



PRACTITIONER BRIEFING

URBAN AIR MOBILITY AND SUSTAINABLE URBAN MOBILITY PLANNING



Imprint

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List of Abbreviations

AED	Automated external defibrillator
ATC	Air Traffic Control
ATM	Air Traffic Management
BIM	Building Information Modelling
BWI	Behörde für Wirtschaft und Innovation (Ministry of Economy and Innovation of the City of Hamburg)
CEN	European Committee for Standardization
DACUS	Demand and Capacity Optimisation for U-Space
DCB	Demand and Capacity Balancing
EASA	European Union Aviation Safety Agency
EIP-SCC	European Innovation Partnership on Smart Cities and Communities
EU	European Union
EUROCAE	European Organization for Civil Aviation Equipment
eVTOL	Electric Vertical Take-off and Landing
FAA	Federal Aviation Administration
FUA	Functional Urban Area
GDP	Gross Domestic Product
GZM	Górnośląsko-Zagłębiowska Metropolia
HAv	Hamburg Aviation
HPA	Hamburg Port Authority
ICAO	International Civil Aviation Organization
ICT	Information and Communications Technologies
IFB	Hamburg Investment and Development
ISO	International Organization for Standardization
ITS	Intelligent Transport Systems
KPI	Key performance indicators
MaaS	Mobility as a Service
MAHHL	Maastricht, Aachen, Hasselt, Heerlen, and Liège
MNM	Mobility Network Management
MRO	Maintenance, Repair and Overhaul
NASA	National Aeronautics and Space Administration
OECD	Organisation for Economic Co-operation and Development
RRI	Responsible Research and Innovation
SECAP	Sustainable Energy and Climate Action Plan
SESAR JU	Single European Sky ATM Research Joint Undertaking
SORA	Specific Operations Risk Assessment
SUMP	Sustainable Urban Mobility Planning
SWOT analysis	Strengths, weaknesses, opportunities, and threats analysis
UAM	Urban Air Mobility
UAS	Unmanned Aerial Systems
UAV	Unmanned Aerial Vehicle
UIC2	UAM Initiative Cities Community
USEPE	U-space Separation in Europe
UTM	Unmanned Aircraft Traffic Management
VLL	Very low level

Guide to the reader

This document provides guidance on Urban Air Mobility (UAM) as specific topic related to Sustainable Urban Mobility Planning (SUMP). It is based on the concept of SUMP, as outlined by the European Commission's Urban Mobility Package¹ and described in detail in the European SUMP Guidelines (second edition)².

Sustainable Urban Mobility Planning is a strategic and integrated approach for dealing with the complexity of urban transport. Its core goal is to improve accessibility and quality of life by achieving a shift towards sustainable mobility. SUMP advocates for fact-based decision making guided by a long-term vision for sustainable mobility. As key components, this requires a thorough assessment of the current situation and future trends, a widely supported common vision with strategic objectives, and an integrated set of regulatory, promotional, financial, technical and infrastructure measures to deliver the objectives – whose implementation should be accompanied by reliable monitoring and evaluation. In contrast to traditional planning approaches, SUMP places particular emphasis on the involvement of citizens and stakeholders, the coordination of policies between sectors (transport, land use, environment, economic development, social policy, health, safety, energy, etc.), and a broad cooperation across different layers of government and with public and private entities.

Chapter 1 introduces the fundamentals on the evolving domain of UAM. Chapter 2 outlines the eight SUMP principles and addresses them within the current UAM context. Chapter 3 presents the SUMP cycle, by focusing on the phases and sub-steps where the SUMP concept and the UAM domain interrelate in specific and interesting ways. Chapter 4 is devoted to the description of examples from UIC2 cities and regions that are actively engaged in UAM and have contributed to this document. Finally, Chapter 5 draws conclusions and recommendations for action.

This document is part of a compendium of guides and briefings that complement the newly updated second edition of the SUMP Guidelines. They elaborate difficult planning aspects in more detail, provide guidance for specific contexts, or focus on important policy fields. Two types of documents exist: While 'Topic Guides' provide comprehensive planning recommendations on established topics, 'Practitioner Briefings' are less elaborate documents addressing emerging topics with a higher level of uncertainty. Guides and briefings on how to address the following topics in a SUMP process are published together with the second edition of the SUMP Guidelines in 2019:

- **Planning process:** Participation; Monitoring and evaluation; Institutional cooperation; Measure selection; Action planning; Funding and financing; Procurement.
- **Contexts:** Metropolitan regions; Polycentric regions; Smaller cities; National support.
- **Policy fields:** Safety; Energy (SECAPs - Sustainable Energy and Climate Action Plans); Health; Logistics; Walking; Cycling; Parking; Shared mobility; Mobility as a Service³; Intelligent Transport Systems⁴; Electrification; Access regulation; Automation.

They are part of a growing knowledge base that will be regularly updated with new guidance. All the latest documents can always be found in the 'Mobility Plans' section of the European Commission's urban mobility portal Eltis (www.eltis.org).

¹ Annex 1 of COM(2013) 91

² Rupprecht Consult - Forschung & Beratung GmbH (editor), 2019 Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan, Second Edition.

³ ERTICO – ITS Europe (editor), Mobility as a Service (MaaS) and Sustainable Urban Mobility Planning (https://www.eltis.org/sites/default/files/mobility_as_a_service_maas_and_sustainable_urban_mobility_planning.pdf)

⁴ ERTICO – ITS Europe (editor): Intelligent Transport Systems (ITS) and SUMPs – making smarter integrated mobility plans and policies (https://www.eltis.org/sites/default/files/the_role_of_intelligent_transport_systems_its_in_sumps.pdf)

Executive summary

Urban air mobility (UAM) is an ever-growing topic of discussions that goes beyond the boundaries of technological developments in the aviation industry as it has attracted the attention of mobility actors and local authorities as a means of contributing to sustainable and integrated mobility across cities and regions. This Practitioner Briefing has been developed by the UIC2, the Urban-Air-Mobility Initiative Cities Community, of the EU's Smart Cities Marketplace. UIC2 was established in October 2017 and is a city-centric (and regions) community that brings the voice of European cities and regions in the emerging sector of urban air mobility. Its mission is to drive the sustainable and responsible transition of urban mobility to the vertical (third) dimension.

As urban air mobility is a relatively newly introduced term, there is not a universally agreed and used definition of it. The definitions vary to the perspective of each stakeholder group. For example, the UAM Initiative Cities Community (UIC2) defines UAM as: 'Very-low altitude airborne traffic, above populated areas, at scale, that is sustainably integrated with surface mobility systems'. Definitions offered by other stakeholders are given in Section 1.2.

UAM, its emerging associated technologies, albeit some of them are not entirely new, and regulatory frameworks, as well as the opportunities they promise to open for various urban stakeholders, can without doubt claim to be innovative. Yet UAM is not only an element of aviation and mobility technologies advancement but predominantly about mobility planning and urban development. To this end, UAM may feature prominently in the formation of urban innovation and sustainable transition strategies. A core question, cities and regions face, is: *how should UAM be integrated in higher level urban mobility planning?* Or in more practical terms: *which role should UAM assume in existing, or envisioned, urban transportation systems?*

The step to introduce UAM in an urban area is nothing short of long-term strategic decision making which touches upon various other high-level fields of decision making, for example, either a city's innovation strategy or the fundamentals of urban planning. The introduction of UAM calls for a holistic planning approach that encompasses not only the integration of UAM, along with its support infrastructure on the ground into the transportation system, but also the urban infrastructure and overall city liveability. This is necessary to ensure the purposeful emergence of a responsible and sustainable UAM ecosystem.

This Practitioner Briefing introduces UAM as a complementary transport of smart mobility in smart cities in the context of responsible innovation for sustainable and integrated urban mobility, and it should

be perceived as part of the wider Mobility Network Management (MNM) concept. It builds on the experience of pioneering European cities and regions that have been involved early on with the topic of urban air mobility. The reported work emphasises the importance of integrating UAM into the Sustainable Urban Mobility Plan (SUMP) process, through the eight SUMP principles and the four phases of the SUMP cycle. It follows with the description of city- and region- cases in dealing with the topic of UAM in the context of supporting their urban and mobility policy goals.



1. Introduction

1.1 Urban air mobility: the future is closer than one might think

Urban air mobility (UAM), or simply put the air traffic, in and around the urban and wider metropolitan airspace, for services such as the transportation of passengers and cargo, is closer to urban reality (and urban mobility planning) than many people might think. UAM, as will be outlined in this document, is “not just another mode of transportation”, but calls for a holistic planning approach that encompasses not only the integration of UAM, along with its support infrastructure on the ground into the transportation system, but also the urban infrastructure and overall city liveability. UAM services are not only innovative as they add a new mobility mode to the existing transportation mix but are also closely intertwined with, and driven by, innovative fields like digitalisation, sustainability, renewable energy systems, and basic research such as material sciences. In addition, UAM services are driven by strong policies and implementation frameworks for improved quality of lives, ethical use of technologies, and liveable cities, such as those of responsible innovation and smart cities.

The decision to introduce UAM services in an urban or regional area is nothing short of long-term strategic decision making which touches upon various other high-level fields of decision making, for example, the fundamentals of urban planning, as well as, a city’s, or a regions’, innovation strategy and economic development. In this practitioner briefing the reported experiences from the cities and regions highlight the need to ‘think big’ from the outset and zoom in on specific topics like UAM (and not vice versa). In line with the basic principles of rational decision making, planning entities in charge may ask themselves fundamental questions from the outset like: *What is the city we want to live in the long term? Which role could UAM services play therein?*

Strategic foresight studies (e.g., scenario planning and back-casting) could support answering the aforementioned questions by exploring (possibly utopian or dystopian future scenarios) in view of determining drivers for change towards the shaping of desirable scenario (outcome). Perhaps movies can be an inspiration to technology fans.

For example, the urban aerial traffic that is taking place in films like *Star Wars* or *The Fifth Element* in the background (see Figure 1), is sometimes more intriguing for them than the action in the foreground.

Figure 1: Urban Aerial Traffic in *Star Wars* and *The Fifth Element* (Source: Price, G.; Helton, D.; Jenkins, K.; Kvicala, M.; Parker, S.; Wolfe, R. (2020): Urban Air Mobility Operational Concept (OpsCon) Passenger-Carrying Operations. NASA, Alexandria/Hampton, VA, p. 9)



In other words, fans may focus on large numbers of both manned and unmanned aerial vehicles manoeuvre safely and well-coordinated in dense urban (air-)spaces. Meanwhile, flying robots perform various services autonomously in those cities, for example, the inspection and maintenance of urban infrastructure.

This may seem quite futuristic, for some dystopic, and far from our everyday life, nevertheless, more positive and sustainable variants might be closer than the reader might think; for example drones (also known as UAVs or UAS, Unmanned Aerial Vehicles/Systems) are already being deployed on an ever-increasing scale for sensor-based data collection purposes; for example, for traffic and incident monitoring, the maintenance of industrial installations and structures like bridges and runways, or for building information modelling (BIM) as well as for emergency and medical cases (see Figure 2). Films like *The Fifth Element* or *Blade Runner* depict rather dystopian socio-technological states where, albeit (mobility) technology is highly advanced, large parts of the urban society live in squalid circumstances. Responsible urban mobility planning indeed aims to avoid undesirable developments and imbalances of this kind by adhering to higher level societal goals like sustainability, liveable cities, social inclusion, and equal opportunities.

Given the increased use of UAS in various fields and the present (and future) challenges in mobility planning, it comes as no surprise that technological innovation increasingly features as enabler in sustainable mobility strategies like the European Commission’s “Sustainable and Smart Mobility Strategy” (COM 2020/789 final).

There, direct reference is made to drones as a possible zero-emission solution for sustainable urban logistics plans (COM 2020/789 final, 11).

Figure 2: Example of an urban air mobility project for critical medical application (Medify project in Hamburg) (Source: ©Lufthansa Technik)



The Commission furthermore expects “the emergence and wider use of drones (unmanned aircraft) for commercial applications” and “fully supports the deployment of drones and unmanned aircraft” (COM 2020/789 final, 16). The Commission will, foreseeably in 2022, adopt a “Drone Strategy 2.0” where different regulatory frameworks for UAS and future technological development paths will be outlined.

The aim of this Practitioner Briefing is to introduce practitioners in mobility planning to the rapidly developing field of urban air mobility (UAM) and to the concept of sustainable urban mobility planning (SUMP) which can be readily applied to integrate evolving UAM technologies, infrastructures and services into existing and new mobility mixes and urban fabrics. In addition, its aim is to support practitioners in mobility and urban planning, and inherently the cities and regions on behalf of which they act, in strategic decision-making about UAM, along with its inclusion and integration in the SUMP process. Furthermore, to highlight the opportunities and challenges that come along with UAM, the cities and regions that contributed to this document share the experiences they have gained in this highly dynamic and innovative field.

Indeed, the number of UAM-related projects and city-driven initiatives is increasing by leaps and bounds worldwide. In Europe, several innovation-driven projects are currently underway, in which cities and regions have a driving role, for example:

- In Hamburg (DE), the project “Medify” explores the possibility to transport time critical medical samples or goods with an UAS, within a highly congested airspace with two airports close by (Figure 2). At the same time, an urban sky (airspace) traffic management system and governance (U-space) prototype shall be set up above the Hamburg harbour as part of the “U-space Reallabor” project funded by the Federal Ministry of Transport & Digitalisation in 2021.
- Toulouse Metropole (FR) is working since 2018 with the UAM ecosystem through constant dialogue and exchange. Toulouse Metropole is involved in different projects and activities at the international, European, national, and local levels.

UAM projects include medical drone delivery, multimodality testbed development, and airspace demand-capacity balance research, among others. Toulouse Metropole wishes to strengthen the strategy of organising local mobilities, and in particular the ones linked to low-carbon mobility. As put forward in this Practitioner Briefing, integrated mobility planning approaches like SUMP would have to take into account the various dimensions of the emerging regulations, its potential for contributing to integrated mobility, its potential impact on decarbonisation of mobility, and the wider impact on society.

- In GZM – Górnośląsko-Zagłębiowska Metropolia (PL), the natural consequence of the creation of SUMP and UAM teams in 2018, was to combine both efforts to develop common definitions and interdependencies between SUMP and UAM. In addition to the implementation of UAM in accordance with the SUMP cycle, the GZM’s approach is characterized by a strong emphasis on multi-level cooperation with the most important stakeholders of the UAV ecosystem at all levels. Thanks to these connections and exchange of knowledge with key legislative, flight safety monitoring authorities, R&D, industry and municipal partners, the key role of GZM in the UAM process is the assessment of its impact on social acceptance. GZM conducts projects identifying the needs of its own cities, participates in demonstrations of UAM services in GZM test areas and participates in international UAM projects.
- In the municipality of Trikala (GR), a drone demonstration for medical purposes was carried out in September 2021 as part of EU’s H2020 funded project ‘Harmony’. The demonstration featured the successful delivery of emergency medicine in the urban-rural interface; namely from the city of Trikala to a pharmacy in Leptokarya, a village of the municipality. There, a pharmacist collected the delivered product from the drone’s storage compartment before the device took off once more.

Details about the different projects already underway in the different cities and regions, including the opportunities for public value creation as well as the challenges, risks and concerns faced with, can be found in Chapter 4. The common aim of city-led UAM project initiatives is the responsible and sustainable implementation of regular UAM services through the operation of UAS, including possibly in the mid- to long-term the so-called eVTOLs (electrically powered vehicles capable of vertical take-off and landing), serving in all cases the common public good and complementarities with ground transportation systems.

1.2 Fundamentals of UAM concepts, physical and digital assets

In this section, the notion of urban air mobility (UAM) is examined in more detail. In fact, as urban air mobility is a relatively newly introduced term⁵, there is not a universally agreed and used definition of it yet. The definitions vary to the perspective of each stakeholder group. Table 1 provides, and elaborates on, UAM definitions offered by different stakeholders.

Table 1: UAM definitions by different stakeholders

WHAT IS URBAN AIR MOBILITY? Viewpoint on UAM definitions in Europe and North America	
Europe	UAM as defined by EASA: UAM is <i>“an air transportation system for passengers and cargo in and around urban environments.”</i> ⁶
	UAM as defined by the UIC2: UAM is <i>“Very-low altitude airborne traffic, above populated areas, at scale, that is sustainably integrated with surface mobility systems.”</i> ⁷
North America	UAM as defined by the FAA: <i>“Urban Air Mobility (UAM) envisions a safe and efficient aviation transportation system that will use highly automated aircraft that will operate and transport passengers or cargo at lower altitudes within urban and suburban areas. UAM will be composed of an ecosystem that considers the evolution and safety of the aircraft, the framework for operation, access to airspace, infrastructure development, and community engagement.”</i> ⁸
	UAM as defined by NASA: <i>“Our vision of UAM is a safe, efficient, convenient, affordable, and accessible air transportation system for passengers and cargo that revolutionizes mobility around metropolitan areas. This vision includes everything from small package delivery drones to passenger-carrying air taxis that operate above populated areas.”</i> ⁹
<p>Elaborating on the offered definitions on UAM:</p> <p>The key feature of the EASA definition is conciseness. No value judgements are being made and no desirable future states or desirable features of UAM are being invoked. The definitions by FAA and NASA in turn are longer and more detailed and encompass exactly those (value) statements about the desirable characteristics of (future) UAM.</p> <p>The definitions by EASA, FAA and NASA have in common that they focus exclusively on the transportation of cargo and passengers. In contrast, the UIC2 definition, while being concise, abstracts from a vehicle-centric definition and the “payload” of drones or air taxis/eVTOLs (e.g., passengers or cargo) and rather focuses on what is at stake from the local authorities and citizens perspective; namely, the airspace over-populated areas where UAM operations take place and the scale (volume) of those operations in the context of integrated and sustainable mobility.</p> <p>Admittedly, none of these definitions could claim to be universal from a strictly logical sense. Rather, they represent different viewpoints, and different perspectives on UAM. Consequently, the reader may lean towards the definition that is best aligned with his/her perspective on the topic or suits his/her interest of knowledge best.</p>	

⁵ To the authors' knowledge, the actual term of Urban Air Mobility was coined by Airbus in its Forum Magazine publication in 2016

⁶ EASA (2021): Study on the societal acceptance of Urban Air Mobility in Europe. EASA: Cologne, p. 3. <https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf>.

⁷ UAM Initiative Cities Community (UIC2), An Overview, Presentation, November 2021.

⁸ FAA (2020): Urban Air Mobility and Advanced Air Mobility. https://www.faa.gov/uas/advanced_operations/urban_air_mobility/, 08.10.2020.

⁹ NASA/Deloitte (2020): UAM Vision Concept of Operations (ConOps) UAM Maturity Level (UML) 4 Version 1.0, Washington D.C.; NASA, p. 76. <https://ntrs.nasa.gov/citations/20205011091>.

The vertical mobility dimension above cities and regions: Developments so far, opportunities and challenges

Unmanned aerial systems (UAS) are the first steps humans took into the skies. Before conducting the first manned flight in history in 1783, the Montgolfier brothers tested their balloons unmanned. In the beginning of the 20th century the idea of helicopter transport was developed as well, basically trying to tackle the same challenges as today (see Figure 3). Nevertheless, all these ideas were limited by the technology constraints of their time, high operating costs, or noise levels. In the past decade technological advances, especially in the sector of lithium-ion batteries, electrically distributed propulsion, advanced materials and digitalisation of the airspace, have led to a rapid increase in the potential of UAS applications in the context of UAM projects. The premise from these advancements lies in the fact that, first and foremost, all aircraft prototypes are electrically powered (see Figure 3), in view of anticipated reduced levels of noise and zero local emissions.

Figure 3: From fiction to reality: the evolution of vertical lift and distributed electric propulsion (eVTOLs) (Source: Own creation; pictures under the creative commons licence or sources acknowledged)



Figure 4: Different types of eVTOL (Source: EASA (2021)¹⁰)

	Vectored Thrust Thrusters used for lift and cruise	Lift + Cruise Independent thrusters used for cruise as for lift	Wingless (Multicopter) Thrusters only for lift, cruise via rotor pitch
Example	 Hyundai SA1 eVTOL	 Wisk (Kitty Hawk) Cora	 Volocopter 2X
Benefits	Optimized for both hover and cruise Lift provided by wings for cruise for highest efficiency Highest cruising speeds	Redundancy benefits of multicopter without collective or cyclic actuation Wing configuration allows for more speed in cruise	High redundancy and simple controls Significantly quieter than helicopters Lower maintenance and lightweight

Generally, eVTOLs can be categorised into three different classes of propulsion systems, as described below and illustrated in Figure 4:

1. *Vectored thrust* – The propulsion units can change between vertical lift and horizontal thrust, as they are mounted rotatable. During cruise flight lift is generated by wings.
2. *Lift + cruise* – Separate propulsion units for vertical take-off and landing and the cruise phase. Additional lift is created by wings during the cruise phase.
3. *Multicopter (wingless)* – A wingless design like today's helicopters, where the multiple propulsion units create lift and thrust at the same time by varying the relative speed of each rotor.

Digitalisation of Airspace

Bolstered by large sums of venture capital, various start-ups are presently competing to be the first to introduce 'air taxi' services in cities and regions on a regular basis. Besides the developments of eVTOL aircraft, a lot of research is done in the areas of UAM control systems, network design, the necessary ground facilities (e.g., vertiports) and the integration of UAM-related aircraft, into the already congested airspace over cities.

In the evolving sustainability and urban mobility context, 'air taxis' are, loosely speaking, electric aircraft (e.g., eVTOLs) capable of passenger and heavy cargo transportation. For this reason, not only in a movie-depicted future but also today some sort of advanced (urban) air traffic management (ATM) is obviously needed to coordinate flight operations in the urban airspace, especially if traffic densities increase. This encompasses not only a technological but also the regulatory, policy and

governance dimensions; with the latter being addressed by the European Union in the form of regulations and regulatory frameworks (legally binding for all EU Member States). One example is the introduction of the "U-space" concept. The EU created a legal framework for the operation of UAS and the possible use cases in the Union.

Literally speaking, the U-space airspace is a special case of a geographical zone (also known as 'geo-zone') of the low-altitude airspace, typically, but not necessarily, above populated areas in, for example, urban, regional, or rural context as illustrated in Figure 5.

Figure 5: U-space airspace operations enabled by U-space services (Source: SEJAR JU (2017): U-Space Workshop 2017¹¹)



¹⁰EASA (2021): Study on the societal acceptance of Urban Air Mobility in Europe. EASA: Cologne, p. 23. <https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf>.

¹¹SEJAR JU (2017a): U-Space Workshop 2017, p 42. <https://www.sesarju.eu/sites/default/files/documents/events/SESAR%20U-Space%20Workshop.pdf>.

As a U-space airspace is a UAS geo-zone, it means it is where UAS operations are only allowed to take place with the support of U-space services as illustrated in Figure 6.

The key regulations already in effect are (EU) 2019/945 and (EU) 2019/947. These regulations define three different categories of UAS operation (open, specific, and certified) with increasing qualification requirements to the operator and mandatory air and ground risk assessments. The UAS themselves, are classified in seven different classes depending on the maximum take-off mass, airspeed and the maximum attainable height above the ground, among others.

More recently, the U-space regulations of (EU) 2021/664, (EU) 2021/665 and (EU) 2021/666 detailing the implementation of U-space, have been finalised in 2021 and shall come into effect from 26th January 2023. These regulations provide guidance to Member States to create low-level airspaces specifically for UAS and provide the necessary regulatory framework. As a special case of

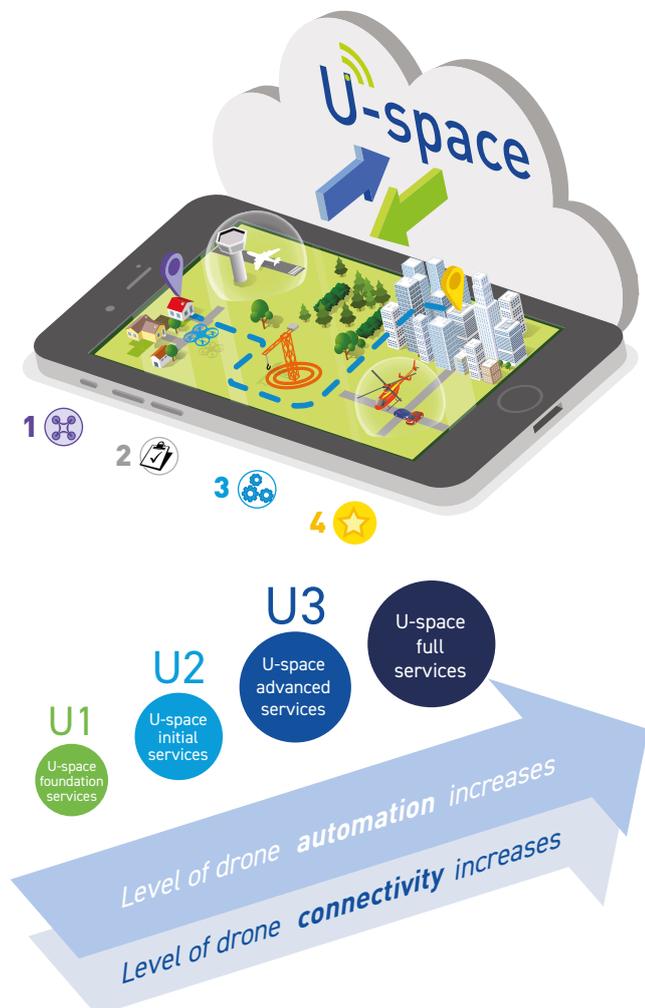
airspace, U-space is designated by Member States that are responsible for setting up a coordination mechanism among diverse stakeholders as outlined in EU’s regulation 2021/664 Article 18(f)¹³. According to this article, the Member States are required to designate authorities for establishing a mechanism to coordinate a U-space deployment with the involvement of various stakeholders including state and other public authorities and entities at national and local levels representing civic society.

Ultimately, the U-space provides a regulatory blueprint which aims for the safe, secure, sustainable, and efficient operations of UAS, including potentially air taxis in the future, in urban airspace, in view of managing scalable airborne traffic that is aligned with society’s needs. A sound regulatory framework like the “U-space” is, as will be outlined later in this document, an enabler rather than a “barrier”. In other words, it is a prerequisite for the responsible and sustainable introduction of urban air mobility services in a city or region on a broad scale.

Air law and the concept of airspace “ownership”

Due to the increasing importance of UAM, cities and regions are starting to claim the low-level airspace above them as part of their urban space. Nevertheless, cities and regions should be aware of the fact that the airspace in general is not part of their jurisdiction. Air law is dealt with at the national or international level; therefore, the competent authorities reside at the same levels. Typically, depending on the legal framework of the respective Member State, the influence of the local level might be restricted to the assessment of ground risks and associated infrastructure. In an attempt to mitigate potential conflict of interests from low-altitude airspace and the extension of the public space to the third dimension, the EU’s Implementing Regulation 2021/664 is explicitly mentioning through its Article 18(f) the importance of coordination at local level as mentioned above.¹⁴

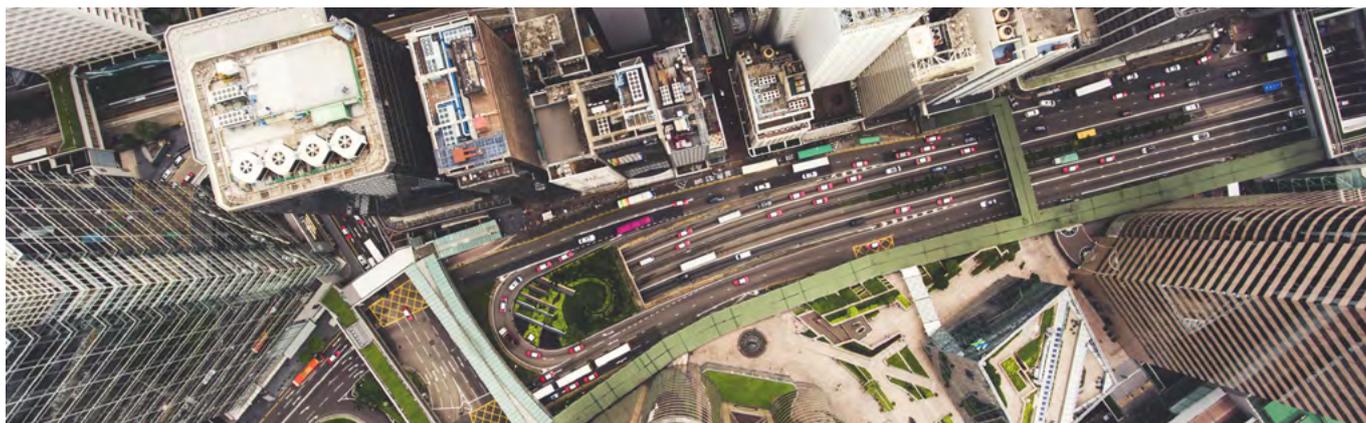
Figure 6: U-Space and the increasing level of automation and connectivity services (Source: SESAR JU (2017): U-Space Blueprint¹²)



¹²SESAR JU (2017b): U-Space Blueprint. Publications Office of the European Union: Luxembourg, p. 5. <https://www.sesarju.eu/u-space-blueprint>.

¹³Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the U-space (Text with EEA relevance) C/2021/2671. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0664>.

¹⁴The UIC2 Task Force on Regulation (City-State of Hamburg and GZM Metropolia) has been part of the working group developing the guidance material for Article 18(f).



Ground Infrastructure

Similarly, to the case of cycling, or even of the most recent e-scooters in ground transport, where infrastructure and its interaction and integration with other modes of mobility infrastructure is essential, a comprehensive SUMP has to incorporate the ground infrastructure that is needed for new UAM services, as well as the interfaces with other ground infrastructure. This includes, for example, places for the safe take-off and landing of UAM aircraft ('vertiports' or 'drone-pads'), parking of aircraft, and their integration in the mobility fabric, the charging infrastructure, as well as the required air traffic control infrastructure, and communications.

Figure 7: A vertiport integrated in a commercial structure
(Source: © MVRDV 2018 – (W. Maas, J.van Rijs, N. de Vries))



Thinking about the UAM-specific ground infrastructure, it is worth acknowledging that there is no distinct predecessor of this new kind of urban infrastructure. Helipads do come close to vertiports (e.g., see Figure 7), but the former are designed for the low intensity operation of large turbine engine powered aircraft,

compared to the high intensity traffic of smaller UAM aircraft at a vertiport or drones at drone-pads. As space is rare in most cities, planners have to think about innovative concepts where the ground infrastructure will be located (e.g., rooftops, floating on waterbodies, above railways or large streets) in accordance with the mobility plans and needs of the cities/regions and the targets set for the levels of quality of life. The underlying prerequisite must always be that the new infrastructure is appropriately integrated into the existing system of urban mobility, and wider urban planning, and is genuinely supported by citizens.

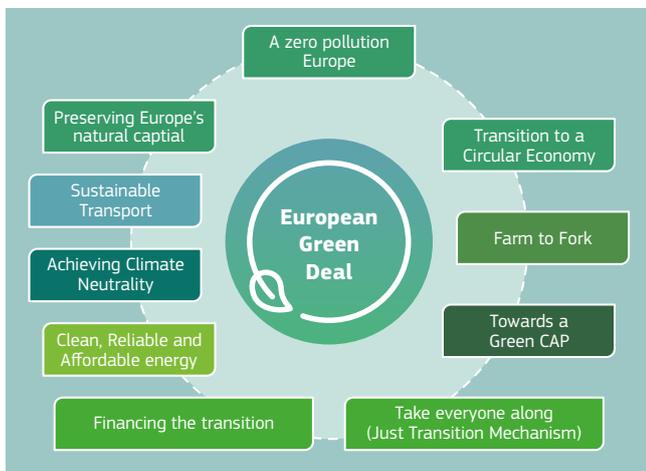
A discussion on urban planning and infrastructure can be found in Section 1.4 where key societal challenges in terms of urbanisation and climate change are discussed in conjunction with the technological advancements and regulatory features of UAM. In addition, the section expands on the role UAM may take on in urban (mobility) planning and urban innovation. Concepts such as the 'functional urban area' and the "15-min city" are discussed and applied to the case of UAM. In Section 1.4, UAM and its position within the concept of Mobility Network Management is discussed

The preparation of UAM services requires consideration of many factors ranging from the aviation safety and security of operations to the integration to existing (or future) surface mobility services. To this end, when analysing the UAM environment, the key aspect is, apart from fundamental safety and security issues, to express public and wider societal benefits in various dimensions, such as improving the quality of life, accessibility as well as economic and environmental aspects. A recent EASA study on the social acceptance of UAM shows that Europeans clearly favour UAM use cases that have a distinct social benefit. This includes any kind of medical and emergency related transportation, including use cases for disaster management.

1.3 Accessing the vertical dimension to complement the efficiency and effectiveness of surface transportation systems

The world is becoming increasingly urbanised. Since 2007, more than half the world’s population has been living in cities, and that share is projected to rise to 60 per cent by 2030. Cities and metropolitan areas are powerhouses of economic growth contributing about 60 per cent of global gross domestic product (GDP). However, they also account for about 70 per cent of global carbon emissions and over 60 per cent of resource use. Against the backdrop of climate change and bold policies like the European Green Deal (Figure 8) and the UN’s Sustainable Development Goals (Figure 9), many cities and regions have set themselves ambitious sustainability goals that aim, amongst other, at the transition from fossil fuels to carbon-free renewable energies within relatively short periods of time.

Figure 8: Main policy areas of the EU’s Green Deal (Source: European Commission¹⁵)



In many (if not all) cases, a core element of such ambitions is a full-fledged transformation of the urban transport system, often based on the substitution of fossil-fuelled vehicles by more sustainable modes of transportation, but also through improvements of public space, safe walking and cycling, better transport links and improved logistics. This indicates that urban mobility planning is a multi-dimensional, multi-faceted issue that is becoming increasingly challenging.

Figure 9: The United Nations Sustainable Development Goals for 2030 (Source: United Nations¹⁶)



Smart living, or enhanced quality of life, includes mobility services that contribute to citizen’s welfare in a sustainable manner. A sustainable approach in terms of social, environmental, and economic benefits is the cornerstone of smart living. Metropolitan areas, regardless of their size, are facing increasingly pressing challenges, such as urban sprawl, population growth and increasing traffic density, which are all connected to urban mobility. At the same time, citizens are having even greater demands on the urban transport systems.

On the one hand, mobility is increasingly regarded, and put to market, as a service (e.g., concept of Mobility-as-a-Service – MaaS¹⁷) that should be available at one’s fingertips – every time, everywhere. Thereby, the ambition of MaaS is to eliminate the need for personal ownership of a car through the provision of a state-of-the-art intermodal mobility system. On the other hand, small and medium-sized cities, outskirts, as well as rural and remote areas face quite different challenges. As of today, neither public transport nor on-demand-shuttles have managed to significantly substitute traffic generated by personally-owned vehicles in these areas. To address this, an integrated approach to MaaS and public transport by considering the efficiencies and complementarities among the different modal options is needed.

¹⁵ Main elements of the European Green Deal, p. 5. https://ec.europa.eu/environment/integration/green_semester/pdf/4.%20Agenda%20item%206%20-%20European%20Green%20deal.pdf.

¹⁶ UN Department of Economic and Social Affairs, communications material. <https://www.un.org/sustainabledevelopment/news/communications-material/>.

¹⁷ Mobility as a Service (MaaS) Alliance, <https://maas-alliance.eu/>.

