UMAM Roadmap Report 2020 – Eindhoven

Elaborated by

University College London

BABLE

CARNET Barcelona

CTAG

EIT Urban Mobility

Funded by the European Union

Document information

Author(s) and contributing partner(s)

Name	Organisation	Contribution
David Fernandez	CTAG – Automotive Technology Centre of Galicia	Author
Jantine Claus	Eindhoven	Data submission
Philipp Schmitz	EIT Urban Mobility	Review

List of abbreviations

C-ITS	Cooperative Intelligent Transport Systems
DRT	Demand Responsive Transport
EV	Electric Vehicles
GHG	Greenhouse Gas
LEZ	Low Emission Zone
MaaS	Mobility as a Service
MCC	Micro Consolidation Centre
PPP	Purchasing Power Parity
PT	Public Transport
TOD	Transit Oriented Development
UCC	Urban Consolidation Centre
UMAM	Urban Mobility Assessment Model

Contents

1. City Context

Eindhoven is the fifth largest city in the Netherlands, with a population of 233.983 inhabitants in its core city (88.87km^2) and up to 780,000 in its large metropolitan area, also known as Brainport Region. About 60% of all trips generated per day are made by active modes (walking and cycling), while 35% are made by car[1].

The public transport network consists of 2 rail stations that connect Eindhoven with the main Dutch cities, and up to 25 city bus lines which also serve neighbouring cities.

In 2013, the city embarked in the process of developing its Sustainable Urban Mobility Plan, referred as 'Vision Eindhoven-on-the way' (*Visie Eindhoven op weg*)[2]. Recently, in 2020, the metropolitan area of Eindhoven started in to define a Regional Mobility Agenda and Implementation program, setting up a common 'Mobility Target' for all municipalities within the region[3].

This plan is characterised for being developed through a collaborative approach between the multiple stakeholders within the Eindhoven Metropolitan Area (public authorities, industry, research institutions and interest groups). All of them are working together on its implementation.

The plan focusses on 6 key topics:

- International connectivity with economic centres to strengthen the local economy
- Accessibility in a daily environment
- Liveability, road safety and sustainability
- Stimulating smart mobility in the region

[1] Provided by the representative of the city of Eindhoven as part of the UMAM assessment 2020
[2] https://www.smartwayz.nl/media/1149/eindhoven-op-weg.pdf
[3] https://metropoolregioeindhoven.nl/thema-s/mobiliteit

- Linking mobility with other topics such as economy, energy-transition and rural area transition
- Logistics

These six categories are linked to several main objectives and topics, from which the following are key considerations for the UMAM assessment: Urban Strategy, Accessibility, Cycling strategy, Public Transport, Logistics, Parking, Smart Mobility, Shared Mobility and Public and Green Spaces.

2. UMAM Scoring

2.1. Policy and Innovation

The objective of this dimension is to analyse how city authorities manage urban mobility and their policy making process. This is done by analysing public policies, actions and protocols that are developed to think about the mobility of the future, today. The importance of this indicator is to be the first approximation of the strategies of cities, as a regulatory body and manager of urban mobility.

The analysis model is divided into three dimensions: mobility of people, mobility of goods and innovation.

Mobility plan

Mobility plan and policy making is analysed in the dimensions of network city integration, public transport service, reduced mobility, touristic plan and resilience and sustainability in terms of policy development and implementation. Each of the five dimensions is analysed using a scale of 1 to 5[4] depending on its level of implementation in public policies defined according to:

- Analysis of problems and opportunities concluded: working structures set up, planning framework defined, analysis of mobility city environment- 1
- Vision, objectives and targets agreed: build and assess scenarios, vision and strategy developed with stakeholders, indicators and targets are set- 2
- Policy adopted: measures/actions/projects are bundled and run through stakeholders, agree actions and governance for implementation agreed, develop implementation plan and finance - 3
- Measure implementation evaluated: actions and projects start implementation, outcomes are monitored, change management implemented, communication strategy deployed, plan reviewed - 4
- Process has iterated and it counts at least with 2 policy cycles - 5

Cities with values between 1 and 2 will be those with greatest room for improvement, while those with 4 or 5 already have a more consolidated position. This is due to the

[4] A letter N is shown where data was not submitted or is not available.

progressive character of the policy making process based on the stages of the Sustainable Urban Mobility Plans.

