



Universiteit
Leiden
The Netherlands

What is in a name: defining key terms in Urban Air Mobility

Andritsos, K.; Scott, B.I.; Trimarchi, A.

Citation

Andritsos, K., Scott, B. I., & Trimarchi, A. (2022). What is in a name: defining key terms in Urban Air Mobility. *Journal Of Intelligent & Robotic Systems*, 105, 1-9.
doi:10.1007/s10846-022-01694-1

Version: Publisher's Version

License: [Creative Commons CC BY 4.0 license](#)

Downloaded from: <https://hdl.handle.net/1887/3514127>

Note: To cite this publication please use the final published version (if applicable).



What is in a Name: Defining Key Terms in Urban Air Mobility

Konstantinos Andritsos¹ · Benjamyn I. Scott² · Andrea Trimarchi³

Received: 19 February 2022 / Accepted: 8 July 2022
© The Author(s) 2022

Abstract

As the world's population increases, new ways of improving transportation systems in, around and between urban areas are being suggested. Early discussions on this have been technology-focused, pointing at the use of Unmanned Aircraft Systems (UAS) for cargo delivery and electrical Vertical Take-Off and Landing (eVTOL) aircraft for passenger transportation. Recently, the term 'Urban Air Mobility' has become widely used to encompass these vehicles within a new mobility ecosystem. However, due to deficiencies in this term, other proposals – namely 'Advanced Air Mobility', 'New Air Mobility' and 'Innovative Air Mobility' – have emerged. The rise in different terms can lead to confusion as their scope is not always fully known or appreciated, and they are often used interchangeably. This paper, therefore, shifts focus from the recent debate about the definition of 'UAS' to the aforementioned ecosystem terms so to address and evaluate them as potentially different aspects of the same concept. An interpretive approach of the terms, an assessment of their major characteristics, as well as an analysis of their relationship with the aircraft types will take place. This will show the scope of these terms so that the context can be properly understood and then appropriately applied.

Keywords Advanced air mobility · Innovative air mobility · New air mobility · Unmanned aircraft systems · Urban air mobility · Vertical take-off and landing

1 Introduction

1.1 A Growing Aviation Vocabulary

The aviation sector does not shy away from acronyms as they unclutter and streamline texts such as in operational manuals, as well as to facilitate efficient speech, such as between pilots. These acronyms add to the already dense list of terms used to refer to *inter alia* specific technologies, activities or resources in aviation. That is why many of the aviation-related regulations and *soft law* resources – including Standards and Recommended Practices (SARPs)

and Acceptable Means of Compliance (AMC) – produced at a national, regional (i.e., the European Union (EU)) and international level have dedicated sections on definitions. The plethora of terms and acronyms is not so problematic for well-established topics or communication between experienced individuals, as the acronyms and terms will be well understood by those using them. However, when new technologies or types of activities arise, this can result in a bloom of new acronyms and terms which need to be clearly defined and properly understood.

A key example of this is within the context of unmanned aircraft. Here, a plethora of terms have been created to categorise these aircraft, including but not limited to Drones, Model Aircraft, Remotely Operated Aircraft (ROA), Remotely Operated Vehicle (ROV), Remotely Piloted Aircraft (RPA), Remotely Piloted Aircraft System (RPAS), Remotely Piloted Vehicle (RPV), Unmanned Aircraft (UA) and Unmanned Aircraft System (UAS) and Unmanned Aerial Vehicle (UAV).¹ In some cases, these terms are used interchangeably (rightly or wrongly), but in others, they are used to differentiate, for example, the aircraft from its

✉ Benjamyn I. Scott
b.i.scott@law.leidenuniv.nl

Konstantinos Andritsos
konstantinos.andritsos@protonmail.com

Andrea Trimarchi
a.trimarchi89@gmail.com

¹ University of Cologne, Cologne, Germany

² Leiden University, Leiden, the Netherlands

³ University of Verona, Verona, Italy

¹ See, Scott, B.I., de Pinho Veloso, G.N.: Terminology, Definitions and Classifications. In Scott, B.I. (ed) The Law of Unmanned Aircraft Systems, Chp. 2. Second Edition. Wolters Kluwer (2).

system, the level of interaction with a remote pilot (e.g., level of automation) or its type of operation (e.g., commercial, recreational or indoors).

An interesting term, which is associated with UAS, but, at the same time is distinct, is ‘Urban Air Mobility’ (UAM). This term, as well as its associated terms, will be addressed thoroughly below, both in reference to its comprising sub-terms and in reference to its special characteristics that make it distinct.