1.4 The role of UAM in urban mobility planning and urban innovation

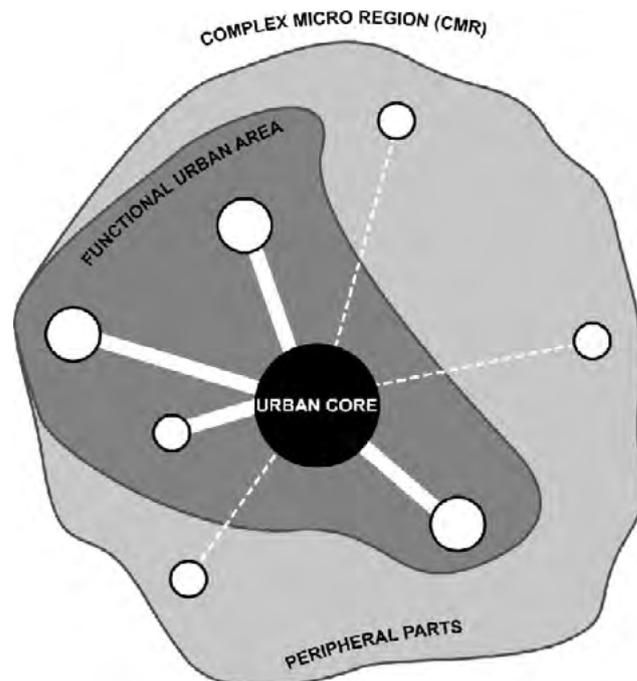
A core question cities and regions face is: How should UAM be integrated in higher level urban mobility planning, or in more practical terms: which role should UAM assume in a given (or envisioned) urban transportation system? To address this issue two advanced concepts of urban mobility planning are discussed in this section, namely the “functional urban area” and the “15-minute city”, as well as the role UAM may assume therein. At the same time, mention is made to the concept of Mobility Network Management (MNM) that employs a systemic view of the transport system as a whole.

Urban mobility planning is innovative, as it utilises new technologies to provide answers to various mobility challenges, expands the possibility for space of the urban population (i.e., the set of mobility options), and serves higher level societal goals. Primarily, urban mobility planning serves societal goals such as sustainability, social inclusion, or the overall quality of life,¹⁸. At the same time urban mobility planning usually forms a core element of innovation strategies that, especially for large cities, metropolitan areas, and regions, aims to attract talents and businesses to ensure economic growth. UAM therefore, not only is becoming one of the elements of mobility planning, but also a prominent pillar in the formation of urban innovation strategies. Cities typically face the following strategic decision regarding UAM: *how innovative do we want to be as a city (in general), and how can new services like UAM and their underlying enabling technologies could contribute to our urban innovation strategy?*

The “functional urban area”

Urban mobility planning would be ill-advised to restrict itself to a municipality as defined by its administrative boundaries, because traffic flows and economic activities usually go well beyond these confines. The regional map of municipalities, that is, the partition of a region that is created by municipal boundaries, usually does not match with the map of regional transport systems and traffic flows. Relying solely on the former would amount to ignoring relevant elements of the actual planning problem and lead to insufficient planning results.

Figure 10: Scheme of Functional Urban Area (FUA) in the context of a complex micro region. [Source: Sýkora, & Muliček 2009, 293]



To overcome these issues and to provide mobility planners with a powerful statistical tool, the OECD and the European Union have jointly devised the concept of the “functional urban area” (FUA)¹⁹. By defining grid cells, urban centres, local units and commuting zones, the FUA-concept transcends municipal boundaries, especially by taking commuting flows into account. Figure 10 illustrates a scheme of a FUA in a complex micro-region context. If applied on a broad scale, the FUA-concept allows for the statistical comparison of different functional cities – a key strength on which for instance the OECD readily draws in its “Territorial Reviews”.²⁰

¹⁸For example, the City of Hamburg has identified the following five top-priority future challenges in the latest version of its “Regional Innovation Strategy (brought to the public in May 2021): (1) health, (2) climate and energy, (3) data science and digitalisation, (4) materials science and new materials – and indeed: (5) mobility (see the Regionale Innovationsstrategie der Freien und Hansestadt Hamburg. <https://www.hamburg.de/contentblob/15087588/42f8df5ead27b63d3e1b34330cc2f477/data/2021-05-18-bwfgb-ds-ris.pdf>).

¹⁹Dijkstra, L.; Poelman, H. & Veneri, P. (2019): The EU-OECD definition of a functional urban area. OECD Regional Development Working Papers 2019/11, OECD Publishing: Paris.

²⁰See the OECD Territorial Reviews, https://www.oecd-ilibrary.org/urban-rural-and-regional-development/oecd-territorial-reviews_19900759. For example, the Territorial Review of the Hamburg Metropolitan Region can be accessed here: https://www.oecd-ilibrary.org/urban-rural-and-regional-development/oecd-territorial-reviews-hamburg-metropolitan-region-germany_29afa27f-en.



Obviously, the FUA relies on “two-dimensional data” that is generated in the urban/regional area. The question that immediately springs to mind is, if, and if so, how is the FUA-concept altered, as soon as UAM operations introduce the third (vertical) dimension to the urban mobility system. *Can, or should, a UAM ecosystem be set up relatively independently from the “ground-based” transportation system, or are there dependencies and interrelations with the traffic in the urban airspace which must be considered?*

For starters, the frequency, density, and flow of flight operations in a fully-fledged UAM ecosystem, integrated with other modes of transport, will certainly differ from the number of commuting flows on the ground²¹ and therefore from the flows at functional urban area as delineated in Dijkstra, Poelman & Veneri (2019).

There will be a considerable increase in regulatory and technological complexity in the urban sky as soon as operations in the urban airspace are picking up momentum, for example in terms of Unmanned Aircraft Traffic Management (UTM). The aforementioned UAS/drones and U-space regulations aim to ensure the safe, secure and sustainable use of the urban skies. Projects funded under the H2020 SESAR JU such as the DACUS (“Demand and Capacity Optimisation for U-Space”) and USEPE (“U-space Separation in Europe”) address these and other related issues²².

The complexity induced by UAM to the vertical dimension will almost certainly spill over to the ground where an associated support infrastructure needs to be built up.

This may consist, as already outlined, of vertiports, drone-pads as well as of aircraft parking and MRO-facilities (MRO: maintenance, repair and overhaul), energy supplies and management, check-in areas for passengers, cross-docking areas for cargo and logistics operations, or integration with the infrastructure of medical and emergency services.

The ground-based transportation system will certainly be affected by UAM as substitution effects between traffic flows on the ground and in the urban airspace occur.²³ Furthermore, portions of traffic flows will be diverted to, and from, the landing zones of cargo drones and air-taxis to shuttle passengers and transport cargo to their final destinations. Architecture and urban planning will be affected by UAM as well, as related infrastructure needs to be integrated in the urban landscape and urban construction.

²¹See e.g. Balac, M.; Vetrella, A. R.; Rothfeld, R. & Schmid, B. (2018): Demand estimation for aerial vehicles in urban settings. In: IEEE Intelligent Transportation Systems Magazine, 105-116; Ploetner, K. O., Al Haddad, C., Antoniou, C., Frank, F., Fu, M., Kabel, S., Zhang, Q. (2020). Long-term application potential of urban air mobility complementing public transport: an upper Bavaria example. CEAS Aeronautical Journal, 11(4), 991-1007; and Pukhova, A.; Llorca, C.; Moreno, A.; Staves, C.; Zhang, Q. & Moeckel, R. (2021): Flying taxis revived: Can Urban air mobility reduce road congestion? In: Journal of Urban Mobility 1, 1-8.

²²For a full list of the U-space, UAS and UAM related projects funded by the European Commission and SESAR JU under H2020 see the Annex.

²³Such substitution effects, especially bringing relief to the congested transportation system on the ground, are intended and one of the main reasons why an UAM ecosystem might be introduced to the urban environment.

Another aspect of emerging complexity is related to the fact that the sheer number of stakeholders, both for land mobility and UAM, will grow with their areas of common interest becoming naturally more and more divergent and so effective communication and decision-making tools will have to emerge to support those multi-level stakeholder management challenges.

It is crucial to understand and consider the needs of the key stakeholder: the citizen. In order to analyse the preferences of the citizens on fundamental, UAM related, questions and to arrive at meaningful answers which effectively guide strategic decision-making in urban (mobility) policy and planning, a public discourse with all relevant stakeholders is indispensable. For example, how might the advent of UAM services transform FUAs?

This question might be put up for discussion in the wider expert community, but as the above deliberations show, the interrelations between infrastructure, transportation systems on the ground, and flight operations in urban airspace can be expected to be multi-faceted and complex. For example, some operations, as it has been the case with various UAM pilot projects, will take place within strictly defined spatial boundaries and do not expand beyond a municipality's limits; and thus, they may be conducted relatively independently from the conditions on the ground. Currently, these boundaries are usually imposed by the air traffic control authority in charge, predominately for safety reasons, to protect lives and infrastructure on the ground as well as interferences with conventional manned flight operations. Thus, it makes sense to consider that the 'functional urban airspace' is currently and predominantly managed from the safety and security constraints as well as the risks and opportunities originating from the ground. To this end, the integrated approach prompted by the SUMP process may benefit from an extended version of a FUA that takes into account traffic in the third (vertical) dimension. In the long run UAM has a potential to radically impact FUAs due to its range and being relatively infrastructure-light (compared to rail and road transportation) – SUMP is a tool to assure that this impact is positive in nature.

The “15-minute city”

The 15-minute city is a concept that shifts focus from mobility to accessibility. The question becomes: *“How much can I get in a given amount of time?”* instead of *“How far can I get in a given amount of time?”*

This way, people's needs coverage and not the speed of the travel are at the forefront of planning decisions. This leads to more access, proximity and safety, which could boost creation of community among residents, thereby leading to improved urban living. Additionally, this approach received a lot of extra praise recently, as it is perfectly aligned with implications of pandemics (e.g., lessons learned during COVID),²⁴ by helping to contain the spread of potential infections since citizens would not have to commute as far to meet their needs. The 15-minute city concept promotes walking and cycling as main mobility modes, creating dense, walkable cores; however, opponents of the concept point out the increased potential for marginalisation of people with disabilities and for gentrification, where increased quality of life in certain neighbourhoods could elevate property prices.

At the first glance there is no space for UAM within boundaries of 15-minute city concept, as the first one (i.e., UAM) is perceived as technology-driven mobility-expanding concept (longer distance and higher speed aspects) and the latter is community-focused mobility-scoping concept (shorter distance and reduced time aspects). Could SUMP constitute a potential bridge linking these two potentially exclusive concepts?

First, UAM used in a physical layer of e-commerce deliveries, could reduce mobility anxiety and the need to drive to purchase goods, allowing for reinforcing position of public transport, supporting and not jeopardizing the 15-minute city concept. Second, addressing the marginalisation critique, UAM could be used as a tool for introducing more equity in the spaces which already had been transformed following 15-minute city concept by allowing fulfilment of mobility needs for people with disabilities. UAM services could support the positive aspects of the '15-minute city' concept by shifting focus from mobility to accessibility. In the long term, one can imagine that it might be necessary to introduce policies which would even regulate access to 15-minute city spaces using eVTOLs, or drones, in view of managing issues linked to gentrification and property prices.

²⁴Smitham E. & Glassman A. (2012): The Next Pandemic Could Come Soon and Be Deadlier. In: Center for Global Development. <https://www.cgdev.org/blog/the-next-pandemic-could-come-soon-and-be-deadlier>, 25.08.2021.
Murdoch, D. (2020): The next once-a-century pandemic is coming sooner than you think – but COVID-19 can help us get ready. In: The Conversation. <https://theconversation.com/the-next-once-a-century-pandemic-is-coming-sooner-than-you-think-but-covid-19-can-help-us-get-ready-139976>, 14.06.2021.

INTRODUCTION

The development of UAM services could mitigate urban sprawl, or negative externalities of urban and regional planning. UAM services used in a physical layer of e-commerce deliveries, could reduce mobility anxiety and the need for driving to purchase goods, allowing for a reinforcing position of public transport. Another essential challenge that could be addressed is making e-commerce deliveries more environmentally friendly and reducing congestion and

cars' dominance in the cities' modal split. The reduction of traffic congestion and greenhouse gas emissions within the city centre of the city could be facilitated by providing better a connection network into the 3rd dimension to the peri-urban and rural areas. UAM could be used as a tool for introducing more equity in the spaces which already will be transformed by allowing fulfilment of mobility needs for people with disabilities.

GOOD PRACTICE EXAMPLE The 15-minute city concept in GZM (Poland)		
<p>Since the beginning of the SUMP work in Metropolis GZM, the biggest challenge was to approach a specific layout with many centres and a network of districts (neighbourhoods), the location of which is largely due to the location of former factories/industrial plants. Citizen's opinions have been filtered and analysed in order to find solutions regarding the vision of the development of three basic types of areas:</p>		
<p><i>Good district (neighbourhood)</i> – a response to the concept of a 15-minute city and an increasing need/compulsion in the pandemic era to meet one's needs in the immediate surroundings. The idea is to create residential areas located both in large cities and rural municipalities, which are safe for all users, including mainly pedestrians and cyclists. The primary tool for creating a good neighbourhood is traffic calming.</p>	<p><i>Good centre</i> – a destination for many journeys, which take place in a specific short-term purpose. A centre, where places and points of interest are located on the map of the city/ municipality – public places, offices, institutions. In this regard, the problem of the mass influx of private cars into the centres with limited capacity for individual traffic must be tackled. The main tool more restricted parking policy.</p>	<p><i>Good transport</i> – as the bond of districts (neighbourhoods) with centres and all cities with each other. It is mainly based on a good public transport, complemented – for shorter distances – by bicycles and pedestrian traffic. This is a task not only for the transport manager but also for municipalities providing such task, which is reflected in the analysis of complaints about public transport.</p>
GOOD DISTRICT	GOOD CENTRE	GOOD TRANSPORT
<p>All these areas (pedestrian traffic, safety and traffic calming, parking problems in the city as well as cycling and public transport problems) should be treated together. These problems are intertwined and have a direct impact on each other. Activities carried out in all areas have a common denominator – sustainable mobility implementation. The means for this purpose are:</p> <ul style="list-style-type: none"> • Reduction: reducing those forms and mobility cases, which are not necessary (i.e. reducing the necessity to deal with matters far away from home instead of in the immediate vicinity) • Substitution: replacing parts of individual car journeys with other means of mobility, which implement the principle of sustainability (e.g. through new bus connections or cycling routes) • Reorganisation: better management of existing resources (e.g. adapting infrastructure to pedestrian and bicycle traffic during ongoing renovations or forcing rotation of existing parking spaces) • Redistribution: fair distribution of resources in order to increase the accessibility of mobility and competence for its efficient and pleasant cultivation (e.g. the management of a road lane in such a way that there is a space for safe and comfortable mobility not only that by car but also by bicycle or on foot) 		

The concept of Mobility Network Management (MNM)

Urban innovation, as outlined above, encompasses both the concepts of urban mobility planning and that of the '15-minute city'. Both concepts prioritise on the better quality of life for the citizens in modern urban areas. Nonetheless, the question arises on whether UAM can be truly integrated to the entire system of mobility while satisfying both the needs of the individuals and those of the public authorities that act as goal setters for the urban mobility planning.

As UAM operations necessitate an accompanying infrastructure (vertiports, aircraft parking, UAM users parking) and related facilities such as energy hubs and MRO the impact of the use of these should be taken into account and, in addition, absorbed by the Mobility Network Management (MNM). It has been described already how the traffic distribution will be needed when UAM is in operation within an urban area but how this traffic can be distributed should not be left to chance.

An integral part of a city's, or a region's, planning and design of its mobility is the architecture of its mobility network system. As UAM is one of the transport modes in a multi-modal and multi-dimensional mobility ecosystem, it should be accounted for, when a city sets its social, environmental and mobility targets. In modern (ground) traffic management practices, public authorities cooperate with (ground) traffic stakeholders and agree on specific sets of targets that include geofencing certain areas, re-routing in well-defined cases and prioritising of certain mobility users (the most common is prioritising bicycle traffic over vehicle traffic, as is the practice in Copenhagen and Amsterdam). As the priority of the city authorities is the alleviation of congestion, the reduction of negative environmental impact of mobility, more and more cities work together with mobility operators and service providers in guiding and dispersing traffic into alternative modes that will aid the users to reach their destination, albeit using modes and routes in a variety of combinations. The management of all mobility modes in balancing the (wider) mobility network is more successfully done when the stakeholders agree to follow the guidelines of the decision makers at city level regarding high level goals while still being able to compete on quality of services offered to their individual users (TM 2.0 principles of Co-opetition and trust among mobility stakeholders²⁵).

UAM can contribute to the successful implementation of MNM, when the ground modalities and traffic are either

predicted to be congested or not sufficient to provide the accessibility required. Subsequently, the decision makers should anticipate and mitigate on potentially negative consequences and route the traffic to the vertical (third) dimension. This applies in the first instance to emergency, medical and other logistics and deliveries or critical nature within urban environments but not only. Another application of the MNM that involves the optimal use of UAM is in the redistribution of traffic flow to the vertical dimension in cases of roadblocks and energy outages with the latter usually being the cause of traffic collapse in most of the cities. As UAM is one of the mobility modes within the multi-modal mobility system, it could be treated as a channel to either purposefully deal with ground traffic bottlenecks when needed or enhance the accessibility of certain locations. A good understanding between the city/regional authorities, UAM and mobility operators (including MaaS operators) is key in this holistic mobility network approach.

Initial strategic choices for cities and regions pertaining to UAM

Cities and regions face the following strategic choice regarding UAM:

1. Shall we engage in UAM at all?
2. If so, when in terms of technology maturity and regulation shall we start engaging in UAM, and how far shall our engagement go?

The choice options associated with the first decision-making step simply is "Yes" or "No", whereas the choice options associated with the temporal dimension, *-when in terms of technology maturity and regulation shall the engagement of a city in UAM commence-* are, broadly speaking:

- a) Engage as early as possible and become a "frontrunner" or innovator in UAM services deployment.
- b) Adopt UAM services after the technology and the regulatory framework have reached a certain maturity stage and sufficient operational experience has been gained elsewhere (i.e., by frontrunner cities and regions or early UAM adopters).
- c) Adopt UAM services after they have reached full (operational) maturity elsewhere and the benefits have been fully proven.

²⁵See the TM2.0 Innovation platform, www.tm20.org.

To support their decision-making process, cities and regions may consider the 'technology adoption lifecycle'²⁶ as a useful tool to establish clarity about their own aims, preferences, risk attitudes and resources regarding innovation. The extent of the engagement in UAM services may range from highly specific uses, for example the transportation of medical goods, to full-scale implementation that includes not only the full spectrum of public, but also commercial UAM services. In accordance with the aforementioned technology adoption lifecycle, it is fair to acknowledge as 'innovators', a significant number of cities and regions involved in the UIC2. These cities and regions, as they sail (or rather fly) into uncharted territory with their efforts to establish UAM infrastructure and services in their respective cities and regions.

The strategic choice issues outlined above may, of course, be revisited later or recurrently in light of new information and new developments in the field of UAM. Furthermore, it is important to note that the authors, who represent frontrunner cities and regions in the field of UAM, by no means intend to set up an imperative to prefer one strategy to another; for example, "engage as soon as possible" or "adopt later". In other words, depending on the objectives of a municipality, or a prefecture, and its population, for example, the specific circumstances and restrictions it faces, as well as the uncertainties associated with UAM services, and the collective "risk mitigation culture" of the municipality, each of the strategic choices outlined above may be both perfectly rational and legitimate. To address the decision-making issue outlined in this section the "Rational Decision Making" approach²⁷ comes in handy. This approach provides decision makers with a set of techniques which are devised to arrive at decisions that are aligned with the decision-makers' objectives to the best possible extent, while taking into account the given choice options, as well as the uncertainties that may interfere with the process of goal achievement. The SUMP concept that is outlined in the following chapters, readily draws on this approach, and provides not only a powerful planning framework, but also a set of useful decision-making tools.

As the UAM journey has only just begun, the four phases of the SUMP cycle as they are outlined in Chapter 3, have not yet been performed entirely in the field of UAM. Thus, emphasis is being placed in this document on the first two stages of the SUMP cycle where considerable experience has been gained by the authors; namely, *the preparation and analysis* stage and *the strategy development* stage. Based on this experience, a set of possible strategies to address the last two stages of the SUMP cycle, namely, *measure planning*, and *implementation and monitoring*, are discussed.

The UIC2 cities and regions that have contributed to the development of this Practitioner Briefing, are already engaged in various activities that aim at the policy making and implementation of UAM environments. Still, the approaches among cities and regions differ significantly in many aspects, such as the resource endowment, the institutional frameworks, the cultural attributes, or the planning approaches of local authorities, whether at city/municipal or regional/ prefectural levels. Thereby, the reader pondering about the introduction of a UAM infrastructure, should be able to learn from a rich variety of experiences gathered and detailed in this Practitioner Briefing and provide his/her institution's decision-making process with valuable information. Furthermore, this document deals with the integration of UAM as a new and innovative mode of transportation into the concept of sustainable urban mobility planning (SUMP), as well as, more generally, into the urban planning policy and practice. While the cities in the Sci-Fi films are, despite all the technological advancements, usually dark, dystopian places, UAM and SUMP aim at creating the opposite, making cities liveable and better places. This target calls for a holistic approach that integrates virtually all dimensions of urban planning, as well as responsible research and innovation.

The remainder of the documents is structured as follows:

- Chapter 2 outlines the eight SUMP principles, which are fundamental to sustainable urban mobility planning, and addresses them within the current UAM context.

²⁶Wikipedia contributors (2021a): Technology adoption life cycle, https://en.wikipedia.org/wiki/Technology_adoption_life_cycle.

²⁷Eisenführ, F. & Weber, M. & Langer, T. (2010): Rational Decision Making. Berlin/Heidelberg: Springer. Useful background can be found also at: Wikipedia contributors. (2021b): Rational planning model, https://en.wikipedia.org/wiki/Rational_planning_model.

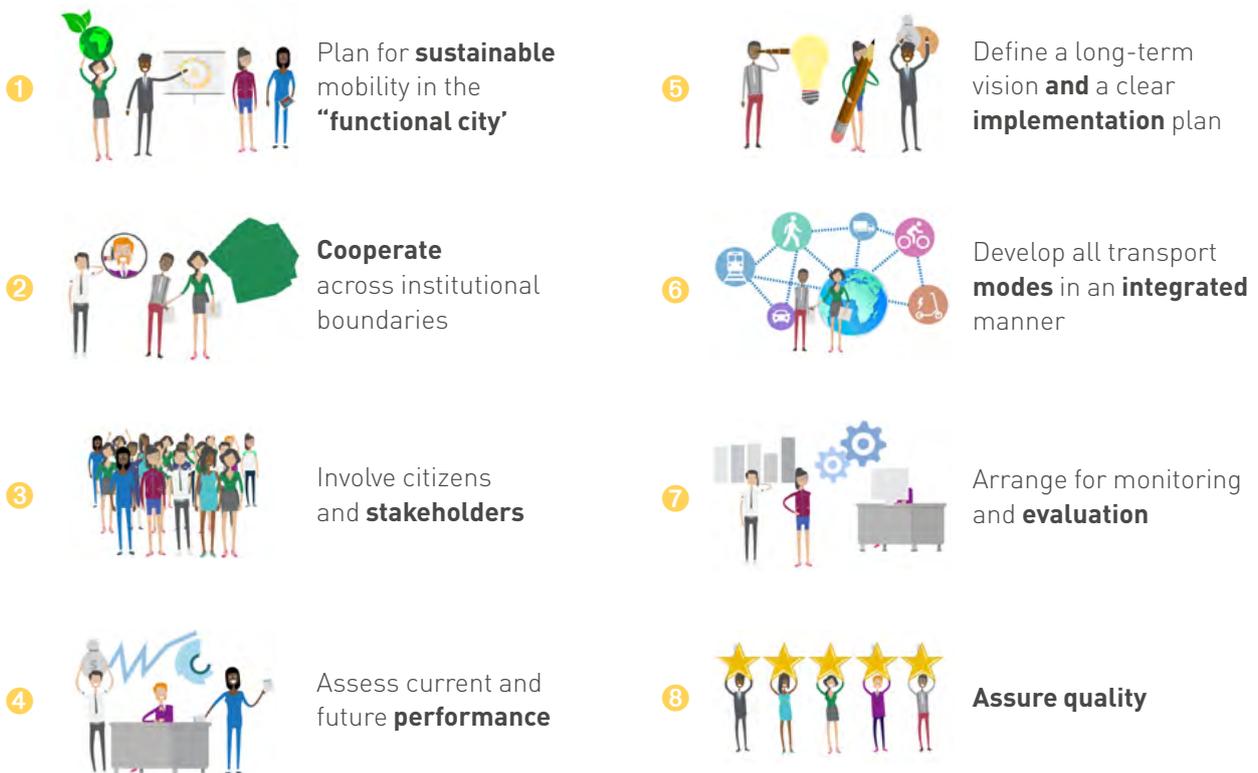


- Chapter 3 presents the SUMP cycle, the primary SUMP-planning tool, while particular attention is given to its phases and sub-steps where the SUMP concept and the UAM domain interrelate in specific and interesting ways. This is especially the case in phases 1 and 2 of the SUMP cycle (“preparation and analysis” and “strategy development”). Examples of practice from various cities and regions are included to highlight the challenges and opportunities which may occur during the SUMP cycle.
- Chapter 4 is devoted to the description of examples from UIC2 cities and regions that are actively engaged in UAM and have contributed to this document. The reader will get acquainted with a variety of city/region approaches to UAM planning and implementation that range from “already closely aligned to the SUMP-concept” (e.g., GZM case), through “integrated top-down” (e.g., Toulouse case) to “experimental in a quadruple helix innovation context” (e.g. Hamburg case). Chapter 4 concludes with remarks on the role, and future, of UAM in sustainable mobility planning and within the SUMP-concept more specifically. These remarks are envisaged to be especially helpful for those cities and regions that either think about setting up, enabling, and facilitating UAM ecosystems, or are simply considering their next steps regarding UAM.

2. The eight SUMP principles in the context of Urban Air Mobility

The eight SUMP principles (Figure 11) are applicable for all modes of transport. However, the context of UAM is a special case as typically these principles have been applied to ground and surface modes of transport. UAM therefore is more than a completely new mode of transport that yet has to be integrated into existing mobility systems of a functional urban area. It is about airborne traffic at low altitudes, above populated areas at scale; and this brings opportunities and constraints from both the aviation and the ground transportation sectors (e.g. safety regulations and urban planning policies). Airborne traffic is experienced today at urban and regional levels predominantly from the operations of commercial airlines close to airports. Commercial aviation has the highest safety standards of all public transport modes, and those standards are currently used as the basis, where applicable, to shape the safety and security measures for the emerging UAM services.

Figure 11: The eight crucial principles for successful Sustainable Urban Mobility Planning [Source: Eltis. The EU’s Urban Mobility Observatory²⁸]



²⁸Eltis (2021): The SUMP concept, <https://www.eltis.org/mobility-plans/sump-concept>.

1. Plan for sustainable mobility in the “functional urban area”

Based on the technological developments on the one hand and the more and more stringent regulations on the European level, cities and regions should plan early about the potential benefits that UAM services could have for them and consider how they would like to proceed with UAM services’ definition and implementation. In a functional urban area, a holistic approach is needed, where UAM complements other modes of transport and does not restrict them in any way.

UAM services have the power to influence the mobility of a city or region in many different ways, for example whether it is goods or passenger transportation and might initiate a deep transformational process. For example, UAM services could offer the advantage of typically longer commuting distances while keeping constant the average commuting time. In other words, making it possible for those commuters who live farther away from their jobs, quicker commuting times than currently possible. In the case of logistics, delivering medicine or other critical needs. In order to manage and influence this process, cities and regions need to be aware of the nature of UAM services prepare themselves accordingly.

Key questions:

- Are the local institutions ready for this transformation of mobility?
- Which changes might be necessary, at which institutional level, for UAM needs to be addressed?

2. Cooperate across institutional boundaries

UAM services cannot be managed and planned by a single institutional sector. It is therefore important, that the subject is approached from different perspectives and backgrounds. The potential cross-sectoral cooperation can range from the local aviation authorities to the departments for urban planning, environmental affairs, and/or economic development. This cooperation might even lead to new institutional structures that could take over the responsibility for this new mode of transportation.

This co-creation extends the traditional borders of expertise, bringing everyone into the decision-making process as an expert on one issue or another beyond the usual actors. This is a situation we can witness in the case of Toulouse, which is described in the next section.

Urban sustainable mobility is a key terrain for co-creation because of the daily implications to different social groups. The citizens, either as users or non-users, along with an array of diverse stakeholders should be engaged in different ways. In this context, the UIC2 (see Figure 18 in Chapter 4) has been serving as a city-centric platform to ensure a holistic approach to urban mobility, proactively engage with citizens and foster co-creation among public and private actors (incl. citizens). In the context of co-creation, tools like living labs (also “Experimentierraum”), social media engagement campaigns, public surveys and traditional media communication campaigns should be used, depending on the context.

Key questions:

- Which expertise is needed from the different institutional stakeholders?
- Which type of cooperation is feasible?
- Is there a need for different/new institutional structures?
- Depending on the context, what is the most appropriate tool?

3. Involve citizens and stakeholders

As per this SUMP principle, the city should put the citizens in the centre of mobility development as well as allocate resources and define a plan to engage citizens in each development stage; for example, some cities like Toulouse already have a digital platform named “*je participe*” to engage citizens and also have dedicated team and tools to do so. Even though the citizens are the main stakeholder it should be remembered to address needs of other groups, for example, tourists, business visitors and daily commuters from other cities or regions within the functional city.

As of now, citizen acceptance is the most important aspect that has to be taken into account. This is a prerequisite for the commercial update of UAM services. To this end, UAM services for the public good can nurture societal embracement and resilience. It would be beneficial, if a city with academic institutions and industry partners were to organize dedicated workshops and interactive sessions for the community to provide information and create a dialogue with citizens. Pilot projects, if possible, should be focused on important social aspects, to achieve higher social acceptance. For example, in most cases health related pilots (like blood transport) gain higher social acceptance than crowd surveillance.

It is highly encouraged to implement methods and tools in the context of Responsible Research and Innovation (RRI) that implies that societal actors (e.g., researchers, citizens, policy makers, business, third sector organisations) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society. This is critical for UAM services as the interests and potential conflicts among different stakeholders need to be aligned and resolved as necessary. Thanks to the participation in the process, attitudes towards the issues being developed might change, thanks to which UAM acquiring natural ambassadors in various places of its ecosystem.

Key questions:

- What do my citizens think about UAM services and do they have enough high-quality information to form a qualified opinion?
- Which information do my citizens need and how can I get it to them?
- How to get in touch with the citizens and engage them into the process?

4. Assess current and future performance

As of today, UAS applications in the context of UAM are in most cases still at either an experimental level or at a very early stage of the introduction process. This makes it rather difficult, to assess their current performance. Nevertheless, by evaluating the experiences and results of these experimental projects²⁹ the potentials of this new technology can be assessed to some degree. In Toulouse Metropole for example, the local authority is trying to develop a future multimodality testbed to anticipate future mobility scenarios.

The additional performance in the future can be assessed by applying methodologies like scenario development or a SWOT analysis.

Key questions:

- Are the experimental projects that are relevant for the potential application in my city or region?
- How to get their results or contact the project team?
- How should UAM be integrated in the current transport assessment?
- What are potential future scenarios?

5. Define a long-term vision and a clear implementation plan

Even though UAM might still sound like “science fiction”, the new regulations set up by the European Commission show that UAM and the application of UAS in cities and regions are closer than some might expect. Therefore, it is important for municipalities and prefectures to have a plan for capacity building to deal with the upcoming integration of UAM services into their functional urban areas. For example, Toulouse Metropole has included UAM use cases inside its multi-year urban mobility project called VILAGIL to test and verify the positive impact of UAM on society. The findings and knowledge gained from this project can inform the early phases of the SUMP process cycle.

In order to define a clear implementation plan, there is the need for a profound analysis to identify the contributions as well as potential adverse effects that UAM services may have in the frame of sustainable mobility. All relevant stakeholders need to be effectively identified and efficiently involved. To this end, the ambition and scope of UAM services should be determined right from the beginning; for example, distinguishing between passenger transportation and logistics, as well as the kind of desired logistics operations.

Key questions:

- Do UAM services align with the different institutional goals of my city/region and are there any potential adverse effects?
- Are the resources available to create feasibility and implementation plans?
- Are there mitigation measures for potential negative effects of UAM services?

6. Develop all transport modes in an integrated manner

UAM can only be a success, if it is integrated in a wider and holistic mobility strategy that integrates all the different transportation modes. To achieve this, the different modes, especially in the case of a new mode like UAM, must be well interfaced and integrated into the system.

²⁹ The European Commission has funded a series of research and innovation projects in the context of H2020 through the SESAR JU, the MG3.6 and the LC-1.12 funding programmes, for example. A comprehensive list of EU-funded, UAM-related projects can be found in the Annex.

As a reminder, the ultimate aim is not for UAM services to replace existing transportation systems, but rather to sustainably, and responsibly, complement the existing modes of transportation.

A special case of the integration with other transportation modes, is the integration of UAS into the airspace above the city, especially if there are major airports with their respective control zones. An intensive collaboration with the responsible Air Traffic Control (ATC) organization is mandatory here. Furthermore, the potential effects on emergency and police helicopter operations have to be taken into account. The new EU U-Space regulation will facilitate this process.

Key questions:

- Where are the UAM services and other modes of transportation connected?
- How to enable interfaces and build these integration points?
- How to safely integrate UAS into the (controlled) airspace above the city?



7. Arrange for monitoring and evaluation

UAM services have the potential for a wide range of different use cases and the city needs to define quantitative and qualitative benefits accompanied by measurement mechanisms in order to be capable of measuring potential trade-offs of deploying UAM services. The use of key performance indicators (KPIs) might be a good starting point. The latter is already happening in the case of Toulouse Métropole, where the French government will measure the impact of all the components of the VILAGIL project that includes a UAM component (see Good Practice Example, Orange box) through KPI's monitoring.

Aspects that should be monitored could include:

- Air quality
- Levels of noise pollution
- Medical emergency response times

- Energy consumption
- Traffic flows and congestion levels
- Potential “visual pollution”
- Citizens’ privacy

This list is only indicative and it is not by any means conclusive. Consultation and co-creation with citizens and other local stakeholders are the most effective way of collecting and prioritising the local concerns and opportunities from UAM services.

Key questions:

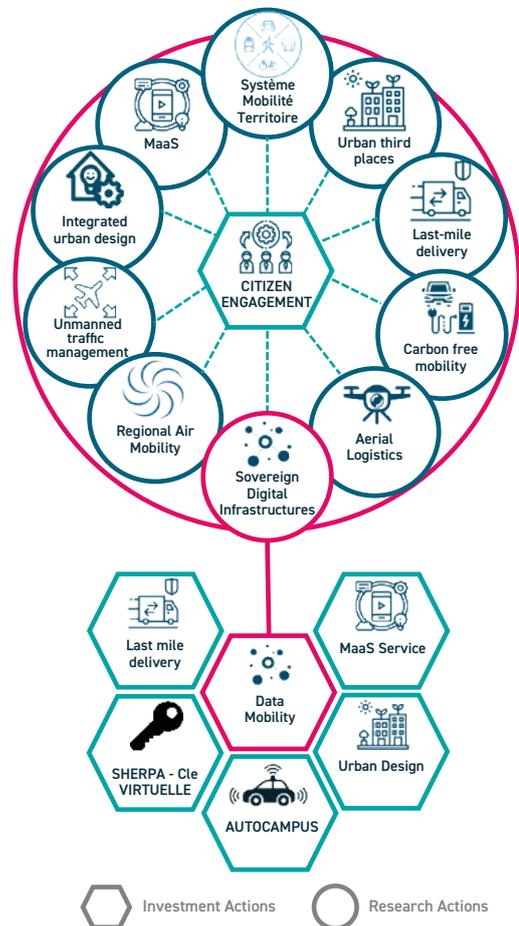
- What resources are needed to be able to carry out this monitoring?
- What are the correct performance indicators?

