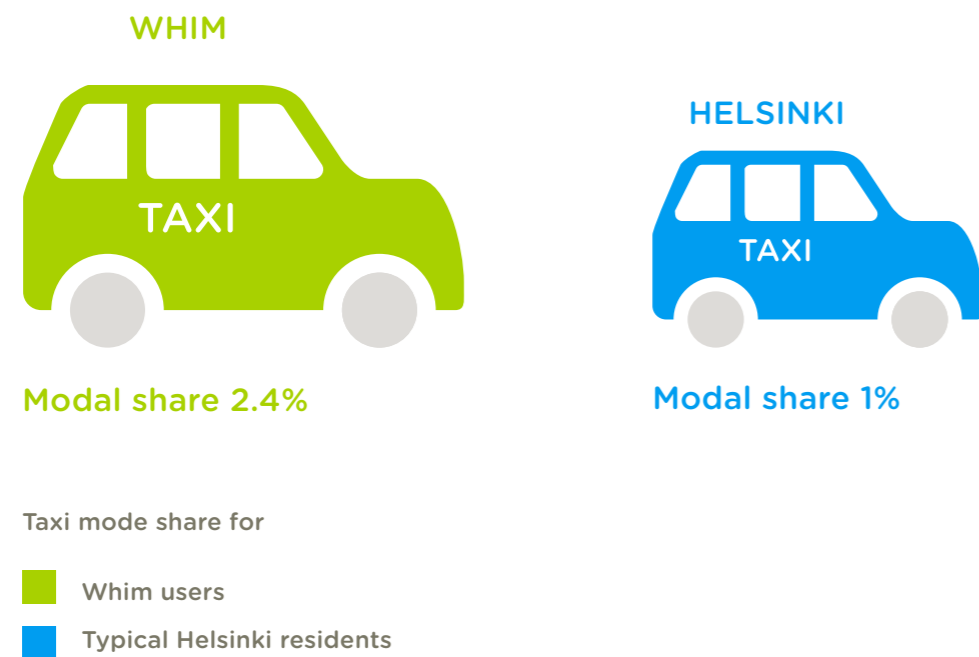Trip densities in relation to public transportation trip

Bicycle trip density increases just before and after public transportation trips, suggesting that Whim users know how to solve the last mile problem with alternative modes. The density of taxi trips does not seem to increase before the public transportation trip; however, it does so afterwards. Moreover, the total taxi trip distance almost never exceeds 5 km (the maximum allowable distance in the Whim service before additional fees apply). When considering these two characteristics of the Whim user data, it appears that Whim users are not only using bicycles and taxis to help them connect to and from public transport, they seem to be doing so more regularly than typical Helsinki residents. We suspect the convenience of using multiple modes in the same service facilitates this tendency.

8.4

TAXIS ARE A WELCOME OPTION TO MAAS USERS

Whim users travel by taxi **2.4** times more often than the typical Helsinki resident

WHIM

TAXI

Modal share 2.4%

HELSINKI

TAXI

Modal share 1%

Taxi mode share for

■ Whim users

■ Typical Helsinki residents

Whim users use 2.4 times more taxis than the typical Helsinki resident. The overall modal share of taxis in Helsinki among the control group is 1%. As the application does not record trips other than those made using Whim, Whim data have been normalized for comparison purposes with Helsinki residents in the Travel behavior survey. The closest matching user group has been identified from the Travel behavior survey, and the missing modal shares are copied from this same group of people.

Whim users use taxis for 2.4% of all their trips (including also trips outside Whim). This indicates that taxis have an important role within the MaaS ecosystem, as taxis fulfil a niche of mobility which public transport may not cover. This service may be a result of Whim users more readily including taxis in their daily travel choices. Furthermore, the mode share of taxis does not seem to be unsustainable, especially if the use of a taxi results in fewer cars on city streets. Moreover, if the use of taxis fulfils the needs of personalized mobility, it also reduces the parking demands in cities.

8.5

MAAS USERS MAKE SHORTER CITYBIKE TRIPS

Whim
1.9 km

HELSINKI
2.1 km

Average City Bike Trip Distances

Whim users

Helsinki City Bike average

The average trip distance for Whim users by citybike is 1.9 km. This is about 10% shorter than the 2.1 km distance for citybike users overall. This could be because Whim users are predominantly users in city centres, where distances between stations are shorter. The citybike season in Helsinki is from early April to the end of October.

Interestingly, the average duration among both user groups is roughly the same: about 15 minutes. Speeds closer to the city centre might drop a bit, which further supports the use of city bikes in the city centre. Overall Citybike data is understood to include a significant number of longer trips as visitors and residents use the bikes for leisure trips. Whim users may make shorter trips because they use bikes less for leisure and more as a part of their daily travel activities, such as using city bikes for last mile solution.

8.6

AVERAGE DAILY TRIPS OF MAAS USERS AND TYPICAL HELSINKI RESIDENTS ARE ABOUT THE SAME

Whim-trips avg per person	No. Of trips	Modal share %
Public transportation	2.15	73.1%
Taxi (from Whim data)	0.07	2.4%
Car (Trips added, Travel behavior survey)	0.2	3.4%
Bicycle + Walking (Trips added, Travel behavior survey)	1.0	20.4%
Total	**3.4**	

Control group avg per person (From HSL Data)	No. Of trips	Modal share %
Public transportation	1.6	47.6%
Taxi	0.03	1.0%
Car	0.2	7.3%
Bicycle + Walking	1.4	43.6%
Total	**3.3**	

Trip numbers and modal share among control group in Helsinki metropolitan area vs. Whim-users. 2.24 trips are made with Whim per day per user, but the missing modal shares are added from the corresponding control group.

■ Helsinki metropolitan area

■ Whim-users

Whim users make **3.4** trips per day

Although Whim users appear to make significantly more public transport trips than typical Helsinki residents, their total number of average daily trips is about the same. There has been some speculation that unlimited MaaS packages might lead to a major uptick in total trips — particularly by taxi — but the data suggest this is not the case. Indeed, not only are daily trip averages about the same, Whim users are more likely to choose public transport than the typical Helsinki resident.

As Whim does not capture all of the trip modes (walking, private cycling, etc.), a comparison to overall trip numbers in the Travel behavior survey data cannot be directly made. To make the comparison, the corresponding user subset is

excerpted from the data and the missing modal shares (car, private bicycle and walking) for Whim users have been matched to the Travel behavior survey's data. The table illustrating trip numbers in the Helsinki metropolitan area shows the average trip numbers for people with similar demographics. The added modal shares for Whim users are excerpted from a narrower sample, due to the fact that Whim users are predominantly from the city centre. This is admittedly a rough estimation to evaluate the total number of trips made by Whim users, but it does serve to demonstrate important relationships.