1.2 Contextualising UAM

It is a reality that there is an increasing number of people in the EU facing congestion in their streets on a daily basis due to the high number of vehicles and the associated increase in pollution.² This, in conjunction with the growing population in the EU, poses a risk for a significant increase in the pollution levels in European urban environments.³ As an answer to the aforementioned issues, many discussions have been made and many approaches considered. One of them is a method capable of addressing the above via a holistic system, which encompasses greener, smarter, unified and more sustainable characteristics in urban transportation. This holistic environment comes with many names, which will be addressed below, but all of them come with the same main attribute, the addition of a new dimension (i.e., air) to the present urban transportation system.⁴

Modernising urban mobility has been underway for more than a decade now, with major players such as Uber or Lime operating in many urban areas worldwide.⁵ The air component is now, however, considered as a viable addition to the present mobility network, capable of addressing the issues of pollution and traffic in the European urban environments. In the EU, this emerging mobility system is widely called ‘UAM’. The term ‘UAM’ is relatively new⁶ and, as such, it does not have a standard definition widely accepted either by the international legal community (or at least by the majority of the States), or by the aviation and mobility communities.

A key element for the development of the UAM concept is, in addition to the more established UAS market, the use of eVTOL aircraft. The reason why they will play such a significant role in proposed UAM environments is undoubtedly

its advanced technological aspects, especially their use of electric lithium-ion batteries. This alternative power source, in contrast to the conventional combustion engine aircraft, produces less noise and greenhouse gas emissions, being compliant with the environmental protection rules that are gradually adopted worldwide.⁷ Furthermore, eVTOL aircraft boast high safety standards, but require less space for take-off and landing due to their design.⁸ On top of the above, eVTOL aircraft – due to their advanced engines and sustainable components, as well as mass predicted mass production – are likely to be much cheaper to manufacture and operate than conventional transportation aircraft.

Prospective UAM services, in addition, offer new opportunities for cities, regions and their citizens, create new economic spaces, but also raise new challenges and responsibilities as UAM services are envisaged to generate very-low altitude air traffic at scale. Such low-level altitude airspace intended for both eVTOL and UAS operations is perceived as an extension of urban public space and, as such, the governance and management of the U-space shall be of a multilevel nature and extend down to the level of local and regional authorities.⁹ U-space, in other words, envisages a set of new services and specific procedures designed to support safe, efficient and secure access to airspace for a large number of vehicles.¹⁰

Most of the UAM launching projects involving eVTOL aircraft, at the time of writing, envisage some type of flying taxi service. In certain instances, these will operate from airports to city centres; in some others, they are expected to be used for short transportation during major sports events. For example, Volocopter plans to operate some services

⁷ Volocopter: ‘The Roadmap to Scalable Urban Air Mobility’, 8. Edition 2.0, (2021).

⁸ In Volocopter’s Roadmap, it is stated that “eVTOLs such as the Volocity are designed to take-off and land in areas as small as 17×17 m (56×56 feet) and consequently they do not need long runways and landing strips as the conventional aircraft do.” *Ibid*.

⁹ SESAR Joint Undertaking: Smart ATM U-SPACE. <https://www.sesarju.eu/U-space>. Access 14 February 2022. See, Andritsos, K., Agouridas, V.: Urban Air Mobility: Legal and Societal Stakes of an Upcoming Mobility Network. In Scott, B.I. (ed): The Law of Unmanned Aircraft Systems, Chp. 21. Second Edition. Wolters Kluwer (2).

¹⁰ These services rely on a high level of digitalisation and automation of functions, whether they are on board or are part of the ground-based environment. As such, U-space is enabling a framework designed to facilitate any kind of routine mission, in all classes of airspace and all types of environment – even the most congested – while addressing an appropriate interface to manned aviation, ATM/ANS service providers and authorities. See, Schnitker, R., van het Kaar, D.: Drone Law and Policy: Integration into the Legal Order of Civil Aviation, 185. Eleven Publishing (2021).

² EASA: Study on the Societal Acceptance of Urban Air Mobility in Europe, 7. 19 May (2021).

³ *Ibid*.

⁴ Volocopter: ‘The Roadmap to Scalable Urban Air Mobility’, 7. Edition 2.0, (2021).

⁵ The term ‘urban mobility’ may include public transportation, taxis, ride-hailing, urban ridesharing, car rental, personal cars and bicycles, bicycle sharing, e-scooter sharing and air mobility.

⁶ The term urban air mobility (UAM) was likely coined by Airbus Group in its FORUM Magazine No. 88 (2016).

during the 2024 Olympic Games in Paris¹¹ and Skyports' announcement regarding the creation of a vertiport network during the 2026 Winter Olympic Games in Milan/Cortina.¹²

As of 2022, the UAM market is still in its nascent stage and, while although showing increasing momentum, it has not yet manifested. Many start-ups and long-established companies are active across the entire value chain. In particular, the eVTOL manufacturing and Original Equipment Manufacturer (OEM) sector is rapidly evolving. More than 200 eVTOL designs and concepts are currently being investigated and developed with many prominent ones like Airbus, EHang, Joby, Lilium, Kitty Hawk and Volocopter. Some of these air vehicle systems are already in advanced certification stages with the European Union Aviation Safety Agency (EASA) and have projects, for example in Cologne, Dusseldorf, Frankfurt, Helsinki, Ingolstadt, Linz and Paris.¹³

The questions that arise from the above are: what is *Urban Air Mobility*? Which are the other terms that attempt to define the same concept? and What is the relation between this network with eVTOLs and the rest of the aircraft that can operate in urban environments?