GOOD PRACTICE EXAMPLE VILAGIL-Territoire d’innovation: Toulouse Métropole approach towards integrated and sustainable future mobility including UAM

The VILAGIL programme, supported by Toulouse Métropole, Tisséo, SICOVAL and the Pôle d’Equilibre Territorial et Rural (PETR) Portes de Gascogne, was selected at the end of 2019 by the state from among 24 others in France as part of the national *Territoires D’innovation* programme.

The VILAGIL territory is marked by strong demographic growth (+1.55% per year), aggravating the phenomenon of urban sprawl and leading to an increase of 500,000 daily trips by 2025. In order to pursue an ambition of sustainability, recovery, but also innovation and decarbonisation of the territory, the VILAGIL programme aims to provide operational and concrete solutions. Thus, VILAGIL is a project to decarbonise and decongest the territory with the aim of encouraging the emergence of new forms of mobility and sustainable economic development. This programme is structured around a public, private, and academic ecosystem and three areas of work deployed in 15 projects (9 investment projects + 6 grant projects):

- Putting technological improvements and data at the service of intelligent and efficient mobility.
- Changing behaviours and uses by placing the citizens at the heart of the project.
- Transforming the organisation of living areas and places of activity in the region from an ecological and digital perspective, as well as the management of the home-work journey.





8. Assure quality

A SUMP is one of the key concepts for the development of an urban area. Having mechanisms in place to ensure a SUMP's general professional quality and to validate its compliance with the requirements of the SUMP concept (i.e., this document) is an effort worth taking.

The assurance of data quality and risk management during implementation requires specific attention. These tasks can be delegated to external quality reviewers or another government institution (e.g., on the regional or national level), while it can be facilitated by the use of tools like the SUMP Self-Assessment Tool. A city or region, in coordination with other relevant authorities, needs to define a policy which covers not only every aspect for the safe and secure operation of UAM services but also their public value and wider societal embracement. Furthermore, it should develop and deploy UAM services in close collaboration with regulatory authorities (e.g., aviation, ground mobility, environmental), and entities across sectors and governance levels (e.g. national and regional).

The aviation experts active in the UAM community has a well-established reputation for quality assurance when it comes to operations safety, technological reliability and resilience as a part of the aerospace sector heritage.

In the SUMP context, the definition of quality should include the level of fitness with SUMP principles and relevant metrics as well. A common set of quality standards and certification requirements for UAM operations and services, preferably prepared by the interested parties under the auspices of European entities and standardisation organisations such as the European Committee for Standardization, EASA, EUROCAE, CEN, ISO, to name a few, should be developed. In a first step, existing well-established quality management systems (and associated families of standards like ISO 9000 or ISO 14000) may be checked for their suitability in the SUMP-UAM context.

Key questions:

- What are the relevant quality criteria in the area of UAM and UAS and where to find them?
- Which other governmental institution(s) could help to assure quality?

3. SUMP steps for the introduction of Urban Air Mobility

This chapter investigates how the introduction of UAM, as a new and innovative mode of transportation, relates to the concept of the SUMP-cycle (Figure 12), as outlined in Section 2 of the SUMP Guidelines (2019, 30) and how UAM can be integrated into a given SUMP-framework.

One the one hand, UAM may be regarded as “just another mode of transportation” which fits in seamlessly with the SUMP concept. One the other hand, UAM has some special characteristics (e.g., the utilisation of the vertical (third) dimension, the urban airspace), which warrant a closer inspection of the interrelations between planning and implementation issues related to UAM and different planning and implementation stages of the SUMP cycle.

The benefits of such a dual approach are as follows:

- Cities and regions, which contemplate introducing UAM or have decided to do so, can readily draw on the authors’ experiences outlined in this and the following chapter.
- By interrelating UAM and the SUMP concept, planning entities active in the field of UAM are inspired to integrate UAM planning into an existing SUMP-framework.

Figure 12: The SUMP Cycle (Source: SUMP Guidelines 2019, p. 31)



In either case, a city or region active in UAM simply arrives at better, more coherent sustainable mobility planning.

The UAM experience furthermore sheds a light on the interrelatedness between mobility planning and various other fields of urban planning, e.g. sustainable energy provision (UAM should indeed rely on green energy in the first place) or the smart city concept, and the necessity to integrate different areas of urban planning into one coherent approach.

Albeit dealing in the first place with the specialities of UAM (in relation to the SUMP concept), some general insights about the integration of a new mode of transportation to an existing mobility mix can be drawn as well.

In the following, only those parts of the SUMP-cycle are highlighted in which UAM differs significantly from other modes of transportation. If there are no major differences, references to the general SUMP guidelines are given. Particular attention will be given to the initial preparation and analysis stage, when UAM planning and a given SUMP effort need to be aligned to some degree, the strategy development stage, where the necessity for the participation of all stakeholders in the UAM-planning process is highlighted, as well as the pivotal role cities and regions play as facilitators of UAM-related citizen participation, collective creation of common visions and collective decision-making.

GOOD PRACTICE EXAMPLE The Hamburg approach to urban mobility planning: Continuous Transport Development Planning)

An integrated approach to urban mobility planning that bears similarities to the SUMP-concept was recently introduced in Hamburg in 2018. Developed and implemented by the Ministry of Transport and Mobility, the "continuous Transport Development Planning" (cTDP, "*kontinuierliche Verkehrsentwicklungsplanung*") takes into account all issues relevant to urban traffic. This includes environmental issues (i.e., climate protection, air pollution control and noise pollution) as well as the various demands logistic services, cyclists, car drivers, or pedestrians place on the transportation system. The cTDP also encompasses port development planning as well as housing plans (which already goes beyond the domain of mobility planning), and exhibits three stages:

1. *Analysis of the state of urban mobility in Hamburg and the identification of future challenges* – This includes the evaluation and consolidation of existing mobility plans and measures and a prediction of the development of the traffic in Hamburg until 2030. The urban airspace, however, is not explicitly considered in these analyses.
2. *Identification of measures and scenarios* – For the given fields of action (e.g., pedestrian traffic, bicycle traffic, public transport, motorized private transport) different measures and, if necessary, integrated strategies are developed and assessed (in terms of costs and "impact value"). Different measures are matched with different scenarios in order to be able to give optimal responses to different possible future developments.
3. *Development of an integrated concept for action* – Based on a target scenario, a strategy for action is developed which bundles the measures necessary to achieve the mobility goals set in the preceding planning stages. Eventually, a mobility plan is drawn up containing elements like cost estimations, allocations of responsibilities and deadlines.

During all three stages of the cTDP, citizen participation forms a core element. The first three years after its initialisation are devoted to the evaluation of the state of urban mobility in Hamburg and, by engaging in a public discourse, the elucidation of the mobility needs of the population. Proposals for improvement, which may be submitted by all stakeholders, are developed in a participatory fashion and compiled. From this catalogue, an optimal set of mobility measures is chosen.

Another integral feature of cTDP are living labs, which allow for the experimentation within designated areas where the rules and regulations that usually apply within the city area are suspended or attenuated to some degree.

To sum up, cTDP, the Hamburg approach to urban mobility planning, is a relatively young concept and has many elements in common with the SUMP-approach, e.g. the sustainability goals or the emphasis on citizen participation and can indeed be mapped on the 12 steps of SUMP. However, there are also significant differences: The cTDP may be a continuous process, but lacks the circular, recursive structure of the SUMP-planning cycle.

3.1 Preparation and analysis

Figure 13: Phase 1 (preparation & analysis) [Source: SUMP Guidelines 2019, p.33]



Figure 13 illustrates the preparation and analysis activities required for the purposes of Phase 1.

3.1.1 Set up working structures

The decision to integrate UAM in a SUMP-context: the initial situation

Once the (high-level) decision has been made in your city/region to develop a UAM environment and to integrate it in a SUMP-context, you almost never start with a white canvas, i.e., some forms of (advanced) mobility planning, or at least some structures, or even UAM work, which would become relevant to your mobility planning presumably already exist and should be taken into account.

Hence, it would be recommended to thoroughly investigate the initial setting in your city/region:

- Which structures in your city or region are modifiable and which are not with regard to your UAM- / SUMP- effort?
 - “Unmodifiable structures” are restrictions which cannot be altered and encompass for example the climate in your city/region, geographical restrictions, legal and regulatory aspects, institutional and organisational particularities, or budget restrictions.
 - Some “soft structures” may also create “hard restrictions”, e.g., cultural aspects, citizens’ beliefs or behavioural patterns.
 - The distinction between modifiable and unmodifiable structures is important because unmodifiable structures define the realm of possibilities of a planning entity, i.e., which choices or actions are feasible (the “feasible set” of actions) and which are not.

- Scan and analyse the organisational and institutional landscape and identify all relevant stakeholders as well as their attributes, e.g. [strategic] objectives, choice sets, powers over other actors or to influence your planning effort, and the networks they form.
- Which entities and actors in your city/region are active in the field of UAM and/or SUMP, or may become relevant for your own SUMP-UAM planning in the future?
- Relevant entities and actors may encompass different departments of the municipality involved in urban (mobility) planning, research facilities, private businesses, active in the field of UAM/urban mobility, as well as civil society organizations which represent public interests.
- Gaining an oversight over the organisational and institutional landscape in your city/region is by no means a trivial undertaking. In a large city or metropolitan area, it can be a challenge to identify all actors and networks relevant to your UAM-/SUMP-planning effort. Likewise, you might be surprised to find out about the variety of the activities already taking place in the field of UAM, which may have an impact on your own planning effort.

UAM is a new and innovative mode of transport and needs to be integrated in the existing urban transport system in order to become a recognised and sustainable complement. Likewise, UAM-planning, which is only commencing in a coherent fashion in the moment the (high-level) decision is made to introduce UAM, needs to be integrated in the existing urban mobility planning (and even higher-level urban planning, as it is discussed below. Hence, UAM planning will in many cases need to catch up and to be “synchronised” with existing mobility planning activities.

Evaluate capacities and resources

The capacities and resources a planning entity has at its disposal shape the above-mentioned realm of possibilities and should be sufficient to accomplish the planned measures and activities, both with regard to UAM and higher-level sustainable mobility planning. Capacity gaps and resource scarcities that might occur during the various planning and implementation phases should be addressed accordingly.

Create an inter-departmental core team

In accordance with the SUMP guidelines (SUMP Guidelines 2019, 38), it would be beneficial to set up

an inter-departmental, interdisciplinary core team. The following should be considered to ensure an effective team formation:

- Which staff need to be members of such a team?
- Does the core team have the necessary management and technical skills?
- Are the necessary resources and decision-making powers at its disposal to accomplish its tasks and is the core team sufficiently well-connected to do so?
- Can the core team expand if necessary?

Above-mentioned structural restrictions may indeed have an impact on the size, composition of your team and its scope for action. When the team is established, make sure that sufficient effort goes into establishing a common understanding of underlying SUMP and UAM assumptions and definitions.

Ensure political and institutional ownership

Stakeholders need to be convinced that their interests are being duly considered and that they have influence on the UAM-/SUMP-planning and the implementation process. To succeed, your UAM-/SUMP-effort needs the backing from the political and institutional realm, whereas political and institutional actors in turn need to feel ownership over the UAM-/SUMP- process. Form “coalitions of the willing” and address and convince sceptics and include them in the planning and implementation process as early as possible. Identify the relevant stakeholders, their attributes and interrelations as well as possible synergies and conflicts, e.g. by conducting a stakeholder analysis (SUMP Guidelines 2019, 42).

Stakeholder and citizen involvement

According to the SUMP Guidelines, involving all stakeholders throughout the planning process and giving due consideration to their requirements and concerns is crucial for the success of a SUMP (SUMP Guidelines 2019, 44). This holds especially true for UAM, which is a relatively new and innovative mode of transportation and might therefore be met with scepticism in some parts of the population in your city/region. Without the involvement of all stakeholders, an UAM-planning and implementation effort will lack legitimacy and might encounter considerable resistance in some parts of the population.

In virtually all UAM-projects, which have been conducted in the cities and regions the authors represent, the issue of public involvement and public acceptance of UAM is duly addressed, e.g. in form of surveys, or by applying different collaboration methods like e.g. stakeholder round tables or public discussions. See the SUMP Guidelines (2019, 48) for an assortment of interaction tools and methods that might be applied throughout the UAM- and SUMP planning and implementation process, as well as some use cases. Without sufficient public acceptance, your UAM- and SUMP-ambitions will almost certainly be destined to fail.

3.1.2 Determine planning framework

UAM and sustainable urban mobility planning is (hierarchically) embedded in higher-level planning frameworks like urban planning (which integrates the plans of various policy fields of a municipality) or national, regional or European UAM/mobility plans. Higher-level planning frameworks may impose restrictions on your own planning effort, but also offer opportunities (by expanding your “possibility space” e.g. by funding or by creating favourable legal frameworks). Make sure that your planning approach is in line with the higher-level planning framework or fundamental goals, if existing.

What are the fundamental goals that guide your planning and actions in the field of urban (air) mobility and in how far does UAM serve the fundamental objectives of SUMP (SUMP Guidelines 2019, 32)?

1. To meet the general goals of SUMP, UAM services should serve the public good and be equally accessible for all, irrespective of wealth, social status, or special needs. Given the current specific design restrictions eVTOLs face, it remains to be seen to which extent UAM will be barrier-free, or how they could be made so. To serve the public good, municipalities may also decide to subsidize UAM services or to offer UAM as a public service.
2. UAM enthusiasts may argue that UAM services will add new, technologically advanced options to the existing modes of urban transport, thus enhancing the quality of life and the attractiveness of the urban environment. However, some parts of the public may encounter an increase in noise and visual pollution as soon as the traffic in the urban airspace increases or may feel threatened by (low-flying) drones and eVTOLs, and may thus experience a reduction in the

overall quality of life. Such issues need to be addressed in a cooperative, inclusive, and well-balanced approach that takes into account the effects UAM and SUMP exerts on all stakeholders and the population as a whole.

3. By utilizing the urban air space for the transportation of cargo and passengers, traffic density will be reduced on the ground, and consequently, road safety is expected to improve. However, new risks will inevitably emerge as soon as the traffic in the urban airspace intensifies, e.g., drones might cause accidents or might be used for criminal offences. The purpose of regulatory concepts like the “U-space” is to reduce such risks (or to avoid them entirely), and the high degree of risk aversion it exhibits, basically stems from the risk-avoidance culture of manned aviation.
4. UAM can indeed make a significant contribution to the reduction of air pollution and greenhouse gas emissions as long as green energy is being used to power air vehicles like drones or eVTOLs. By the laws of physics, flight operations unavoidably consume large quantities of energy and assuring a sustainable mix of mobility modes will remain a problem even when green energy is produced in sufficient amounts at low costs. For health, well-being and social purposes, walking and cycling should be prioritised/encouraged when feasible. In other words, UAM applications shall be developed and deployed as complementary to the existing urban and regional mobility fabrics. At this point, it is worth recalling the motto of the UIC2: *Walk.Ride.Drive.Fly.* (see Figure 18 in Chapter 4).

As can be seen from the deliberations above, the implications of UAM go well beyond the mobility domain. In order to meet the SUMP goals, UAM not only depends on a green economy, but may even play an integral role therein: drones and eVTOLs may be used in smart grids as storage devices for green surplus energy (as produced by wind farms or photovoltaic plants).

Assess planning requirements and define geographic scope (‘functional urban area’)

In line with the SUMP guidelines and based on the concept of the ‘functional urban area’, define the geographic scope of your planning effort. In the case of UAM, the airspace that is accessible for drones or eVTOLs is by making reference to legal frameworks like the ‘U-space’, defined by the respective aviation authorities in charge.

As long as UAM operations take place within the area of responsibility of one aviation authority, the issue of the functional urban area (or more precisely: the “functional urban airspace”) is fairly straight forward: The national aviation authority specifies the ‘in-large’ functional urban airspace by defining no-fly zones and geographical zones that could be designed as U-space airspaces; the latter may be considered as the ‘actual’ functional urban airspaces as their designation involves an array of stakeholders from the public and private sector.

Challenges may occur, however, as soon as UAM services and operations cross the borders between two or more

areas (e.g., country borders) of responsibility: each involved aviation authority may have to grant a flight permission and air traffic control needs to be transferred from one authority to the other in real-time as soon as an aerial vehicle crosses the respective borders of responsibilities³⁰.

By taking into account the new tasks and responsibilities for cities and regions as well as the coordination required among different actors, be prepared to expand your typical SUMP “planning horizon”, as UAM services may well be expanding (geographically) in the future (and beyond the area of responsibility of a single aviation authority).

GOOD PRACTICE EXAMPLE GZM: Cooperation with associated cities

Plan stakeholder and citizen involvement

Perceiving the associated cities as a value and common space, while working on UAM development at GZM, we defined a need to involve citizens early on. The achievement of goals by GZM should be dictated by the benefits of the inhabitants living there; therefore, any considerations on the implementation of UAM and SUMP must at every step respond well to the requirements of these stakeholders. When implementing tasks in the development of unmanned aerial vehicles in cities, we used participatory methods of developing conclusions and guidelines, involving representatives of public institutions (cities), research centres (universities), research institutions (experts in the field) or independent experts and finally we tried to confront the results with representatives of the industry and a potential customer. The first step in this regard was the initiation of the work of the Metropolitan UAM Team of municipal stakeholders, designed as a tool for acquiring ‘drone ambassadors’ among the authorities of associated cities – potential recipients of drone services and public opinion leaders.

The following conclusions were revealed already at an early stage of cooperation. The work of local authorities’ representatives on concepts for the development of future mobility and future security, which are not included in the municipal tasks, is significantly impeded. Difficulty in assigning employees of specific departments to the work of the team was identified. In some cases, the offices did not start cooperation, seeing no place for this type of tasks in their responsibilities. It was also observed that in individual cities, representatives of various departments had been delegated to cooperate in some cases related to e.g., geodesy, or urban planning, in others, e.g., crisis management.

The limited interest in cities was also caused by insufficient knowledge and lack of access to real implementations of drones and technologies available in Poland. Various concerns, including the safety of new technologies that pose a direct threat to human health, as well as concerns about privacy of residents were also presented. Apart from public acceptance aspect, the local authorities’ representatives were hesitant about the real possibilities of spending public funds due to the lack of guidelines and examples for public procurement of this type.

The natural consequence of the above analyses was the U-space Katowice Project under which cooperation with representatives of the Katowice City Hall was undertaken regarding the identification of challenges and concerns in the process of preparing the city for drones in the areas of spatial management – urban planning, space management, risk management. Ongoing cooperation involves both individual consultations and workshops with stakeholders. The effects of reflection became the basis for creating a textbook for cities in the abovementioned topic.

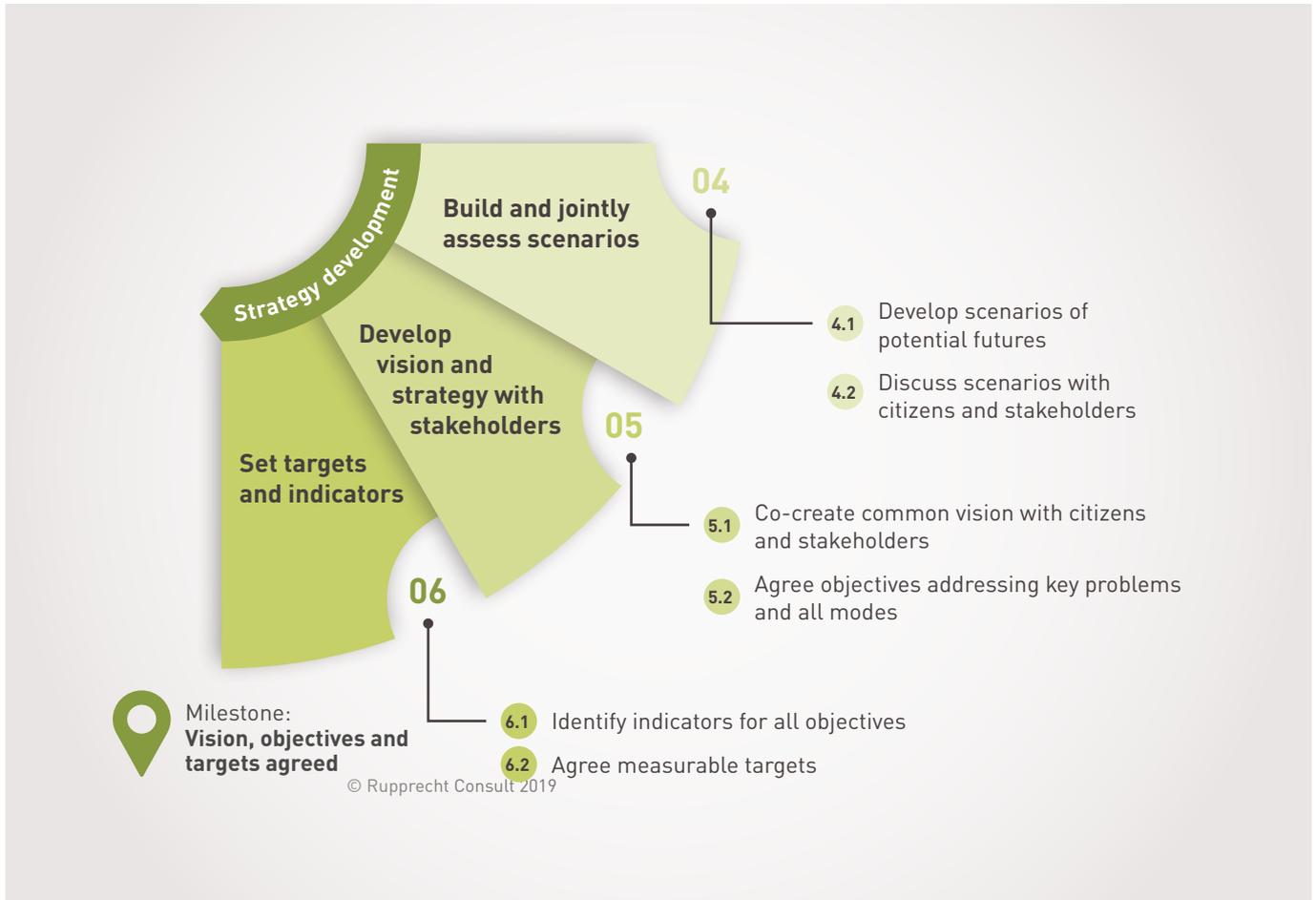
Discuss scenarios with citizens and stakeholders

GZM, wanting to realistically support the development of UAM processes, chose to carry out a pilot project of the UAM service expected by cities and municipalities, to be implemented in at least two of them. The officials from cities such as Katowice, Sosnowiec, Będzin, Dąbrowa Górnicza, Mikołów, Łaziska Górne, Zabrze and Gliwice worked as part of a series of on-line workshops organized together with an inter-ministerial GovTech Polska” team, operating at the Chancellery of the Prime Minister. The goal of the meetings was not only to identify the real needs of local governments, but also to identify the opportunities and threats associated with the use of unmanned aerial vehicles (UAVs) and to indicate the technical, organizational and legal possibilities of providing specific public services with the use of drones. During phase 2 of the workshop, initiated in April 2021, participants took up the challenge of creating a concept of monitoring for the environmental protection public service with using an UAV able to meet the needs of the local government in an innovative way.

³⁰ See e.g. project “GrenzFlug” which addresses drone-based cross-border search and rescue missions in the German-Dutch-Belgian border area, <https://www.fsd.rwth-aachen.de/cms/fsd/Forschung/Projekte/-kdmvn/GrenzFlug/>.

3.2 Strategy Development

Figure 14: Phase 2 (Strategy Development)[Source: SUMP Guidelines 2019, p.79]



This sections details Phase 2 of the SUMP process cycle and their applicability to UAM. Figure 14 shows the main strategic development activities during Phase 2.

As mentioned at the beginning of Section 3, UAM may be regarded as “just another mode of transportation”, which can be easily integrated into the SUMP concept (and into a given urban/regional transportation system). UAM however, as well as the associated technologies, regulatory frameworks and market opportunities, are fast moving, complex and highly volatile fields which come along with great promises, but also with great challenges. Accordingly, future UAM scenarios discussed in public, range from highly optimistic, for example a new mobility revolution is imminent which transforms urban transportation, the urban economy and urban life, to highly sceptical and pessimistic, for example UAM will not lift off anyway due to the many technological and social challenges that need to be overcome, or it will at best occupy a niche within the existing transportation system.

It comes as no surprise that optimistic attitudes regarding the future of UAM are exhibited predominantly by firms active in this field, such as developers of drones or eVTOLs and prospective UAM services providers as well as the investors who have placed their bets on these businesses. Sceptical assessments of the promises and projections made by UAM optimists are frequently put forward by the community of technical experts and market analysts who put both the technological concepts and business models, developed by UAM firms, to closer scrutiny.

In the publication “Basics for Investors: An introduction to navigating the new landscape of urban air mobility”, Head (2021) provides an example of a balanced assessment that weighs the opportunities, challenges and risks associated with UAM from an investor’s perspective³¹.

³¹ Head, E. (2021): Basics for Investors: An introduction to navigating the new landscape of urban air mobility. MHM Publishing, Kitchener, Ontario. <https://assets.evtol.com/wp-content/uploads/2021/07/eVTOL-Basics-For-Investors.pdf>

Garrett-Glaser (2021) meanwhile compares the present “UAM hype” to the dot-com era speculation and predicts in the light of the given challenges and uncertainties in the field of UAM that only a few eVTOL companies will survive in the long run³².

Obviously, a wide range of future UAM scenarios is conceivable, not only on the “macro level” outlined above, but also on the “micro level”, that is in cities and regions where the given specificities shape the “scenario space”, the set of scenarios, to which a positive probability of occurrence can be assigned. That is why the first substage of the Strategy Development, building and jointly assessing future scenarios³³ is especially important in the UAM context.

The collective development of future UAM scenarios introduces the population of a city or region to the topic in hand and informs collective decision-making on future UAM strategies.

Jointly building scenarios implies the identification of exogenous factors and disturbances that may have an impact on your UAM strategy and the projection of relevant trends into the future. This allows for the assessment of the interaction between different strategic choices and exogenous events and disturbances as well as of their associated outcomes.

The SUMP guidelines recommend either the modelling or a qualitative analysis of future scenarios (or a combination of both), an assessment of the interdependencies between different modes of transportation, as well as a “sensitivity analysis” as a way to carry out an assessment of the robustness of different UAM strategies against exogenous disturbances.

After the set of relevant scenarios has been identified, a planning entity can proceed to the second substage of Strategy Development, namely, the development of a vision and a strategy with stakeholders.

The core question to be answered in collective vision-creation is (SUMP Guidelines 2019, 87): What should the city or region we want to live in look like, and how can the transport system (and UAM in particular) contribute to the envisioned positive future? The common vision co-created by the stakeholders should not only encompass the mobility dimension, but also urban and societal development in general.

Visions that have been co-created, allow for the formation of a common set of goals which put the common, possibly abstract visions in concrete terms, thus providing

guidance for the strategic orientation and the consecutive measures and actions to be taken to make the common vision become reality (SUMP Guidelines 2019, 92). To arrive at a common understanding and a vision of desirable future scenarios and to agree on a common set of objectives discussions with all relevant stakeholders (e.g., aviation and other public authorities, mobility actors, and citizens) is an indispensable task.

The third substage of Strategy Development is to set targets and indicators. To be able to measure the achievement of the objectives, suitable indicators and targets need to be established for each objective (SUMP Guidelines 2019, 95). Mobility planners with limited resources at their disposal may wish to consider a reduced, but nevertheless significant set of strategic indicators to measure overall goal achievement; such indicators should not be confused with the indicators for monitoring concrete measures introduced in stage seven of the SUMP cycle. In the case of UAM, mobility planners may readily draw on the rich body of key performance indicators proposed by International Civil Aviation Organization (ICAO) and EUROCONTROL in the field of manned aviation³⁴.

At this point, the pivotal role cities and regions assume in UAM-related strategy development becomes obvious: Cities, regions, and their citizens are in the best place to collectively envision future UAM- and mobility-scenarios that can eventuate in their respective domains. It is at their discretion to develop a common understanding of desirable future scenarios and to agree on a common set of objectives which guide both UAM-strategy development and UAM-related strategic choices (SUMP Guidelines 2019, 81).

Cities and regions and their citizens have the power to decide – collectively and independently – about the most salient features of their UAM strategy and the UAM infrastructure in their respective domains.

³² Garrett-Glaser (2021): Entering the era of peak uncertainty for eVTOL. In: EVTOL, 23.02.2021, <https://evtol.com/features/entering-era-peak-uncertainty-evtols/>.

³³ For details on how to encompass scenario planning and foresight techniques during the SUMP process cycle please refer to document ‘Developing Transition Pathways towards Sustainable Mobility in European cities: Conceptual framework and practical Guidance’ accessible at https://sump-plus.eu/fileadmin/user_upload/Resources/Reports_and_publications/SUMP-PLUS_-_developing_transition_pathways_-_D1.2_final_version_compressed.pdf

³⁴ See e.g. SESAR 2017c: Review of current KPIs and proposal for new ones, <https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5bb74e0b8&appld=PPGMS>.

To accomplish this, a well-developed concept like SUMP provides a practical guide and process that eliminates the need to “reinvent” methods of collective strategic decision making.

The relevance of citizen participation in urban mobility planning: the UAM-case

The following sections provide two examples from the UAM domain that illustrate how important stakeholder and citizen participation is in urban (air) mobility planning and strategy development:

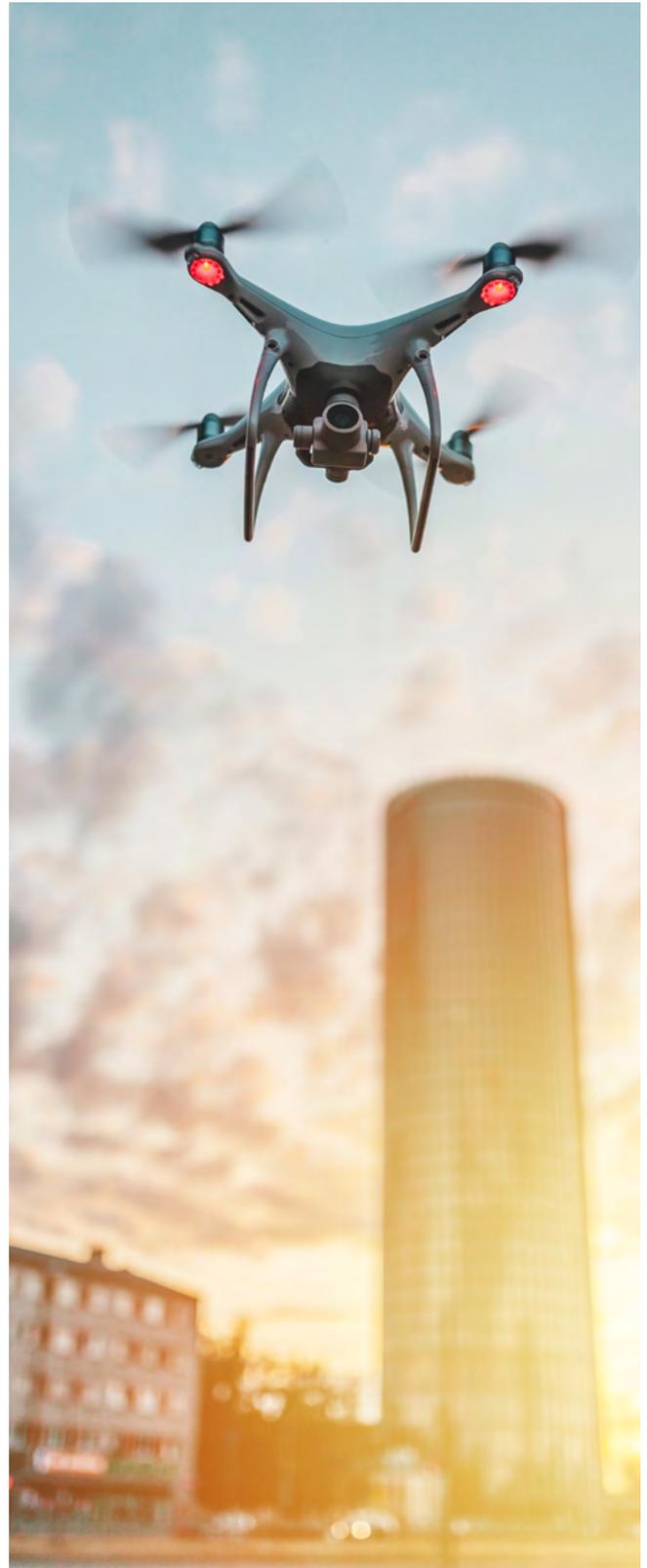
Technical feasibility versus “societal feasibility” in UAM

In the engineering community it has been claimed that it is, or is becoming, technically feasible to safely operate hundreds, if not thousands, of drones simultaneously in urban airspaces. If UAM planning would be solely guided by considerations of technological feasibility, a planning entity would tend to install a UAM system that allows for the maximisation of the traffic density in the urban airspace. This, however, conflicts with the dimension of “societal feasibility”: Due to noise, visual pollution, privacy and safety concerns, maximum traffic density, as induced by the social acceptance dimension, is much lower than the maximum traffic density that is technologically feasible. Social acceptance is what has been labelled a “soft structure” at the beginning of Section 3, a soft structure that nevertheless creates “hard restrictions” for urban mobility planning.