In the Helsinki metropolitan area, users with similar demographics make on average 1.6 public

transportation trips on weekdays. Whim users tend to make public transportation trips significantly more (2.15 trips) than the regional average, but the total number of trips does not increase above the regional average. This means that while the modal share of public transportation is higher, walking and bicycle trips are lower than average. We suspect that this might be because public transportation service levels are very high in the city centre, and some walking or bicycle trips are replaced with public transportation. However, the lower number of walking + bicycle trips is not a characteristic of Whim per se, but rather the control group of people from the city centre.

8.7

PUBLIC TRANSPORTATION IS THE BACKBONE OF MAAS

- PUBLIC TRANSPORT: 95.2%
- TAXI: 3.75%
- BICYCLE: 1.02%
- CAR RENTAL: 0.03%
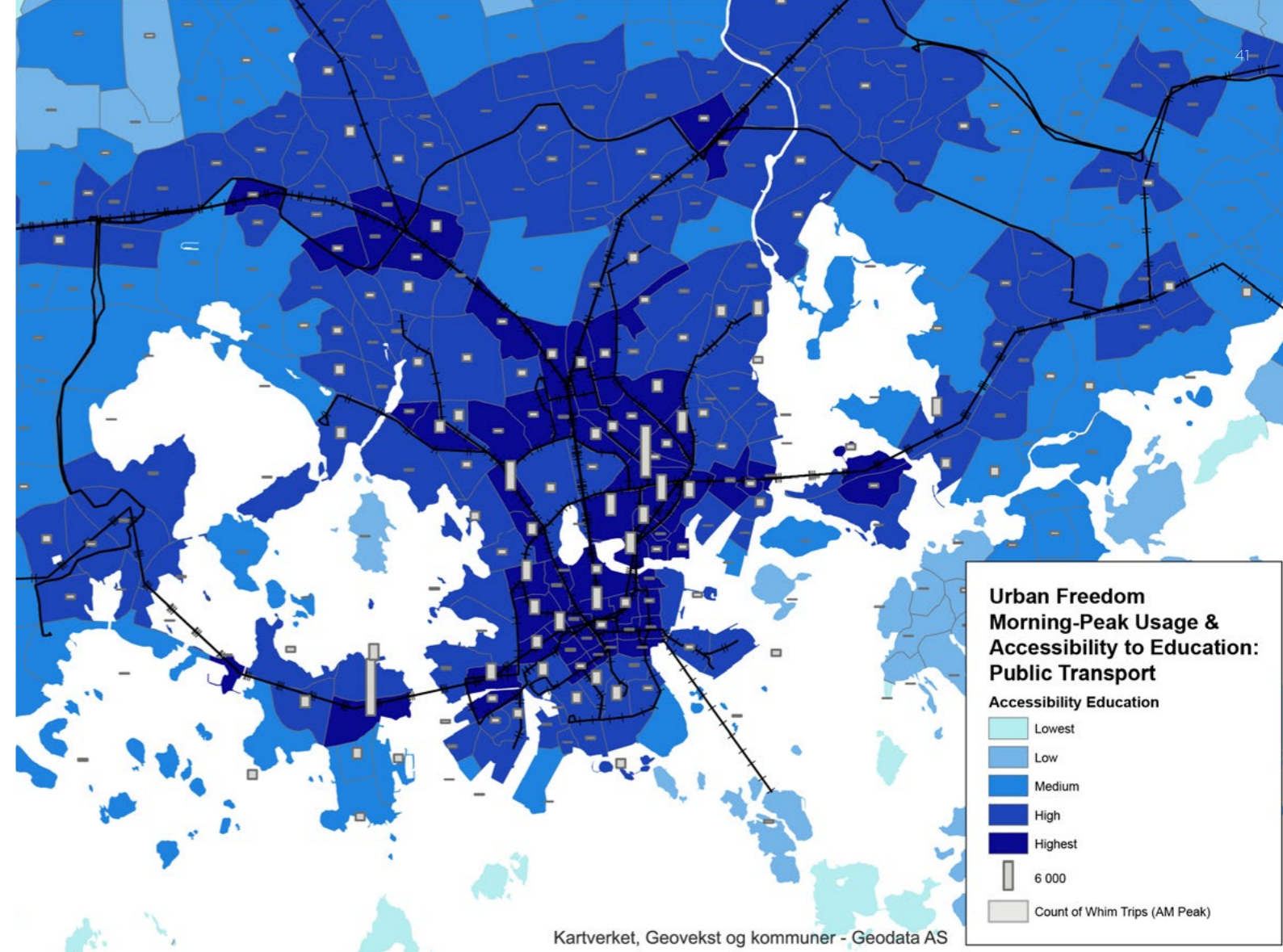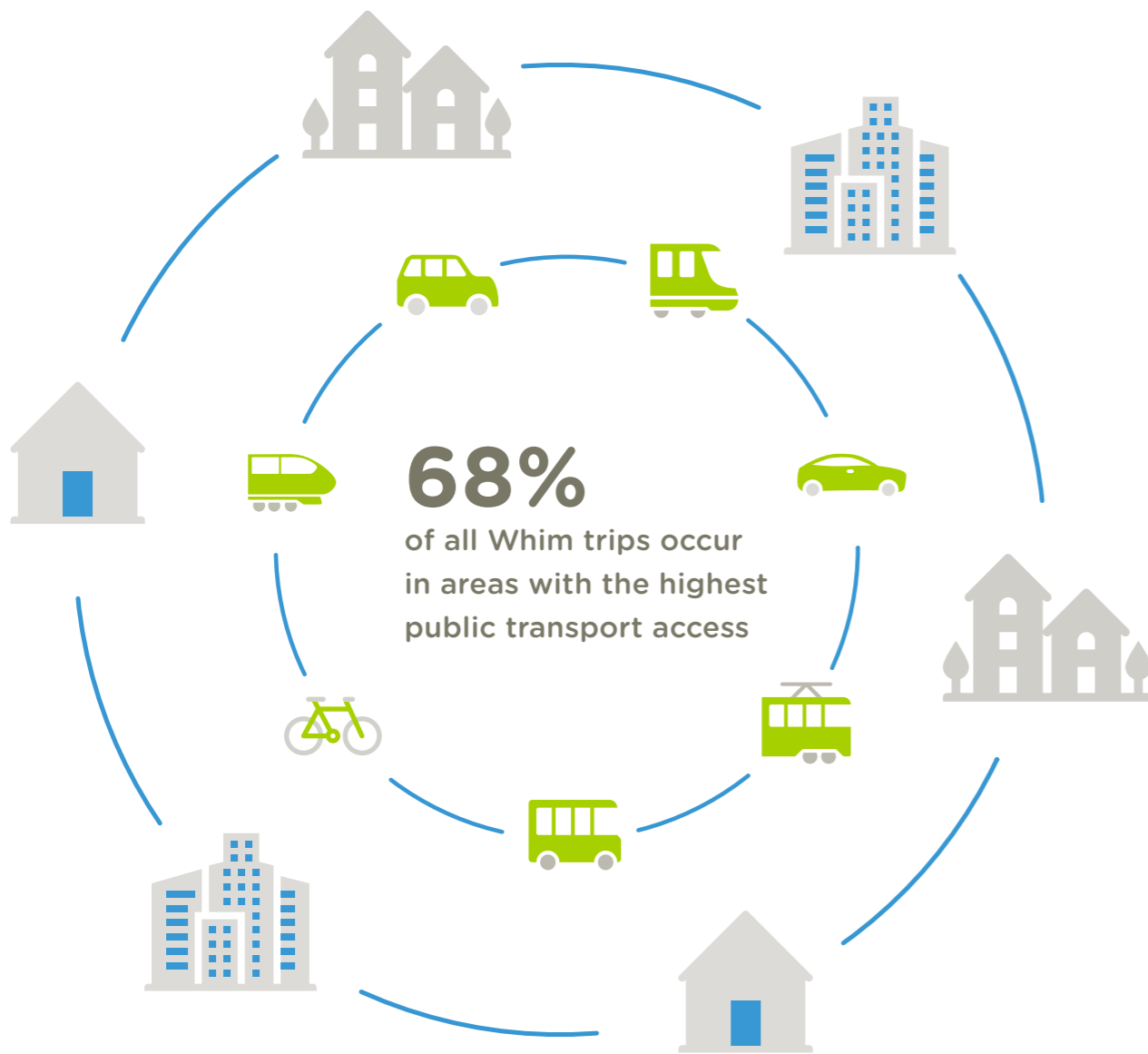- SHARED CAR: 0.001%
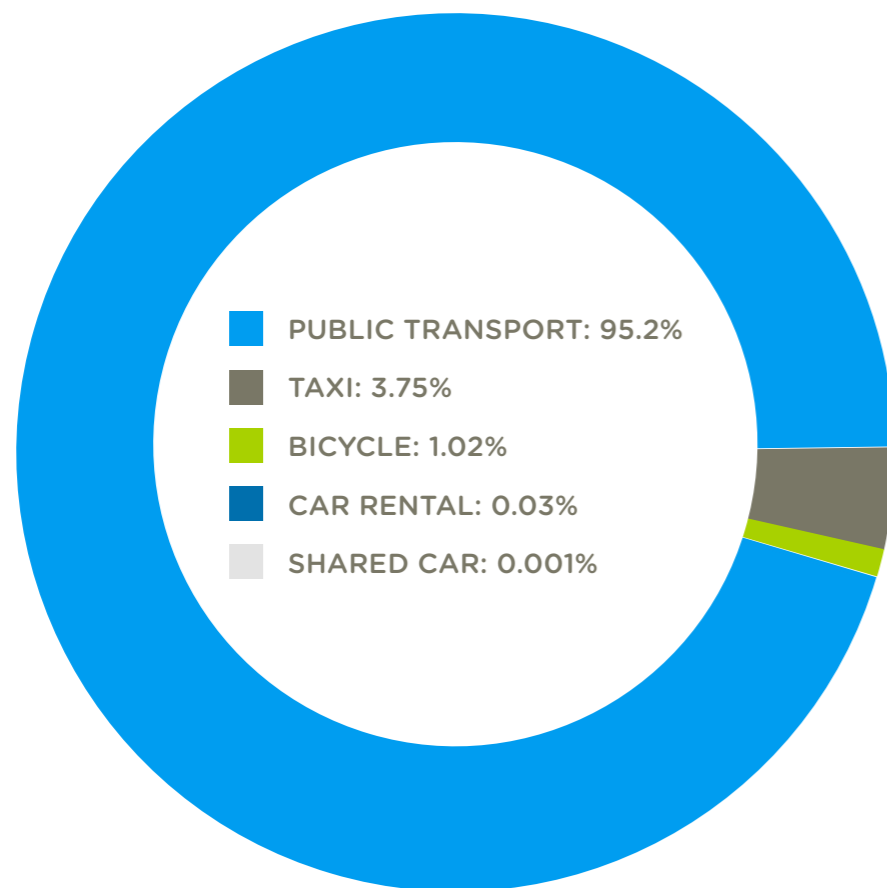
Modal share of Whim