1.3 Patchwork Attempts at Defining the UAM Ecosystem

Although there is a lack of a legal definition, several stakeholders have attempted to define 'UAM'. For example, according to the United States National Aeronautics and Space Administration (NASA), UAM is "a system for air passenger and cargo transportation within an urban area, inclusive of small package delivery and other urban unmanned aircraft systems services."¹⁴ Alternatively, it is the "safe and efficient air traffic operations in a metropolitan area for manned aircraft and unmanned aircraft systems."¹⁵

EASA, on the other hand, has avoided the term 'UAM' in its regulatory materials and instead focuses on the

technology at the heart of UAM, such as eVTOL aircraft and UAS. This is because EASA is responsible for drafting the aviation safety-based rules for aircraft (including UAS and eVTOL), as opposed to regulating the whole UAM ecosystem. However, this is not to say that EASA does not use the term, which is evident from its study on the Societal Acceptance of Urban Air Mobility in Europe.¹⁶ In a recently published document, several EU funded project members came together to build an unofficial UAM glossary. In this document, the term 'UAM' is defined as "[v]ery-low altitude air traffic above populated areas, at scale, that is sustainably integrated with surface (ground, underground and water) mobility systems."¹⁷

Industry members have proceeded with its own definitions for 'UAM'. For example, Airbus has defined the term as "a third-dimension addition to a multimodal urban transportation network."¹⁸ Additionally, Honeywell expressed the opinion that UAM is "an aviation industry term for on-demand and automated passenger or cargo-carrying air transportation services, typically flown without a pilot."¹⁹

The above information both from public and private organisations create a plexus of definitions that all have as a common characteristic the existence of UAM as a holistic urban aviation network that can engulf all means of mobility and transportation both manned and unmanned, conventional and innovative (e.g., eVTOL) involving populated areas. However, the lack of a common definition hints at the complexity in defining 'UAM' and, with a lack of a legal definition, it must be unpacked.

¹¹ Reuters: German Firm's Air Taxi Aims to be Operational for Paris 2024 Olympics. <https://www.reuters.com/lifestyle/sports/german-firms-air-taxi-aims-be-operational-paris-2024-olympics-2021-06-21/>. Access 14 February 2022.

¹² Aviation Tourism: Partnership Between SEA Milan Airports and Skyports for the Development of Vertiports in Italy. <https://www.aviontourism.com/it/informazioni-utili/info-utili/nuove-tecnologie/partnership-tra-sea-milan-airports-e-skyports-42266>. Access 14 February 2022.

¹³ EASA: Study on the Societal Acceptance of Urban Air Mobility in Europe, 21. 19 May (2021).

¹⁴ Malaud, F.: Urban Air Mobility: Is This a Different Way of Saying 'Aviation in Cities'?. <http://www.unitingaviation.com>. Accessed 14 February 2022.

¹⁵ See, NASA: Urban Air Mobility Airspace Integration Concepts and Considerations, 1. Conference Paper, 24 June (2018).

¹⁶ EASA: Study on the Societal Acceptance of Urban Air Mobility in Europe, 3. 19 May (2021): "New technologies such as the enhancement of battery technologies and electric propulsion as well as major investments made into start-ups are enabling the development of new vertical take-off and landing Urban Air Mobility (UAM) aircraft. Thus, Urban Air Mobility – defined as an air transportation system for passengers and cargo in and around urban environments – may be deployed in Europe within three to five years, offering the potential for greener and faster mobility solutions."

¹⁷ UAM Explained: Creating a Common Language on Urban Air Mobility (UAM), 31 January 2022, <https://www.safir-med.eu/uam-explained> (accessed 13 February 2022).

¹⁸ Airbus: Urban Air Mobility. <https://www.airbus.com/en/innovation/zero-emission/urban-air-mobility>. Accessed 14 February 2022.

¹⁹ Honeywell: What is Urban Air Mobility. <http://www.honeywell.com/en-us/newsroom/news/2019/01/what-is-urban-air-mobility>. Accessed 14 February 2022.

2 What is Urban Air Mobility?

2.1 Urban

The first component of ‘UAM’ is the term ‘urban’, which stems from the Latin word ‘*urbs*’ to mean ‘city’ or ‘space delimited by walls’.²⁰ Human populations are increasingly concentrating in towns and cities, thus away from rural areas. This is posing mobility challenges, such as delays caused by traffic congestion, and public health and environmental issues resulting from pollution caused by personal automobiles. Many see clean and affordable mobility, as well as liveable and sustainable cities as fundamental for society. Therefore, the pursuit for integrated and seamless transportation solutions that enhance people’s lives and foster the movement of goods is high on policy-makers’ agendas and is currently being pursued in several cities, regions and States, and among numerous cross-sectoral stakeholders. As a result, the people and where they live is a critical element of this new mobility ecosystem.