Societal acceptance factors as key elements of strategy development in UAM

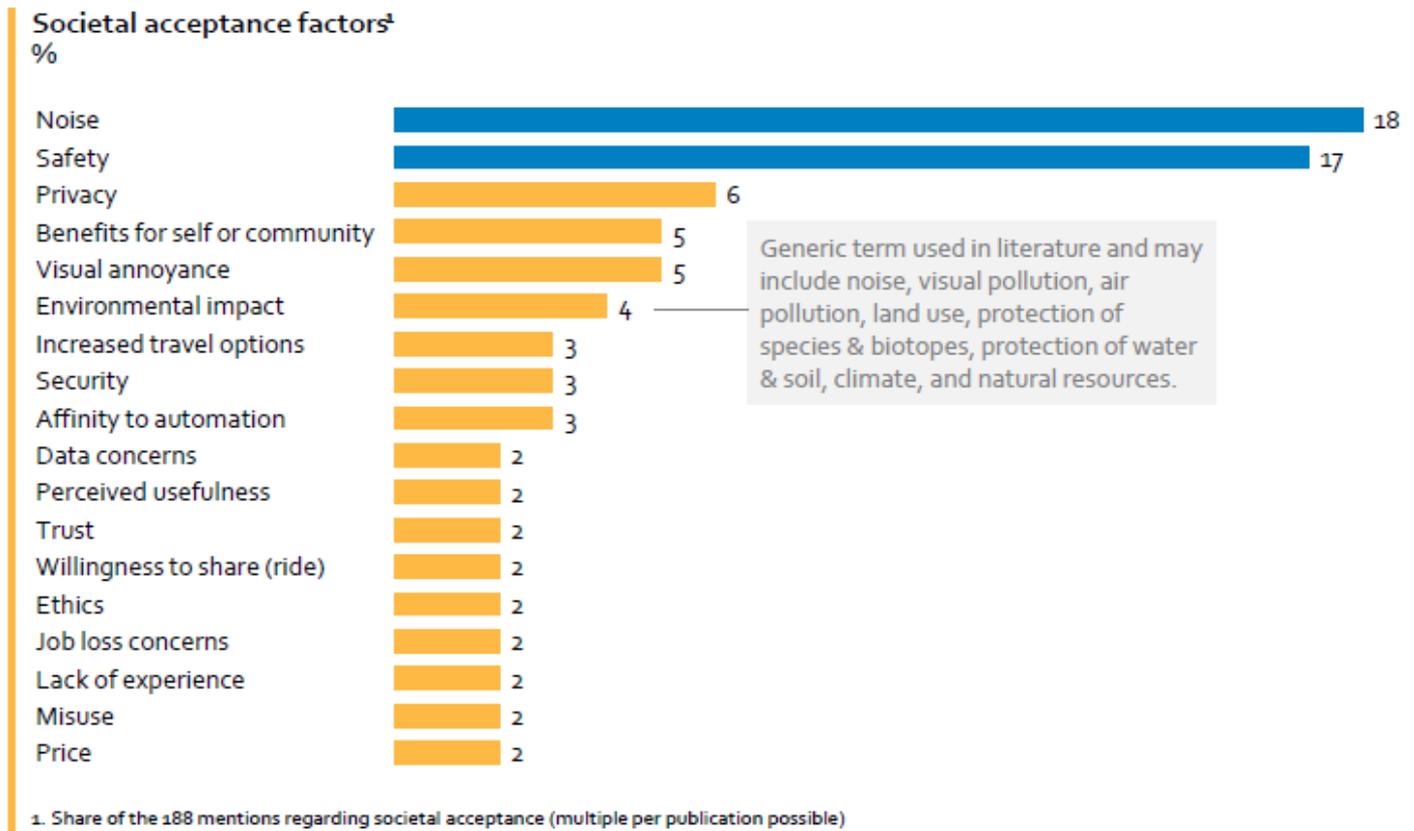
Social acceptance issues can create hard restrictions for mobility planning and should therefore be given due consideration by a planning entity.

In the field of UAM, surveys are being conducted on a regular basis that explore social acceptance issues³⁵, especially with regard to drone and eVTOL flight operations and deployment. The results of such research should be considered when developing a UAM strategy, and can inform the creation of a common vision, the identification of relevant objectives and the determination of suitable targets and indicators.



³⁵To quote all surveys and sources at this point is virtually impossible, as there are already way too much. The reader could start with the EASA study on societal acceptance and proceed for more details and updates with published articles of academic research.

Figure 15: A ranking of UAM societal acceptance factors
 (Source: EASA 2021, p.18)



In a recent survey conducted by EASA on social acceptance of UAM in Europe³⁶. Figure 15 depicts the ranking of factors associated with social acceptance of UAM.

Noise and safety concerns rank first and second, with a share that is three times higher than the share of the third-placed factor privacy. Such results should undoubtedly have an impact on the “possibility space”, the strategic choice set of urban (air) mobility planning: A planning entity would for instance opt against the deployment of very loud drones and eVTOLs. Furthermore, based on the above results, the fundamental objectives “minimization of UAM noise levels” and “high levels of operational safety” may be added to a given set of objectives. Regarding indicators and targets, noise levels of drones and eVTOLs can be measured directly (actually, standardised procedures exist to do so); and to measure the safety level of UAM operations, planning entities may refer to the number of accidents and/or the number of casualties caused by drones or eVTOLs (in a given period, e.g., per year).

The results of such research on public preferences and public attitudes towards different modes of transportation can inform practically all decisions that are being made, and all measures and activities throughout the whole SUMP cycle that are being taken by an UAM planning entity. Table 2 provides an infographic of the EASA’s study on the UAM Societal Acceptance and outlines the ten key findings.³⁷

The complexity of the societal acceptance topic, due to the interrelationship of factors of transdisciplinary nature, has triggered EASA to establish in Q4 2021 a dedicated task force with targeted stakeholders and experts across Europe to derive further recommendations and actions that EASA can take to tackle the topic in a holistic, sustainable, and responsible manner.

³⁶ EASA (2021): Study on the societal acceptance of Urban Air Mobility in Europe. EASA: Cologne. <https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf>

³⁷ An interactive infographic of this image can be found at <https://www.easa.europa.eu/uam-10-key-findings>

Table 2: The ten key takeaways from the EASA UAM Societal Acceptance study (Source EASA, 2021).

Graphical representation of findings	Brief description of findings
<p>URBAN AIR MOBILITY 10 KEY SURVEY RESULTS Urban Air Mobility (UAM) is a new mode of air transport of goods and passengers in urban environments, using electric aircraft taking off and landing vertically, with or without a pilot on board. First operations will be a reality 3 to 5 years from now.</p> <p>1. A POSITIVE INITIAL ATTITUDE TO UAM THROUGHOUT THE EU</p> <p>2. STRONG SUPPORT FOR USE CASES THAT ARE VALUABLE TO ALL</p> <p>3. TOP 3 EXPECTED BENEFITS: FASTER, CLEANER, EXTENDED CONNECTIVITY</p> <p>4. TOP 3 CONCERNS: SAFETY, ENVIRONMENT/NOISE AND SECURITY</p> <p>5. SAFETY: EXISTING AVIATION SAFETY LEVELS ARE THE BENCHMARK</p> <p>6. ENVIRONMENT: PRIORITY IS PROTECTION OF WILDLIFE</p> <p>7. NOISE: ACCEPTABLE AT LEVEL OF FAMILIAR CITY SOUNDS</p> <p>8. NEED TO BUILD CONFIDENCE AND TRUST IN CITIZENS</p> <p>9. GROUND INFRASTRUCTURE: MUST INTEGRATE WELL</p> <p>10. REGULATORY AUTHORITIES: MUST WORK TOGETHER AT ALL LEVELS</p> <p><small>Context: While UAM projects and demonstrators are developing in Europe, EASA wants to anticipate this new mode of transport and provide an enabling comprehensive regulatory environment for the EU to become one of the first movers in this field at global level. To this effect, EASA conducted in early 2021 a study to measure the societal acceptance by EU citizens of UAM operations. Read more at www.easa.europa.eu/UAM or download the infographic.</small></p> <p>EASA Your safety is our mission <small>European Union Aviation Safety Agency</small></p>	<ol style="list-style-type: none"> 1. EU citizens initially and spontaneously express a positive attitude toward and interest in UAM; it is seen as a new and attractive means of mobility and a majority is ready to try it out. 2. The notion of general/public interest is a determining factor for acceptance: use cases for the benefit of the community, such as medical or emergency transport or those connecting remote areas, are better supported than use cases satisfying individual/private needs. 3. The main benefits expected from UAM are faster, cleaner and extended connectivity. 4. However, when encouraged to reflect upon the concrete consequences of potential UAM operations in their city, EU citizens want to limit their own exposure to risks, in particular when related to safety, noise, security and environmental impact. 5. Safety concerns come first, but the study also shows that citizens seem to trust the current aviation safety levels and would be reassured if these levels were applied for UAM. 6. Noise is the second main concern expressed; the study indicates that the level of annoyance varies with the familiarity of the sound, with familiar city sounds at the same decibel levels being better accepted; it also confirms that the distance, duration and repetition of the sound impacts its acceptance. 7. UAM is seen as a good option to improve the local environmental footprint, through reduced urban traffic congestion and better local air quality; but at the same time citizens express major concerns about UAM’s impact on wildlife. 8. The results also demonstrate a limited trust in the security and cyber security of UAM, requiring threat-prevention measures. 9. The integration of UAM into the existing air and ground infrastructure must respect residents’ quality of life and the cultural heritage of old European cities. 10. Finally, local residents and authorities feel directly affected by the deployment of UAM and want to engage and play an active role in its implementation.

GOOD PRACTICE EXAMPLE Toulouse Métropole's approach to citizens' engagement**Citizen Engagement: Toulouse's Smart City Approach**

Toulouse's innovation work is framed through a Smart City approach launched in 2015. After an initial phase of co-construction of a shared roadmap and the 2015-2020 strategy with all the supporting relays of civil society, the Smart City has chosen different methods to draw people in and foster the emergence of operational actions by citizens and businesses. In 2017-2018 a key stage in acceleration took place around 2 axes: a project factory that sets citizens and economic players back in the whole innovation process and a citizen-metropolitan relationship "enhanced" by data and artificial intelligence through the first significant achievements in 2017, like the Violette chatbot.

As part of its Smart City Open Metropolis approach, Toulouse Métropole places the question of citizen uses and practices at the heart of its strategy. The objective is to co-construct the city of tomorrow with users by providing innovative solutions that meet their needs. The Laboratory of Usages is a co-constructed open approach with citizens and businesses through creative thematic workshops. The aim is the convergence between administrations' projects and citizens' needs. It encourages the administration's openness and agility regarding citizens' and businesses' proposals. The aim of the Laboratory of Usages is to provide support for the creation of new public services and the improvement of existing services. It brings together businesses, citizens, researchers, members of the local community and students, among others, using participatory methods.

Digital Tool – *jeparticipe.toulouse.fr*

"Je participe - <https://jeparticipe.toulouse.fr/>" is a dedicated digital platform to open the dialogue between the city and citizen and to share the future Sustainable Urban Mobility Plan (SUMPs) of the city as well as transport/logistic plans of the individual institutions with citizens. The digital platform for citizen participation www.jeparticipe.toulouse.fr is committed to creating websites with universal design and accessible content, without visual or technological barriers and for as many users as possible, thus bringing municipal communication and the use of new technologies closer to citizens. To achieve this objective, it applies the WAI (WAI Accessibility Initiative) standard adopted by the European Union. The aim is for this platform to comply with the AA accessibility guidelines defined by the WAI standard (WCAG 2.0). This means that a person with a disability, as well as any other person who is in a situation that makes it difficult to access information on the platform, can successfully access the content.

GOOD PRACTICE EXAMPLE Hamburg's approach to citizens' engagement**Citizen Participation in Hamburg: The "Urban workshop" – building on dialogues**

In 2012, at the request of the city's parliament, the Hamburg Senate decided to establish a "*Hamburger Stadtwerkstatt*" ("Hamburg Urban Workshop") as a platform for those interested in planning, with the aim of promoting a new planning culture in Hamburg. The basic philosophy is that a new planning culture will only emerge if as many people as possible participate. The goals of the *Stadtwerkstatt* are to provide interested citizens with more information, more transparency, to establish more participation and more acceptance and to arrive at better results for planning projects.

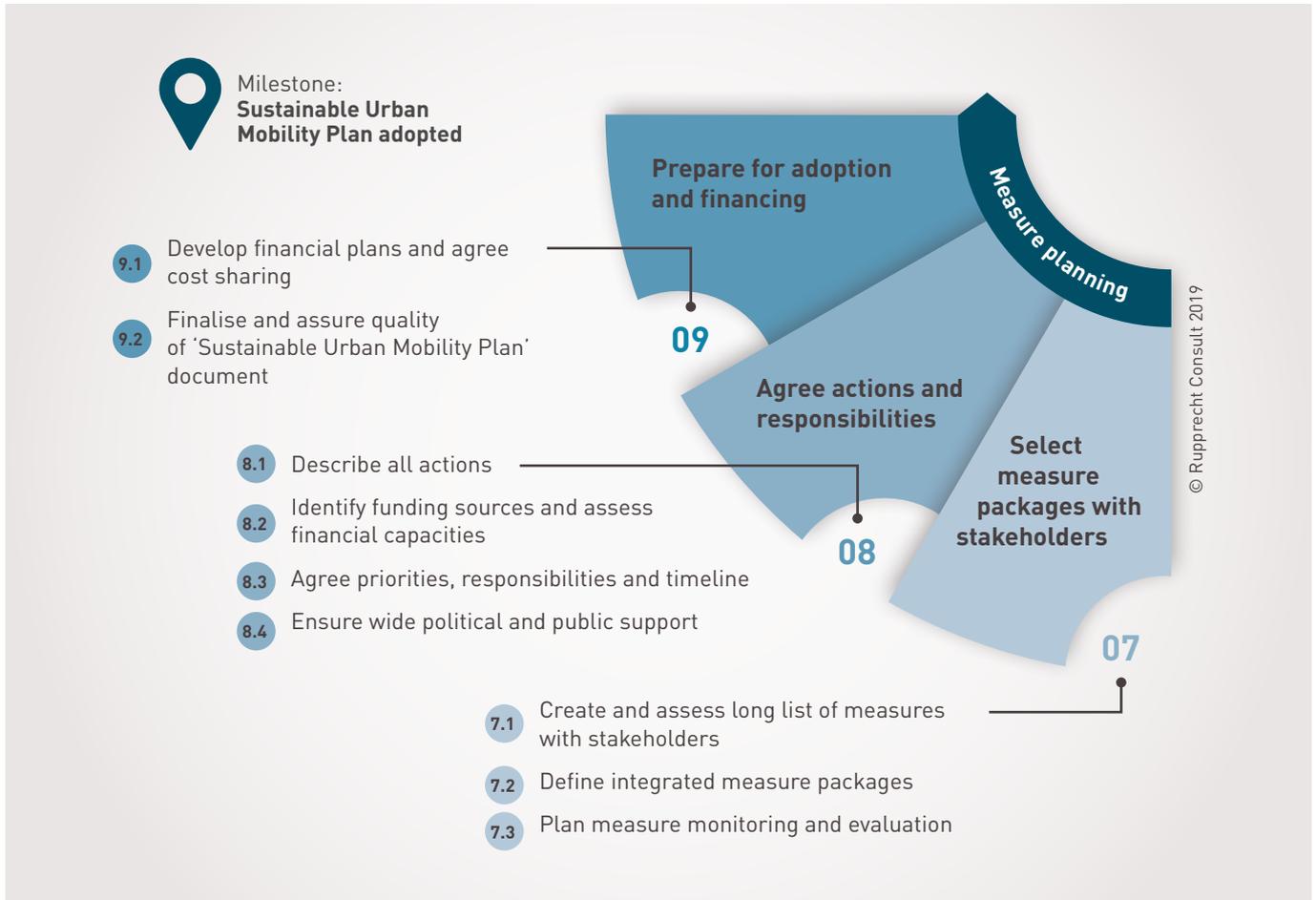
Hamburg aims to achieve this new planning culture by strengthening information and participation in urban development projects and environmental protection issues. This includes all information and participation procedures that go beyond formal citizen participation, as laid down e.g. in the "*Baugesetzbuch*" (Federal Building Code). The *Stadtwerkstatt* provides a platform for informal citizen participation in planning projects conducted in Hamburg. Its procedures serve to support opinion-formation and decision-making in politics and administration. Within the framework of the *Stadtwerkstatt*, citizens can collaborate with planners and representatives of the city to develop approaches to solutions for Hamburg's current problems and challenges in various fields of urban planning. Link: <https://www.hamburg.de/stadtwerkstatt>

Tools for Citizen Participation in Hamburg: The Digital Participation System (DIPAS)

DIPAS combines an online participation tool with digital planning tables to create an integrated digital system for citizen participation. With DIPAS, citizens can access digital maps, aerial photos, 3D models and other geodata – from home using their smartphones or at events with the help of interactive data tables – and provide precisely localized feedback on planning projects. DIPAS can be used for a wide range of topics, ultimately for all planning procedures that have a clear spatial reference; be it urban planning, green planning, traffic planning (which indeed includes UAM), whose topics and contents can be made accessible via maps and visualizations. The system uses public geodata of various sources for this purpose and thus facilitates an informed discussion between experts and laypersons. Links: <https://dipas.org/>, <https://www.hamburg.de/dipas/>

3.3 Measure Planning

Figure 16: Phase 3 (measure planning)[Source: SUMP Guidelines 2019, p.103]



In this section, the steps of phase 3 (measure planning) of the SUMP cycle (see Figure 16) are outlined as well as the specific roles UAM may take in each of these steps.

3.3.1 Select measure packages with stakeholders

Create and assess list of measures with stakeholders

- Create a comprehensive long list of measures that can serve the objectives identified in the preceding stages (SUMP Guidelines 2019, p.105). To arrive at an exhaustive list all stakeholders and the public should participate in this effort. Additionally, a planning entity may use all sorts of expert knowledge available, the experiences practitioners have made with SUMP (and UAM in particular) in their respective cities or utilise databases of urban mobility measures (see SUMP Guidelines 2019, 105 for examples).

- Select a short list of measures which are both feasible and promise a high, if not maximal, degree of goal achievement. Feasibility is usually subject to a set of restrictions; for example, the available budget, considerations of cost effectiveness or issues of public acceptance which may preclude certain choice options. Involve all stakeholders, the public, and experts in the selection process.
- Specify each of the selected measures in more detail: Who implements the measure when and how; provide precise cost estimates; involve those entities and stakeholders who will foreseeably have to bear larger parts of the costs associated with the planned SUMP measures (e.g., the department of finance).

The UAM case:

The introduction of the third dimension to the mobility mix comes along with a considerable increase of complexity

and may pose a challenge to the creation of a long list of measures mixing aviation safety and security requirements with urban mobility prerequisites and imperatives. This may be extremely time-consuming as the planning entity has to deal with a high number of sources and measures.

It is therefore conceivable to resort to strategies of complexity reduction, should the UAM dimension be involved in a SUMP:

- Use heuristics and rational decision-making at the outset to eliminate (classes of) measures from the list. For example, you may immediately sort out those measures which violate at least one of the restrictions you face as a planning entity (e.g., time restrictions or budget restrictions).
- Skip the creation of the long list entirely and start with the next step, the definition of integrated measure packages. These packages create a partition of the “measure space” and may be dealt with in parallel while avoiding cognitive overloads or the violation of time restrictions.

Define integrated measure packages

- For easier implementation, bundle the selected measures into consistent packages of complimentary measures, which may be easily allocated to certain agents and allow for easier execution as well as the assessment of the progress of the SUMP and overall degree of goal achievement (SUMP Guidelines 2019, p.113).
- Design measure packages such that sectoral planning in fields like environment, energy, health, or economic policy can be easily integrated or taken into account.
- Involve all stakeholders, the public, and experts in the design of the measure packages.

The UAM case:

Regarding the definition of integrated measure packages, the integration of the UAM dimension to the SUMP approach imposes no specific challenges, maybe with the exception of the aforementioned increase in overall complexity of the planning effort.

Plan measure monitoring and evaluation

- Monitoring and evaluation are key to assess the progress a of a SUMP both in terms of the planning process and the implementation of measures (SUMP Guidelines 2019, p.121).
- Monitoring and evaluation allow for the identification of gaps between planned and actual progress and results and to react accordingly, for example, by revisiting and reiterating earlier steps of the SUMP cycle, or by adapting the SUMP for its next iteration, and to avoid certain mistakes in the future.
- Introduce suitable quantitative and qualitative indicators which allow for sufficiently precise and straightforward assessment of goal achievement, both on the measure level and the strategic level. Refer to existing data sources or generate your own data (e.g., by conducting surveys); utilise existing and well-established indicators, if possible. To this end, sustainable urban mobility indicators (SUMI)³⁸ are a useful tool for cities and urban areas to identify the strengths and weaknesses of their mobility system and to focus on areas for improvement. As cities and urban areas continue to develop Sustainable Urban Mobility Plans (SUMPs) and work towards EU policy goals, it is important for this progress to be documented to ensure that such achievements become visible.
- Involve stakeholders in the selection process of indicators, report evaluation results transparently to the public and encourage an open public debate on the results and the future course of SUMP (and UAM, in particular).

The UAM case:

The integration of the UAM dimension into the SUMP concept should have no significant repercussions on measure monitoring and evaluation, as the related criteria can be applied independently of the transportation modes that are being addressed. However, the contributing cities have not yet developed the instruments and criteria for monitoring and the evaluation of (overall) goal achievement in the UAM domain to their full extend. The reasons are:

- UAM is still in a developing process and the UAM-related projects carried out presently are in most cases experimental (e.g., innovation projects and living labs)

³⁸You can learn more, get inspired, benchmark your data from the SUMI project: https://transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/sumi_en

and/or demonstrators of feasibility of certain technologies or regulatory frameworks like the U-space. Thus, monitoring and evaluation criteria as well as performance indicators, informed by the SUMI framework, might be in place on the project level, but not necessarily, at present, on the higher level of a SUMP, as these activities are still relatively far away from phase three (and four) of the SUMP cycle.

- More specifically, monitoring and evaluation of UAM in the context of SUMI framework could be influenced in a considerable degree by the criteria and the rich body of (key) performance safety indicators established in manned aviation and recent or forthcoming, U-space and UAM regulatory frameworks.
- At the same time, it has to be taken into account that establishing an easily accessible and highly operational UAM ecosystem, on the one hand, while ensuring high levels of safety and security on the other hand, the SUMI framework is expected to be updated to capture aviation-driven UAM-metrics. Taking into account the iterative character of the SUMP cycle, one should make distinction between high-level indicators from the SUMI framework that should be treated as 'fixed', and lower-level indicators which could be developed to address UAM-related activities.
- It should be acknowledged at this point, that differences in culture and opinions among the different sectors involved in UAM, are presently becoming subjects of developing debates and consensus-seeking.
- There is considerable scope for the standardisation of monitoring and evaluation criteria and performance indicators in UAM. Such a set of standards would eliminate the need to develop these steps from the beginning each time and would allow for the comparison of different approaches to UAM. Nevertheless, such standardisation initiatives are yet to be launched by interested parties.

3.3.2 Agree actions and responsibilities

In step 8 of the SUMP cycle, an operationalisation of the planning effort is taking place by breaking down measure packages into "actionable tasks" (SUMP Guidelines 2019, 125). This encompasses agreements on detailed descriptions of actions and cost estimations, assignments of responsibilities, priorities, and timelines.

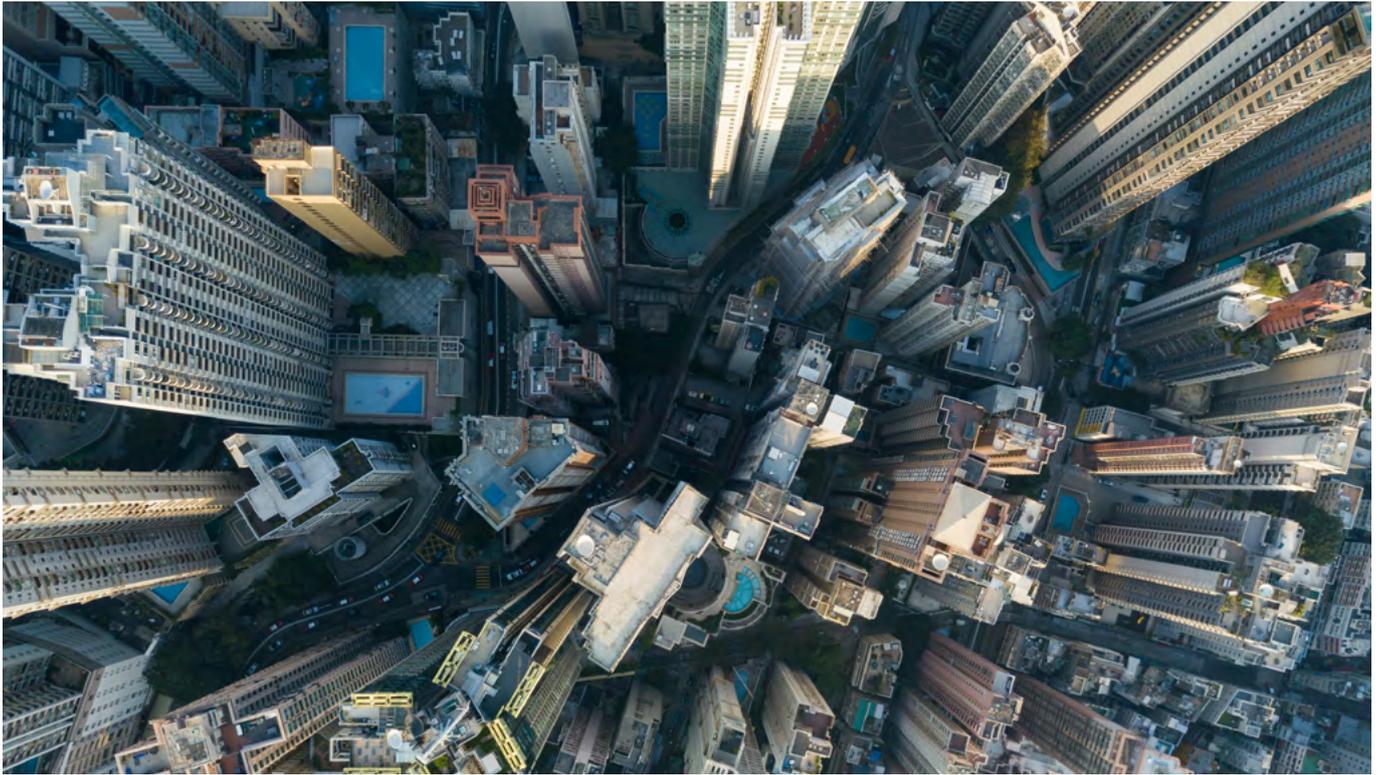
Describe all actions

- In preparation for the implementation phase and to reach the underlying objectives, detailed and comprehensive lists of actions are being derived from the measure packages: which action is being taken when, where, by whom, and to what extent?
- A detailed description of all actions allows for the identification of interdependencies between different actions and to define priorities, responsibilities and timelines.

The UAM case:

Independent from any given transportation mix, the added complexity of UAM may pose a challenge to the task of describing all actions. To overcome those issues a planning entity may resort to similar strategies like in the case of measures (i.e., heuristics or "action packages").

An additional challenge is the diversity and number of stakeholders involved in UAM while FUAs do not always correspond to airspace authorities. From GZM's point of view, its CEDD membership (see chapter 4 for details) allows not only the actual participation of the Metropolis (GZM) in the development of UAV procedures for UAM services, but also to manage complexity associated with a number of stakeholders. Cooperation within the CEDD also allows the associated cities to learn about the potential of the industry, and also prepares them to manage a new dimension of space and other areas that may be affected by the appearance of drones (e.g., crisis management or spatial planning). On the other hand, GZM obtains knowledge from cities about their needs and concerns related to the introduction of the unmanned mobility sector to the market. These data, in turn, allow for better design of UAM services and the legal regulations related to them.



Identify funding sources and assess financial capacities

The planned actions should be financially viable; cost-effectiveness is a core criterion of measure designs. A financing plan should account both for the expected costs and revenue streams as precisely as possible. The planning entity should be aware about the sources of financing and funding that are available. The core team may be composed in such a way as to maximise the access to existing sources of financing and funding. For instance, universities can access other sources of financing and funding than firms or agencies of a federal state can.

The UAM case:

Basically, the scope for financing of UAM may not differ substantially from other modes of transportation. However, in terms of long-term funding, substantial differences between different modes of transportation exist. The pricing scheme of an urban subway operator will certainly differ from the pricing schemes an air taxi or air shuttle service provider may introduce, as well as the costs associated with the operation of the respective modes of transportation.

Which UAM services will be economically viable in the long run remains to be seen. Economic success will depend to a large extent on the price of accessing the urban airspace. In the case of eVTOLs, optimistic predictions by the developers on technological viability and revenue growth in the UAM domain are met with scepticism both by urban mobility actors as well as by a significant part of the aviation expert community.

Another important aspect of UAM will be the insurance and liability issues. By diverting portions of the urban traffic to the third dimension, UAM will foreseeably mitigate some risks on the ground albeit new risks will certainly emerge, and/or known risks increase (e.g., the malevolent use of drones or drone crashes).³⁹ How insurance companies will exactly assess these new risks is still unclear and could become a barrier for starting a UAM services market and should be an issue considered early.

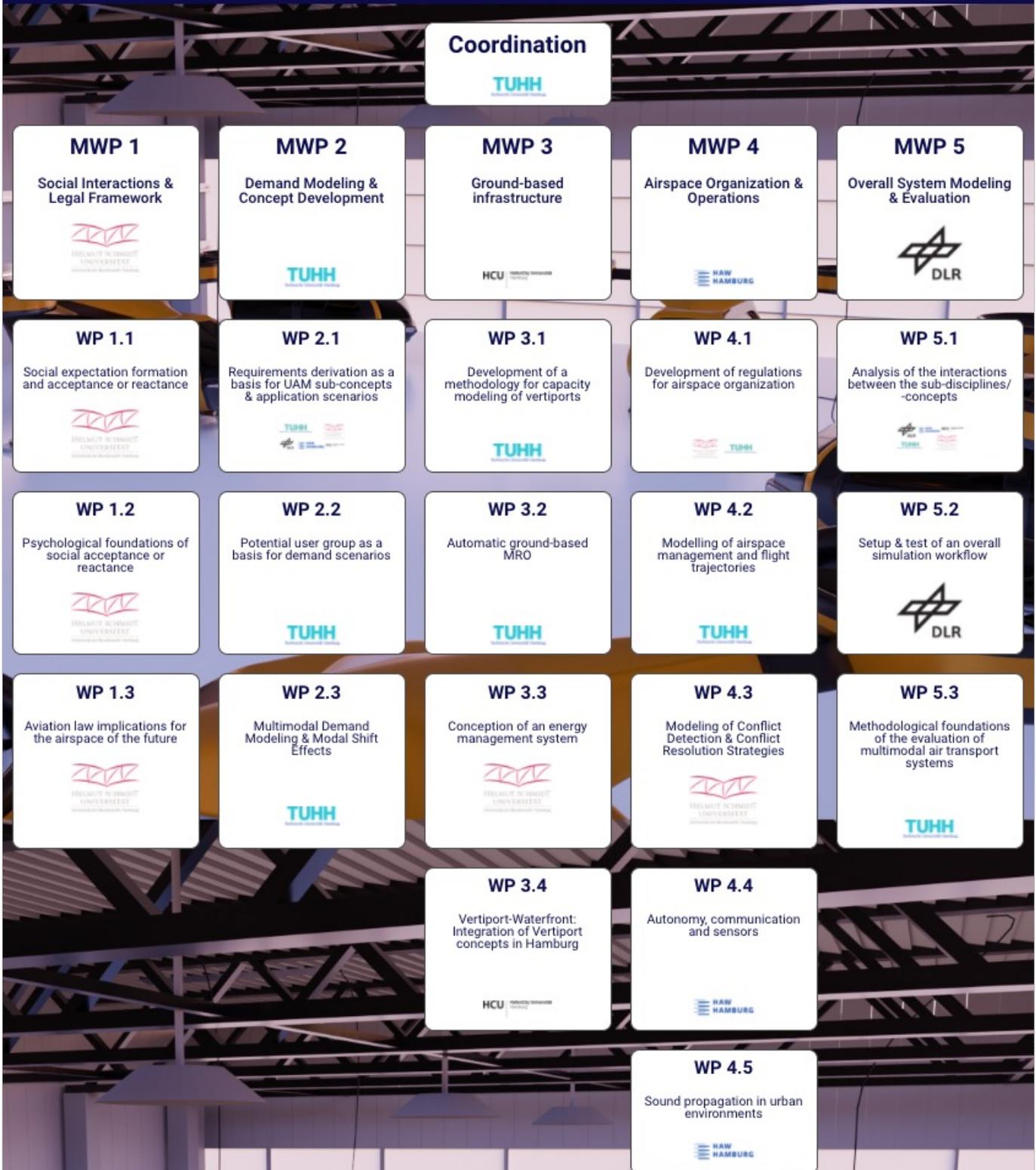
³⁹ The role of risks and insurance companies in UAM was addressed at the Amsterdam Drone Week 2020 in the UIC2 Forum "UAM as part of an integrated Smart Mobility approach?" A recording of the round table can be found online: <https://www.youtube.com/watch?v=XZWETxJ3tuY>.

GOOD PRACTICE EXAMPLE Hamburg: Preparing ‘measures planning’ through state funded research: The i-LUM project

The City-State of Hamburg has funded an UAM project that aims to address in a holistic and integrated manner transdisciplinary and cross-sectoral topics associated with the development and deployment of UAM services in its territory.

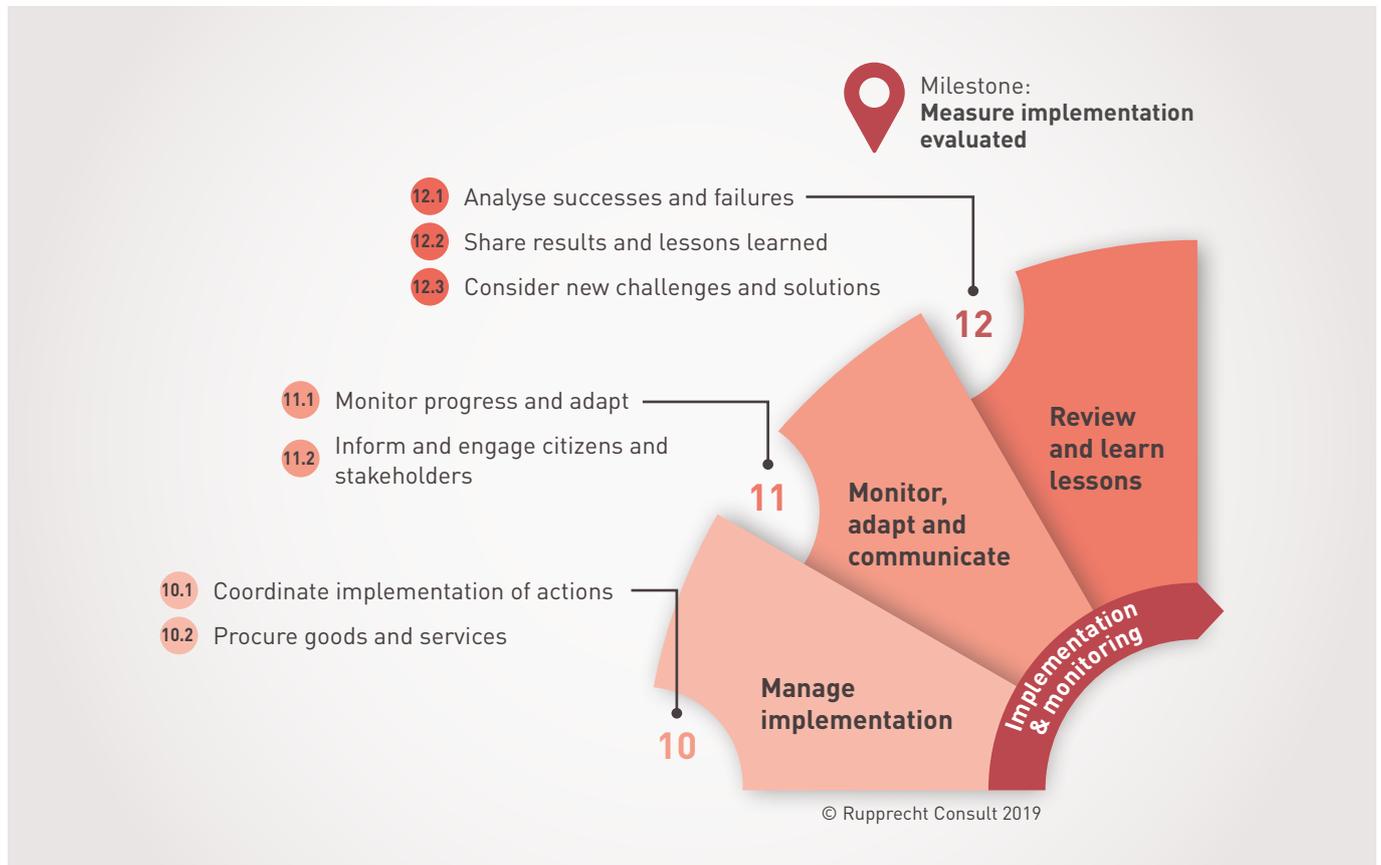
An outline of the many different topics addressed in the project is illustrated through the project’s work package structure (<https://i-lum.de/>).