Freight mobility plan

Freight mobility plan dimension is analysed based on the sub-dimensions of last-mile policies, delivery timings, virtual loading bays, digital management and resilience, and sustainability. Each of the five dimensions is analysed using a scale of 1 to 5 levels depending on its level of implementation in the public policies as defined above.

Innovation

The last dimension of the analysis is innovation. This is key to understand how the capacity and willingness of each administration is to seek and implement new mobility proposals in the city. The analysis is done by considering its innovation objectives, as well as the practice through the example of pilots already carried out. The ratio between total euros and number of pilots is also calculated, to understand an average value per pilot and the importance of each pilot project.

2.2. Transport Supply

This dimension analyses the infrastructure provision within the city and how well it supports a transition towards sustainable mobility. It analyses the availability of different modes within the city and how some infrastructure has been introduced. It is important in that it assesses the current situation and enables more detailed analysis with respect to criteria in other dimensions (e.g. modal split within transport demand). It further helps determine what kind of policies might be most beneficial in terms of infrastructure investment, improving accessibility and what the focus for provision of transport should be when considering availability of sustainable options for individuals.

Each one of the transport modes can be assessed both separately and as part of the total provision in the city. Each mode is scored separately using threshold values and allocating a score from 1 to 5 for each threshold. Additionally, UMAM assessed car ownership, number of charging stations, service reliability, and the number of consolidation centres (to show availability of last mile infrastructure).

2.3. Transport Demand

The transport demand section explores how the city is performing in terms of number of trips conducted by different modes of transport and the annual congestion levels which represent the additional travel time drivers experience compared to a free flow traffic situation with no congestion. Transport demand indicators provide an overview on how well the transport system of a city is performing, which can lead to insights regarding the improvement of traffic conditions and the modes of transport that are better suited to support sustainable mobility.

Within the modal split category, the aim for cities should be to achieve higher modal share for sustainable modes (i.e. active modes, public transport, sharing mobility) as opposed to private vehicles. The thresholds of scores for the different modes (1-5 based on the index) show whether the score for each mode is positive or whether there should be additional work and targeted intervention for this in particular. The criteria measured within Transport Demand is modal split and traffic flow and efficiency.

2.4. Data

The goal of this dimension is to analyse how city authorities divulge urban mobility data. The importance of this indicator lies on how best to benefit from the huge data flowing in our cities and determine recommendations to strengthen urban mobility. UMAM focuses on certain data types: travel behaviour, real time disruption, air quality, socioeconomic data, active travel, motorised traffic, public transport and road and street congestion. Each of these types is then assessed according to the actions taken in regard to their collection and availability: data collected, public authorities management, data availability to third parties, open data and data availability for application development. Each of one of these actions correspond to a point in a 1 to 5 overall score for each type of data.

2.5. Environmental Aspects

The goal of this section is to consider the environmental impacts of urban mobility systems on a local level. Currently, the transport sector emits 27 % of the European GHG emission[5]. But, decreasing local emissions does not only contribute to the current main

[5] https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases/transport-emissions-of-greenhouse-gases-12

political targets of the European Union (e.g. Green Deal) to reduce the global emissions but also to the quality of life of citizens.

The indicator considers four sub indicators: the presence of low emission zones, data on the European Air Quality Index, Green House Gas Emissions, and noise. The data cities input for these sub indicators are matches to a threshold and scored from 1 to 5.

2.6. Social Aspects

The objective of this dimension is to analyse how well urban mobility systems meet the needs of end-users from a social perspective. This is done by taking into account how people live and interact with mobility systems and infrastructure in their city, including socioeconomic and physical considerations.

The importance of this indicator is to be the first approximation of how closely aligned a city's mobility system is to the needs and desires of its users from a social perspective.

The analysis model is divided into four dimensions for assessment according to its objective in order to provide a holistic understanding of how well the system is meeting social needs: pricing of public transport, accessibility, traffic calming and traffic safety. The data is allocated to thresholds, which are link to a score from 1 to 5.

2.7. Roadmaps

After data is submitted, the UMAM score is generated. A brief literature review is completed to capture basic information of the city. With the information provided through the UMAM tool and the literature review, a roadmap is produced for each city. The roadmap follows a Avoid/Reduce, Shift/Maintain, and Improve approach.