The term ‘urban’ can be understood to include different airborne operations. For example, the following have been discussed in the literature:

- **Intra-City:** An operation within a single city, such as a short distance taxi service from one side of a city to the other.
- **Peri-City:** An operation between a city and a location outside of the city or *vice-versa*, such as a service between downtown and the local airport.
- **Inter-City:** An operation between more than one urban area, such as a service between two cities.
- **Rural–Urban–Rural:** An operation between two points crossing or circumnavigating an urban area that connected rural areas.

No matter the type of activity, the key characteristic is that the airborne segment will involve populated areas of some kind. While the term ‘urban’ is used, the involvement of an ‘urban’ area is not per se crucial nor is the definition of the term ‘urban’ specifically important. What is important is that people can benefit from enhanced mobility of themselves, others or goods via the third dimension (i.e., parts of the airspace).

²⁰ Online Latin Dictionary: Urbs. <https://www.online-latin-dictionary.com/latin-english-dictionary.php?parola=urbs>. Accessed 14 February 2022.

2.2 Air

From a purely linguistic perspective, the term ‘air’ refers to the “invisible gaseous substance surrounding the earth, a mixture of mainly of oxygen and nitrogen”.²¹ Within the remit of aerospace regulation, for example, the air, which is traditionally referred to as airspace, identifies the geographical and physical location where a certain (flying) activity takes place.²²

Within the context of ‘air mobility’, the term air seems to assume a different connotation, which must necessarily be read in conjunction with the other terms and adjectives encompassed, such as, among others, ‘urban’, ‘advanced’ and ‘innovative’. For instance, when considering UAM, the term ‘air’ appears to simply refer to the environment in which such mobility occurs, that is, the urban airspace (the third dimension of urban mobility). Such a third dimension adds up to the already existing features of mobility a new vertical dimension, which makes use of the airspace above urban areas to ensure faster, smoother, cost-effective and sustainable mobility.

2.3 Mobility

In terms of mobility, the considerations regarding UAM are more in the sociological sphere than in the legal or technological. A very interesting element of UAM is the use of the term ‘mobility’ instead of the term ‘transportation’,²³ something that has its own deeper meaning giving information about the intended nature and expected quality of services from the UAM environment. The etymological analysis of ‘transportation’ (‘across-carry’ in Latin) clarifies that it is just the act of moving people and cargo from point A to point B.

On the other hand, the term ‘mobility’, which stems from the Latin term ‘*mobilitas*’ to mean “to move or to be capable to move”,²⁴ is broader as it covers “the ability of people to move safely and affordably between where they live, work

²¹ Oxford Dictionaries: Air. https://www.oxfordlearnersdictionaries.com/definition/english/air_1. Accessed 14 February 2022.

²² Different linguistic approaches are in place, for example, to identify a certain branch of law as ‘aviation law’ rather than ‘air law’ depending on whether the regulation focuses on the activity and the machine that operates or on where the activity takes place. See, for instance, Scott, B.I., Trimarchi, A.; Fundamentals of International Aviation Law and Policy, 2. Routledge (2020).

²³ The term ‘transport’ is utilised in Article 100(2) of the Treaty on the Functioning of the European Union, which provides the European Union with aviation transport competencies. However, no definition of the term is provided.

²⁴ Jordan McKay: ‘What’s the Difference and Why Does It Matter?’, 13 November 2019, <https://www.forumforthefuture.org/blog/transport-or-mobility>. Accessed 14 February 2022.

and spend their leisure time.”²⁵ As such, ‘mobility’ “is the ability to move or to be moved freely” and since it is a wider term than ‘transportation’, it implies the ability to move by utilising an integrated network of transportation modes. Hence, in accordance with the above, mobility is the ability to move or to be moved, by having access to an array of multiple, quality options of integrated transportation systems.²⁶

3 Other Terms

3.1 Advanced Air Mobility

The relatively new term ‘Advanced Air Mobility’ (AAM) is neither uniformly used nor defined. Despite the fact that this term is still in its infancy, it undoubtedly has a direct link with UAM. In fact, AAM not only conceptually stems from UAM, but also extends this concept so as to include more applications, to provide more sophisticated functionalities, as well as to identify a new (third) dimension of mobility, which will make mobility safer, more efficient and reliable and reduce passengers’ waiting times and shorten the miles travelled.²⁷ Here, AAM, in principle, will not be limited to urban applications, as this form of intermodal transportation could extend well beyond high-density urban centres or surrounding areas.

With particular regard to the latter, AAM delineates a new concept of air transportation – that can use eVTOL aircraft – to move people and cargo between places not currently or easily served by surface transportation or existing aviation modes. Aircraft may be powered by hybrid electric systems, batteries or potentially hydrogen fuel cells. These aircraft, which will range in size from single-passenger aircraft to large shuttles, will bring accessibility to cities, underserved communities and geographically distant regions.