The project



3.4 Implementation and monitoring

Figure 17: Phase 4 (implementation and monitoring) [Source: SUMP Guidelines 2019, p.145]



Implementation and monitoring, the final stage of the SUMP cycle (Figure 17), encompasses the substages “Manage implementation”, “Monitor, adapt and communicate”, and finally “Review and learn lessons”.

3.4.1 Manage implementation

The core team usually does not implement the SUMP, as this task is carried out by entities specialised in the related activities, e.g., departments of the municipality. The core team oversees and manages the implementation process, ensures its integrity, assesses risks and plans for contingencies, assigns tasks and responsibilities, and provides support for the acting entities, if needed.

Procurement of goods and services basically is a standard activity for public administrations but may also yield strategic leverage due to the purchasing power of municipalities. Their procurement decisions

can create critical masses and pave the way, for example, for innovative and sustainable transportation technologies, while minimising negative social and environmental side effects.

The UAM case:

The management techniques applied to implement a given SUMP are by large universally valid, i.e., independent from any given transportation mix and the inclusion of UAM therein.

The procurement decision of municipalities can nevertheless have far-reaching consequences and may tip the balance in favour of one or the other UAM service or shape the entire UAM ecosystem. In many cases, municipalities also have considerable leeway to fund UAM-related projects or research that may serve higher-level innovation strategies or economic policy goals.

3.4.2 Monitor, adapt and communicate

Monitor continuously the advancement of the implementation process and become active as soon as the gap between baseline values of goal achievement indicators and actual values reach pre-set critical thresholds.

Be flexible and adapt to changes in the legal, technological, or political environment relevant to your effort, for example, by realigning your objectives, measure packages, or planned sets of actions.

Communicate the reasons for the realignment of objectives, measure packages, or actions transparently to the stakeholders and seek backing from the political realm.

The UAM case:

What holds for sustainable urban mobility planning in general, holds for the UAM case in particular: Continuous monitoring of project progress and goal achievement, adapting to changes in the environment relevant to the project (e.g. regulatory topics and maturity of UAM-related technologies), as well as transparent communication with all stakeholders at all stages of the project are necessary conditions for the successful implementation of a UAM ecosystem and for a smooth integration of UAM into an existing mobility mix.

3.4.3 Review and learn lessons

The SUMP cycle is a continuous process: after completing one iteration, the next iteration starts. The experiences gained from the completed cycle, for example, from monitoring and evaluation, as well as consultations with stakeholders, are being fed into the next iteration.

Share your experience as widely as possible with other cities, regions, and the wider SUMP and UAM community (e.g., through the UIC2 – UAM Initiative Cities Community and the EU's H2020 UAM projects communities, (see Annex, e.g. the projects Assured-UAM, AiRMOUR, Aurora, an FF2020). Especially insightful are those experiences about challenges and mistakes and how to overcome them. Thus, feel encouraged to report frankly on non-successes, plan deviations, disturbances, and similar incidents.

At the start of the next iteration of the SUMP cycle, check for any changes in the framework conditions which may have – either as new challenges or new solutions – a significant impact on your mobility planning and the implementation of measures and actions, and adapt your SUMP accordingly.

The UAM case:

Reviewing your achievements and learning the associated lessons are key principles of every continuous and circular planning approach and indeed apply both in the SUMP case as well as the UAM case. Reviewing your experiences, as well as gaining knowledge from the experiences of others through your involvement in UAM communities and acting accordingly are necessary conditions for improving your planning approach and preparing for the success of the subsequent planning cycle.

To conclude Chapter 3, it should be highlighted that UAM still is in a nascent state in practically every city or region active in this field, and that many technological and regulatory challenges are yet to be overcome. Especially phases 3 and 4 of the SUMP cycle are presently perceived by UAM planning entities as parts of a distant future and hardly feature in any of the existing UAM planning and implementation efforts. As a result, the authors can make only rather generic statements and projections on phases 3 and 4 in the UAM context.

Chapter 4 introduces the readers to the different approaches of the contributing cities and regions to UAM planning and describes the present state of UAM implementation. A variety of approaches are put on display that range from “already closely aligned to the SUMP-concept” (GZM) through “integrated top-down” (Toulouse) to “experimental in a quadruple helix innovation context” (Hamburg). The authors hope the readers will draw inspiration from the examples in Chapter 4 and will be put into the position to arrive at better-informed decision making in their own UAM-related efforts.

4. Strategic learnings from city-centric use cases

As outlined at the beginning of this document, this Practitioner Briefing has been developed by city and region members of the UIC2. The documented experiences and reflections have been elaborated through their local ecosystem development and projects work that have been triggered at European level through the establishment and deployment of UIC2. Figure 18 gives an overview of UIC2's deployment as of December 2021.

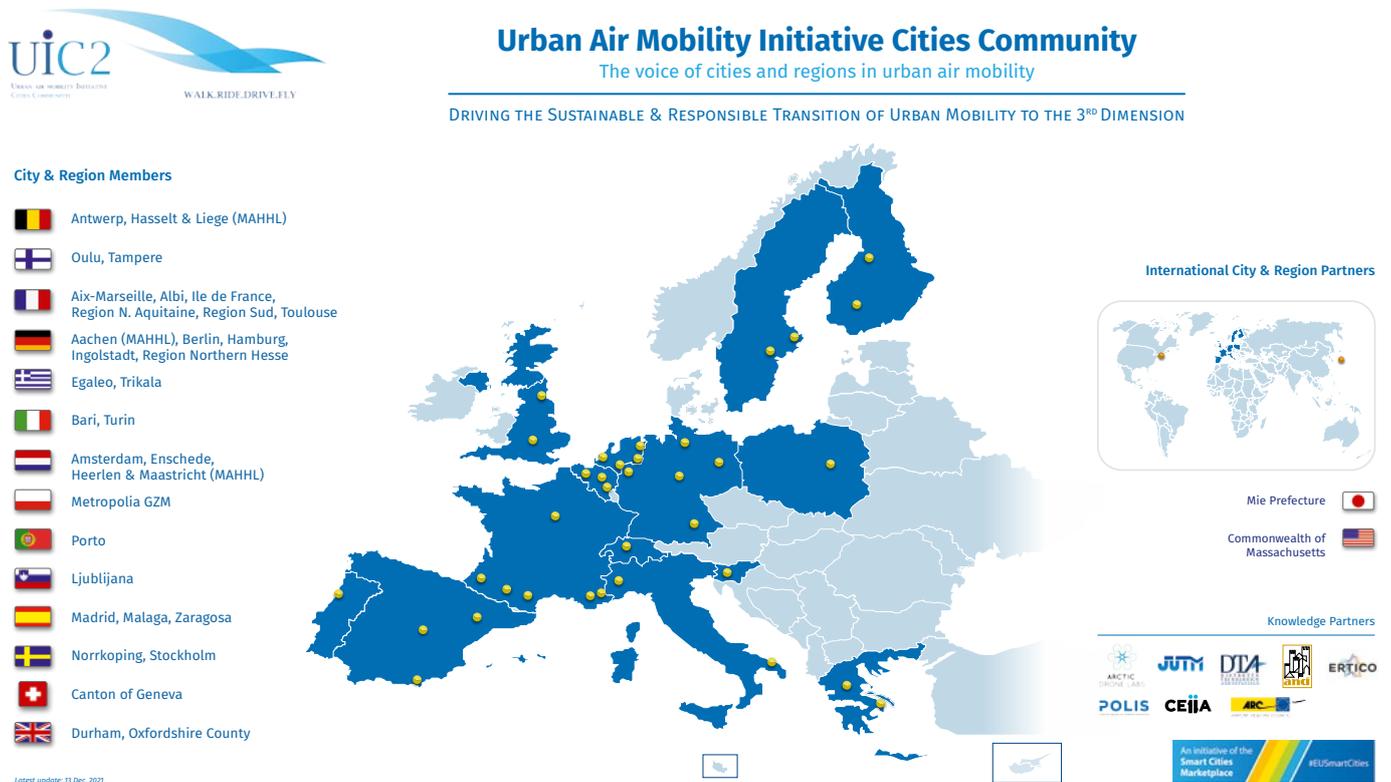
In this chapter the different approaches to UAM preparation and planning drawn from the UIC2 contributing cities and regions are outlined. Three generic approaches to UAM can be derived from these examples:

1. The top-down approach: UAM is part of a higher-level comprehensive mobility plan that has usually been devised by a central planning entity (e.g., a state, federal, regional, or municipal planning authority) and is passed along the hierarchical chain for

implementation. A top-down approach may indeed already be based on the SUMP-concept or may include elements thereof. Toulouse Metropole provides an example for a top-down approach in UAM planning and implementation (see Section 4.1.1).

2. The bottom-up approach: Without adhering to any overarching masterplan, a single actor or a coalition of actors provides the initial momentum to introduce and build up UAM-structures in a city or region. This may be initiated by companies who develop and roll out products or services with UAM relevance, research facilities active in the field of UAM, civil society organisations which articulate public interests regarding UAM, or the municipality (typically through spin-off activities of municipal departments) which may pursue certain UAM related policies. The Hamburg case illustrates how companies, research facilities, the civil society and the municipality cooperate in UAM within a quadruple helix framework of innovation.

Figure 18: An overview of the UIC2 (UAM Initiative Cities Community) of the EU's Smart Cities Marketplace [Source: UIC2]



3. The green-field approach: No UAM structures exist in a city or region and must be built from scratch and integrated in existing mobility as well as regional/urban planning. As the GZM case shows, a comprehensive mobility planning approach like the SUMP process fits purposefully in such an initial situation by providing structure to the planning process and by integrating elements of both the top-down approach as well as the bottom-up approach. In addition, the GZM case sheds light on regional and inter-departmental cooperation in urban mobility planning, as well as the challenges that may occur while integrating UAM-planning into higher level mobility and regional planning.

In the following sections, the examples of Toulouse Metropole, Hamburg and GZM are elaborated on in greater detail; additionally, brief descriptions of the UAM activities of other UIC2 partner cities and regions are provided, namely the regions of Northern Hesse and MAAHL (focus on the city of Aachen) and the cities of Ingolstadt, Turin, Oulu, and Trikala.

4.1 The top-down approach

4.1.1 The case of Toulouse Metropole, France

Toulouse Metropole is actively working towards improving the quality of life of its citizens and willing to improve and keep monitoring parameters including city pollution, congestion, civil security, fast medical services, equality of transportation between rural, suburban, and urban areas. Prospective UAM services provide hope for Toulouse Metropole to be able to address all these problems.

Analysis of the mobility challenges

Toulouse Metropole quantitatively analysed potential UAM services on all three factors explained below:

- **Social Benefit** – UAM will help to improve the emergency medical transportation which will lead to saving lives.
- **Environmental Benefits** – Electric or hydrogen or hybrid cargo drone will remove the logistic car from the road, which will lead to solving the problems of decongestion and decarbonisation.
- **Economic Benefits** – Development of a new sector will create new job opportunities for citizens, income for businesses and tax revenues for the city.

In January 2018, Toulouse Metropole conducted a day-long workshop with citizens to gather their public opinion on the utility of drones.

- A majority of citizens supported the idea of 3D mobility for emergency medical transport.
- Local government or authorities need to take lead as per their opinion.

Toulouse Metropole joined the UIC2 on September 19th, 2018, by signing *The Manifesto of Intent for the UAM Initiative* of the EU's Smart Cities Marketplace (formerly known as EIP-SCC). The manifesto was co-signed by strategic partners and supporters such as local authorities, companies and research institutions to engage and support Toulouse Metropole's vision to plan and develop the UAM sector.

Toulouse Metropole organised multiple meetings with stakeholders with a vision to understand UAM benefits and concerns. The following eight topics, or parameters, were identified after the working sessions which would be required for sustainable development and deployment of UAM services.

1. **Technology** – all technology partners need to be involved including vehicle manufacturers, traffic management providers, telecommunication companies, and payload manufacturers.
2. **Regulation** – Interoperable & uniform regulations need to be defined and local, national & European regulatory bodies need to be involved.
3. **Policy** – Policies need to define safe, clean and sustainable implementation of UAM inside an urban environment and will need to address, among others, noise, safety, insurance, and procurement policies.
4. **Public Acceptance** – UAM services need to be defined for the benefit of citizens which won't be possible without involving them in the decision-making process.
5. **Inter-modality** – Coordination between ground and air mobility is necessary to manage the traffic network, ensure the citizen safety and efficiently deploy the UAM solution.
6. **Energy** – Energy demand and infrastructure need to be considered before deploying the electric or hydrogen vehicle or UAM system or system of systems.

7. **Data** – Cybersecurity of the whole system and data privacy & management need to be ensured for the safety and security of the citizens.
8. **Infrastructure** – Without ground infrastructure including vertiport and emergency landing pads as well as air infrastructure including telecom network availability, UAM solution deployment is next to impossible.

The UAM strategy of Toulouse Metropole

Through the following nine steps, Toulouse Metropole has tried to highlight its experience and possible way for the definition and development of UAM projects that can lead to services for the citizens.

- **Step 1 – Governance and Legitimacy:** Local government authorities may help by taking leadership of the UAM project as they could push the ecosystem towards the collaborative approach. Also, the local authority would have to take into account the state of the art of UAM in its various dimensions (its potential for uses, its potential impact on decarbonisation, regulations) inside urban mobility strategy and planning, and especially in the SUMP, as long as the regulations of the Member State include UAM in its regulations applicable to SUMP and the effective operation of UAM systems above public and private spaces.
- **Step 2 – Stakeholder involvement:** The local authority will invite all the concerned stakeholders responsible for 8 parameters defined above.
- **Step 3 – Identify use case(s):** Post citizen and stakeholder consultation, none, one or many use cases may be identified.
- **Step 4 – Define service(s):** Sustainable service(s) will need to be defined for the selected use case(s) and responsibility will be divided among the stakeholders.
- **Step 5 – Arrange Financing and Funding:** A business plan will need to be developed for a defined solution, which will be either submitted for grant/public funding, or to an external investor for equity investment.
- **Step 6 – Test and Validation:** The complete service solution will be tested under real environment for validation and approval of the eight aforementioned parameters. Citizen's validation will be equally important for the success of the project so one shouldn't forget to involve them.

- **Step 7 – Demonstration in an Urban Area:** Once the overarching system architecture, including the system of systems definition, will be developed, tested and validated, a small demonstration will be conducted for the use case(s) defined in Step 3.
- **Step 8 – Deployment in an Urban Area:** All ground and air infrastructure as well as operation & maintenance base will need to be developed before deploying the solution for that particular use case.
- **Step 9 – Horizontal Expansion:** Post completion of Step 8, ecosystem stakeholders can start expanding the sector as well as services for other use cases, cities nations etc.

Measure Planning

Considering the nascent stage of the UAM sector, implementation of steps 1 to steps 9 mentioned above is difficult due to the following challenges and questions:

- How to identify a use case and define a project?
- How to engage technology partners and convince them to invest in UAM?
- How to get funding/investment for development and implementation of UAM?

Toulouse Metropole: How is Toulouse Metropole tackling these questions mentioned above?

Toulouse Metropole included UAM inside their submission proposal the national level mobility projects named “Vilagil-Territoires d’innovations”. Further, it launched a call for interest to participate in a project (VILAGIL) for a different domain. In addition, Toulouse Metropole won with public, private and academics partners a national level project named “VILAGIL-Territoire d’innovation” that aims to develop sustainable solutions for mobilities proposed and developed by private and public actors, including research support.

Implementation and Monitoring

The implementation and monitoring process needs to be iterative and cover the following questions:

- How to identify a gap and validate the solution before deployment
- How to validate and measure the sustainability of the solution

Toulouse Metropole: How is Toulouse Metropole tackling these questions mentioned above?

Toulouse Metropole has acquired 38 hectares of land around a current airport and aims to develop this zone as the place of sustainable and innovative mobilities. Within the “Vilagil-Territoires d’innovations” Project, the French government will measure the impact of all the components of the VILAGIL project (UAM part included) through KPI’s monitoring.

Toulouse Metropole is part of a research project DACUS (H2020-SJU) which aims at the development of a service-oriented Demand and Capacity Balancing (DCB) process for drone traffic management. Also, Toulouse Metropole is on the advisory board of Tindair (H2020-SJU) which aims to provide U-space users with a tactical deconfliction service. The TindAIR consortium will operate a series of demonstrations, covering a range of representative and operational use cases, featuring a combination of manned or unmanned aircraft.



4.2 The bottom-up approach

4.2.1 The city-state of Hamburg, Germany

UAM-related facts about Hamburg

The City of Hamburg is the second largest city in Germany (1.8m inhabitants) with a strong industrial base, especially in manufacturing, transport, logistics and the media sector, the largest port in Germany, and a thriving research sector.

Densely populated, cultivated, and with only limited space to expand its borders, Hamburg faces the challenges and trends typical for large cities, like urbanization, high traffic density, and ever-growing mobility needs.

Hamburg is the world’s third largest location for civil aviation with about 40,000 employees in research, development, and production. Given its two airports (Hamburg Finkenwerder, which is owned by Airbus, and Hamburg International Airport), two glider airfields, seven heliports, and extensive air medical service and police aviation operations, air traffic over Hamburg is already intense. Large parts of the airspace over Hamburg lie within controlled airspaces.

As a federal city state, and unlike many other cities, Hamburg maintains its own aviation authority which not only manages the air traffic over Hamburg, but also actively engages in regulatory issues, e.g. in the drafting and implementation of the UAM-related Regulations of the European Union, most notably the U-space regulatory framework.

With an area of more than 7,000 hectares, various industrial installations, including 45 terminals, 300 kilometres of railroad tracks and more than 120 bridges, the Port of Hamburg provides an ideal testbed for drone applications and operations in an industrial setting. The Hamburg Port Authority (HPA) not only operates drones on a regular basis (especially for the surveillance and maintenance of the port infrastructure), but also initiates and coordinates projects with UAM reference in the port area. The Port of Hamburg provides not only a complex industrial environment, but also residential areas in which advanced UAM- and drone-technologies can be tested and applied. Furthermore, the Port of Hamburg constitutes an HPA-controlled regulatory environment, which allows for the experimentation with different UAM-related regulatory approaches.

Given the competition with other cities and regions, both nationally and internationally, the City of Hamburg considers it a necessity to continuously innovate, to continuously reinvent itself. The latest version of its “Regional Innovation Strategy”⁴⁰, brought to the public in May 2021, is human-centred and identifies the following five top-priority future fields of innovation: (1) health, (2) climate and energy, (3) data science and digitalisation, (4) materials science and new materials – and indeed: (5) mobility.

UAM-related activities (with a focus on drones) in Hamburg take place under the auspices of the Ministry of Economy and Innovation (*Behörde für Wirtschaft und Innovation*, BWI), which devises and implements UAM-related measures as well as overarching innovation strategies like the above-mentioned “Regional Innovation Strategy”, initiates and funds projects with UAM reference, establishes and fosters, by making reference to the quadruple helix model of innovation⁴¹, networks between industry, research and civil society (especially advanced cluster structures, of which Hamburg Aviation is part of, see below), and represents the City of Hamburg and its economic and innovation-related interests on the national, European and international level. In fact, the Hamburg Aviation Authority as well as the HPA are departments of the BWI which allows for well-coordinated regulatory approaches in UAM-related matters. In general, the BWI aims to balance the interests of the involved stakeholders and to safeguard the public interest.⁴²

Regarding civil aviation and UAM, the cluster “Hamburg Aviation” (HAv) plays a key role. The HAv is a Public Private Partnership, which connects and represents more than 300 members active in the field of aviation, UAM, and drone technologies (e.g., original equipment manufacturers, suppliers, consultants, research facilities etc.). Within the HAv, UAM activities are coordinated by the Windrove-Network⁴³ which engages in various forms of cooperation and initiatives, not only in the city of Hamburg, but also with other German and European cities active in the field of UAM.

At the time of writing, drone technologies are already being applied on a considerable scale in Hamburg, mostly for professional, sensor-based data collection purposes (e.g., for the maintenance of industrial installations and structures like bridges and runways, building information modelling (BIM) or situational awareness, e.g. in emergency cases). Drone-based cargo transportation is picking up momentum.

To sum up, Hamburg provides an ideal testbed for advanced UAM-environments for the following reasons:

- While it is a city in the first place, Hamburg is also a federal state within the German federal system, with all the corresponding state-like institutional features that allow for the full-scale implementation and testing of regulatory frameworks for UAM.
- A highly evolved aviation industry as well as a dynamic start-up ecosystem and top-notch research facilities in the field of aviation and UAM already exist in Hamburg, doing away with the need to build up such structures from scratch.
- Both on the ground and in the airspace, traffic in Hamburg is dense, multi-modal and complex. Hence, if certain advanced UAM-related technologies or regulatory frameworks (or a combination of both) work in such a demanding environment, it is fair to expect that it will work elsewhere.

However, challenges exist in Hamburg regarding the SUMP-UAM issue in hand:

- Opinions within the municipality about the optimal mobility plan may differ, e.g. across departments or political affiliations and convictions (and may neither be “sustainable” nor include the UAM-dimension at all).
- Opinions within the wider society about benefits and costs of UAM may differ and may become even harder to reconcile in an increasingly complex and fragmented urban environment.
- The COVID 19 pandemic has plunged the aviation industry into crisis.

⁴⁰ Regionale Innovationsstrategie der Freien und Hansestadt Hamburg. <https://www.hamburg.de/contentblob/15087588/42f8df5ead27b63d3e1b34330cc2f477/data/2021-05-18-bwifg-ds-ris.pdf>.

⁴¹ See e.g. Carayannis E, Campbell D (2009): ‘Mode 3’ and ‘Quadruple Helix’: toward a 21st century fractal innovation ecosystem. In: *International Journal of Technology Management* 46(3/4), 2011-2234.

⁴² It should not go unnoticed that at the beginning of June 2020, after the Hamburg state election on 23 February 2020 and the ensuing coalition talks between the Social Democrats and the Green Party, the Ministry of Economy, Transport and Innovation (Behörde für Wirtschaft, Verkehr und Innovation, BWVI) was split into the “Ministry of Transport and Mobility Turnaround” (Behörde für Verkehr und Mobilitätswende, BVM), with Senator Dr. Anjes Tjarks of the Green Party at its helm, and the BWI, where Senator Michael Westhageman (independent) continued to hold his post.

⁴³ Windrove: “Wirtschaftliche Nutzung eines Drohnen-basierten Luftverkehrssystems”, which translates into “Economic use of a drone-based air transport system”.



The Hamburg approach to urban mobility planning: Continuous Transport Development Planning

An integrated approach to urban mobility planning that bears similarities to the SUMP-concept was introduced in Hamburg only in 2018 (see the Good Practice Example in Section 3).

The Hamburg approach to UAM

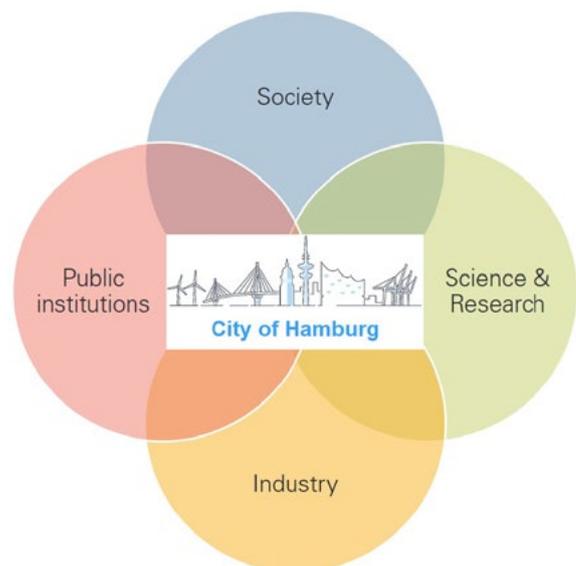
The first steps in Hamburg into the realm of UAM were based on a Triple Helix-approach⁴⁴, as depicted in Figure 19, that fosters the close innovation-driven interaction between three groups of stakeholders, namely the research community, the business community and, of course, city authorities, rather than on a top-down approach or an integrated, overarching mobility plan like a SUMP. The foundation of the Windrove Network in 2016 is based on the initiative of an applied research centre which soon gained support of the BWI and the business community active in aviation and drone technology. Funding by the Ministry of Education and Research (BMBF) in 2017 and the Hamburg Investment and Development Bank (IFB) in 2019 helped to institutionalize the network.

In 2018, the City-State of Hamburg joined the UAM Initiative (UIC2) of the EU’s Smart Cities Marketplace (formerly known as the European Innovation Partnership on Smart Cities and Communities, EIP-SCC) as the second city after Geneva.

For UAM, the City-State of Hamburg is preparing a dedicated strategy process that takes into account both the mobility as well as the industrial part of UAM.

The mobility part addresses the various stakeholders that are affected by UAM planning, in which the local Civil Aviation Authority now plays a crucial role as the urban airspace is being developed. The industrial part addresses the economic opportunities UAM offers to businesses in Hamburg, the world’s third largest business location in civil aviation. While the mobility part spans the frame for UAM operations to be run at the city’s level, the industrial part aims at strengthening the position and focusing on topics already dealt with in Hamburg, like hydrogen.

Figure 19: The Quadruple Helix approach in Hamburg (Source: Windrove)

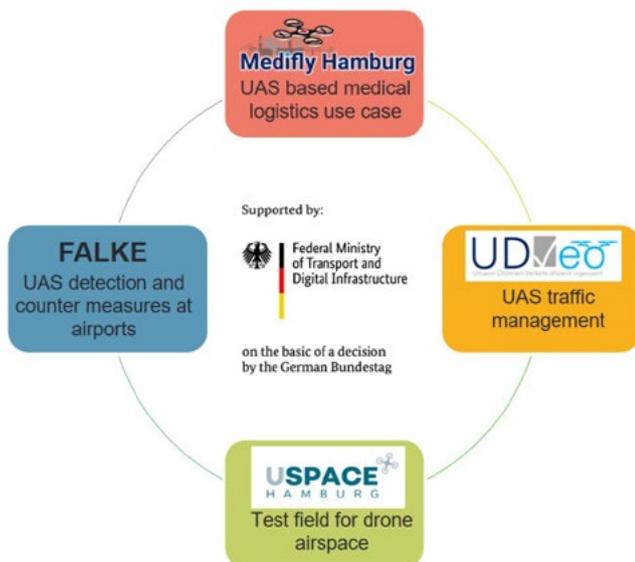


⁴⁴See Etzkowitz & Leydesdorff (1995) on the triple helix model of innovation.

Examples of UAM-related projects in Hamburg

Several projects are already performed in Hamburg (see Figure 20) that will affect the strategy process. First of all, the “Medify” project where tissue samples and urgent medical goods are transported between hospitals. In the first phase a feasibility study was performed that ended up with a successful first flight in February 2020. Currently, the second phase is performed that aims at the regular operation of drones between hospitals. The project is accompanied by events to inform the public and find out about their attitude towards drone traffic. That will result in a study on public acceptance.

Figure 20: UAM-projects in Hamburg (Source: Windrove)



The research project “Udveo” sheds light on the regulatory prerequisites and technical implementation of a UTM system related to the practical realisation of the U-space concept in Germany. One of the project’s goals is an IT-based control system for unmanned air traffic with the components of registration, flight authorization, monitoring and control being developed. The project will take into account the interests of all those involved and affected (manufacturers, operators, authorities, the population).

Thematically affiliated with that project is the “U-space living lab” the German Federal Ministry for Transportation and Digital Infrastructure, which is currently being implemented at the Hamburg port. Since Hamburg has a very challenging airspace, the ministry aims to answer pending issues with respect to the integration of different

stakeholders, be it the operator, the U-space service provider, the common information service provider and local authorities. At the end of the project duration, Germany’s drone economy is invited to test and validate their own U-space technologies and devices under real conditions.

Finally, the project “FALKE” deals with the detection and interception of non-cooperative drones, especially around airports.

Beside these example projects, there are many more ongoing UAM research and development projects. To support the establishment of an ecosystem with various UAM competencies, Hamburg observes the project landscape and funds new projects that fill gaps and involve existing competencies from other sectors. A current example is a vertiport project that is pursued by engineering services providers who traditionally work for the civil aerospace industry.

4.2.2 The Aachen / MAHHL-region (Germany/Belgium/Netherlands)

Traditionally, Aachen is known to be a strong research location (RWTH Aachen University, University of Applied Sciences Aachen), specifically with regards to its engineering competence.

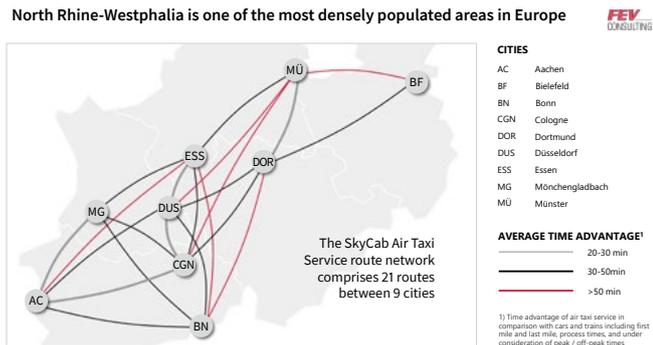
The City of Aachen maintains close partnerships with both research institutions as well as with many innovative companies on-site. They are working together closely to develop innovative technologies that contribute to Aachen’s development into a more resilient and climate neutral urban environment – a smart city.

The goal to further develop an innovative aviation cluster is supported by the government of the state of North Rhine-Westphalia as well. To boost the already dynamic start-up ecosystem as well as the strong research environment, local actors work together in so-called “innovation networks”. The UAM-initiative is one of them. Currently, two active innovation networks: Erlebnisswelt Mobilität Aachen, Urban Air Mobility Initiative.

The national borders provide a special challenge to the region when it comes to implementing UAM services. In addition, the cross-border situation brings a number of mobility challenges in terms of connectivity of the city, and the wider region, to airports, for example. Although Aachen does have a SUMP in place, the topic of UAM, although promising for improving the city’s connectivity

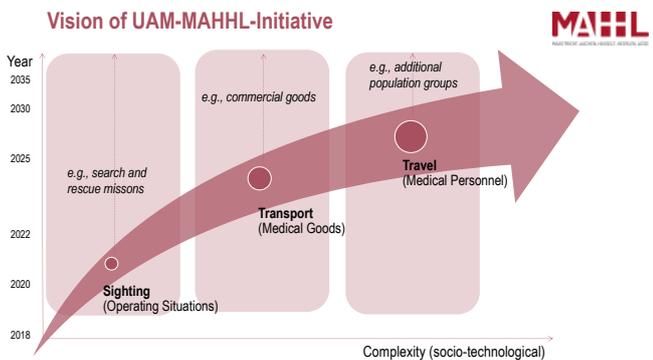
(see Figure 21), it is still dealt with as an innovation project. There is a regular exchange between the UAM team in the city and the SUMP mobility planners in view of voicing their interest for integrating UAM within the SUMP as soon as the UAM experimental and innovation projects start to mature.

Figure 21: Research and innovation at Aachen exploring the role of UAM for improving the city’s and wider region’s connectivity (Source: City of Aachen / FEV Consulting)



Economic, scientific, and administrative actors from the MAHHL-region – under the coordination of the City of Aachen – define the focus and development of UAM together. The goal is to pilot UAM-services that are developed locally, in the MAHHL-region first – and to expand successful projects nationally and internationally. Aachen is one of the five German pilot regions for Urban Air Mobility and works closely with its cross-border neighbours Maastricht, Hasselt, Heerlen, and Liège. Aiming to develop and implement socially beneficial innovative aeronautical applications, the medical use case builds the core of the local initiative. Figure 22 illustrates the roadmap for UAM at MAHHL level established in since 2018 when the region of MAHHL joined the UIC2.

Figure 22: UAM roadmap at the cross-border region of MAHHL (Source: City of Aachen)



Aachen is also exploring the possibility of air-taxis (eVTOLs) as an additional, complementary means of transport. The main UAM focus areas and corresponding projects are outlined below:

Drone Delivery

- *RescueCopter* – Transport of medical supplies (AED etc.) to emergency sites to provide first responders with the necessary equipment. Integration of a communication structure to the already implemented tele doctor.
- *GrenzFlug* – UAV to assist emergency services in cross-border search and rescue missions. Fully automated flight of a tilt-wing aircraft to assist rescue services even in problematic weather conditions.
- *SAFIR-Med/LegalMed* – Transport of medical supplies (e.g., blood, tissue samples, surgical instruments) between hospitals in the MAHHL-region.

Air-taxi (eVTOL) Services

- *SkyCab* – Development of a socially beneficial drone taxi service, including technical and style design, integration into current and future mobility systems.
- *Silent Air Taxi* – Development of a sustainable innovative aircraft for medium distances.

4.2.3 The city of Trikala, Greece

The city of Trikala is dealing with UAM as an innovation project; as such UAM is not directly taken into consideration in the city’s immediate SUMP work. In fact, the city is exploring the innovative aspects of UAM to respond to the need for immediate accessibility to urgent medication through a future, remote-based UAM service. Trikala is participating in the Harmony project (see Annex) in which a UAM, drone-focused, pilot has been designed for medical logistics. The experimental pilot consists of a drone delivery service for medicines from the city centre to the pharmacies in the surrounding rural areas, aimed to serve primarily the urgent needs of elderly and other vulnerable social groups with limited accessibility to mobility services.

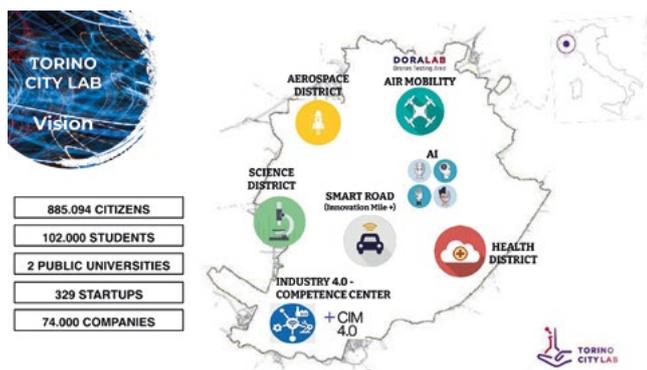
A UAM service that could be developed from the experiences of the Harmony pilot has the potential to improve the everyday life of citizens by decreasing the delivery time, reducing operational costs and operating in a safer way promoting social distancing if needed, like in the context of the COVID-19 lockdowns.

4.2.4 The city of Turin, Italy

Turin provides another example for a bottom-up approach which relies on living labs and experimentation projects.

Turin is one of the most innovative and urban experimentation pro-active cities in Europe. In 2016, the city launched the first living lab, which thanks to the activation of 29 projects on different areas such as environment, mobility and tourism, has become the first urban space in Turin dedicated to innovation and smart city. "Torino City Lab" (Figure 23) is then an evolution of Torino Living Lab, with the aim of transforming the city's territory into an always open living lab. Torino City Lab (TCL) operates in a very dynamic environment.

Figure 23: Torino City Lab (TCL) – Transforming the city’s territory into an always open living lab (Source: City of Turin)



The mission of TCL is to facilitate testing operations in real conditions of innovative solutions of public interest. In the framework of drones, Dora Park has been identified as testing area for drone operations, namely the DORALab. This is an optimal area for its position, security conditions and technology infrastructure. DORALab aims to promote and support the development of testing activities on technologies used for the flight of drones (Figure 24), helping to promote, in this way, research in the field of remote piloted aircraft and the development of a sector, such as aerospace, strategic for the economic system of the territory of Turin.

Figure 24: Turing COD – DORALab. Project by Elite Consulting SRL (Dealer DJI) (Source: City of Turin)



Innovative experiences enabled by 5G (see Figure 25) in UAM are currently on going.