The approach, known as A-S-I (from Avoid/ Reduce, Shift/Maintain, Improve), seeks to

- achieve significant GHG and air pollutants emission reductions,
- reduced energy consumption,
- less congestion,
- while increasing the levels of physical activity through walking and cycling as a daily mode of transport,
- more efficient use of public space,
- better accessibility, with the final objective to create more liveable cities.

Avoid/Reduce: Activities that are considered for this column are aimed to improve the efficiency of the transport system through integrated land-use planning and transport demand management, to reduce the need to travel and the trip length. There is a negative correlation between the activity and the objective, for instance: reduce car dependency in transport supply or demand to improve the city scoring.

Shift/Maintain Activities are aimed to improve trip efficiency, while encouraging modal shift from the most energy consuming urban transport mode (i.e. individual motorised transport) towards more environmentally friendly modes. There is a positive correlation between the action and the indicator, for example: Maintain and continue gathering Environmental data to keep the city score high.

Improve Activities focus on vehicle and fuel efficiency as well as on the optimisation and innovation of transport infrastructure and network. There is a beneficial correlation between the action and the scoring, for instance: improve stakeholder engagement practices for the city to achieve a higher score.

Additionally, each action is professionally assessed in terms of timeline and complexity. As regards timeline, the options are short, medium or long term, which can roughly be interpreted as 0-1, 1-3 and +3 years. Complexity is assessed at a high level according to the resources needed to implement such measures.

The analysis has been conducted on the basis of the data provided by the city of Eindhoven using the UMAM online platform. The overall score of the UMAM assessment tool for the city of Eindhoven is 3.6.

Figure 1: UMAM scoring for the city of Eindhoven

3. UMAM Roadmaps

3.1. Policy and innovation

The Strategic Mobility Plan for the city of Eindhoven scored 3 out of 5. All indicators for the following dimensions: Network City integration, Public Transport Service, Reduced Mobility and Resilience and Sustainability dimensions scored 4. The Tourist Plan indicator was assigned the score of 1.

The Strategic Freight Plan for the city received the score of 2 for all indicators: Last Mile Policies, Delivery Timings, Digital Management and Resilience and Sustainability. During the data collection for the UMAM Assessment 2020 the city could not refer to an exact number of innovation pilots innovation pilots during the last 12 months in the new mobility sector.

Recommended actions

Within the Strategic Mobility Plan of the city of Eindhoven, more focus could be given on plans for the tourists of the city with specific measures to be included in the Action Plan of the city's transport policies.

An example of such an intervention is the introduction of discounted transport fares for the tourists of the city or a certain number of free rides. Any tailored advice on navigation options in the city for tourist, as well as facilitating the integration between modes could ease access for guests while increasing the attractiveness of the city. Such measures involve the synergy of a few stakeholders therefore the complexity is considered medium.

In addition, specific measures for the provision and integration of new mobility services (e.g. shared mobility, MaaS, etc.) could be incorporated in the Action Plan of the Urban Mobility Strategy, similar to the extensive list of measures already included in the plan. Such effort would require a relatively intense stakeholder process and a long period to be implemented which can coincide with the time of publication of the next updated policy plans.

Among the different indicators in the Strategic Freight Plan section, the Last Mile Policies and Delivery Timing areas could be enhanced through the implementation of integrated mobility, freight and land-use planning approaches. Environmental / size / load access restrictions, vehicle pricing and charging measures, special definition of loading zones by commercial areas or the implementation of policies regarding delivery timings (e.g. time access restrictions, off-peak deliveries, night delivery, etc.) are some examples that can help reconciling two potential conflicting elements: a freight distribution system satisfying the market demand, and a liveable, emission-free urban environment. This combined planning approach, though it requires a medium to high level of complexity, should be considered as one of the first decisions to take in the short term. In parallel, to facilitate public acceptance and implementation of such measures, a participatory approach is recommended. This involves in the short term the creation of freight boards and forums (e.g. Freight Quality Partnerships), where all stakeholders assess and discuss measures.