In the United States, AAM, which is also often referred to ‘Advancing Aerial Mobility’, indicates the adoption of electric and hybrid aircraft to urban, suburban and rural operations. In this context, AAM includes and involves the emergence of transformative and disruptive new airborne technology supporting an ecosystem designed to transport people and things to locations that are not traditionally – or regularly – served by the current modes of air transportation.

These may include both rural and more challenging and complex urban environments.²⁸

This broader definition is also behind the reason why NASA has moved from using the term ‘UAM’ to the more inclusive notion of ‘AAM’, as to which, from 2021, NASA is developing its AAM project and mission. In this regard, NASA’s AAM Mission is:

“to help emerging aviation markets to safely develop an air transportation system that moves people and cargo between places previously not served or underserved by aviation – local, regional, intraregional, urban – using revolutionary new aircraft that are only just now becoming possible”.²⁹

In the United States, AAM is a joint initiative of the Federal Aviation Administration, NASA and the industry to develop an air transportation system that moves passengers and cargo with new electric (i.e. green) air vehicles in various geographies previously underserved by traditional aviation. Companies worldwide are racing to create urban aircraft prototypes and, in partnership with major aerospace suppliers, certify the technologies for urban flying. This push is putting pressure on cities and government agencies to create rules for using urban airspace, which is not an easy task considering the differences in air vehicle designs and sizes, manoeuvrability, speed, take-off procedures, automation, surveillance, and communication capabilities.³⁰

In the European Union, it is explicitly acknowledged that AAM has a broader catch as compared to UAM.³¹ While underlining that both terms are in common use, EASA specifically clarifies that AAM covers a wider scope than UAM as it covers passenger and cargo transport as well as other aerial missions in urban, regional, and interregional geographies. In this regard, the Agency observes that UAM shall be deemed as a subset of AAM embracing transportation systems that move people or cargo by air in and around urban environments only.³²

In the European Union, the term ‘AAM’ does not appear consistently, as EASA commonly uses the term ‘UAM’ to

²⁵ *Ibid.*

²⁶ *Ibid.*

²⁷ See, Volocopter: ‘The Roadmap to Scalable Urban Air Mobility’, 8. Edition 2.0, (2021).

²⁸ See, United States National Academies of Science, Engineering and Medicine: Advancing Aerial Mobility: A National Blueprint, 11. (2020).

²⁹ National Aeronautics and Space Administration: Advanced Air Mobility Project, (2021). <https://www.nasa.gov/aeroresearch/programs/iasp/aam/description/>. Accessed 14 February 2022.

³⁰ Bauranov, A., Rakas, J.: Designing Airspace for Urban Air Mobility: A Review of Concepts and Approaches, 3. *Progress in Aerospace Science* 125 (2021).

³¹ EASA: Study on the Societal Acceptance of Urban Air Mobility in Europe, 5. 19 May (2021).

³² *Ibid.*, 8.

indicate specifically the ecosystem where VTOL or eVTOL aircraft will operate in the next years.³³

Interestingly, the Italian Civil Aviation Authority (ENAC) recently published its AAM Strategic National Plan (2021–2030) for the development of Advanced Air Mobility in Italy.³⁴ This unique policy endeavour provides a roadmap that aims to transition towards a more digitalised air mobility, as well as to the creation of innovative, safe, efficient and sustainable vehicles, to be more suitable for operation in densely populated areas, with a view to inter-modal transportation as well as better accessibility into local and/or regional transportation systems.³⁵ Interestingly, this document describes AAM as the system of innovative inter-modal transportation services offered by means of electric aircraft, mostly VTOL, with or without a pilot on board or autonomous, alongside the appropriate relevant infrastructures. This system is conceived with the aim of improving accessibility and mobility within and between cities, metropolitan areas and territories, the environmental footprint and the life and security of citizens of such urban areas.³⁶

3.2 The Winds of Change

On 17 January 2022, EASA published the 11th edition of its annual 5-year rulemaking programme, which is called the ‘European Plan for Aviation Safety (EPAS)’.³⁷ This document is prepared in close collaboration with the Agency’s various stakeholders, and “sets out the strategic priorities and main risks affecting the European aviation system, and defines the necessary actions to mitigate them, with the primary objective of further improving aviation safety.”³⁸ This edition of the EPAS sets out the rulemaking activities of the Agency which relate to urban air mobility.

³³ EASA defines ‘UAM’ as an air transportation system for passengers and cargo in and around urban environments and it expresses the opinion that it may be deployed in Europe within 3 to 5 years, offering a greener and more efficient mobility for citizens. *Ibid.*, 3. See, Andritsos, K., Agouridas, V.: Urban Air Mobility: Legal and Societal Stakes of an Upcoming Mobility Network. In Scott, B.I. (ed): *The Law of Unmanned Aircraft Systems*, Chp. 21. Second Edition. Wolters Kluwer (2).

³⁴ ENAC: Piano Strategico Nazionale AAM (2021–2030) per lo sviluppo della Mobilità Aerea Avanzata in Italia (2022).