95% of Whim-trips are made by public transportation. It is evident that public transportation is fundamental to a successful MaaS system. We estimate that the overall public transportation modal share for Whim users is 73% (including trips not accounted for in the Whim user database); for a comparable user group in Helsinki, this number is 48%. It should be noted that not all modes are represented in the Whim data set; for example, the data set does not tell us how many walking or private car trips a Whim user might take. Nonetheless, the initial findings suggest that the first Whim users tend to use public transportation a lot and that public transportation is the backbone of the MaaS system in Helsinki. A common concern about MaaS is that access to car-based options (e.g. car rental, car sharing, taxis) may encourage a car-dependent user base; as the vast majority of Whim trips are made by public transportation, the data do not seem to support this concern.

8.8

MAAS GROWS ALONG PUBLIC TRANSPORT CORRIDORS

68%
of all Whim trips occur
in areas with the highest
public transport access

**Urban Freedom
Morning-Peak Usage &
Accessibility to Education:
Public Transport**

Accessibility Education

Lowest
Low
Medium
High
Highest

6 000

Count of Whim Trips (AM Peak)

Kartverket, Geovekst og kommuner - Geodata AS

There is an overall strong relationship between public transport usage and the number of Whim trips in the same zones. Indeed, 68% of MaaS trips occur in areas with the highest Public Transport modal share. More specifically, Whim usage in the morning peak hour is concentrated in areas with the highest accessibility to jobs via public transport, although this concentration is limited to the inner city of Helsinki, at least in this first year.

The relationship between the jobs-accessibility via public transport and Whim trips illustrated in the map, where the background-colour represents job accessibility via public transport (ranging from low, represented as light blue, to high, represented as dark blue), and the bars represent the count of Whim trips in the morning peak period. The Accessibility is highest within the city region, and spreads out in the northern, western and eastern direction following the public transport lines. Even though Whim trips are concentrated in the inner-city area (and to some extent the south western public transport line), usage in areas with high job accessibility via public