Figure 2: Policy & Innovation: Recommended interventions

	Avoid/Reduce	Shift/Maintain	Improve	Timeframe	Complexity
Strategic Mobility Plan			Incorporate specific measures for tourists	Long	Medium
			Involve new market players	Long	Medium
Strategic Freight Plan	Integrate mobility, freight and urban planning			Short	Medium
			Start a stakeholder process	Short	Medium
	Digitalisation of services			Medium	Medium
R&D Innovation		Additional pilot projects		Medium	Low

Additionally, the Digital Management area could be enhanced with digitalisation of services. Examples include vehicle occupancy management, reservation of loading bays or booking of time slots for deliveries which can both contribute to improve the efficiency in the freight sector avoiding the use of more energy demanding solutions (e.g. additional km driven looking for a parking space). The timeframe for the digitalisation of delivery and logistics services ranges from short to long term depending on the scale of implementation which could either focus on a specific part of the system or implement more holistic approaches in which case complexity also increases.

3.2. Transport supply

The transport supply section of Eindhoven received an average score of 2.5. The city has a moderate size public transport network in relation to its area and population. Shared mobility modes such as ride hailing services, car sharing vehicles, bike sharing and micromobility options are also present in the city, but not widely available. The car ownership levels in the city are near to low, but still show a certain degree of car dependence. Thus, this indicator receives a score of 4. At the same time the city has a good coverage of EV charging stations and received the best possible score of 5. Both the Service Reliability and Consolidation Centres indicators of this section received a score of 1, highlighting the need for improvements in the public transport and urban freight transport systems.

Recommended actions

The Transport Provision can be improved by implementing enhancements in the public transport (PT) / transit system that provide a sufficient level of accessibility while ensuring high levels of service quality (i.e. availability, convenience and reliability). Options include improved bus services, Bus Rapid Transit (BRT) networks or public transport partnerships blending public and private mobility services, to offer integrated services, frequencies and tickets (e.g. on-demand PT services / Demand Responsive Transit (DRT), PT feeders in low coverage areas, MaaS applications, etc.). Easy access and intermodal integrations (e.g. intermodal mobility hubs / terminals) are key and should be an integral part of planning to improve passenger's experience and create seamless networks.

Car ownership can be reduced through measures that limit the road space for cars in favour of more sustainable options as well as promoting new and more efficient models of car use (e.g. car-sharing, car-pooling, ride-sharing, van-pooling, etc.)

The service reliability of public transport services can be improved by optimising timetables to meet the forecasted demand while taking into account disruption management techniques. Testing the resilience of public transport services to optimise their operation has a short timeframe and low complexity levels when looking into one system at a time. At the same time, shifting to alternative modes of transport can decongest unreliable services and better regulate capacity levels. Reduced public transport reliability might result from different causes, however it is worth exploring this area since reliability is an important factor that increases the attractiveness of public transport modes.

Urban Freight Transportation (UFT), a main contributor to pollution and congestion in urban areas, can be enhanced by promoting the use of consolidation points and shared storage space that allow for multimodal systems and more sustainable, effective and efficient city logistics streams. Examples include the use of transhipment hubs, such as

Urban Consolidation Centres (UCC), Microconsilidation Centres (MCC) or Cooperative hubs.

Figure 3: Transport Supply: Recommended interventions

	Avoid/Reduce	Shift/Maintain	Improve	Timeframe	Complexity
Transport Provision		Implementing PT / transit improvements		Medium	Low
Car Owner-ship		Limit expansion of road space for cars		Short	Medium
			Promotion of new models of car use	Long	Low
Service Reliability		Facilitate integration of shared-connected services into PT		Medium	Medium
			Test resilience of PT services	Short	Low
Freight			Incentivise the use of UCCs and cooperative hubs	Medium	Low

3.3. Transport demand

Modal split and Traffic flow & efficiency indicators of the transport demand section received a score of 2 and 4 respectively. Active modes (walking and cycling) in the city of Eindhoven have a share of 59% in the modal split which is higher than the share of trips done by private vehicles (35%). Despite the good levels of active mobility in the city, collective transport modes have a relatively low share with respect to private vehicles. This shows that Eindhoven is still to a certain extent a car dependent city.

The overall average annual congestion rating in 2019 for the city was 22% according to TomTom Traffic Index which is below the global average of 29% and other Dutch comparable cities (The Hague, Amsterdam, Rotterdam, Utrecht).