³⁵ *Ibid.*, 3.

³⁶ *Ibid.*, 3.

³⁷ EASA: European Plan for Aviation Safety (EPAS) 2022–2026. 17 January 2022. <https://www.easa.europa.eu/document-library/general-publications/european-plan-aviation-safety-2022-2026>. Accessed 14 February 2022.

³⁸ *Ibid.*

See, for more information on the EPAS, Scott, B.I., Sousa Uva, R.: ‘Soft Law’ and its Role in European Aviation Safety’, 69(4) *Zeitschrift für Luft- und Weltraumrecht* 604–627 (2020).

- RMT.0230 – Introduction of a regulatory framework for the operation of drones: This covers the regulations for the safe integration of both UAS and eVTOL aircraft.
- RMT.0730 – Regular update of the AMC & GM to Regulations (EU) 2019/945 and 2019/947: This involves updating the soft law (AMC and Guidance Materials) materials for UAS in both the ‘Open’ and ‘Specific’ categories.³⁹
- RMT.0731 – New Air Mobility (NAM).⁴⁰

Recognising that the “current European regulatory framework for aviation safety has initially been designed for conventional fixed wing aircraft, rotorcraft, balloons and sailplanes”, RMT.0731 on NAM was introduced in EPAS 2021–2025 to include gyroplanes and tilt rotors as “[t]he introduction of new technologies and air transport concepts (from multi-modal vehicles to autonomous vehicles) requires revisiting this framework”.⁴¹ As of the 2022 EPAS, “airship⁴² and flying car⁴³ developments are now being closely monitored by EASA.”⁴⁴

³⁹ See, for more information on the ‘Open’, ‘Specific’ and ‘Certified’ categories, Scott, B.I.: Open Skies for Unmanned Aircraft in Europe: An Outlier or a New Approach?, 46(1) *Air & Space Law* 57–80 (2021).

⁴⁰ Rulemaking Tasks are set by EASA and action it to draft secondary EU legislation (e.g., EU Commission Regulations) or prepare soft law materials (e.g., AMC, Guidance Materials and Certification Specifications). EASA has been active in both areas, developing the aviation safety regulatory environment for UAS (Open, Specific and Certified Categories), UTM and Special Conditions for VTOL. EASA’s competencies are limited, so it does not have the ability to conduct rulemaking activities on areas outside of its scope (e.g., insurance, privacy, law enforcement, data protection, security and liability).

⁴¹ EASA, ‘The European Plan for Safety (EPAS 2022–2026)’, 182. Vol. II, <https://www.easa.europa.eu/downloads/123563/en>. Accessed 14 February 2022.

⁴² “Airships: There are a number of airship projects in Europe. These lighter-than-air aircraft are likely to be used in commercial operations in the medium term; for instance, with more than 60 tons payload for cargo transport.” EASA, ‘The European Plan for Safety (EPAS 2022–2026)’, 74. Vol. I, <https://www.easa.europa.eu/downloads/134918/en>. Accessed 14 February 2022.

⁴³ “Flying cars: There are currently a number of ‘flying car’ projects under certification by EASA. These flying cars are dual-transport mode aircraft capable of being operated both as a flying machine and as a terrestrial vehicle. The aviation safety regulations (e.g. air operations regulation, continuing airworthiness regulation) will need to be adapted to incorporate this type of aircraft.” *Ibid.* See, for more information on flying cars, Scott, B.I.: Roadable Aircraft: An Analysis of the Current Legal Environment. 40(3) *Air & Space Law* 255–269 (2015).

⁴⁴ EASA, ‘The European Plan for Safety (EPAS 2022–2026)’, 74. Vol. I, <https://www.easa.europa.eu/downloads/134918/en>. Accessed 14 February 2022.

The goal of RMT.0731 is to either develop or amend existing rules in order to “address new technologies and operational air transport concepts”.⁴⁵ From this, it is clear that EASA is not trying to replace ‘UAM’ with ‘NAM’. Rather, it covers the safety rules for *non-traditional* aircraft and their operations, under the competencies of EASA.⁴⁶ Therefore, it is similar to ‘eVTOL’ and ‘unmanned aircraft’, which cover a specific technology, as opposed to a wider ecosystem that utilises such technologies. This is supported by EASA’s use of ‘UAM’ in both the EPAS 2022 and other sources. Of course, it is not surprising that EASA has a technology focus due to its competencies in aviation safety, which is narrower than what is encompassed by the UAM ecosystem (e.g., societal acceptance).

There have been some calls within EASA to adopt a more suitable term so to replace ‘UAM’. One such proposal has been ‘Innovative Air Mobility’. However, this has not yet picked up momentum as the term ‘innovative’ brings its own limitations. For example, the aircraft currently being developed for flying taxi operations may not be deemed as ‘innovative’ once they are engaged in large scale commercial operations. Additionally, some of the technology has already been utilised for many years, so it is established. As a result, ‘innovative’ is subjective and a moving target, which does not give any greater clarity to the subject matter than, for example, UAM.