transportation is higher overall than in the areas with medium-high or medium accessibility. Given this pattern, it is natural to assume that, as Whim grows, the growth will be largest in the areas with highest accessibility via public transportation, extending more readily along the public transportation corridors.
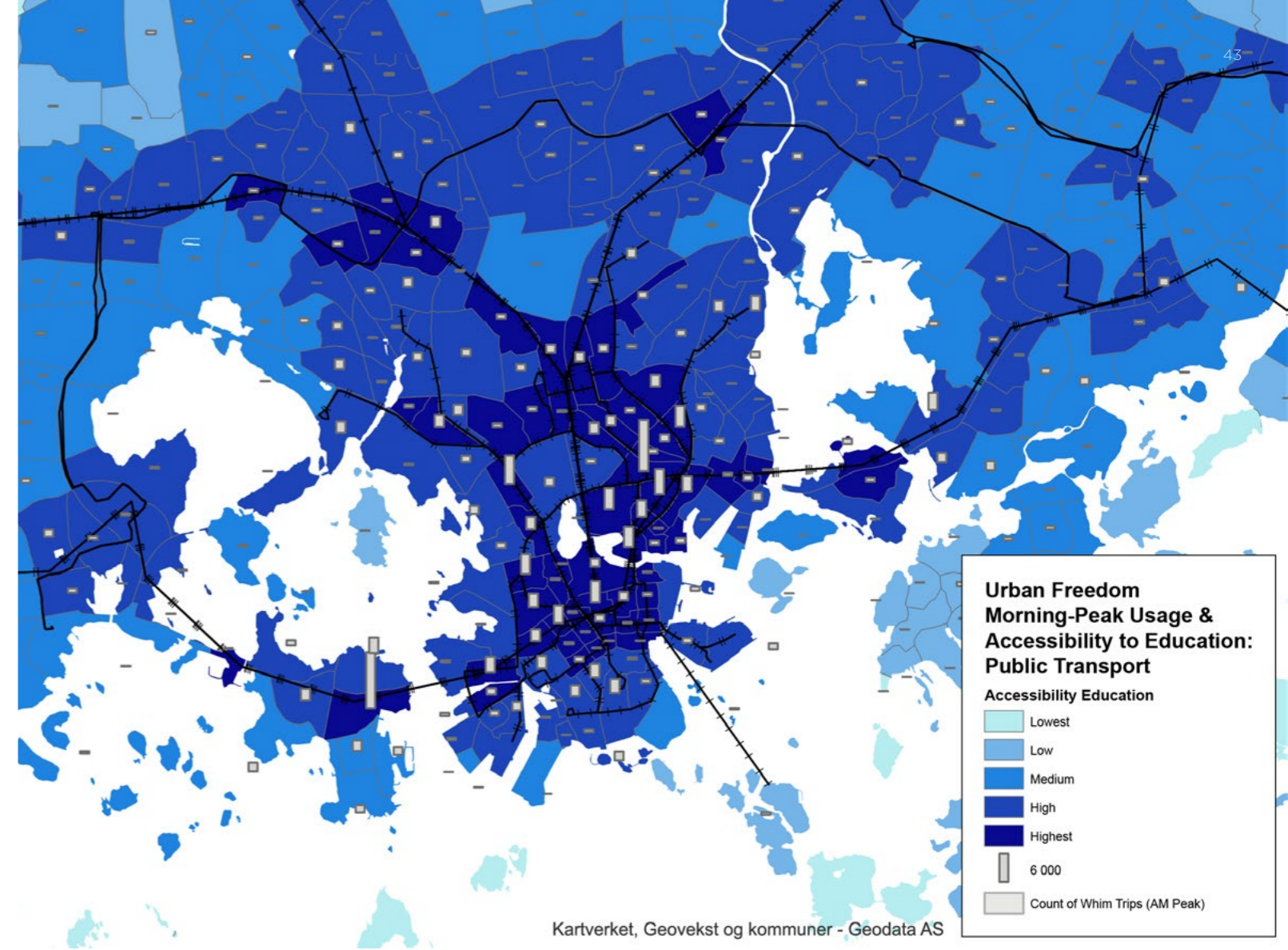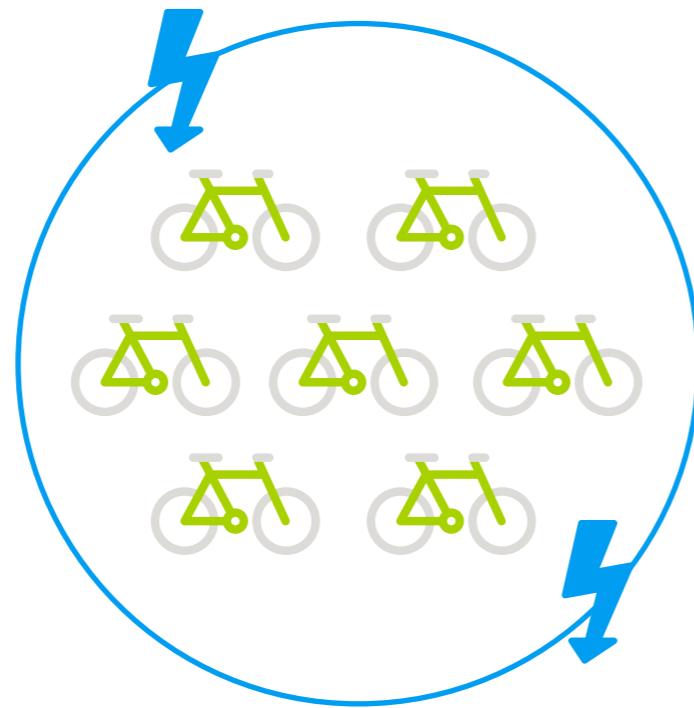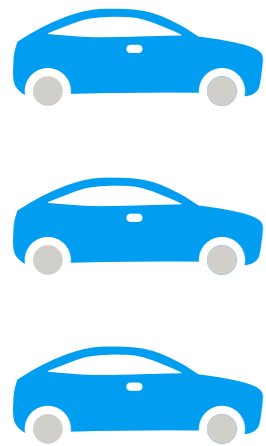
8.9

NEW TRANSPORTATION SOLUTIONS CAN REPLACE 38% OF DAILY CAR TRIPS

New Mobility options can replace up to

38%

of daily car trips

**Urban Freedom
Morning-Peak Usage &
Accessibility to Education:
Public Transport**

Accessibility Education

- Lowest
- Low
- Medium
- High
- Highest

6 000

Count of Whim Trips (AM Peak)

Kartverket, Geovekst og kommuner - Geodata AS

The early adopters of MaaS show a high preference for multimodal transportation. The most successful areas of usage of Whim correspond to areas with the highest accessibility by bicycle. If this tendency means that the lack of multimodal options has functioned as a restriction to growth in MaaS usage beyond the inner-city region, this restriction is likely to be eliminated as new multimodal options are introduced to the system. To give an illustration of how the introduction of new transportation solutions to MaaS may impact the current core area of usage, we have depicted the relationship between the reported Whim usage of 2018 together with the estimated accessibility gained from using E-bikes. To demonstrate E-bike accessibilities, we have re-estimated the bicycle travel costs by increasing the average speed from 15 km/h to 19 km/h. The increase in average speed correspondingly expands the area with high accessibility. Therefore, a theoretical introduction of E-bikes to MaaS is likely to increase the current core area of Whim far beyond its current boundaries.