Figure 25: Example of the drone experimentations in Turin (Source: www.eliteconsulting.it)

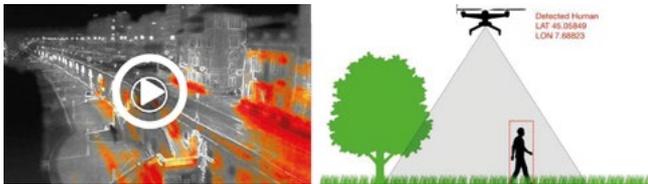


One object of the experimentation is the provision of three drones type Mavic Pro for testing by the Turin Municipal Police and the accompaniment to the establishment of a Drones Unit.

Other experimental projects include:

- *Tim/Seykei*: river monitoring with drones, sensors and 3D reconstruction using big data analysis.
- *Leonard* – Last-mile logistics experimentation with transport of objects weighing <25kg using drones (Sumeri Project).
- *Skypersonic Turin* – Launch of a trans-oceanic experimental indoor inspection and sanitation project in Detroit in BLVOS (Beyond Visual Line of Sight) using special drones remotely controlled from Turin.
- *Territorial monitoring service* (Figure 26) with drone patrols in parks and green areas.

Figure 26: Day and night drone patrolling in parks and green areas (Source: City of Turin)



- *CTE Next* – In 2021, Turin started the project CTE Next, a technology transfer and innovation hub enabler programme funded by the Italian Ministry of Economic Development to support the creation of enabling technological infrastructure and entrepreneurial ecosystems for smart cities. CTE Next strategic areas include: Smart Road, Urban Air Mobility, Industry 4.0, and Innovative Urban Services.
- *SkyGate* – the project (Figure 27) has been presented in the session of the Special Commissions Smart City and Urban Planning of April 15, 2021. SkyGate is located in the immediate vicinity of the region’s most important industrial aerospace hub, in the heart of Piedmont’s urban fabric, in the future “Aerospace City” of Turin. Paolo Pari, president and CEO of DigiSky srl and co-founder of Always srl, explained at the Commission: “It was created to revitalise the Turin airport site and to encourage the transport of people and goods by air using eVTOLs (electrically-powered vertical take-off and landing aircraft) and drones. It also intends to offer acceleration services for

businesses and certified airport services, as well as train professionals working in the sector, in partnership with Turin Polytechnic. Taking advantage of Turin’s expertise and international history in aerospace and automotive. The objective is to create a model for the growth and development of air mobility that can be replicated in other parts of the world.

Figure 27: The consortium of the SkyGate project in the Turin Airport area (Source: City of Turin)



The described work in this section about the progress of the City of Turin in UAM demonstrates that the city has ambitious plans to become a European leader in UAM. In fact, Turin is the first city to offer a “complete eVTOL ecosystem dedicated to UAM services”. Although Turin has made considerable progress in UAM, Turin has not yet fully embraced UAM in the SUMP process for two reasons. First, the UAM work is still at the very early innovation and experimental stages; and second, the city’s SUMP was only recently adopted in summer 2021 by the Metropolitan City of Torino.

4.2.5 The city of Ingolstadt, Germany

The city of Ingolstadt represents another example for a bottom-up approach which relies on living labs and exploratory, experimental projects as shown in Figure 28. To this end, formal links to the development of a SUMP have not been developed yet. Still, Ingolstadt has a Transport Development Plan in place which is an overarching, conceptual guideline for transport planning in the city of Ingolstadt and serves as a basis for decision-making in municipal policy. With the target year 2025, it defines transport policy guidelines and action goals for the next 10 to 15 years. UAM is not yet considered within the Transport Development Plan. As an innovative technology branch the topics regarding Urban Air Mobility are driven and coordinated by the Department of Economic Affairs of

the City of Ingolstadt while the professional expertise is provided by the specialist offices (e.g., Department for Urban Development).

Ingolstadt focuses on establishing an ecosystem that enables the development and testing of UAM applications. Therefore, many use cases are considered (Figure 28).

Figure 28: Exploratory use case for UAM in the city of Ingolstadt and its wider region (Source: City of Ingolstadt)



Moreover, Ingolstadt has set up a start-up company incubator and accelerator especially for companies that provide technologies or services for the mobility of the third dimension (briggAir). The military controlled airspace above Ingolstadt offers unique possibilities in testing of UAM applications. The military site south of Ingolstadt provides long-term expertise in testing novel airspace technologies and has created an open experimental environment together with local partners in order to create a testbed for civil applications.

Ingolstadt has developed and has been successfully maintaining since 2018 a very large network of academic, industrial and institutional partners as part of its UAM Initiative Ingolstadt (established in 2018 when the city joined the UIC2). Up until today the network has grown to over 80 members. This initiative has been instrumental in raising funding at State (Bavaria) and Federal levels. Today, Ingolstadt is figuring as a pioneering city in UAM managing a diverse portfolio of UAM-related projects linked to public acceptance and integration to mobility systems as illustrated in Table 3.

Table 3: Portfolio of UAM-related projects taking place in Ingolstadt and its region.

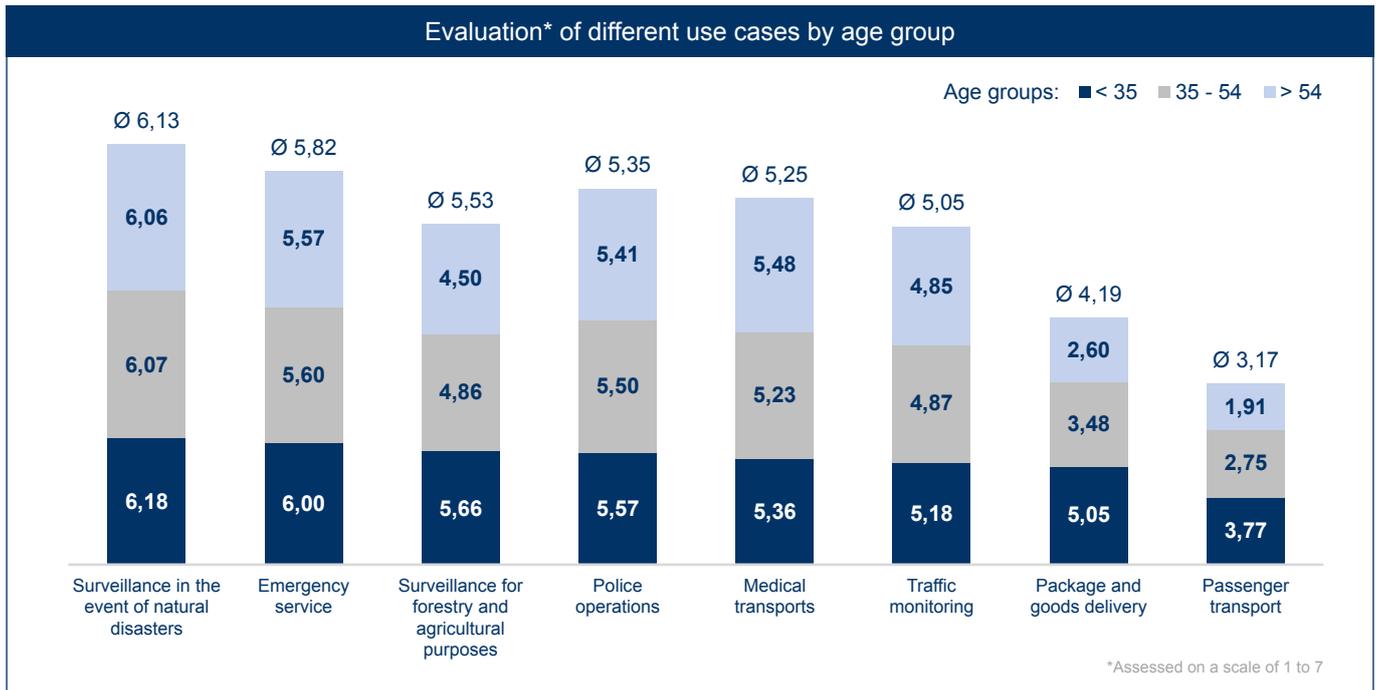
Project title	Objective
GABi (finished)	Identification of key drivers and barriers to individual and societal acceptance of UAM applications and early involvement of the public.
FreeRail (ongoing)	Research on a fully automated drone-based system for digitalised vegetation control and registration of damage after severe weather events along the Deutsche Bahn track network.
MEDinTime (ongoing)	Development of a solution for the rapid supply of medicines for primary care clinics from the central pharmacy of a large clinic by means of automated UAS.
InCity TakeOff (ongoing)	AI-based requirements analysis for the use and integration of vertiports and vertistops in Ingolstadt based on practical planning using the example of the new Ingolstadt central station.

In INCityTakeOff, the city of Ingolstadt takes care of the urban planning considerations, building parameters and the participation of users and residents. The other partners contribute their knowledge of aircraft, simulation and the use of artificial intelligence to the project. The theoretically planned location of the vertiport is at the main train station of the city of Ingolstadt, where it is possible to transfer to train or bus. But the project focuses not only on the needs of users, but also on the impact on local residents - noise, for example.

The project GABi dealt with social aspects of UAM. The main objectives were to find factors influencing the acceptance of UAM and to promote citizen participation in the development and introduction of UAM applications. The results (Figure 29) provide insights for the design of different forms of citizen involvement and participation. One key finding was that especially applications that serve the common good are considered useful while there exists still scepticism about the passenger transportation use case. This is also closely linked to safety concerns. It is thus important to create UAM applications together with potential users and the public in order to give them the possibility to familiarize with the new technology as well as to enable UAM providers to create a product that serves a public need.⁴⁵

⁴⁵ Janotta, F., Peine, L. & Hogreve, J. (2021): Public opinions on Urban Air Mobility – The significance of contributing to the common good. OSF Preprints, 5 May 2021. DOI: <https://doi.org/10.31219/osf.io/m62yd>

Figure 29: Evaluation of different use cases by age group 5 (Source: Janotta et al (2021))



4.3 The greenfield approach

4.3.1 The case of Metropolis GZM

Some, UAM-related facts about GZM

Górnośląsko-Zagłębiowska Metropolia (GZM) is a highly urbanized and polycentric metropolitan area associating 41 cities and communes in the south of Poland (the Silesian Voivodship), with a population of over 2,2 million inhabitants.

Metropolis GZM is situated on the Baltic Adriatic TEN-T corridor, on the main national and international routes, both road and rail ones. Mobility between cities within the conurbation is high and largely car-dominated.

Being the Polish industrial heartland, GZM and its freight transportation also adds to road traffic in the region. In addition to challenges of common development and integration, the conurbation also faces deteriorating environmental conditions which are among the worst ones in Europe.

The GZM joint approach to urban mobility planning and Urban Air Mobility

Implementation of sustainable transport is one of GZM’s flagship tasks. Every day, thousands of residents of

Metropolis GZM and its surroundings, take different routes and travel in different ways. Therefore, in GZM, innovative solutions are looked to as a possibility to overcome some of these challenges e.g., integrated ticketing on public transport across the entire metropolitan area to improve ridership.

Understanding the role which other innovations could play, all UAV-related activities are guided by the assumption that the proactive approach of cities to the development of the UAM today, is a precondition for a truly sustainable mobility of tomorrow (Figure 30).

Figure 30: The UAM-ecosystem of GZM (Source: GZM)



That approach is additionally supported by numbers. According to the analyses presented by the Ministry of Infrastructure and the Polish Economic Institute in the White Book of the Unmanned Aerial Vehicle Market, the value of the drone market will amount to PLN 3.26 billion by 2026, but the effect for the entire economy may be as high as PLN 576 billion, according to a moderate scenario.

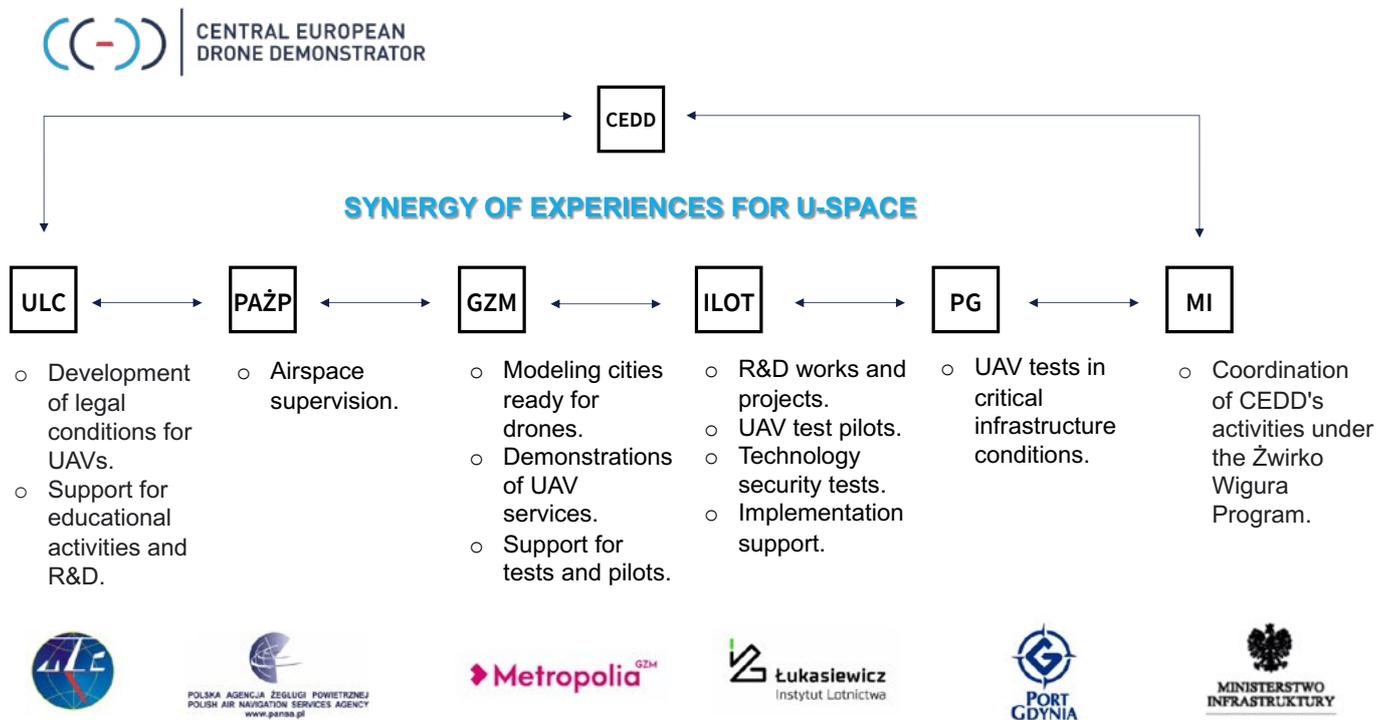
The high development potential of drones in Poland is also shown by the increase in the number of drone users observed in recent years. From 2013-2018, the Polish Civil Aviation Authority issued almost 10,000 qualification certificates for unmanned aircraft operators and at the end of 2020, the number of operators holding qualification certificates amounted to over twenty-one thousand. From December 31, 2020 to mid-March 2021, more than fifty thousand UAV operators (who had undergone basic training required by the new EU regulations) became registered in the electronic system of the Polish Civil Aviation Authority.

Following the SUMP-cycle, from its initial preparation and analysis stage the key GZM effort wants to *ensure political and institutional ownership*.

To address the potential of the development of unmanned aerial vehicle (UAV) use, along with ensuring safety and public acceptance, GZM conducts its activities in many ways, participating in the continuous exchange of experiences and using the resources of individual parts of the drone ecosystem.

At the local level, such activities have been included in the strategic program of activities of the GZM, ensuring budget funds in the next few years. At the supra-local level, the Central European Drone Demonstrator program was created, which was then included in the larger program “Żwirko i Wigura” and placed in the “Strategy for Responsible Development” of the Polish government in the perspective of 2030 (see figure 31). This is a strong mandate for carrying out work in the area that it is highly conceptual and goes beyond the current possibilities (it does not directly solve the problems here and now).

Figure 31: Synergies within the Polish UAM-ecosystem (Source: GZM)



Plan stakeholder and citizen involvement

Perceiving the associated cities as a value and common space, while working on UAM development at GZM, we defined a need to involve citizens early on. The achievement of goals by GZM should be dictated by the benefits for the inhabitants living there, therefore any considerations on the implementation of UAM and SUMP must at every step respond well to the requirements of these stakeholders.

When implementing tasks in the development of unmanned aerial vehicles in cities, we used participatory methods of developing conclusions and guidelines, involving representatives of public institutions (cities), research centres (universities), research institutions (experts in the field) or independent experts, and finally we tried to confront the results with representatives of the industry and a potential customer.

The first step in this regard was the initiation of the work of the Metropolitan UAM Team of municipal stakeholders, designed as a tool for acquiring 'drone ambassadors' among the authorities of associated cities – potential recipients of drone services and public opinion leaders.

The following conclusions were revealed already at an early stage of cooperation. The work of local authorities' representatives on concepts for the development of future mobility and future security, which are not included in the municipal tasks, is significantly impeded. Difficulty in assigning employees of specific departments to the work of the team was identified. In some cases, the offices did not start cooperation, seeing no place for this type of tasks in their responsibilities. It was also observed that in individual cities, representatives of various departments had been delegated to cooperate in some cases related to e.g., geodesy, or urban planning, in others, e.g., crisis management.

The limited interest in cities was also caused by insufficient knowledge and lack of access to real implementations of drones and technologies available in Poland. Various concerns, including the safety of new technologies that pose a direct threat to human health, as well as concerns about privacy of residents were also presented.

Apart from the public acceptance aspect, the local authorities' representatives were hesitant about the real possibilities of spending public funds due to the lack of guidelines and examples for public procurement of this type.

The natural consequence of the above analyses was the U-space Katowice Project under which cooperation with representatives of the Katowice City Hall was undertaken regarding the identification of challenges and concerns in the process of preparing the city for drones in the areas of spatial management – urban planning, space management, risk management.

Ongoing cooperation involves both individual consultations and workshops with stakeholders. The effects of reflection became the basis for creating a textbook for cities in the above-mentioned topic.

Discuss scenarios with citizens and stakeholders

GZM, wanting to realistically support the development of UAM processes, chose to carry out a pilot project of the UAM service expected by cities and municipalities, to be implemented in at least two of them.

The officials from cities such as Katowice, Sosnowiec, Będzin, Dąbrowa Górnicza Mikołów, Łaziska Górne, Zabrze, and Gliwice worked as part of a series of online workshops organized together with an inter-ministerial GovTech Polska” team, operating at the Chancellery of the Prime Minister. The aim of the meetings was not only to identify the real needs of local governments, but also to identify the opportunities and threats associated with the use of unmanned aerial vehicles (UAVs) and to indicate the technical, organisational and legal possibilities of providing specific public services with the use of drones.

During phase 2 of the workshop, initiated in April 2021, participants took up the challenge of creating a concept of a monitoring for the environmental protection public service with using UAV able to meet the needs of the local government in an innovative way.



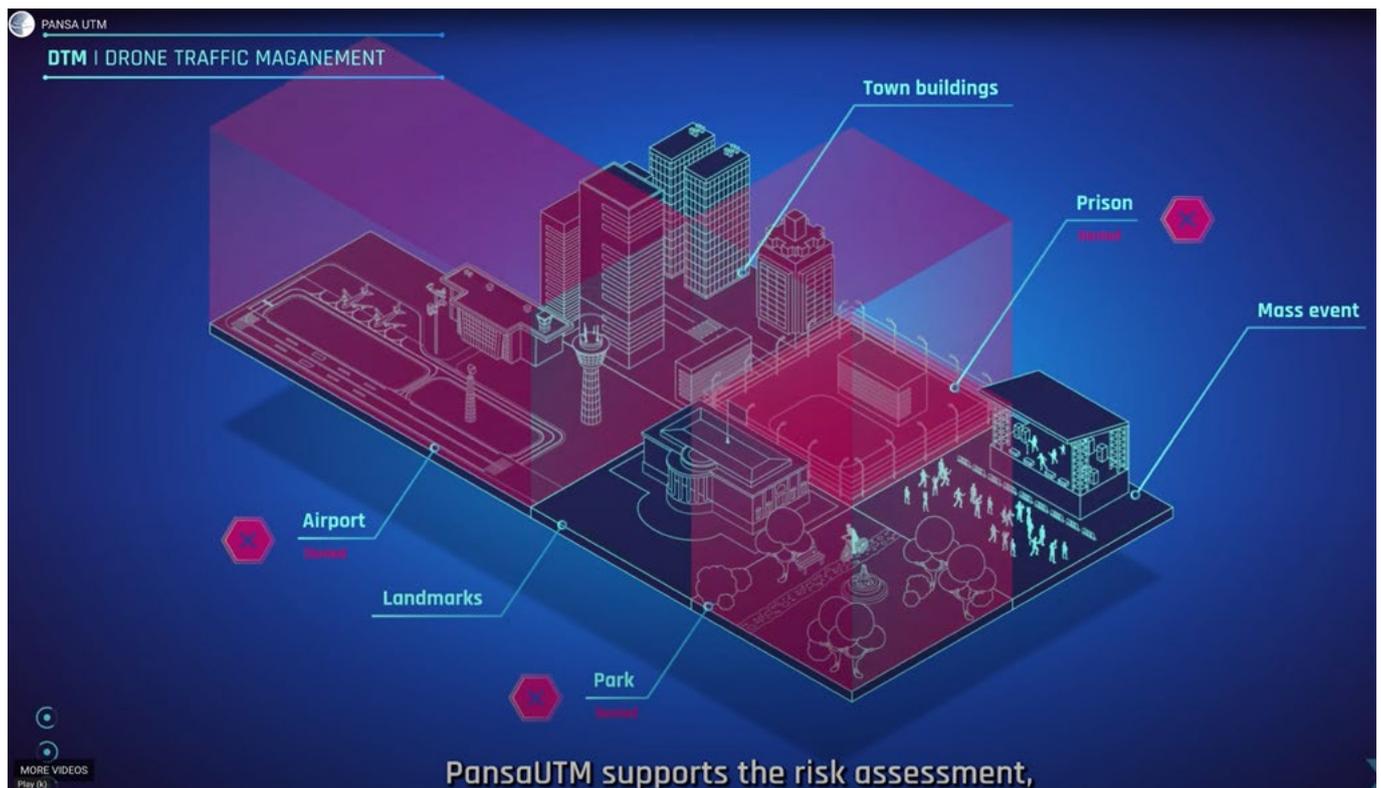
Identify information sources and cooperate with data owners

An important part of the work on introducing UAM is removing roadblocks which could stop our partners in achieving their goals. Sometimes a good solution is already implemented but stakeholders are not aware of it; in such cases it is sufficient to make sure everyone is aware of the benefits a given solution brings.

Among the many positive aspects of cooperation within the CEDD, direct access to the knowledge and technological solutions of partners from all areas of the drone ecosystem should be mentioned. One of the resources used for research and implementation by all partners is PANSa-UTM.

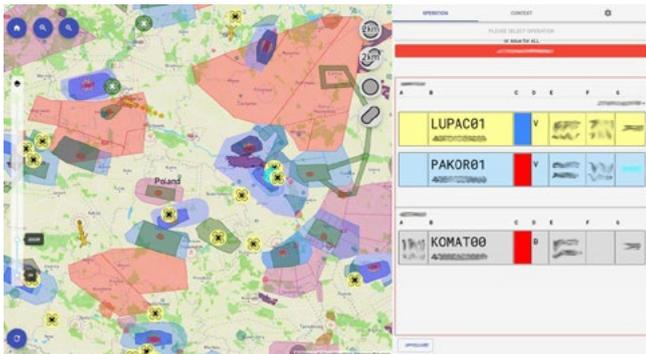
The Pansa-UTM system enables fast, digital UAV flights coordination in Poland. The system helps drone operators to check flight possibility in a given area (see Figure 32), digitally submit a flight plan, and obtain permission to fly if it does not threaten the safety of manned aircraft. For air traffic controllers, Pansa-UTM provides information about drone flights planned in the vicinity of international airports (CTRs) along with simple authorization/ non authorization tools. The controller also has dynamic geofencing tools and can create alert zones which would order drone pilots to land.

Figure 32: Example of managing the urban airspace operations (e.g. flight authorisations) in the PANSa-UTM systems (Source: PansaUTM)



The system covers the whole of Poland (Figure 33) and is the first European UTM system certified for operational use on daily basis. With a few clicks the area of responsibility of a Local Administration Unit (LAU), such as a city or national park can be defined – allowing for parallel flight authorization shared through a common interface.

Figure 33: The PANSA-UTM covering the whole of Poland (Source: PansaUTM)



Set up working structures. Create inter-departmental core team. Link with other planning processes

Bearing in mind that GZM was established to implement projects that go beyond one city and make use of new solutions and technologies to better employ the region’s potential, building on the unique situation of establishing the GZM SUMP and UAM teams nearly at the same time, as well as the abovementioned potential of the Central European Drone Demonstrator (CEDD) cooperation, it additionally shows the necessity of linking to various planning processes and cooperation with different interest groups, entities and organizations, to which Metropolis GZM and the Central Subregion of Silesian Voivodeship contribute. Joint efforts, while working on a concept of interdependencies between UAM and SUMP, led to identifying of white spots in processes and to agreeing on common definitions of underlying phenomena (even though initially we thought that we understand everything in the same way). Creation of cross-organisational teams, such as the team established to work on this document, helps to deal with negative consequences of organisational silos. Thus, there are opportunities to quickly associate activities and bring about greater synergy.

Bearing in mind that the cities’ interest should be properly instilled beyond the current tasks and immediate problems, we put the effort of increasing the awareness of the long-term benefits of taking actions at SUMP and UAM. To achieve that, we decided to identify an official in each of the cities who would join our work and, what is especially important in the first stages, who would be the ambassador of the Metropolitan Team for UAM activities.

Consider getting external support

Since its establishment, Metropolis GZM, in addition to carrying out passenger services, has been carrying out tasks related to sustainable urban mobility as one of its statutory tasks. Having in mind its key role in the sustainable mobility ecosystem and the significant lack of qualitative analysis as a starting point for SUMP elaboration, Metropolis GZM, together with the Central Subregion of Silesia Voivodeship, has joined the pilot programme of the Ministry of Funds and Regional Policy and then received support from JASPER’s experts.

As a metropolitan area, GZM benefits also from participation in the Horizon 2020 projects e.g., Harmony or Assured-UAM. Due to international cooperation, access to the other partners best practices, as well as the division of tasks among e.g. diverse HARMONY stakeholders enables taking up complex activities such as planning recommendations for an updated SUMP which may reflect the potential of new technology and the complexity of the entire expanded metropolitan area. The insights into testing drones and autonomous vehicles aims to help with future demonstrations planned in GZM. Moreover, the project will provide links to other cities and foster fruitful exchanges for GZM.

GZM is benefiting from both: the Harmony and Assured-UAM projects by expanding the organizational experience and management skills under the Horizon 2020 programme. The above-mentioned knowledge, competences and experience GZM intends to use for the implementation of other international projects of this type, e.g. further Horizon Europe funded projects, international consortia, and communities among them - UIC2 (Urban Air Mobility Initiative Cities Community). GZM also intends to use the effects of the above-mentioned projects to implement its own projects for the inclusion of drones in urban mobility, aspiring to the position of the first choice in Poland in terms of modern urban mobility development, including unmanned mobility.



Analysis & Strategy Development

The active involvement of Metropolis GZM in the process of implementing drone services for cities is evidenced by the inclusion of the development of this type of services in the Strategic Action Program of the Metropolis GZM until 2022.

Locally, taking advantage of the infrastructural and natural diversity of 41 cities and municipalities, GZM conducts its activities in the area of mobility and UAVs in cooperation with associated cities.

Evaluate capacities and resources. Assess planning requirements and define geographic scope (functional urban area)

The concept of mobility, as understood by GZM, is much broader than transport itself or moving from point A to B. Mobility is a collection of all elements of our moving and all features which affect it. We are talking not only about the different means of transport, but also about the ways in which they are used and experienced, along with the needs, emotions, and ways of thinking behind it, and last but not least, the ways how to manage mobility.

Metropolis GZM represents 41 cities and communes of a very diverse nature, both in terms of the area and type of buildings, but also different management methods, with goals and development strategies not always

perfectly aligned. This gives the opportunity to check what are the real barriers to the acceptance of drone services, what are the opportunities arising from the integration of these solutions for different cities and municipalities, or how the attitude of residents' changes depending on the perception of the activities of their city.

Taking into account the limitations of the global and local ecosystems, which are the key determinant of the Sustainable Urban Mobility Plan for Metropolis GZM and the Central Subregion of Silesian Voivodeship, we assume that in terms of capacity and resource management, transport should serve the fulfilment of diverse citizens' needs as effectively as possible.

Such course of action is making mobility more coherent, reflected in particular objectives such as safety, certainty, efficiency, compactness, fairness, healthiness, accessibility, environmental care, proximity, and uniformity, which constitute the SUMP's specific objectives.

The team working on SUMP for Metropolis GZM and the Central Subregion of Silesian Voivodeship has adopted – as a goal and a leading idea – recommendations of solutions, which guarantee better use of the (existing) system's resources, rather than its expansion.

4.3.2 The city of Oulu, Finland

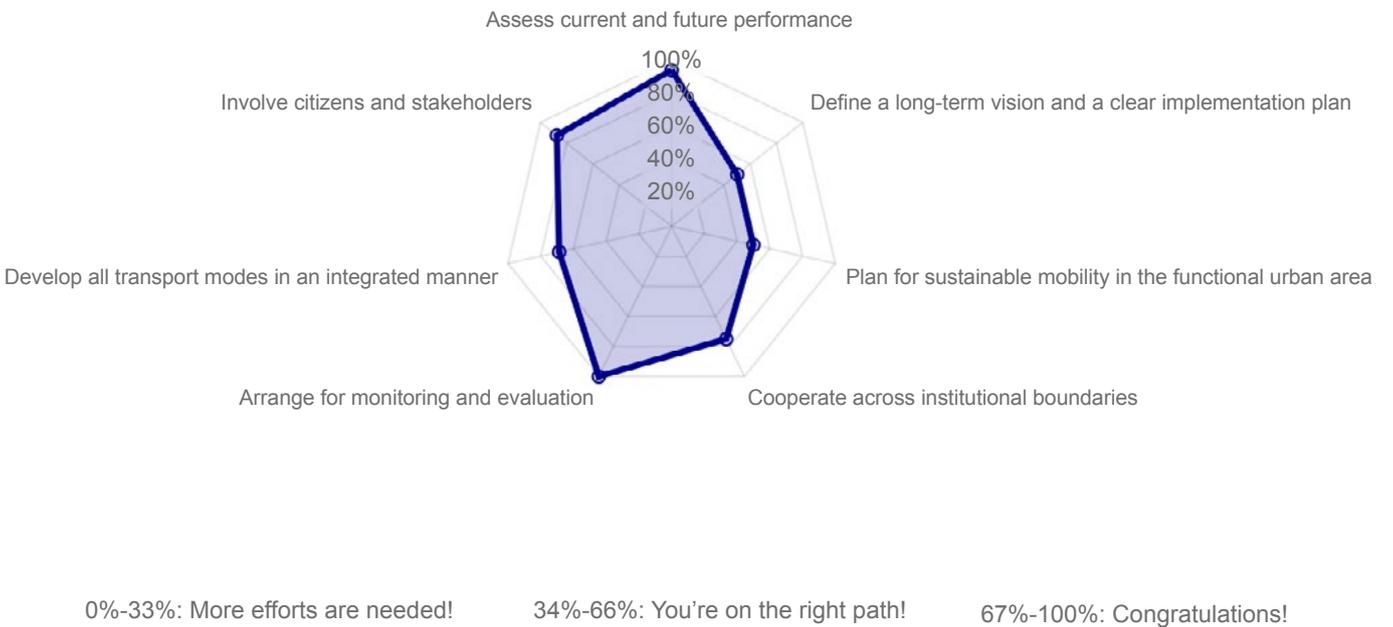
The City of Oulu is successfully implementing the UAM strategy to match the Sustainable Urban Mobility Plan principles. The main target for Oulu’s SUMP approach is that 50% of traffic in the city will be based on sustainable solutions. That means finding new options and optimising, sponsoring cycling and walking, and supporting other sustainable means and modalities for transportation. The City Council recently approved the SUMP of Oulu.

From 2019-2020, the City of Oulu investigated the landscape of the requirements and anticipated challenges and evaluated the capacities and resources. At the beginning of 2020, UAM Oulu⁴⁶ strategic initiative was established, led by a team formed from representatives of the leading research organisations and the City of Oulu. Since that time, the team has kept weekly meetings where the UAM-relevant matters are discussed and planned. A big boost to the planning processes the City of Oulu received by joining the UIC2 initiative. The exchange of information and experiences and the collaborative processes that were achieved through the UIC2 community are very valuable.

The political and institutional ownership is ensured through the BusinessOulu⁴⁷ – organisation, which is a part of the City of Oulu organisational structure and empowered to be in charge of the business development. BusinessOulu closely cooperates with the local universities and research functions and also engages in international networking with other cities and entities. The involvement of stakeholders and citizens is a continuous process that utilises the power of communication channels, public and dedicated events, RDI projects, the abilities of the involved stakeholders, and the city’s functions.

In 2021, UAM Oulu conducted various activities that match the implementation of the second and third stages of SUMP. The initial timeline set at the beginning of 2020 was revised and updated to match the recently adopted European Commission U-space regulatory framework. At the same time, exploration of the SUMP concept and communication with key stakeholders in Oulu started regarding the opportunity to establish a formal SUMP (Figure 34).

Figure 34: SUMP Self-Assessment Tool reflection on the UAM Oulu activities (Source: City of Oulu)



⁴⁶Urban Air Mobility Oulu (UAM Oulu), www.uam-oulu.com.

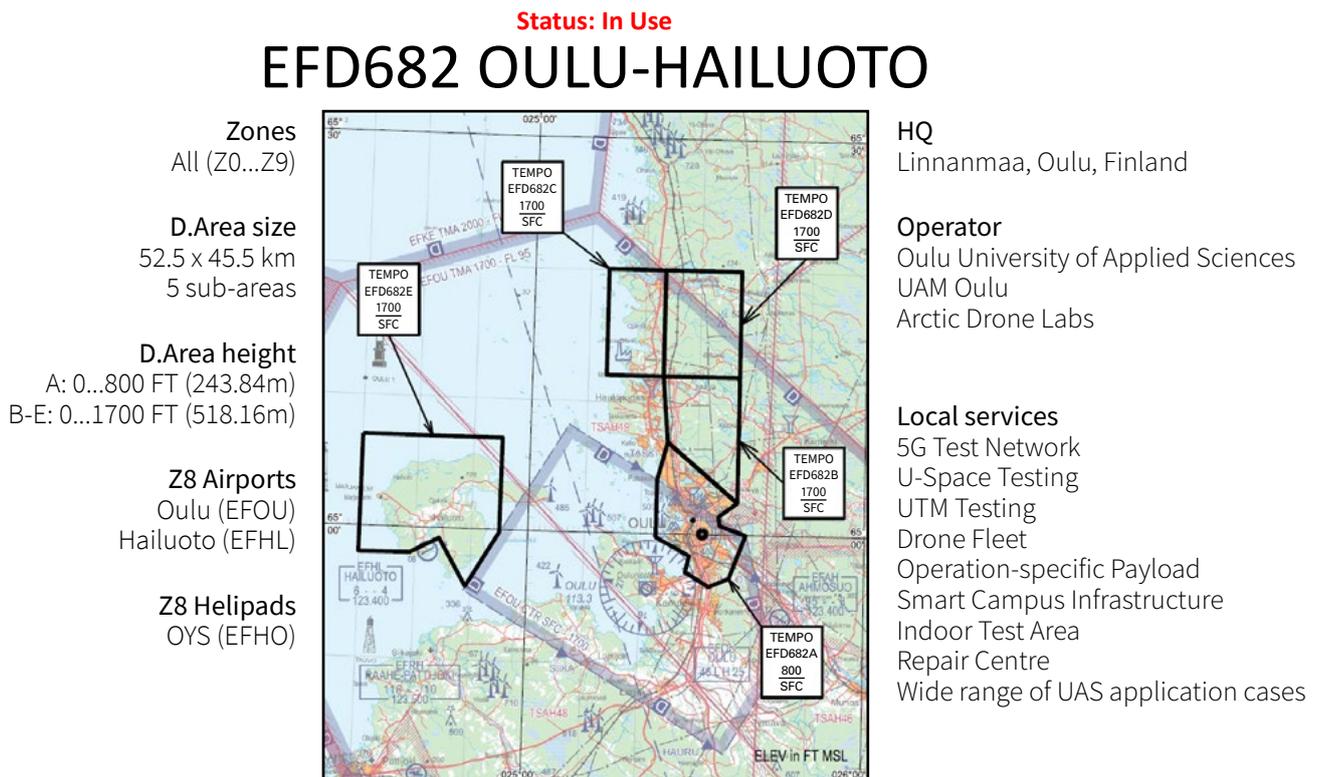
⁴⁷BusinessOulu, www.businessoulu.com.