4 Concluding Remarks

This article provides an introduction to the new set of terms that define the emerging mobility environments around the world that involve the third dimension. Despite the fact that this article mainly focused on ‘UAM’ as the core term, alternative terms such as ‘AAM’ and ‘NAM’ were underlined. The above argumentation and presentation of the existing terminology have led to three principal conclusions.

First, the three main terms presented in this paper, regardless of the differences in one of their sub-terms (Urban-Advanced-New), seem to describe mobility environments in urban and populated contexts. Thus, despite their initial differences, the terms seem to envision similar mobility networks via the addition of the third dimension in the present mobility systems.

Second, it became evident that this new era of mobility will have an ‘air’ aspect as a core element, since all of the three

presented terms contain the word ‘air’ as a sub-term. Nevertheless, an important question that arises from the aforementioned fact is whether those proposed environments should be addressed solely under the prism of air law and by aviation organisations such as ICAO and EASA. It is the opinion of the authors that UAM, AAM and NAM are definitely concepts with a strong presence of the air element in their core, thus air law and its principles will most likely play a significant role in their function (e.g. aviation safety rules for UAS and VTOL). However, they do not solely belong to the aviation-air domain. Consequently, these emerging mobility ecosystems should be a forum of cooperation between many different players and stakeholders (e.g., cities; citizens; public, urban planning entities; manufacturers; National Aviation Authorities).

Third, as it was hinted above, one factor of paramount importance for the materialisation of the new era of mobility are the cities of tomorrow or as they tend to be called, ‘smart cities’. Despite the initial differences between UAM, AAM and NAM in content and application, there will be an aspect of those environments, attempting to reverse the negative effects that the population growth has brought. The addition of the third dimension in urban environments will most likely create a basis for a new form of human mobility, with an emphasis on a green and sustainable tomorrow.

In conclusion, the materialisation of smart mobility environments is far from reaching the desired levels of feasible application around the world. The proposed terms available now, seem to encapsulate the main opportunities and issues of the envisioned mobility environments adequately. As a result, there does not seem to be a need for additional terms, but a level of common understanding of the existing ones is required. However, at this stage, this does not need to be codified in law. It is also evident that cooperation between stakeholders from various backgrounds is necessary for the aforementioned implementation, while a broad perception must be adopted in reference to their nature and the organisations/authorities that will monitor and regulate their implementation both nationally and internationally.

Authors' Contributions In relation with your submission: (This is “Applicable”—Who made your manuscript and did the research?). Kindly provide complete list of all authors (names or initials) and each contribution in your “Authors' contributions” section.

The following authors contributed equally to all aspects of the study:

1. Konstantinos Andritsos LL.M. (Adv.) is an Aviation Law Research Assistant at University of Cologne, Cologne, Germany. Email: konstantinos.andritsos@protonmail.com.

2. Benjamyn Scott Ph.D., LL.M. (Adv.) is Assistant Professor at Leiden University, Leiden, the Netherlands. Email: b.i.scott@law.leidenuniv.nl.

3. Andrea Trimarchi, Ph.D., LL.M. (Adv.) is an Aviation Legal Consultant and Lecturer, Rome, Italy. Email: a.trimarchi89@gmail.com.

Funding (Information that Explains Whether and by Whom the Research was Supported) The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

⁴⁵ *Ibid*, 83.

⁴⁶ Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on Common Rules in the Field of Civil Aviation and Establishing a European Union Aviation Safety Agency, and Amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91, OJ L 212, 22.8.2018, p. 1–122, Art 2.

Code or Data Availability (Software Application or Custom Code) Not applicable.

Declarations

Ethics Approval (Include Appropriate Approvals or Waivers) Not applicable – No animals, including humans, were studied in any way during the writing of this paper.

Consent to Participate (Include Appropriate Statements) This study did not involve any 3rd party participation. All authors consent to participation.

Consent for Publication (Include Appropriate Statements) This study did not involve any 3rd party participation. All authors consent to publication.

Conflicts of Interest/Competing Interests (Include Appropriate Disclosures) The authors have no relevant financial or non-financial interests to disclose.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