8.10

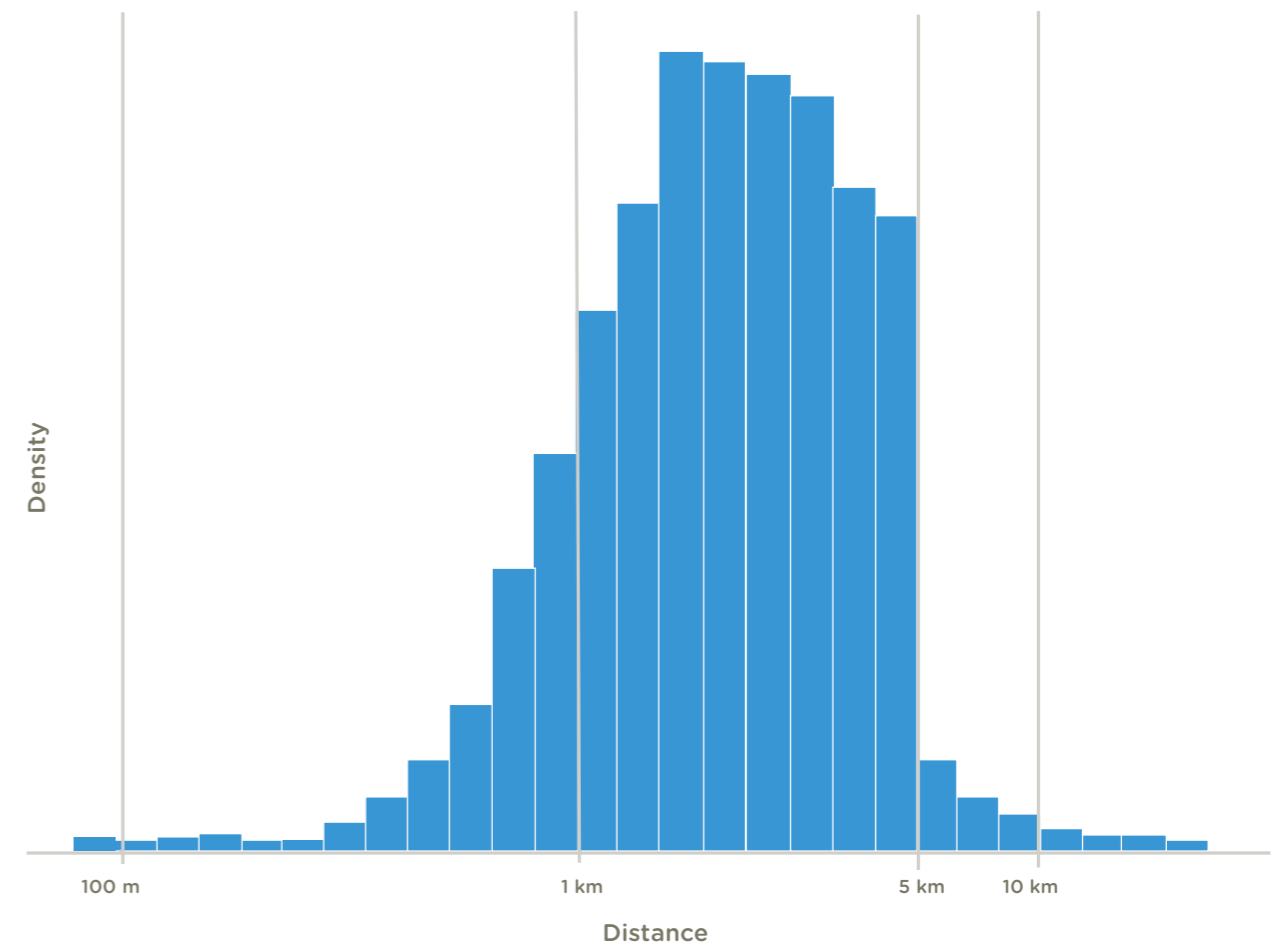## MAAS USERS PLAY BY THE RULES

🕐 < 30 min   🛣 < 5 km

🚲

97%
of bike trips are less
than 30 minutes

🚕 TAXI

87%
of taxi trips are less
than 5 km

Taxi trip density

The Whim Urban -subscription includes unlimited city bike trips, but only for one half-hour at a time. After that, additional fees apply. The Urban subscription also includes 5 km taxi trips for a maximum of 10 euros, which is a significant discount (5 km taxi trip would normally cost roughly 14-16 euros). The vast majority of the Whim trips with these modes are made within these restrictions, but rarely combine these trips in series to game the system.

These findings indicate that pricing clearly affects mobility behaviour, as indicated in the trip density chart depicting a steep fall-off of taxi trips beyond the limit of 5 km. It may not be a

surprise that users will want to benefit from the discount; this is a reminder that with pricing, MaaS users can be influenced towards more sustainable modes of transportation It should be noted that 5.1% of bike trips are chained together. In other words, a second bike trip is taken immediately after the previous bike trip. This most likely happens because users are avoiding additional fees, which apply beyond a 30-minute bike ride. However, since this number is overall quite small, it does not represent a significant phenomenon. With taxis, the phenomenon is practically non-existent, with only 0.5% of taxi users taking another taxi right after the previous one.

8.11

RENTAL CARS ARE PART OF MAAS DAILY TRIPS

900 trips
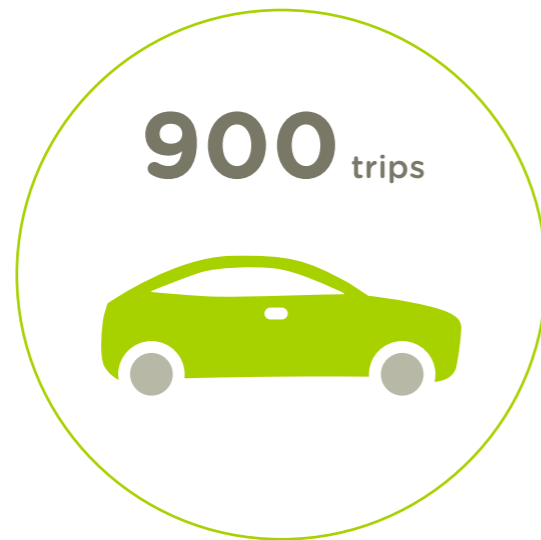
While the total number of car rental trips in the Whim data set is comparatively small, a growing number of Whim users are including rental cars to their trip planning. It has also been noted that several Whim users find the availability of rental cars an incentive to offset car ownership. While small, the numbers suggest that MaaS users are open to the idea of using car rentals, and are likely finding the options as an alternative solution to owning a car for infrequent trips.
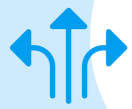
PROSPECTS OF MAAS

MaaS does not change the transport system itself; rather, it facilitates a more dynamic and inclusive use of the existing one.