Recommended actions

Reduced car dependency can potentially lead to decreased congestion levels and several measures within the Avoid or Shift approaches can contribute towards achieving this. Transport demand management and integration of land use and transport planning are some approaches which can reduce travel demand and tackle congestion levels. For example, mix of land uses or transit-oriented development (TOD) can significantly reduce travel distances or even eliminate the need to travel. The implementation of such measures involves "rethinking the rhythms of the cities" -something enabled by the

COVID-19 pandemic- and creating cities which offer services and quality of life within a reduced reach from home (e.g., the '15-minute city principle').

In parallel, the potential effect of digitalisation of services measure recommended in the Strategic Freight Plan indicator, may benefit the Transport Demand section too by reducing the need to travel.

Additionally, Mobility Management should aim to create an optimised road network, which make the best use of existing infrastructure by managing the demand for transport and encouraging the use of sustainable modes of transport. The use of Cooperative Intelligent Transport Systems (C-ITS) technologies creates a stream of quality traffic information for all networks users: vehicles, infrastructure, passengers, vehicle occupants, pedestrians and cyclists. (e.g., on-time performance, road conditions, advice and enforcements, hazards, etc.) contributing to improve road network efficiency, enhance safety and operational efficiency. The deployment of C-ITS is in line with the measures provided within the Shift approach for the Transport Provision and Service Reliability sections.

Figure 4: Transport Demand: Recommended interventions

	Avoid/Reduce	Shift/Maintain	Improve	Timeframe	Complexity
Modal Split	Reduce travel needs			Medium	Medium
		Encourage the use of active modes and PT		Long	Low
	Integration of urban and transport developments			Long	Medium
Congestion		Increase alternatives to car travel		Medium	Low
	Optimise the road network and its use			Medium	Medium

Campaigns to encourage the use of active modes and public transport or improvement of cycling and walking infrastructure can lead to more attractive alternatives to car travel. The measures within the Shift approach here align with those addressing Service Reliability in the Transport supply section.

3.4. Data

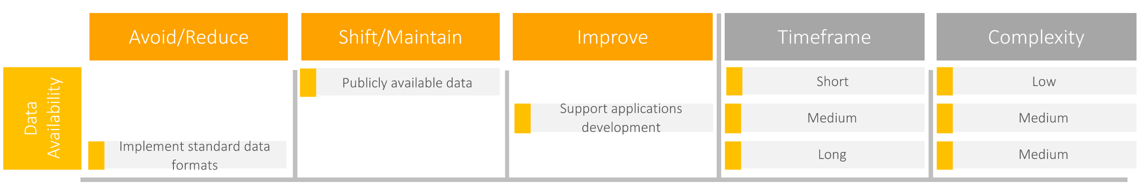
The data availability section received an average score of 4.6. The city collects several types of data such as real-time disruption data, air quality indicators, socioeconomic statistics, data on active transport, motorised traffic and public transport as well as road and street congestion, which is accessible to public authorities, third parties, open to the public and used in the development of mobile applications. Travel behaviour data for transport insights is not systematically collected and is only accessible to public authorities.

Recommended actions

Availability of data often fosters innovation with data demanding projects coming into play. The accessibility of data to third parties or publicly available data such as travel behaviour data, socioeconomic statistics and data on public transportation can initiate projects that examine for example the factors that influence individual decisions therefore understanding better mobility patterns. Making data available to the public and accessible by third parties is considered to have low complexity levels and a short timeframe. Moreover, when data can be used in the development of mobile applications, the city can explore further topics of interest such as equity and social inclusion of vulnerable users in urban transport using smartphone apps. The process of aligning data collection with the requirements of mobile applications has medium complexity levels and timeframe.

Furthermore, the long-term vision of the city regarding data availability and management should align with developing and implementing data standards, which set minimum data sharing requirements between transport providers and city authorities for service added value. Such approach would allow to collect disaggregated data from end-users providing quality information about all mobility solutions and infrastructure components while enabling monitoring and evaluation of measures implemented, without the need to carry out resource intensive data collection campaigns.