Among the most significant challenges for implementing UAM in the City of Oulu are integrating the UAM elements, such as vertiports and landing pads, into the city landscape from the point of urban planning. Also, planning the U-space operation areas ready for the deployment of the first in Finland UTM system was found to be challenging. As a positive challenge, several ongoing R&D projects conducted by Oulu University of Applied Sciences, the University of Oulu and VTT Technical Research Centre of Finland either directly contribute to the development of UAM (e.g., Flying Forward 2020⁴⁸, FUAVE⁴⁹, DroLo⁵⁰), or are relevant to UAM (e.g., 5G!Drones⁵¹), and therefore the ongoing communication and coordination are required to synchronise the diverse activities.

The project Flying Forward 2020 funded by the European Commission as part of Horizon 2020 Framework Programme develops the UAM Blueprint that lists

elements of UAM. These elements will be implemented and engaged in conducting a series of demonstrators in Oulu and several other European cities, such as Eindhoven, Milan, Zaragoza and Tartu. The city of Oulu is traditionally strong with 5G communications, which is one of the essential elements of the UAM ground infrastructure. Still, the other elements are planned to be developed to create the fully functioning UAM space open for testing purposes, citizen needs, and business use. For example, among the plans is building two vertiports to enable a passenger transfer from the Oulu Airport to the new residential area that will be open in 2025 (Figure 35). Linking with other planning processes, identifying information sources and analysing problems and opportunities does not happen only through the activities of UAM Oulu. On a larger scale, under the umbrella of Oulu Innovation Alliance⁵², the key city stakeholders match their plans towards big commonly agreed targets.

Figure 35: UAM Oulu Operating Areas (Source: City of Oulu)



⁴⁸ FLYING FORWARD 2020 www.ff2020.eu.

⁴⁹ Finnish UAV Ecosystem (FUAVE), www.fuave.fi.

⁵⁰ Project Drolo, www.drolo.fi

⁵¹ Projekt 5G!Drones, www.5gdrones.eu.

⁵² www.businessoulu.com/en/frontpage-old/en/company-networks-2/oulu-innovation-alliance

4.4 Lessons learned from the city cases

4.4.1 Opportunities of UAM

UAM comes along with the following promises:

- Drones and eVTOLs (air taxis) can play a vital role in a fully integrated mobility concept and effectively complement other modes of transportation.
- UAM may enable the transition towards a more sustainable modal split in a city or region, or may even, according to more optimistic points of view, substantially reduce traffic densities on the ground, if rolled out on a large scale.
- UAM exhibits considerable prospects of economic growth and a high potential for innovations and innovative business models.
- UAM attracts a qualified workforce to a city or region, fosters start-up ecosystems and incentivises top-notch research.
- UAM could be a sustainable mode of transportation (given that it taps into green sources of energy and its use results in overall energy use reduction).
- Regulatory frameworks like the U-space provide for efficient and safe air traffic, even with the highest traffic densities.

4.4.2 Challenges of UAM

Throughout this document, various sources of uncertainty were addressed that may have a significant impact on the future and implement-ability of UAM and the UAM strategies cities devise. Uncertainty indeed is an integral part of decision-making (and human life) and could interfere with the process of goal achievement and may lead to undesirable, unintended outcomes. To summarise, the uncertainties pertaining to UAM are, among others:

- The operation of drones and air-taxis on a large scale pose new safety risks to the urban environment, as the impact from the probability of crashes or collisions (even with the highest standards of airworthiness) increases in a densely populated air space. Regulatory frameworks like the U-space are designed to minimise such risks as well as to implement high safety standards in UAM.

- At the time of writing, regular operations of (cargo) drones are rather an exception than the norm, and virtually non-existent in the case of air taxis. Presently, air taxis fly at best for a few seconds without passengers in highly controlled test environments, and many technical issues still need to be resolved. For example, it is by no means certain that the advances in battery technology (especially in terms of power density) will suffice to significantly extend the range and flight duration of drones and air taxis.
- *Will there be UAM business models that are both viable and profitable?* A regulatory framework like the U-space is based on a highly evolved technological infrastructure which will presumably be costly to set up and manage, and costly to be accessed and utilised by UAM service providers. High costs of utilising the urban airspace may imply narrow profit margins for commercial UAM service providers, or, in a worst-case scenario, no profits at all, thus shutting down any commercially viable business model.
- *Will ground-based modes of transportation eventually turn out to be safer, cheaper and more efficient than (cargo) drones or air taxis?* Basically, a universal answer to this question does not exist; rather the optimal transportation mix may depend on the specific local conditions in a city or region and the collective mobility preferences of the population.
- *Which eVTOL design will eventually turn out to be the most effective or the best match for given use cases?* The certification of eVTOLs is a long and costly procedure and it is by no means certain that each eVTOL market contender will eventually succeed.
- *Which financing models are eventually viable, regarding the whole lifecycle of an eVTOL or a drone?*⁵³ Insurance and liability issues still need to be addressed as well.

The uncertainties addressed so far are, in the terminology of Donald Rumsfeld, “*known unknowns*”, i.e., the sources of uncertainty known to the decision-making entity, as are the events that can emanate therefrom.⁵⁴ However, “*unknown unknowns*”, i.e. sources of uncertainty, of which the decision-making entity does not even know

⁵³ See e.g. Lobo Leasing (2021): Financing the eVTOL revolution, part 1: Business models and useful life. In: EVTOL. <https://evtol.com/opinions/evtol-financing-part-1-business-models-useful-life/>, 09.08.2021.

⁵⁴ In rational decision-making, (subjective) probabilities of occurrence are assigned to each of these events and used to calculate the optimal solution to the given decision problem.

that they exist, can – unexpectedly – step into existence. For instance, it came as a surprise to UAM experts, that in Canberra, ravens felt annoyed by drones in the nesting season and started to attack them in flight.⁵⁵

4.4.3 The aspect of rational decision-making in SUMP

Applying the SUMP-concept provides a planning entity not only with a coherent and well-structured planning framework but is also an exercise in rational decision-making.⁵⁶ In this approach, decision problems are usually differentiated into three basic components⁵⁷:

1. The objectives a decision-making entity wants to achieve
2. The set of alternatives relevant to the decision problem in hand from which the decision-making entity, given its objectives, chooses the optimal, i.e. the utility-maximising alternative
3. Uncertainties that emanate from the environment and interfere with the process of goal achievement

Objectives

Indeed, the issue of goal formation, of setting-up of the system of objectives which a decision-making entity in mobility issues pursue, features prominently in the early stages of the SUMP-cycle. The reason is that without a well-defined set of objectives, rational decision-making as well as goal-oriented conduct are virtually impossible. As a decision maker, do not shy away from addressing the high-level, long-term strategic objectives your region or city wants to achieve, as they provide guidelines for goal formation in more specific fields like (urban air) mobility and the choice of the associated measures.

The SUMP concept asks for a collective effort in goal formation, for a public and transparent discourse between all relevant stakeholders about the (most fundamental) objectives, society wants to achieve with urban mobility planning (and UAM, in particular). Reaching a consensus on these objectives is by no means an easy feat, as many different, if not opposing individual attitudes and preferences towards urban (air) mobility need to be reconciled. This however is a prerequisite for the successful implementation of UAM infrastructures; acting against the will of larger parts of society will almost certainly be crowned with failure.

Alternatives

The set of alternatives a decision-making entity has at its disposal is shaped by the given set of restrictions (e.g., budget restrictions, legal rules and regulations, laws of physics, the topology of the city area, etc). The set of alternatives under consideration in a mobility context are, roughly speaking, the different mobility mixes that are available to a mobility planning entity. There, UAM may cover the entire spectrum from “no UAM at all” to “full-scale implementation”.

Uncertainties

The uncertainties that interfere with human decision-making in general and UAM in particular have already been addressed above.

The final step: “Synthesising” an optimal decision from the given information

Finally, the information contained in the components of a decision problem (objectives, alternatives and uncertainties) are re-integrated or “synthesised” and “condensed” into utility functions, which allow for the calculation of the optimal choice. This is what Stage 2 of the SUMP cycle is eventually dealing with, whereas steps 3 and 4 deal with the operationalisation and implementation of the optimal decision.



⁵⁵ Christian, K. & Allen, C. (2021): ‘Territorial’ ravens disrupt surge in Wing drone deliveries under Canberra’s lockdown. In: ABC News, <https://www.abc.net.au/news/2021-09-22/territorial-ravens-disrupt-canberra-drone-deliveries/100480470>, 22.09.2021.

⁵⁶ For an introduction to rational decision-making see e.g. Eisenführ, F./Weber, M./Langer, T. (2010): Rational Decision Making. Springer, Berlin et al.; and Keeney, R.L. (1996): Value Focused Thinking. Harvard University Press, Cambridge et al.

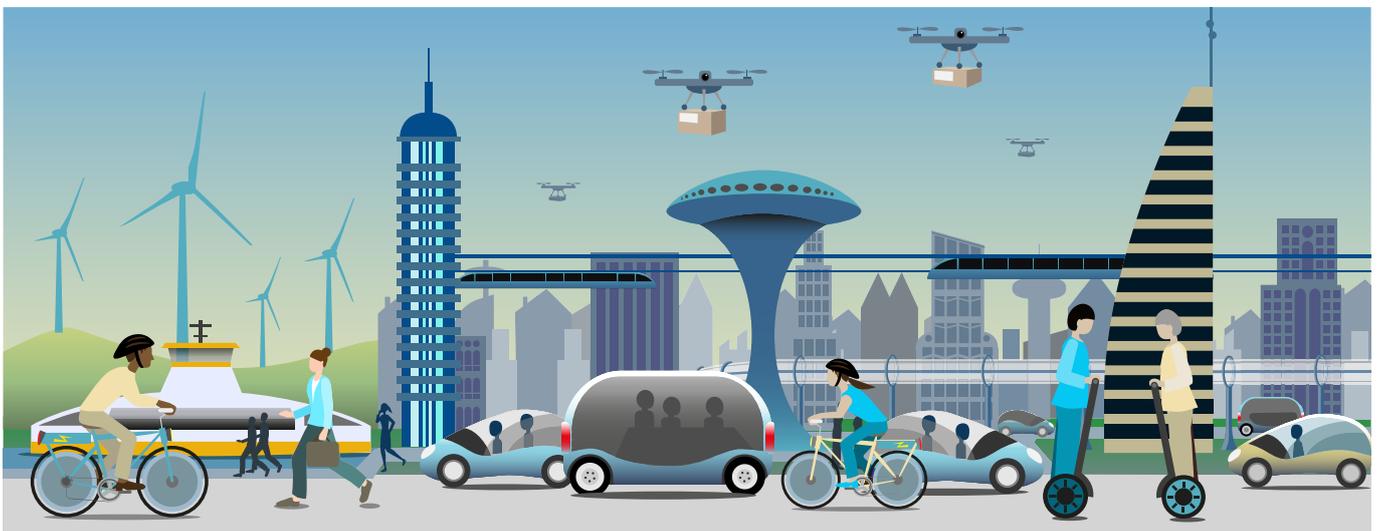
⁵⁷ Eisenführ et al. 2010, 36.

5. Conclusions and recommendations for action

This Practitioner Briefing has introduced UAM in the context of the SUMP process. The opportunities, challenges, and limitations of integrating UAM as a complementary mode of transport have been described and discussed. Consequently, a debate is developing between UAM proponents, who believe that UAM will play significant role in cities and regions, and UAM sceptics believing the opposite. There is an imperative to address the knowledge asymmetry in the emerging UAM ecosystem; namely, between UAM technology experts coming mainly from the aviation and digitalisation sectors and mobility, urban planning and local authorities' staff. Both groups have a lot to learn from one another – eventually they will be able to jointly find the common ground to address integrated mobility issues relevant for their city.

UAM might be closer than many mobility planners and local authorities' administration might have thought. First, the rapid progress of UAM-related technologies (e.g., drones, eVTOLs and UTM systems) as well as the definition and approval of relevant regulatory frameworks set a legitimate foundation for the introduction of UAM services by third parties in a city or region; in some cases, being even unnoticed by the local authorities. Second, UAM offers flexibility on the development and investment on required infrastructure for operations. In fact, UAM is less demanding on space requirements and other geographic restrictions when compared with ground transport space requirements. As the entry cost of UAM services is not heavily dependent on ground physical infrastructure investments, when compared

with other modes, UAM has the potential to alleviate the restrictions that exist on the ground infrastructure development. This in turn, if not managed early on, may interfere, or not be aligned with the ongoing mobility and urban plans of local authorities. To avoid such developments and to preserve the integrity of the own mobility planning and network management approach, sufficient knowledge in the field of UAM is indispensable for mobility planning entities and local authorities. In addition, mobility planners and aviation authorities should be aware that UAM may transform the typical FUA for land-based transport, as discussed in Section 1.4. Consequently, this situation influences the diversity of sectoral stakeholders that should be involved in the case of a 'SUMP-UAM' process cycle. This further exacerbates the issues and challenges that cities and regions face with the distribution of responsibilities during planning and deployment of transport systems. Therefore, the land transport SUMP local ecosystem and the UAM stakeholders should not only be aware of this challenge but also prevent any prospective discrepancies during planning and deployment through early engagement of all necessary stakeholders. A multi-stakeholder and multi-level governance approach is, therefore, an imperative. To this end, the SUMP step of engaging a wide range of stakeholders (e.g., see sub-steps in Phases 1 and 2 of the SUMP cycle in Figures 13 and 14) and the U-space coordination mechanism guidance material of Article 18(f) [(EU) 2021/664] could jointly and synergistically support a collective approach to mitigating any planning and deployment risks at FUA level.



Urban mobility planning is indeed a multi-dimensional, multi-faceted issue that is becoming increasingly challenging, especially in a “VUCA-World”, i.e., a place where Volatility, Uncertainty, Complexity and Ambiguity are steadily increasing in virtually every sphere of life. Given the high degree of uncertainty pertaining to the future of UAM, a “wait and see”-approach by a city or region on how the UAM-frontrunner cities and regions perform can therefore be both perfectly legitimate and rational as long as it is accompanied by a regular follow up of the sector, and where applicable, a systematic preparation in acquiring and developing pertinent UAM skills and competences. To this end, local authorities and policy makers shall be equipped to dynamically assess current and future performance of UAM services. For example, UAM is not, as yet, a mature new mode of transportation to be considered in existing or short-term modal split analysis, as shown by early research⁵⁸.

As discussed in Chapter 3, monitoring and evaluation criteria as well as performance indicators, informed by the SUMI framework, might be in place on a project level, but not necessarily, at present, on the higher level of a SUMP, as these activities are still relatively far away from phase three (and four) of the SUMP cycle. Monitoring and evaluation of UAM in the context of SUMI framework could be influenced in a considerable degree by the criteria and the rich body of (key) performance safety indicators established in manned aviation and recent or forthcoming, U-space and UAM regulatory frameworks. In fact, the SUMI framework is expected to be updated to capture aviation-driven UAM-metrics. In this context, it should be highlighted the importance of not only ensuring high levels of safety and security but also ensuring the establishment of an easily accessible and highly operational UAM ecosystem. The iterative nature of the SUMP cycle can facilitate this process by drawing a distinction between high-level indicators from the SUMI framework that should be treated as ‘fixed’, and lower-level indicators which could be developed to address UAM-related activities. The development of standards for the monitoring, evaluation criteria and performance indicators would substantially accelerate and streamline the process as it would eliminate the need to develop these steps from the beginning each time while allowing for a comparison of different approach to the implementation and operation of UAM services.

This Practitioner Briefing has highlighted the importance of citizen- and stakeholder-involvement at virtually every planning and implementation stage of urban mobility and, in particular, UAM. Public involvement and public

acceptance have become key issues in UAM-related projects, as it has become obvious to the UAM community that without sufficient public involvement and acceptance, even the best and socially most beneficial UAM-plan will almost certainly fail. Considering the aforementioned issues, the UAM community may draw parallels and lessons learnt from the European Partnership on Connected, Cooperative and Automated Mobility (CCAM), established in 2021; CCAM, is addressing similar issues in mobility and urban planning.

The particular challenge, with regard to public engagement and acceptance in the case of UAM, is that the enabling technologies and their prospective applications are not, as yet, experienced by citizens and stakeholders in real situations –*e.g., what does it mean to have a number of drones or eVTOLs flying over a certain area for a long period of time?*– but rather through either controlled, technology demonstrations or simulated environments. Subsequently, first, neither citizens and stakeholders can form a well-informed opinion (e.g., on acceptance or not), nor effectively and meaningfully participate in co-creation activities about a prospective state of the world where UAM services and traffic take place on a large scale in urban environments. To cope with this situation short- and long-term actions should be put in place by policy makers at all levels of governance:

- **Short-term:** Initiate and coordinate public discourse in which the potential benefits and challenges of UAM are discussed in an unbiased and open manner transparent fashion.
- **Short-term:** Co-create with different stakeholder groups in different forms (e.g., advanced simulations and augmented reality experiences) with a focus on use cases that serve the public good.
- **Mid-term:** Provide the public with first-hand experiences of drones, air taxis and their characteristics (e.g., the noise they create, their size, flight behaviour etc) as early as possible. This should

⁵⁸ See e.g. Balac, M.; Vetrella, A. R.; Rothfeld, R. & Schmid, B. (2018): Demand estimation for aerial vehicles in urban settings. In: IEEE Intelligent Transportation Systems Magazine, 105-116; and, Ploetner, K. O., Al Haddad, C., Antoniou, C., Frank, F., Fu, M., Kabel, S., Zhang, Q. (2020). Long-term application potential of urban air mobility complementing public transport: an upper Bavaria example. CEAS Aeronautical Journal, 11(4), 991-1007; and Pukhova, A.; Llorca, C.; Moreno, A.; Staves, C.; Zhang, Q. & Moeckel, R. (2021): Flying taxis revived: Can Urban air mobility reduce road congestion? In: Journal of Urban Mobility 1, 1-8.

be expanded from ‘technology demonstration sandboxes’ to ‘UAM services pilots in living labs’ in the context of UAM feasibility planning an implementation.

- **Mid- to long-term:** Trigger and maintain continuous cooperation and alignment among the different authorities (across sectors and layers of governance) to frame how UAM will be integrated in mobility and urban planning, and how it fits harmoniously into the existing urban environment.

European cities and regions, which opt for a more proactive, innovative approach to UAM are cordially invited to join fellow cities and regions of the UIC2 (UAM Initiative Cities Community). UIC2 fosters collaboration across disciplines and sectors pertinent to UAM with the aim to jointly shape the future of UAM. For example, collaboration with city and mobility institutions such as the Polis Network, EIT Urban Mobility, Ertico / ITS Europe, and UITP to name a few. Another example being EU’s U-space Network of Stakeholders that brings the latest development in terms of regulatory, e.g., EASA’s regulatory frameworks, and technological advances and lessons learnt from the U-space, drones and eVTOLs domains, e.g., SESAR JU’s, EU’s H2020 UAM projects and Eurocontrol’s support and know-how.

One of the essential messages the authors intend to convey with this Practitioner Briefing is that the cities

and regions are best placed to define the fundamental characteristics of the UAM services to meet their citizens’ needs. Article 18(f) of the (EU) 2021/664 enables local authorities and entities to actively participate and coordinate their activities with the U-space competent authorities designated by Members States. In addition, local authorities can, not only have an influential, or even deciding, role in the development of UAM infrastructure (physical and digital assets for UAM), but also in the co-shaping of UAM-related policy, regulatory and legislative issues; both at the national and European levels⁵⁹. For example, ongoing policy work led by the European Commission deals with the EU’s Smart Mobility Strategy as well as the Drones Strategy 2.0.

As a last thought, one could express the utility of this Practitioner Briefing on SUMP-UAM in the following metaphorical manner from a city/region perspective:

Every city has a “mobility party”, SUMP-UAM is helping you to establish the dress code for this party. When we (city/region) invite UAM to this party, we kindly ask the UAM ecosystem to respect the dress code and the SUMP principles.

⁵⁹The UIC2 Manifesto on the Multilevel Governance of the Urban Sky, presented during the Amsterdam Drone Week in December 2020 is such an example. <https://www.amsterdamdroneweek.com/manifesto/>



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Annex: UAM-related projects repository

This repository is a comprehensive list (we believe a complete list) of all EU-funded, multinational projects, activities and initiatives since 2016 contributing to the development of Urban Air Mobility in diverse areas. It is divided in the thematic sections according to the following domains:

- Sustainable urban (mobility) planning, social aspects and policy making. Projects and activities covering the city perspective in terms of UAM deployment and integration within urban transport system.
- UTM/ATM, ICT and digitalisation. Activities aiming at development of U-space assuring efficient and safe operations over urban areas, integrated with manned aviation.
- UAM dedicated technologies. Projects and solutions for future UAM applications covering both airframe, propulsion, as well as ground infrastructure.

Projects are presented in chronological order.

Project: [Acronym, title, call number/ title, funding scheme]	Status: ongoing/ ended -year	Objectives & key results (if available)	Cities involved (if any)	Source for further reading
Sustainable urban (mobility) planning, social aspects and policy making and regulations				
EU-DRONES The European Commission in Drone Community: a New Cooperation Area in the Making, H2020-MSCA-IF-2016, MSCA-IF-EF-ST - Standard EF	Ended, 2019	The objective of this research was to examine how the European Commission is shaping regulatory framework development, production and use of drones considering the diverging interests among actors concerned in Europe (and beyond) where multiple authorities overlap. A comprehensive analysis of drone operations as a whole, including actors' perceptions, expectations, interests and practices is still lacking. This research was therefore devoted to study the European Commission's strategy to join and shape the drone community (rule makers, interest groups, manufacturers, operators and users) as well as the impact of its action. Referring to the Commission's policy entrepreneurship literature, it is interested in how the Commission, by building on its competencies and resources, has exercised its leadership capacity to initiate action in a new domain that may not fall de facto under its prerogatives and thus has an effect on a strategic industry.	No cities involved	https://cordis.europa.eu/project/id/747947

ANNEX: UAM-RELATED PROJECTS REPOSITORY

<p>Sharing Cities Sharing Cities, H2020-SCC-2015, IA</p>	<p>Ongoing 01/01/2016 31/12/2021</p>	<p>The Sharing Cities 'lighthouse' programme is a proving ground for a better, common approach to making smart cities a reality. By fostering international collaboration between industry and cities, the project seeks to develop affordable, integrated, commercial-scale smart city solutions with a high market potential. The project partners work in close cooperation with the European Innovation Partnership on Smart Cities and Communities and with other 'lighthouse' consortia. Sharing Cities offers a framework for citizen engagement and collaboration at local level, thereby strengthening trust between cities and citizens. The project developed new approaches and tools to improve the public's understanding of how smart cities should operate. Promote the citizens' active participation.</p>	<p>Lisbon, London, Milan, Bordeaux, Burgas, Warsaw</p>	<p>https://www.sharingcities.eu https://cordis.europa.eu/project/id/691895</p>
<p>MATCHUP MAXimizing the UPscaling and replication potential of high level urban transformation strategies, SCC-1-2016-2017 - Smart Cities and Communities lighthouse projects, IA</p>	<p>Ongoing 01/10/2017 30/09/2022</p>	<p>MATCHUP project aims at strengthening the planning processes for urban transformation, consolidating the benefits of deploying large scale demonstration projects of innovative technologies in the energy, mobility and ICT sectors, by means of substantially improved models for replication and upscaling, based on impacts evaluation, and ensuring the bankability of the solutions by means of innovative business models, which lead to achieve real deployment further than the pilots carried out in the lighthouse cities. The expected results will be achieved working in parallel in demonstration and upscaling/replication levels, so the lighthouse cities (Valencia-Spain, Dresden-Germany and Antalya-Turkey) and followers (Ostend-Belgium, Herzliya-Israel, Skopje-FYROM and Kerava-Finland) will assume a huge commitment in this project. in order to:</p> <ul style="list-style-type: none"> - deploy innovative solutions in the energy, mobility and ICT sectors with a strong monitoring program to validate all of them, - develop very rigorous upscaling and replication plans that will be the basis to update at least the SEAPs/ SECAPs, that are the major standard commitment at European level that a city can assume in terms of city transformation, and other existing city plans as Sustainable Mobility Plans or Digital Agendas. 	<p>Valencia, Dresden, Antalya, Ostend, Herzliya, Skopje, Kerava</p>	<p>https://cordis.europa.eu/project/id/774477</p>
<p>AW-DRONES Contributing to a well-reasoned set of Airworthiness Standards for mass-market drones, MG-2-3-2018 - Airworthiness of mass-market drones, H2020-MG-2018-SingleStage-INEA, CSA</p>	<p>Ongoing 01/01/2019 31/12/2021</p>	<p>The AW-Drones Coordination and Support Action intends to contribute to the safe use of mass market drones by facilitating the on-going EU regulatory process for the definition of rules, technical standards and procedures. The Action will benefit from the contribution of the most relevant stakeholders in the drone value-chain including drone suppliers, operators, academia and regulators. These actors will support, from their respective point of view, the collection of data, information and perspectives regarding the use of drones worldwide and contribute to its analysis supporting EASA's regulatory due process.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/824292</p>

<p>HARMONY Holistic approach to improved, sustainable transport LC-MG-1-2-2018 - Sustainable multi-modal inter-urban transport, regional mobility and spatial planning, RIA</p>	<p>Ongoing 01/07/2019 30/11/2022</p>	<p>The EU-funded HARMONY project aims to develop a new generation of harmonised spatial and multimodal transport planning tools that will enable metropolitan authorities to lead the transition to a low carbon new mobility era in a sustainable manner. The HARMONY model provides an integrated approach necessary for authorities which quantifies the multidimensional impact of various concepts, soft and hard policies on citizens' quality of life, sustainability, economic growth, while identifying the most appropriate solutions and recommending ways to exploit advances in mobility concepts. The model suite is already linked to six EU metropolitan areas assisting research: Rotterdam, Oxfordshire, Turin, Athens, Trikala and Upper Silesian-Zaglebie Metropolis.</p>	<p>Rotterdam, Oxfordshire, Turin, Athens, Trikala and GZM</p>	<p>https://cordis.europa.eu/project/id/815269</p>
<p>AURORA Safe Urban Air Mobility for European citizens, H2020-MG-2020-SingleStage-INEA, MG-3-6-2020 - Towards sustainable urban air mobility, RIA</p>	<p>Ongoing 01/12/2020 30/11/2023</p>	<p>AURORA focuses on emergency-related applications, such as medical emergency services and/or critical mobility infrastructure-related services, where urban air mobility can extend and complement current mobility systems. AURORA focuses on facilitating the integration of urban air mobility in a safe, secure, quiet and green manner. AURORA will focus on the development of intelligent and fail-safe guidance-navigation-control features of unmanned aerial system and augmented manned platform operating in urban environment. This includes, among others, an autonomous and continuous selection of emergency landing sites and automated landing in case of fatal malfunctioning of the unmanned aerial vehicle itself. The use-cases include decision making support to emergency services and insertion and extraction of life support items or victims/first responders at location of incident.</p>	<p>No cities involved</p>	<p>https://aurora-uam.eu https://cordis.europa.eu/project/id/101007134</p>
<p>ENTRANCE European matchmaking platform for innovative transport and mobility tools and services, H2020-MG-2020-SingleStage-INEA, CSA</p>	<p>Ongoing 01/01/2021 31/12/2021</p>	<p>The project will identify innovative zero-emission transport solutions and promote their registration on the ENTRANCE platform where they can be matched with potential buyers and financing opportunities. Knowledge on good practices on the deployment of innovative solutions, European and national tenders and legislation, will be exchanged through the online platform. Training and brokerage activities will take place and ENTRANCE will facilitate purchase aggregation by setting up a neutral trustee for the orchestration of collaborations. Access to finance will be supported through individual and personalised innovation finance advice and support.</p>	<p>No cities involved</p>	<p>https://www.entrance-platform.eu https://cordis.europa.eu/project/id/101006681</p>

ANNEX: UAM-RELATED PROJECTS REPOSITORY

<p>ASSURED-UAM Acceptance, Safety and Sustainability Recommendations for Efficient Deployment of UAM Call LC-MG-1-12-2020 "Cities as climate-resilient, connected multimodal nodes for smart and clean mobility: new approaches towards demonstrating and testing innovative solutions", CSA</p>	<p>Ongoing 01/01/2021 30/04/2023</p>	<p>Main objective of the project is providing cities with knowledge concerning deployment of UAM services and definition of necessary standards and recommendations assuring common acceptance, safety and sustainability within integrated metropolitan transport system. Divided in to four main parts/blocks corresponding to three-time horizons: 1. Knowledge Block –where the technology, regulatory and integration aspects are addressed. It is finalised with definition of set of the most promising UAM use cases to be deployed in urban environment; 2. Foresights covering the possible operational constraints, cost of system deployment as well as financing and acceptance issues in given three perspectives and 3. Standards and recommendation definition with regard to main components of UAM, from the cities point of view. 4. Cities project support where three cities involved in the project develop their own independent UAM initiatives in cooperation with ASSURED-UAM. Conclusions from all four block will be included in Guidelines.</p>	<p>GZM, Bari, Porto</p>	<p>https://assured-uam.eu/ https://cordis.europa.eu/project/id/101006696</p>
<p>RECIPROCITY Replication of innovative concepts for peri-urban, rural or inner-city mobility, H2020-MG-2020-SingleStage-INEA, CSA</p>	<p>Ongoing 01/02/2021 30/09/2023</p>	<p>The EU-funded RECIPROCITY project will initiate innovative mobility solutions in at least 20 European cities and municipalities to tackle the challenges of urbanisation, climate change and digitalisation - megatrends that make a rethink of mobility inevitable. Areas that differ in size, location, degree of urbanisation and mobility needs will be equipped with tools, knowledge and contacts to accelerate the development process of innovative mobility solutions. Workshops, webinars and matchmaking events will help form new partnerships and local exchange to strengthen networking and knowledge sharing. Successful examples are then to be replicated in other partner regions to make innovative mobility solutions quickly and easily accessible to a larger circle of cities and municipalities.</p>	<p>City network available here: https://reciprocity-project.eu/our-city-network/</p>	<p>https://reciprocity-project.eu https://cordis.europa.eu/project/id/101006576</p>

Project: [Acronym, title, call number/ title, funding scheme]	Status: ongoing/ ended -year	Objectives & key results (if available)	Cities involved (if any)	Source for further reading
UTM/ATM, ICT, digitalisation, safety and security				
CLASS CLear Air Situation for uaS: Maturing ground-based technologies for a real-time Unmanned Aerial System Traffic Management System (UTMS) to monitor and separate Unmanned Aerial System (UAS) traffic, H2020-SESAR-2016-1, SESAR-RIA	Ended, 2019	CLASS aimed to bring the main technologies required for surveillance of Unmanned Aerial Systems (UAS) Traffic at a better level of maturity, allowing developing a pre-operational prototype of a UAS Traffic Management System (UTMS). CLASS aimed to compose existing technologies to build the core functions of a UTMS: real-time tracking and display, aggregation of relevant aeronautical data, provide adjusted services to each stakeholder (operators, ANSP, Authorities), advanced functions such as geo-fencing, geo-caging, conflict detection and resolution. CLASS followed mainly a bottom-up approach starting from technologies up to defining a system meeting users' operational needs for UAS Traffic Management.	No cities involved	https://cordis.europa.eu/project/id/763719
CORUS Concept of Operations for EuRopean UTM Systems, H2020-SESAR-2016-1, SESAR-RIA	Ended, 2019	The CORUS project gathered experts from aviation (manned and drone), research and academia to develop a reference Concept of Operations (CONOPS) for UTM (UAS Traffic Management) in VLL airspace in Europe. Building on the state-of-the-art, CORUS was to develop an operational concept enabling safe interaction between all airspace users in VLL considering contingencies and societal issues. Specifically, CORUS was to aim: 1. Establish a CONOPS for nominal situations, developing use cases for major scenarios. 2. Address drone operations in the vicinity of airfields and controlled airspace and for transfer between controlled and non-controlled airspaces. 3. Describe how losses of safety in non-nominal drone situations can be minimized. 4. Examine non-aviation aspects, identifying key issues for society and offering solutions to ease social acceptance. 5. Identify necessary technical developments, quantifying the level of safety and performance required	No cities involved	https://cordis.europa.eu/project/id/763551

ANNEX: UAM-RELATED PROJECTS REPOSITORY

<p>DREAMS DRone European AIM Study, H2020-SESAR-2016-1, SESAR-RIA</p>	<p>Ended, 2019</p>	<p>The DREAMS project aimed at contributing to the definition of the European UTM Aeronautical Information Management operational concept by exploring need for and feasibility of new processes, services and solutions for the drone aeronautical information management within the new UTM concept. The UTM is seen as the key enabling concept for safe integration of drones within VLL airspace, tailored on the needs of UAS operations. The study put together the knowledge of mission needs and operational requirements of drones commercial operators that want to make their operations safer and cost effective (BVLOS) with the knowledge of operating modes and procedures currently adopted by airlines and aircrew, general aviation associations and pilots, leisure/sport aeronautical activity associations and pilots, accessed information services, required data quality, resolution, temporality and services costs.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/763671</p>
<p>DroC2om Drone Critical Communications, H2020-SESAR-2016-1, SESAR-RIA</p>	<p>Ended, 2019</p>	<p>The key objective of the DroC2om project was to contribute to the definition of integrated cellular-satellite data link specifications for UASs. Major focus was on the design and evaluation of data links based on experimental radio investigations and system simulations. The primary goal is to design a cellular-satellite system architecture concept, which ensures reliable and safe operation for remote controlled, semi-autonomous and fully autonomous small UAS. The DroC2om project was aimed to design and evaluate an integrated cellular-satellite system architecture concept for data links in order to support reliable and safe operation of UAS based on real drone measurements and modelling. The diversity of the project partners ensures a balanced and high-quality expertise in all relevant technological areas.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/763601</p>
<p>PODIUM Proving Operations of Drones with Initial UTM Management, SESAR-VLD1-10-2016 - Safe integration of drones, SESAR-IA</p>	<p>Ended, 2019</p>	<p>The PODIUM project comprised four complementary, large-scale demonstrations, taking place in Denmark, France and the Netherlands where more than 185 drone flights will be conducted. Its partners' quick wins integrated UTM solution was demonstrated in a broad range of realistic operational conditions of drone operations (VLOS and BVLOS) in VLL airspace (controlled & uncontrolled airspace; urban, rural and in the vicinity of airports) interacting with manned traffic. Each of its four sites has its own specificities (e.g. routine day to day operations, emphasis on UTM/ATM communication, normal/abnormal conditions). The demonstrations enabled its safe and secure use by various categories of users (e.g. authorities, drone operations, drone pilots) and for many types of drone operations (e.g. electricity line inspection, emergency services). Together the four sites demonstrations ensure a comprehensive and extensive demonstration of the full potential and technology readiness level of the PODIUM UTM functionalities (from before-flight to post-flight with a special focus on in-flight dynamic geo-fencing). PODIUM is a U-space compliant demonstration.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/783230</p>