In the field of transportation, peer-to-peer, business-to-peer, and business-to-business applications may be designed as platforms, but most are not able to offer the different travel modes that people need in their everyday life — at least not yet. Often these platforms are focusing only on rideshare, chauffeuring services or just equipment rental, and one would need a separate subscription — and app — for each of them. Whim is arguably the first attempt to offer all of these services from single application, and therefore could be understood as an 'umbrella application', which may cover other platforms — offering a more limited range of transportation options — as well.
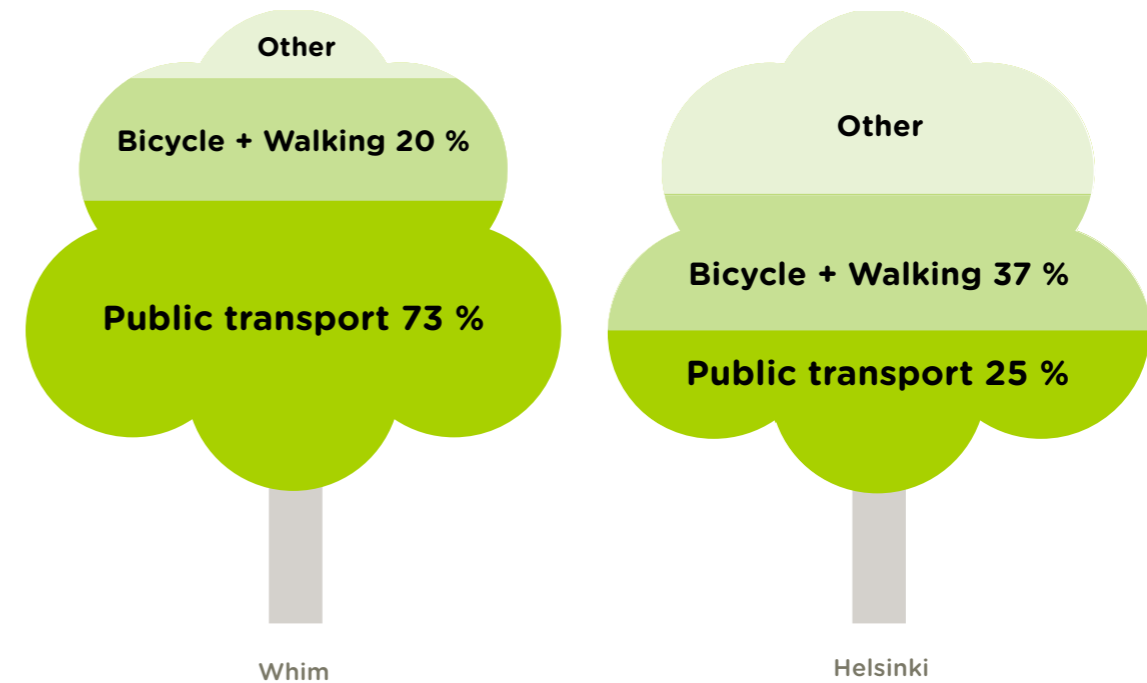
The world continues to urbanize, and cities are facing massive challenges to keep up with the growth with their transportation systems. Through MaaS-platforms, users have the possibility to access a variety of different transport modes, which covers an individual's mobility needs. Platforms could not only combine the different modes, they could also be the "distribution channel" for new mobility services. This has been the case in other industries, such as new content creators in social media, shopkeepers in internet retail, and so on.

A traveller must take physical, cognitive, and affective efforts to prepare and undertaking a journey (Stradler 2006). Lyons et al (2019) suggests that travellers would seek a trip alternative which requires beforementioned efforts as little as possible, which calls for easy planning, booking, payments and ultimately, execution. This has been elaborated, for example, In The Finnish Transport Agency's (FTA) study of travel chains from 2018, where it was highlighted that multi-phase planning and

challenges of buying a ticket are the most hindering factors of the trip. Information is often fragmented, and passengers do not often have a clear understanding or enough information how public transportation works if they are heading to an unfamiliar city. The lack of proper information seems to be one of the biggest factors causing stress for passengers. To use public transportation in an unfamiliar city, one must solve multiple aspects of the trip, for example where does the public transport lines leads, timetables, closest station, price of the ticket and where to buy the tickets. These travel components expend cognitive efforts.

Respectively, the FTA study illustrates that the real-time information, easy to find prices and timetable comparison reduced the stress most. Minimizing stress and uncertainty brings added value to passengers, and passengers wished especially the ability to purchase ticket for the whole journey from a single place. MaaS is answering almost directly this need. With MaaS, the user can have better access to different means of transportation, including renting a car when in need. However, MaaS does not change the transport system itself; rather, it facilitates a more dynamic and inclusive use of existing one.

Over half of the trips made in Helsinki are made by sustainable modes of transportation (Walk, cycling, bus, tram, train, metro). Assuming that most MaaS users might come from this user segment, the MaaS users are mostly using sustainable and city-friendly transportation modes. In addition, as MaaS lets users access alternative modes more easily when they need to, it may attract those users who are thinking either buying a car or give up a car. One of the

Other

Bicycle + Walking 20 %

Public transport 73 %

Whim

Other

Bicycle + Walking 37 %

Public transport 25 %

Helsinki

Average Sustainable Transportation Modal share of Whim users compared to the Helsinki city sub-set of the National Travel Survey

aspect of this is the increased taxi use, and it does really seem that MaaS users are more willing to use taxis. However, if users would switch from owning a car (and making most of the trips with it) to making trips predominantly with public transportation and occasionally with taxis, ultimately this would decrease the car ownership, vehicle mileage, and need for parking. As Whim users' total amount of trip numbers seems to be approximately the same than non-Whim users simultaneously when the public transportation modal share is significantly higher, this will have an impact to their carbon footprint as well. In the future the impact of MaaS to CO_2 emissions may become more evident and evaluated more closely.

As it is often case with mobility, many of the findings in the travel behaviour are directly linked to land-use and existing public transportation network. As the backbone of MaaS ecosystem — at least in Helsinki's case — is the public transportation, it is natural that the big part of user segment comes from the areas close to high accessibility to public transportation. The findings show, that new mobility alternatives and businesses seems to be forming and growing around densely populated area with good connections via public transportation.

The existing city structure and the network of public transportation does have a big role, but the MaaS — at its best — could be one of the last missing pieces for the long lasted last mile problem.

Our initial findings show, that new mobility methods and platforms seems to succeed in mode rich, densely populated urban environment with high accessibility to retail, commerce, and jobs. In addition, the popularity of MaaS correlates strongly with accessibility by bicycle. As new transportation modes are invented and kept adding to this platform, this finding might change in the future, but in the meantime, it can be concluded that MaaS allows the more holistic use of existing transportation system.