Figure 5: Data: Recommended interventions



3.5. Environmental aspects

Regarding the environmental aspects of UMAM index, the city of Eindhoven received and average score of 4.3. The city recently defined a low-emission zone (LEZ) defined as an area where access to some polluting vehicles is restricted or deterred with the aim of improving the air quality. This is reflected in the air quality indicator which received a score of 4, and as the LEZ expands, the score for this indicator will improve. The percentage of the CO2 emissions that derives from the transport sector is 13% and the percentage of the population exposed to high levels of noise is 36% which are the two areas for improvement discussed below.

Recommended actions

Noise pollution and GHG emissions are both externalities of the transport system. Tackling negative effects of those indicators is linked to traffic levels reduction and use of less noisy modes of transport such as walking or cycling. In alignment with the Strategy for energy-neutral Eindhoven by 2045, the city can consider extending their LEZ to more and greater areas. Such an intervention involves medium complexity and a short timeframe. Additionally, in line with the recommendations provided within the data availability section, solutions for a detailed monitoring of urban air quality could be introduced in the short term with a low level of complexity required. Such solutions would contribute to both filling data gaps and improving data quality as well as helping monitor and evaluate benefits of LEZs. Examples can include gathering real time data to discover the origins of GHG emissions, as well as measuring and monitoring CO_2 emissions by combining satellites and ground sensors' data, real time pollution city maps, etc.

Moreover, imposing low speed limits and introducing noise barriers especially in dense residential areas can contribute towards significant reductions in noise pollution levels. Such actions can be implemented within a short timeframe and involve medium complexity in terms of stakeholder engagement and cost.

Figure 6: Environmental Aspects: Recommended interventions

	Avoid/Reduce	Shift/Maintain	Improve	Timeframe	Complexity
Low Emission Zone	Expansion of Low / Zero Emission Zone			Short	Medium
		Managing parking		Short	Low
Air Quality			Solutions for urban air quality monitoring	Short	Low
Greenhouse Gas Emissions		Encourage alternatives to car travel		Long	Low
Noise	Impose low speed limits and introduce noise barriers in residential areas			Short	Medium

3.6. Social aspects

Social aspects within UMAM index for the city of Eindhoven received an average score of 2.1. The city offers good coverage of public transport stations providing assistance equipment and accessibility features for people with disabilities. Moreover, the five-year average road mortality in the city is as low as 5 road fatalities per 100,000 residents with traffic calming zones introduced in the city. The average share of household expenditure spent on transport represents 13% of total expenses.

Recommended actions

Providing good transport accessibility for citizens implies creating a network that makes it easier to reach destinations and activities further away. In the short term, this goes hand by hand with providing convenient and affordable transport options. Simple and fair PT fare structures can have a direct effect on improving mobility affordability. Affecting fare levels by means of special tickets, subsidies, concessions can offer certain sections of the population the opportunity to have better accessibility to PT and increase its attractiveness. In parallel, following the recommendations provided within the Avoid approach in the transport demand section; planning dense and human-scale cities, by implementing mixed used planning approaches can further contribute in the medium term to improve general accessibility by reducing unnecessary travel needs and concentrating services within a reduced reach from home.

Achieving zero fatalities in transport (the so called Vision Zero) is a challenging mission however there are a few measures proven to reduce road accidents. Regulating vehicle access to certain areas, Urban Vehicle Access Regulations (UVARs), can improve safety for vulnerable road users as well as street quality. Other measures for reducing traffic and enhancing road safety include tactic urbanism interventions such as road marking and delineation, narrowing driving lanes, installing speed bumps or introducing woonerfs which can potentially discourage driving.

In line with recommendations provided within the Data section, a feasible data collection strategy to monitor road safety evolution would be positive strategy (e.g. road accident database, collision maps, traffic conflict hot spots, etc.). This way it is possible to identify the success of measures implemented and areas for improvement. Such measures have a medium implementation timeframe and involve low to medium complexity depending on the availability and flexibility of relevant regulations.

Figure 7: Social Aspects: Recommended interventions

	Avoid/Reduce	Shift/Maintain	Improve	Timeframe	Complexity
Transport Prices		Implement simple and fair PT fare structures		Short	Low
Accessibility	Reduce travel needs			Medium	Medium
Traffic Calming	Expansion of UVAR and pedestrian zones			Medium	Medium
Safety		Deploy infrastructure for enhanced road safety		Medium	Low