<p>SECOPS An Integrated Security Concept for Drone Operations, H2020-SESAR-2016-1, SESAR-RIA</p>	<p>Ended, 2019</p>	<p>ECOPS' objective was to push drone technology forward by ensuring that security risks in the Unmanned Traffic Management (UTM) concept are mitigated to an acceptable level. An integrated security concept at TRL2 was aimed to be developed addressing resistance of drones against unlawful interference, protection of third parties and integration of geo-fencing technology; focussing on technological options (navigation, surveillance, in-flight updates, etc.) for both airborne and ground elements, considering legal, regulatory and social aspects. SECOPS aimed include a proof of concept of the integrated security concept, integrating COTS technology of the consortium partners. A preliminary demonstrator, based on a realistic scenario, will be performed at the Netherlands RPAS Test Centre (NRTC).</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/763599</p>
<p>SKYOPENER establishing new foundations for the use of Remotely-Piloted Aircraft Systems for civilian applications, GALILEO-1-2015 - EGNSS applications, IA</p>	<p>Ended, 2019</p>	<p>SKYOPENER was to increase the use of Remotely Piloted Aircraft Systems (RPAS) for civilian applications by contributing to the European RPAS Steering Group's roadmap for the integration of civil RPAS into the European Aviation System. SKYOPENER was to provide a whole operational process and a system that will demonstrate higher capability through Communication, Navigation and Surveillance innovations in RPAS. The SKYOPENER system was designed, in the first instance, for specific operations for tactical RPAS, that are under 25kilos but subject to national aviation authority regulation, operating at Very Low Level of operation (under 500ft). SKYOPENER included live trials in Switzerland for which stakeholders were gathered implicated in the operations of RPAS including RPAS operators, civil aviation authorities, air navigation service providers, RPAS manufacturers, satcom service providers etc.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/687352</p>
<p>TERRA Technological European Research for RPAS in ATM, H2020-SESAR-2016-1, SESAR-RIA</p>	<p>Ended, 2019</p>	<p>TERRA proposed a technical architecture to support VLL RPAS operations, which are assumed to encompass interaction with VFR traffic. The main project objectives were the following:</p> <ul style="list-style-type: none"> • Requirements identification: A set of operational and functional ground-based system requirements will be defined for three representative RPAS operational business cases, considering operator requirements but also potential impacts on stakeholders. • Technological applicability: Analysis of applicability of existing CNS/ATM technologies which could be applied to UTM, identification and development of new technologies (e.g. machine learning classification of flight trajectories) and analysis of their applicability, considering in both cases the performance provided by these technologies with the requirements imposed upon their use. • Architecture proposal and proof of concept: Identification of the most appropriate technologies, comparing their performance and applicability with the user requirements and definition of a technical architecture, which will be evaluated by means of a proof of concept demonstration. 	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/763831</p>

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<p>USIS U-Space Initial Services, H2020- SESAR-2016-2, SESAR-IA</p>	<p>Ended, 2019</p>	<p>U-Space Initial Services project aimed to demonstrate the technical and operational feasibility of providing in a very short time frame U-Space services to UAV/ RPAS operators and to authorities focusing on: UAV/ RPAS/Pilot/Operator Registration Service, Flight Wish/Mission Notification & Authorization Service, U-Space NOTAM Service (including dynamic NOTAM for VLL), UAV/RPAS Traffic Monitoring (including non-conformance vs regulation/authorized mission). The project combined the expertise of key stakeholders of the future U-Space (Civilian Aviation Authorities/Air National Service Provider, UAV/RPAS Operators, Industries and Law enforcement authorities) in order to ensure that the services demonstrated fit for purpose to their requirements, constraints and needs. By bringing 4 Nations together, the consortium puts a particular focus on demonstrating services that can be deployed at a EU level.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/783261</p>
<p>AIRPASS Advanced Integrated RPAS Avionics Safety Suite, H2020- SESAR-2016-1, SESAR-RIA</p>	<p>Ended, 2020</p>	<p>This proposal addressed the on-board technologies for drones that are required in order to implement the Unmanned Traffic Management (UTM) concept for drone operations at Very Low Level (VLL) and within the Visual Flight Rules (VFR) environment. The project covered Detect and Avoid (D&A) systems for cooperative and non-cooperative traffic, auto-pilot systems as well as Communication, Navigation and Surveillance (CNS) systems. This project identified the available CNS infrastructure and on-board technologies to formulate an implementation approach. Based on this an on-board system concept will be developed and evaluated.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/763658</p>
<p>IMPETUS Information Management Portal to Enable the integration of Unmanned Systems, H2020- SESAR-2016-1, SESAR-RIA</p>	<p>Ended, 2020</p>	<p>IMPETUS was to research on the application of the 'micro-services' paradigm as a flexible and cost-efficient solution for lifecycle support of the expected high variety of drones and missions. Moreover, IMPETUS was to explore how to design a Smart UTM Concept taking into consideration the 'Function as a Service' paradigm to develop a cloud-based server-less environment that was be characterized by its scalability to respond to multiple users with diverse business models, its mechanisms to assure the data quality and integrity, and its flexibility to facilitate the integration with manned traffic management systems.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/763807</p>
<p>MoNifly Mobile-Network Infrastructure for Cooperative Surveillance of low flying drones, MG-1-4-2016-2017 – Breakthrough innovation, RIA</p>	<p>Ended, 2020</p>	<p>The MoNifly project targeted the open and specific categories by proposing a drone traffic management system based on mobile network infrastructure. The EU-funded MoNifly project has developed and demonstrated a drone traffic management system based on existing mobile network infrastructure. The team hopes that it will one day be deployed across Europe's cities and elsewhere in the world.</p>	<p>No cities involved</p>	<p>http://www.monifly.eu/ https://cordis.europa.eu/project/id/723509</p>

<p>PercEvite Sense and avoid technology for small drones, H2020-SESAR-2016-1, SESAR-RIA</p>	<p>Ended, 2020</p>	<p>The project was to develop a sensor, communication, and processing suite for small drones for autonomously detecting and avoiding “ground-based” obstacles and flying objects. To avoid ground-based obstacles, project aimed for a lightweight, energy-efficient sensor and processing package that maximizes payload capacity. Self-supervised learning will allow for a breakthrough in perception range. This enabled effective fusion of stereo vision, motion, appearance, ranging and audio information. Our learning process will allow obstacle detection as far as the camera ‘sees’, rather than the current ± 30 m. For close distances, our solution does without energy expensive active sensors such as lasers or sonar. For collaborative avoidance between drones and other air vehicles, we achieved an interoperable solution by combining multiple communication hardware types (ADSB, 4/5G, WiFi) to exchange information on position, speed, and future waypoints. This enabled drones to successfully avoid other flying vehicles even in a very densely used air space. The probability for a collision in a collaborative scenario is to be in the order of 10⁻⁹.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/763702</p>
<p>SAFEDRONE Activities on drone integration and demonstration in VLL operations, SESAR-VLD1-10-2016 – Safe integration of drones, SESAR-IA</p>	<p>Ended, 2020</p>	<p>The scope of the SAFEDRONE project was to acquire practical experience in Very Low Level (VLL) operations where general aviation, state aviation and optionally piloted aircrafts and drones will share the airspace. It is important to highlight that this project had a clear practical focus which primary activities as innovation, integration, and especially, demonstrating activities with flight tests. The specific objectives of SAFEDRONE are the following: 1. Demonstrate how to integrate general aviation, state aviation, optionally piloted aircrafts and drones into non-segregated airspace in a multi-aircraft and manned flight environment, in order to explore the feasibility of U-Space vision by 2019. 2. Perform a large number of demonstrations, 3. Validate proof of concept implementations, 4. Provide evidence to EASA and National Aviation Authorities to reinforce the safe integration of drones under U-Space 5. Coordination with the recently approved SESAR-RPAS projects. 6. Increase the awareness of the advances in U-Space within Europe.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/783211</p>
<p>VUTURA Validation of U-space by tests in urban and rural areas, H2020 SESAR-VLD</p>	<p>Ended, 2020</p>	<p>VUTURA aimed to demonstrate U-space in the Netherlands in three demonstrations at NTRC (Netherlands RPAS Test Centre), Delft and Enschede. Its main goal was to show interoperability between U-space Service Providers (USP) and to demonstrate emergency and priority flights in the context of U-space.</p>	<p>Rotterdam, Enschede</p>	<p>https://www.sesarju.eu/projects/vutura</p>

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<p>STEP2DYNA Spatial-temporal information processing for collision detection in dynamic environments, H2020-MSCA-RISE-2015, MSCA-RISE - Marie Skłodowska-Curie Research and Innovation Staff Exchange (RISE)</p>	<p>Ongoing 01/07/2016 31/12/2021</p>	<p>STEP2DYNA consortium proposes an innovative bio-inspired solution for collision detection in dynamic environments. It takes the advantages of low cost spatial-temporal and parallel computing capacity of visual neural systems and realized it in chip specifically for collision detection in dynamic environments.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/691154</p>
<p>GAUSS Galileo-EGNOS as an Asset for UTM Safety and Security, H2020-GALILEO-GSA-2017-1, IA</p>	<p>Ongoing 01/03/2018 31/12/2021</p>	<p>The GAUSS project aims fast and thorough achievement of acceptable levels in terms of performance, safety and security for both, current RPAS and future UTM operations. UTM helps control, manage and integrate all RPAS in the VLL airspace to ensure the security and efficiency of UAS operations. The key element within GAUSS is the integration and exploitation of Galileo-EGNOS exceptional features for precise and secure positioning. GAUSS will increase resilience in UTM operations and, at the same time, ensure UTM coordination capabilities to increase the number of platforms that can share the same airspace. The GAUSS systems will be validated with two field trials (in-land and sea) with the operation of 4 UTM coordinated RPAS with different types (fixed and rotary wing) and EASA operational categories. The outcome of the project will consist of Galileo-EGNOS based technological solutions to enhance safety and security levels in current RPAS operations and future UTM based operations.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/776293</p>
<p>5G!DRONES Unmanned Aerial Vehicle Vertical Applications' Trials Leveraging Advanced 5G Facilities, H2020-ICT-2018-3, RIA</p>	<p>Ongoing 01/06/2019 30/11/2022</p>	<p>5G!Drones aim is to trial several UAV use-cases covering eMBB, URLLC, and mMTC 5G services, and to validate 5G KPIs for supporting such challenging use-cases. The project will drive the UAV verticals and 5G networks to a win-win position, on one hand by showing that 5G is able to guarantee UAV vertical KPIs, and on the other hand by demonstrating that 5G can support challenging use-cases that put pressure on network resources, such as low-latency and reliable communication, massive number of connections and high bandwidth requirements, simultaneously. 5G!Drones will build on top of the 5G facilities provided by the ICT-17 projects and a number of support sites, while identifying and developing the missing components to trial UAV use-cases.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/857031</p>

<p>COM4DRONES Framework of key enabling technologies for safe and autonomous drones' applications, ECSEL-2018-2-RIA - H2020-ECSEL-2018-2-RIA, ECSEL-RIA - ECSEL Research and Innovation Action</p>	<p>Ongoing 01/10/2019 30/09/2022</p>	<p>The COMP4DRONES project complements SESAR JU efforts with a particular focus on safe software and hardware drone architectures. COMP4DRONES will bear a holistically designed ecosystem ranging from application to electronic components, realized as a tightly integrated multi-vendor and compositional drone embedded architecture solution and a tool chain complementing the compositional architecture principles. The ecosystem aims at supporting (1) efficient customization and incremental assurance of drone embedded platforms, (2) safe autonomous decision-making concerning individual or cooperative missions, (3) trustworthy drone-to-drone and drone-to-ground communications even in presence of malicious attackers and under the intrinsic platform constraints, and (4) agile and cost-effective compositional design and assurance of drone modules and systems.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/826610</p>
<p>DELOREAN Drones and Egnss for Low irspace urbAN mobility, LC-SPACE-EGNSS-1-2019-2020 – EGNSS applications fostering green, safe and smart mobility, IA</p>	<p>Ongoing 01/12/2019 30/05/2022</p>	<p>The project DELOREAN is about urban air mobility (UAM) and how the European Global Navigation Satellite Systems (EGNSS), composed of EGNOS and Galileo, are its enablers by guaranteeing safe navigation to UAM aircraft. Specifically, the main goal of the DELOREAN project is to develop the navigation and positioning requirements for the challenging UAM services, and to demonstrate how EGNSS stands as an enabler of UAM. For this purpose a number of ancillary goals will be pursued and many actions implemented, being the central one the integration of a test environment – an urban lab – for the identification, by means of drone test flights, of EGNSS application specific requirements for UAM and UAD. The Spanish city of Benidorm will host the urban lab.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/870251</p>
<p>GEONAV IoT Galileo dual frequency, 5G, IoT devices and services for Drones, Assets Management and Elite sport, H2020-SPACE-EGNSS-2019, IA</p>	<p>Ongoing 01/12/2019 30/11/2021</p>	<p>The GEONAV IoT project aims at the development and delivery of precise ubiquitous positioning and navigation applications and services. The core activity of the project is to develop and industrialize the 2nd evolution phase of the GEONAV IoT solution, following NAVISP Element 2 outcomes (TRL7). GEONAV IoT is market driven with clear commercialization ambition. It aims to: Use Galileo features that improve performances: Dual Frequency for an improved real-time positioning and TTFF; Improve fusion with other positioning techniques thanks to innovative network fusion techniques with 5G; Optimise power consumption thanks to TTFF improvements and GEONAV IoT algorithms; Expand the range of market application with demonstration on 3 use cases: Elite sports (Rugby), Asset tracking and monitoring; Autonomous Drones based delivery system; Set-up a European Industrialisation chain.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/870249</p>

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<p>ADACORSA Airborne data collection on resilient system architectures, H2020-ECSEL-2019-2-RIA, ECSEL-RIA – ECSEL Research and Innovation Action</p>	<p>Ongoing 01/05/2020 30/04/2023</p>	<p>ADACORSA targets to strengthen the European drone industry and increase public and regulatory acceptance of BVLOS (beyond visual line-of-sight) drones, by demonstrating technologies for safe, reliable and secure drone operation in all situations and flight phases. The project will drive research and development of components and systems for sensing, telecommunication and data processing along the electronics value-chain. Additionally, drone lead smart industries with high visibility and place for improvement will be developed which will pave the way for a higher public / industry acceptance of the drone technologies.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/876019</p>
<p>BUBBLES Defining the Building Basic Blocks for a U-Space Separation Management Service, H2020-SESAR-2019-2, SESAR-RIA</p>	<p>Ongoing 01/05/2020 31/10/2022</p>	<p>BUBBLES is a project targeting the formulation and validation of a concept of a U-Space advanced (U3) 'separation management service' at TRL3. BUBBLES will develop algorithms to compute the collision risk of UAS (taking into account all the involved risk sources), allowing to define separation minima and methods (procedural, tactical self-separated or tactical ground-based) so that a safety level stated in terms of overall probability of collision can be defined and maintained. The project will apply these algorithms to a set of generic CONOPs for UAS Operations defined by BUBBLES. These CONOPs will be detailed enough to cover all envisaged applications, but generic enough not to be linked to any particular one. The generic CONOPs will be classified in terms of risk using the SORA methodology. Afterwards, separation minima and methods will be assigned to them, leading to the definition of a set of generic OSED from which safety and performance requirements for the CNS systems will be derived through a safety assessment and based on the Performance-based Navigation (PBN) and Performance-based Communication and Surveillance (PBCS) concepts, including performance monitoring.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/893206</p>
<p>ICARUS Integrated Common Altitude Reference System for U-SPACE, H2020-SESAR-2019-2, SESAR-RIA</p>	<p>Ongoing 01/05/2020 31/07/2022</p>	<p>ICARUS project proposes an innovative solution to the challenge of the Common Altitude Reference inside VLL airspaces with the definition of a new U-space service and its validation in a real operational environment. In manned aviation, the methods of determining the altitude of an aircraft are based on pressure altitude difference measurements (e.g. QFE, QNH and FL) referred to a common datum. The ICARUS defines a new U-space U3 service tightly coupled with the interface of the existing U-space services (e.g. Tracking, and Flight Planning services). The users of ICARUS service shall be remote pilots competent to fly in BVLOS in the specific category of UAS operations and ultralight GA pilots potentially sharing the same VLL airspace.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/894593</p>

<p>FACT Future All Aviation CNS Technology, SESAR-ER4-24-2019 – CNS, SESAR-RIA</p>	<p>Ongoing 01/06/2020 31/12/2022</p>	<p>The EU-funded FACT project aims to increase the safety, security, efficiency and solidity of future air traffic management (ATM) systems by updating CNS technology. It will support a common performance-based approach for CNS functions to meet the needs of a wide range of airspace users across diverse operations. Moreover, it will connect future fully digital and automated U-space services to conventional ATM systems, considering technological and user aspects. The project will focus on the innovative application of existing technology potentially adapted from related industrial areas such as the automotive and telecommunications sectors. The new methods will increase technical performance and reduce development costs.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/894616</p>
<p>LABYRINTH Traffic Management 4D Path Planning Technologies for Drone Swarm to Enhance Safety and Security in Transport, MG-2-8-2019 - Innovative applications of drones for ensuring safety in transport, RIA</p>	<p>Ongoing 01/06/2020 31/05/2023</p>	<p>The EU-funded LABYRINTH project will study centralised planification systems capable of communicating with drones operating in certain areas and compute paths to avoid collisions. The project will create a U-space-based technology to meet the needs of autonomous drone applications. This technology will be deployed in different civil scenarios such as roads, seaports, and airports. LABYRINTH has identified the need to research on centralized planification systems capable of communicating with the drones in a certain area, processing their desired origin and destination points and compute paths to avoid collisions. This is embodied in the Unmanned Traffic Management Systems (UTM) that, in contrast to EU strategy, are one of the NASA's main research priorities, whose objective is to create flight control centres for auto-piloted drones.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/861696</p>
<p>X-TEAM D2D – Extended ATM for Door-to-Door Travel, SESAR-ER4-10-2019 “ATM Role in Intermodal Transport”, SESAR-RIA</p>	<p>Ongoing 01/06/2020 30/09/2022</p>	<p>The project aims defining, developing and initially validating a Concept of Operations (ConOps) for the seamless integration of ATM and Air Transport into an overall intermodal network, including other available transportation means (surface, water), to enable the door-to-door connectivity, in up to 4 hours, between any location in Europe, in compliance with the target assigned by the ACARE SRIA FlightPath 2050 goals. The project is focused on the consideration of ConOps for ATM integration in intermodal transport network serving Urban and Extended Urban (up to Regional) mobility, taking into account the transportation and passengers service scenarios envisaged for the next decades, according to baseline (2025), intermediate (2035) and final (2050) time horizons. The target ConOps provided and initially validated by the X-TEAM D2D project will encompass both the transportation platforms integration concepts and the innovative seamless mobility as a service including ATM concepts.</p>	<p>No cities involved</p>	<p>https://xteamd2d.eu https://cordis.europa.eu/project/id/891061</p>

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<p>DACUS Demand and Capacity Optimisation in U-space, SESAR-ER4-31-2019 - U-space, SESAR-RIA</p>	<p>Ongoing 01/07/2020 31/12/2022</p>	<p>DACUS aims at the development of a service-oriented Demand and Capacity Balancing (DCB) process for drone traffic management. This overall objective responds to an operational and technical need in European drone operations for a tangible solution integrating the functionalities of the SESAR U-space services for Drone Traffic Management (DTM) to produce timely, efficient and safe decisions. The project intends to integrate in a consistent DCB solution the relevant demand and capacity influence factors (such as CNS performances availability), definitions (such as airspace structure), processes (such as separation management), and services (such as Strategic and Tactical Conflict Resolution).</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/891061</p>
<p>INVIRCAT Carving out a new path for remotely piloted aircraft SESAR-ER4-28-2019 – Control of IFR RPAS in the TMA, SESAR-RIA</p>	<p>Ongoing 01/07/2020 31/12/2022</p>	<p>This proposal addresses the topic “Control of RPAS in the TMA” of the H2020 call “SESAR-ER4-28-2019”. Its objective is to provide means for a safe and efficient integration of RPAS (Remotely Piloted Aircraft Systems) into the existing Air Traffic Control (ATC) procedures and infrastructures within Terminal Manoeuvring Areas (TMA) under Instrument Flight Rules (IFR). The main goals of the INVIRCAT project are the creation of a concept of operations for remotely piloted aircraft systems in the terminal manoeuvring area of airports, assessing it through simulations and draft a set of recommendations for rule makers and standardization bodies.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/893375</p>
<p>METROPOLIS 2 A Unified Approach to Airspace Design and separation management for U-Space, SESAR-ER4-31-2019 - U-space, SESAR-RIA</p>	<p>Ongoing 01/11/2020 31/12/2022</p>	<p>Metropolis 2 is a project that responds to SESAR-JU necessity of providing concrete solutions to enable air traffic in high-density urban environments. As the airspace research market is drifting towards U3/U4 services, the project consolidates the results from U1/U2 services and provides a realistic foundation for future Urban Air Mobility (UAM). It is one of the few projects that is working with U4 services. Metropolis 2 Specific Objectives: Extend the segmentation and alignment principles of geovectoring to an operational concept for airspace rules to enable high-capacity urban airspace; Develop a unified design approach to the management of traffic in high-density urban airspace on all timescales, based on the segmentation and alignment principles of geovectoring, in combination with flight planning and detect and avoid paradigms that are designed to leverage the alignment principles from geovectoring, to define robust and efficient flight plans, as well as safe and compliant resolution strategies, which are suitable for operation in a densely-used airspace.</p>	<p>Vienna (simulations)</p>	<p>https://metropolis2.eu/</p>

<p>SAFIR Med Safe and Flexible Integration of Advanced U-SPACE Services Focussing on Medical Air Mobility H2020-SESAR-2020-1, SESAR-IA</p>	<p>Ongoing 01/12/2020 31/12/2022</p>	<p>The vision of SAFIR-Med project is to demonstrate ways to achieve safe, sustainable, socially accepted and socially beneficial urban air mobility which will contribute to the EU healthcare system, by ensuring that future generations will continue to democratically have access to the best cure and care. Technologies of all partners will be leveraged to make use of the maximum number of U-Space services towards the highest possible operational safety level, including advanced Detect and Avoid U-space services. The demonstrations will enable involved cities to get acquainted with their role in U-space management and keep up with relevant regulatory changes in order to use UAM technology for the benefit of their citizens</p>	<p>Aachen</p>	<p>https://www.safir-med.eu https://cordis.europa.eu/project/id/101017701</p>
<p>AMU-LED Air Mobility Urban – Large Experimental Demonstrations, SESAR-VLD2-03-2020 - U-space capabilities and services to enable Urban Air Mobility, SESAR-IA</p>	<p>Ongoing 01/01/2021 31/12/2022</p>	<p>The AMU-LED project aims to demonstrate the U-space capabilities to enable Urban Air Mobility (UAM). To this end, the project proposes to define, design and deliver a detailed concept of operations and a set of urban air missions. This will be followed by simulations and a large real flight campaign composed of three demonstrations to verify and validate the concepts in order to compare two Unmanned Aircraft Systems (UAS) Traffic Management (UTM) architectures.</p>	<p>Amsterdam, Rotterdam Enschede Santiago de Compostella</p>	<p>https://amuledproject.eu https://cordis.europa.eu/project/id/101017702</p>
<p>CORUS XUAM Concept Of Operations For European U-Space Services – Extension For Urban Air Mobility, SESAR-VLD2-03-2020 - U-space capabilities and services to enable Urban Air Mobility, SESAR-IA</p>	<p>Ongoing 01/01/2021 31/12/2022</p>	<p>CORUS-XUAM is a two-year very large-scale demonstration (VLD) project that will demonstrate how U-space services and solutions could support integrated Urban Air Mobility (UAM) flight operations. These services should allow electric vertical take-off and landing vehicles (eVTOL), unmanned aircraft systems (UAS) and other airspace users (unmanned and manned) to operate safely, securely, sustainably and efficiently in a controlled and fully integrated airspace, without undue impact on operations currently managed by ATM.</p>	<p>No cities involved</p>	<p>https://corus-xuam.eu https://cordis.europa.eu/project/id/101017682</p>
<p>GOF 2.0 GOF2.0 Integrated Urban Airspace VLD, SESAR-VLD2-03-2020 - U-space capabilities and services to enable Urban Air Mobility, SESAR-IA</p>	<p>Ongoing 01/01/2021 31/12/2022</p>	<p>The GOF2.0 Integrated Urban Airspace VLD (GOF2.0) very large demonstration project will safely, securely, and sustainably demonstrate operational validity of serving combined UAS, eVTOL and manned operations in a unified, dense urban airspace using current ATM and U-space services and systems. The demonstrations focus on validation of the GOF 2.0 architecture for highly automated real-time separation assurance in dense air space including precision weather and telecom networks for air-ground communication and will significantly contribute to understanding how the safe integration of UAM and other commercial drone operations into ATM Airspace without degrading safety, security or disrupting current airspace operations can be implemented</p>	<p>No cities involved</p>	<p>https://gof2.eu https://cordis.europa.eu/project/id/101017689</p>

ANNEX: UAM-RELATED PROJECTS REPOSITORY

<p>PJ34-W3 AURA – ATM U-SPACE INTERFACE, SESAR-WAVE3-03-2020 – Collaborative U-space-ATM SWIM interface, SESAR-RIA</p>	<p>Ongoing 01/01/2021 31/12/2022</p>	<p>The global objective of AURA is to lay the foundations for the integration of the new entrants in current and future air traffic environment, developing the required concept of operations and validating U-space services information exchanges with ATM systems. In order to achieve this objective, all relevant stakeholders (drone operators, U-space service providers, data services providers, ATM providers and authorities) will be included during the project development and throughout its lifetime. AURA project will identify the requirements for U-space information exchange with ATM through SWIM and will validate a set of selected U-space services, developing the service definition for the SWIM candidate services. Secondly, it will define a novel Collaborative ATM-U-space Concept of Operations (ConOps) for drones in a fully collaborative environment with ATM that go beyond the existing concepts developed for a U-space and will validate these new concepts.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/101017521</p>
<p>USEPE U-space Separation in Europe, SESAR-ER4-31-2019 - U-space, SESAR-RIA</p>	<p>Ongoing 01/01/2021 31/12/2022</p>	<p>It aims at exploring potential separation methods to ensure the safety of drone operations in urban environments, with a particular focus on densely populated areas. USEPE will propose, develop and evaluate a concept of operations and a set of enabling technologies to ensure the safe separation of drones (from each other and from manned aviation). Expected Outcomes: The project's main outcomes will be: An Initial Concept of Operation, with proposals for an Urban Space Separation Management System. A set of validation experiments of the proposed solutions, to complete the V1 phase as defined by E-OCVM (European Operational Concept Validation Methodology) and achieve the TRL2 (Technology Readiness Level).</p>	<p>No cities involved</p>	<p>https://usepe.eu https://cordis.europa.eu/project/id/890378</p>
<p>TINDAIR Tactical Instrumental Deconfliction And in-flight Resolution, SESAR-VLD2-03-2020 - U-space capabilities and services to enable Urban Air Mobility, SESAR-IA</p>	<p>Ongoing 01/02/2021 31/12/2022</p>	<p>The project aims demonstrating through real flights the proposed technologies for automatic Tactical Conflict Resolution and of Strategic Deconfliction. Demonstrations will take place in France, with the support of the municipalities of Toulouse and Bordeaux. The project will include a complete analysis of the operational concept and mission profiles, before the actual demonstration missions are carried out. After the real-world flight demonstrations, then, detailed activities will be carried out to evaluate the performances of the proposed solutions and, based on this, appropriate recommendations will be drawn up.</p>	<p>Toulouse, Bordeaux, other under evaluation</p>	<p>https://tindair.eu/ https://cordis.europa.eu/project/id/101017677</p>

<p>FlightAI Flight plan artificial intelligence assistant, H2020-FETOPEN-2018-2019-2020-4, CSA-LSP - Coordination and support action Lump sum</p>	<p>Ongoing 01/09/2021 28/02/2023</p>	<p>The project aims to integrate into the web-solution built by EUSC the Artificial Intelligence (AI) technology generated by the FET-OPEN GOAL-Robots project, allowing the search of solutions in highly nonlinear search spaces. The new technology from GOAL-Robots will support the semi-autonomous search of a solution to formulate flight plans based on an interactive interface, that meets the user's requirements (flight start/arrival points, drone available, pilot licences, etc.), the SORA requirements, and the GIS characteristics of the involved overflown territory/airspace. The project will accomplish a systematic validation of the integrated system by testing the acceptability and usability of the proposed technology by selected stakeholders through the wide stakeholder network of the consortium. Moreover, business case refinement and focused dissemination activities will pave the way to the commercialisation of the produced service within the European drone market.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/101034937</p>
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<p>Project: [Acronym, title, call number/ title, funding scheme]</p>	<p>Status: ongoing/ ended -year</p>	<p>Objectives & key results (if available)</p>	<p>Cities involved (if any)</p>	<p>Source for further reading</p>
<p>UAM dedicated technologies and solutions</p>				
<p>OASyS Forecasting future scenarios for Urban Air Mobility (UAM) vehicles and supersonic aircraft, JTI-CS2-2018-CfP09-TE2-01-08 – Overall Air Transport System Vehicle Scenarios, CS2-CSA</p>	<p>Ended, 2020</p>	<p>The environmental impact of future advanced configurations like Urban Air Mobility (UAM) vehicles and supersonic transport (SST) aircraft is attracting increasing attention today. The EU-funded OASyS (Overall Air Transport System Vehicle Scenarios) project will forecast future scenarios for these vehicles in the 2035-2050 timeframe. It will examine current prediction models and detect cases and guidelines to identify and meet data coverage gaps. The project will utilize the IDEA algorithm which is a System Dynamics model representing sector equilibrium of different categories of aircraft classes regulating supply and demand. It has been used to predict the impact new aviation technologies will have on the environment. This effort will provide Clean Sky's Technology Evaluator (TE) with an enhanced modelling capability to estimate the impacts of potential scenarios that include these advanced configuration aircraft with regards to their technology portfolio within the global fleet.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/864521</p>

ANNEX: UAM-RELATED PROJECTS REPOSITORY

<p>ODESSA Obstruction DEtection Sensor for Surveillance on Aircraft, H2020-CS2-CFP07-2017-02, CS2-IA</p>	<p>Ended, 2020</p>	<p>ODESSA developed a prototype, ODESSA, a small-size and low-weight and power consumption sensor which can be installed on small aircraft or drones, to detect obstacles in the short range. It is based on the combination of radar technology, derived from advanced driver assistance systems, with advanced image processing algorithms. The radar provides target detection, and the camera improves detection reliability through object classification. The sensor has a maximum range of 140 m with 15° of elevation and 40° of azimuth, at a speed of 50 km/h. The sensor equipment is composed of two major sub-assemblies, the control unit and the sensor unit, which are industrialised and certified according to civil aviation standards. The conclusions of the project confirmed that the ODESSA sensor equipment could be installed on drones or light aircraft, provided that the right trade-off between performance and dimensions – size, weight, power and consumption.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/821263</p>
<p>HEAVEN High power density FC System for Aerial Passenger Vehicle fueled by liquid Hydrogen, H2020-JTI-FCH-2018-1, FCH2-RIA</p>	<p>Ongoing 01/01/2019 31/12/2022</p>	<p>The main goal of HEAVEN project is to design, develop and integrate a powertrain based on high power fuel cell and cryogenic technology into an existing 2-4 seats aircraft for testing in flight operation. Specifically, the project proposes to design a modular architecture with modular systems that can be scale-up to other sizes of aircrafts and UAV applications. The design methodology is complemented with safety and regulation analysis. Regarding the fuel cell technology, two high power PEM fuel cell systems of 45 kW based on metallic bipolar plates will be adapted for aircraft applications and integrated with optimized balance of plant components to obtain an enhanced 90kW fuel cell system able to propel without support of a battery the aircraft operating modes. The hydrogen storage will be based on cryogenic technology successfully applied in previous space applications in order to achieve a gravimetric index of about 15% for a hydrogen payload between 10 and 25 kg that provides an autonomy range to the demonstrator of 5-8 hours.</p>	<p>No cities involved</p>	<p>https://cordis.europa.eu/project/id/826247</p>
<p>FF20 – Creating the 21st century spatial ecosystem, MG-3-6-2020 - Towards sustainable urban air mobility, RIA</p>	<p>Ongoing 01/12/2020 30/11/2023</p>	<p>Flying Forward 2020 is a three-year collaborative research project that will develop a new Urban Air Mobility (UAM) ecosystem aligned with the Digital Government Transformation (DGT) of European countries, which focuses on incorporating Urban Air Mobility within the geospatial data infrastructure of cities. Building and incorporating all related data from UAM infrastructures and operations within the digital infrastructure of cities will allow helping society to fly forward in a safe, secure and effective way. This will make life easier, cheaper and provide more opportunities by getting products faster and more efficiently across Europe.</p>	<p>Zaragoza</p>	<p>https://www.ff2020.eu https://cordis.europa.eu/project/id/101006828</p>

<p>AIRMOUR Enabling sustainable Air Mobility in Urban contexts via emergency and medical services, MG-3-6-H2020, RIA</p>	<p>Ongoing 01/01/2021 31/12/2023</p>	<p>The AiRMOUR project offers valuable UAM tools and drastically advances the understanding of necessary near-future actions – not only by urban communities, but also by operators, regulators, academia and businesses. The EU-funded AiRMOUR project will study and test solutions to make UAM safe, secure, quiet and environmentally friendly, as well as accessible, faster, cheaper and publicly accepted. Specifically, the project focuses on the UAM in emergency medical services (EMS). Bringing together research, national aviation, regional and local urban authorities, UAM and EMS operators, the project will assist city planners and transport policymakers.</p>	<p>Stavanger, Helsinki, the region of Nord-Hessen, Luxemburg</p>	<p>https://airmour.eu https://cordis.europa.eu/project/id/101006601</p>
<p>U-space4UAM Flying high and safe with urban air mobility vehicles, SESAR-VLD2-03-2020 - U-space capabilities and services to enable Urban Air Mobility, SESAR-IA</p>	<p>Ongoing 01/02/2021 31/12/2022</p>	<p>Aiming to bridge the gap between development and deployment, this VLD project will tackle issues of operational concepts, regulation, and standards, while building confidence in a safe and orderly integration of UAM in everyday air traffic. It will do this with a consortium of forward-looking cities and ANSPs, national regulators and EASA, a well experienced UTM provider, as well as eVTOL manufacturers, research centres, and technology providers. A series of well defined, iterative and multi-national demonstrations, both with drones and UAM vehicles will be conducted. They will cover different use cases, including mixed operations, to allow the project to derive critical enablers for a wide set of UAM service applications that can be applied all over Europe.</p>	<p>No cities involved</p>	<p>https://www.sesarju.eu/projects/U-space4UAM https://cordis.europa.eu/project/id/101017643</p>

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