10

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11

APPENDIX

While the insights provided in this report offer a first glance at the user habits and trip characteristics of a real-world MaaS system, there are a host to challenges to the available data identified that must be clearly stated and shared with the reader.
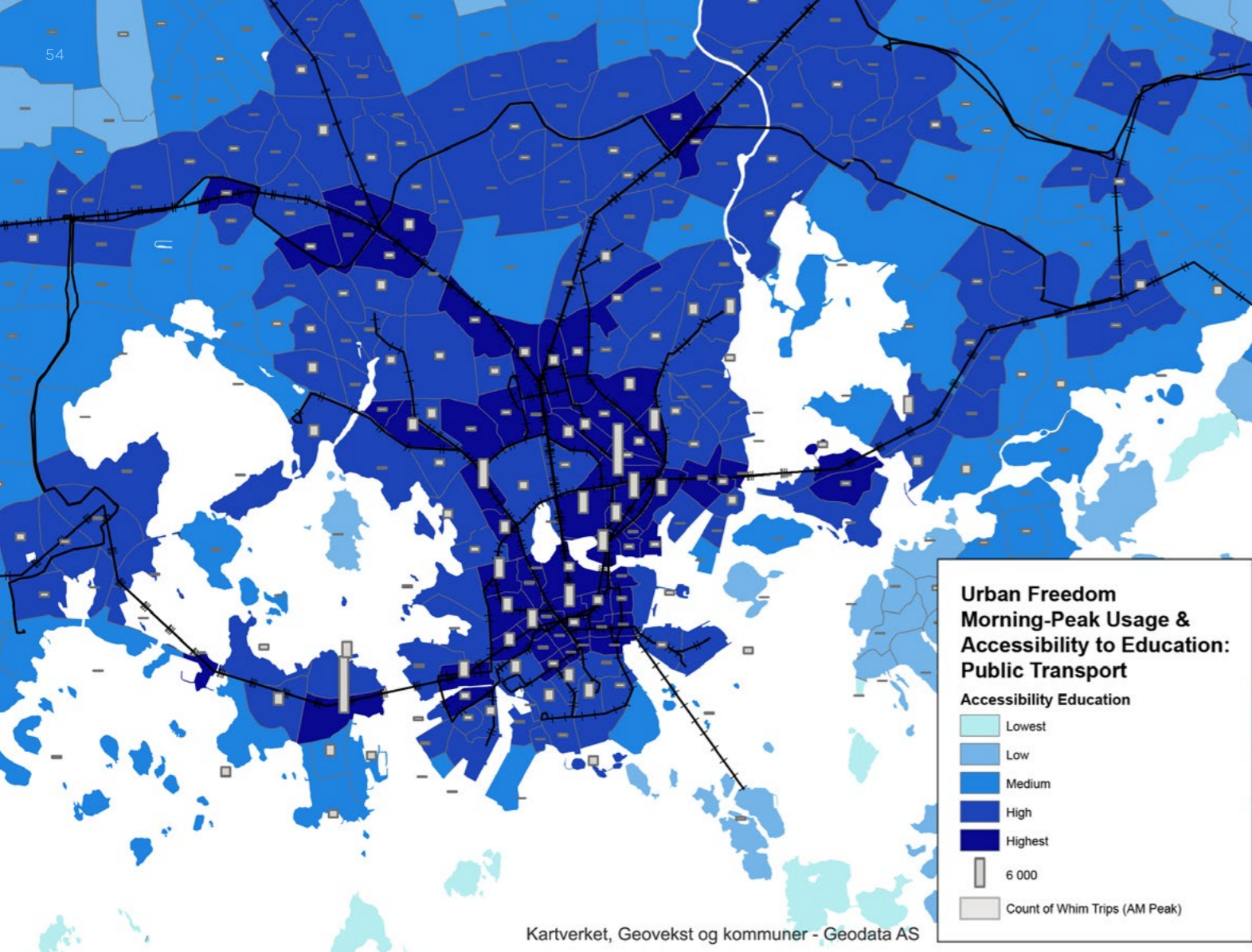
These challenges, while limiting the depth to which inferences can be made from the current data set, do not categorically prevent some early insights from being made. Moreover, they point to opportunities to improve the outcome of future assessments. Nonetheless, limitations do exist. These are listed and explained more in detail below:

- First Marketing Campaign in December 2017: While in operation from 2016 for limited number of users, the hard launch of Whim-application occurred on November 2017, after which a very large increase in users occurred in a short period of time. Subsequently, trip data differ significantly before and after the official marketing campaign. We anticipate that customer counts may see steps in future years during marketing campaigns, but not nearly as significant as those in this first year. Moreover, more than 50% of all users joined within the last six months of 2018, which means that we are studying a growing system that may not reveal features when the service has matured further.

- Continuous User Growth in 2018: Throughout the year, steady growth in users skews the trip data towards the end of the year. Therefore, reliable assessments related to monthly or seasonal activity would not be valid for 2018. While Whim will continue to experience growth in coming years, the impacts of that growth should not be as significant as those in 2018.

- Early Adopters Likely Over-Represent: The data must be understood to represent the very early life of a new service that is little understood by the public, requires a high level of proficiency with technology, and, at least in Helsinki, has no service analogue. As is the case with most new concepts, it is therefore expected that many of Whim users are more adventurous, more experimental, and less fixed in their ways than public at large. Hence, we expect that early adopters are very likely over-represented in the data. This limitation is somewhat buffered by the economically attractive feature of Whim offering — if nothing else — a monthly public transport ticket that is slightly cheaper than the regional public transport agency's price; however, the technology and concept characteristics very likely skew the user demographics to so-called early adopters.

- Demographic Segments Likely Excluded: Since the initial ticket-reselling options offered by the regional public transport agency did not allow equivalents for student and senior monthly tickets, these demographic segments are likely underrepresented in the Whim data set. To illustrate this point, depicts the accessibility to education (background colour ranging from lowest to highest accessibility) together with the total morning rush Whim sales in 2018. The figure depicts how there is a generally high access to education for the majority of the inner city of Helsinki which coincides with the areas with the highest number of sales. However, this apparent correlation breaks down as the University campus
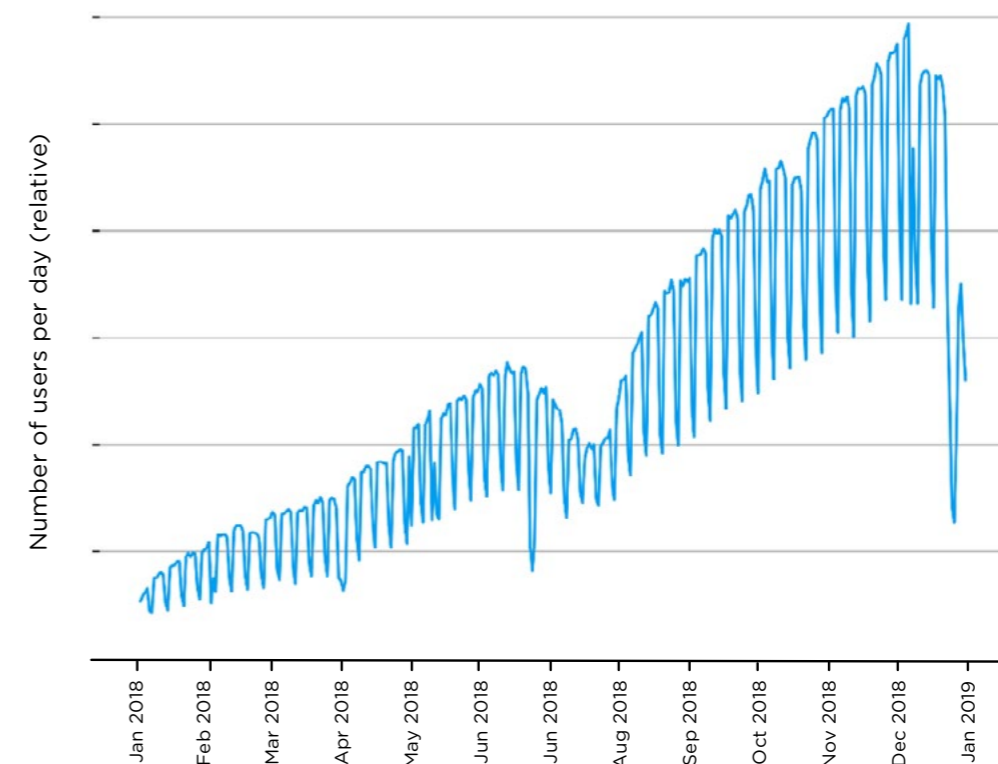
Number of Whim users increased steadily in 2018

of Aalto University (in the south-eastern part of the city) is significantly under-represented in Whim trips bought despite having a high accessibility to education by public transport. This deviation from the more common parity between the referenced criteria seems to indicate that students, and possibly seniors, are likely excluded in significant numbers from the Whim data set. In future years, it may be possible that package bundling or the ticket re-selling terms allow for a more attractive offering to these demographic groups.

- Whim Unlimited User Trips Statistically Insignificant: The total number of full subscription users and their trips (Whim Unlimited) is, in most cases, still too small to glean statistically significant findings. For our analyses, we excluded this subset of trips to prevent their travel behaviours (which are significantly different from the other two tiers) from skewing the findings. In 2019, it is very likely that a more elaborate assessment of Whim Unlimited users could be conducted.

- Total Trip Count of Some Modes Statistically Insignificant: The total number of trips for some modes, such as car rental, is in most cases still too small to glean statistically significant findings, especially when comparing between other modes for example, for evaluating trip chaining. For our analyses, we paid less attention these subsets of trips to prevent a skewing of the findings. In 2019, it is very likely that a more trips in these modes will allow a more elaborate assessment of Whim users to be conducted.

- Origins & Destinations are Based on Ticket Purchase Location: The Whim database maps the geographic zone of ticket purchase events to individual trips, rather than the specific start or end point of a trip. While these locations reasonably estimate trip starts (since users likely don't buy a ticket until they are within reach of the trip start point), it is not strictly the "origin" or "destination" of a trip as understood in transportation planning studies. This is not only a limitation of the Whim database it is also an intentional result of the GDPR requirements

**Urban Freedom
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Public Transport**

Accessibility Education

	Lowest
	Low
	Medium
	High
	Highest

6 000

Count of Whim Trips (AM Peak)

Kartverket, Geovekst og kommuner - Geodata AS

- Mismatch of Modes between Whim and Helsinki Data Sets: Since the Whim data set is based on trips of Whim customers, it inherently ignores any travel that is not immediately connected to the platform; therefore, all suer trips on foot, by personal bicycle, by personal car, as a passenger in someone else's car, as a passenger in a taxi paid for by someone else, etc., are all absent from the data. This makes it extremely difficult to compare Whim user data side by side with the travel data available from government authorities which are more comprehensively collected, for example, in the form of travel diaries. Conversely, publicly available trip data regularly combines trips in rental cars and car-share vehicles with private cars, thereby making it difficult to compare car travel habits between the data sets as well. Future comparative analyses between Helsinki baseline and Whim data require improved coordination with local authorities in advance of the data collection stage and consensus on how modes from each data set can be confidently mapped.

- Whim Terms of Service Idiosyncrasies Skew Travel Patterns: Some constraints are placed on Whim users to prevent the misuse of the service. For example, Whim users are provided access to taxi services, but in some tiers this is limited to a maximum distance of 5km or 10 minutes, after which point the standard rates apply. We see the effects of these artificial limitations to travel patterns in the dramatic deviation from the standard in Whim taxi trip distances. Similarly, the 30 minute bike-share time limitation results in few trips by this mode exceeding that threshold (although, this is the same artificial limit placed on the general bike-share system). Another example is the early "loophole" of users purchase additional tickets simultaneously; while some of these transactions may have been user error or a misunderstanding of the terms, some users may have been offering free rides to others (a clear breach of the terms). This latter example was mitigated by preventing the purchase of multiple tickets within a given time frame.

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Helsinki Transportation Model and
Travel Behavior Survey was provided by
Helsinki Region Transportation.

Maas GLOBAL

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in Europe. In future assessments, it could be possible to ask a certain subset of users to agree to certain data privacy terms that improve the geospatial tracking of users for study purposes.

- Trip Purchase Method Impacts Mode Assignment: In Whim, it is possible to buy individual tickets, or to use the built-in Travel Planner to serve up trip suggestions. In the former case, Whim is not able to discern, for example, which type of public transport might ultimately be used as the same ticket can not only be used on train, tram, bus, ferry, and metro, it can be used to transfer between modes within a specific time period. In the latter case, Whim assigns trips based on the selected combination of modes chosen from the Travel Planner, but has no way of knowing these are ultimately the combination of modes used. The result is an inaccurate representation of the actual public transport modes used. This

assessment attempts to limit the impacts of this characteristic of the Whim data set by combining all public transport trips into an agglomerated "Public Transport" category.

- Data Privacy Limits Resolution: European data privacy terms (GDPR) prevent the use of user-specific identifiers, as well as detailed information about geospatial position and temporal activities. For example, ticket purchases are assigned to zones rather than more detailed latitude and longitude coordinates. Therefore, the resolution to which it is possible to evaluate trip behaviour is limited. This impacts the ability to get a clear picture about trip origins and destinations, as well as trip chains. In future assessments, it could be possible to ask a certain subset of users to agree to certain data privacy terms that improve the geospatial tracking of users for study purposes.

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