1. Schnitker, R., van het Kaar, D.: *Drone Law and Policy: Integration into the Legal Order of Civil Aviation*. Eleven Publishing (2021)
2. Scott, B.I. (ed) *The Law of Unmanned Aircraft Systems*, Second Edition. Wolters Kluwer (2022)
3. Scott, B.I., Trimarchi, A.: *Fundamentals of International Aviation Law and Policy*. Routledge (2020)
4. Bauranov, A., Rakas, J.: Designing Airspace for Urban Air Mobility: A Review of Concepts and Approaches. *Prog. Aerosp. Sci.* **3**, 125 (2021)
5. Scott, B.I.: Open Skies for Unmanned Aircraft in Europe: An Outlier or a New Approach? *Air & Space Law* **46**(1), 57–80 (2021)
6. Scott, B.I.: Roadable Aircraft: An Analysis of the Current Legal Environment. *Air & Space Law* **40**(3), 255–269 (2015)
7. Scott, B.I., Sousa Uva, R.: 'Soft Law' and its Role in European Aviation Safety. *Zeitschrift für Luft- und Weltraumrecht* **69**(4), 604–627 (2020)
8. EASA: European Plan for Aviation Safety (EPAS) 2022–2026. (2022). <https://www.easa.europa.eu/document-library/general-publications/european-plan-aviation-safety-2022-2026>. Accessed 14 Feb 2022
9. EASA, 'The European Plan for Safety (EPAS 2022–2026)'. Vol. I, <https://www.easa.europa.eu/downloads/134918/en>. Accessed 14 Feb 2022
10. EASA, 'The European Plan for Safety (EPAS 2022–2026)'. Vol. II, <https://www.easa.europa.eu/downloads/123563/en>. Accessed 14 Feb 2022
11. EASA: Study on the Societal Acceptance of Urban Air Mobility in Europe. 19 May (2021)
12. Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on Common Rules in the Field of Civil Aviation and Establishing a European Union Aviation Safety Agency, and Amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91, OJ L 212, 22.8.2018, p. 1–122
13. SESAR Joint Undertaking: Smart ATM U-SPACE. <https://www.sesarju.eu/U-space>. Access 14 Feb 2022
14. Airbus Group, FORUM Magazine No. 88 (2016)
15. Airbus: Urban Air Mobility. <https://www.airbus.com/en/innovation/zero-emission/urban-air-mobility>. Accessed 14 Feb 2022
16. ENAC: Piano Strategico Nazionale AAM (2021–2030) per lo sviluppo della Mobilità Aerea Avanzata in Italia (2022)
17. Honeywell: What is Urban Air Mobility. <http://www.honeywell.com/en-us/newsroom/news/2019/01/what-is-urban-air-mobility>. Accessed 14 Feb 2022
18. NASA: Urban Air Mobility Airspace Integration Concepts and Considerations. Conference Paper, 24 June (2018)
19. National Aeronautics and Space Administration: Advanced Air Mobility Project, (2021). <https://www.nasa.gov/aeroresearch/programs/iasp/aam/description/>. Accessed 14 Feb 2022
20. United States National Academies of Science, Engineering and Medicine: Advancing Aerial Mobility: A National Blueprint. (2020)
21. Volocopter: 'The Roadmap to Scalable Urban Air Mobility'. Edition 2.0, (2021)
22. Online Latin Dictionary: Urbs. <https://www.online-latin-dictionary.com/latin-english-dictionary.php?parola=urbs>. Accessed 14 Feb 2022
23. Oxford Dictionaries: Air. https://www.oxfordlearnersdictionaries.com/definition/english/air_1. Accessed 14 Feb 2022
24. Aviation Tourism: Partnership Between SEA Milan Airports and Skyports for the Development of Vertiports in Italy. <https://www.aviontourism.com/it/informazioni-utili/info-utili/nuove-tecnologie/partnership-tra-sea-milan-airports-e-skyports-42266>. Access 14 Feb 2022
25. Jordan McKay: 'What's the Difference and Why Does It Matter?' 13 November 2019, <https://www.forumforthefuture.org/blog/trans-port-or-mobility>. Accessed 14 Feb 2022
26. Malaud, F.: Urban Air Mobility: Is This a Different Way of Saying 'Aviation in Cities'? <http://www.unitingaviation.com>. Accessed 14 Feb 2022
27. Reuters: German Firm's Air Taxi Aims to be Operational for Paris 2024 Olympics. <https://www.reuters.com/lifestyle/sports/german-firms-air-taxi-aims-be-operational-paris-2024-olympics-2021-06-21/>. Access 14 February 2022
28. UAM Explained: Creating a Common Language on Urban Air Mobility (UAM), 31 January 2022, <https://www.safir-med.eu/uam-explained>. Accessed 13 Feb 2022

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Konstantinos Andritsos studied his Bachelor's in Law at the European University Cyprus, focusing on both Continental and Common Law. In 2020, he obtained an LLM (Adv.) in Air and Space Law from the International Institute for Air and Space Law at Leiden University. He is pursuing a PhD in Aviation Law at the University of Cologne, where his research mainly focuses on the legal implications of the proposed advanced urban mobility systems on the concept of a smart city. Mr Andritsos has a strong background in commercial and corporate law, having worked as a barrister and a mediator on these sectors.

Benjamyn I. Scott is an Assistant Professor at Leiden University working at both the International Institute for Air and Space Law, and eLaw – Centre for Law and Digital Technologies. Dr Scott holds an LLB (Hons) in Law with EU Legal Studies from the University of Kent and the University of Amsterdam, an LLM in International Commercial Law with a focus on space law from the University of Kent (Distinction), an LLM (Adv.) in Air and Space Law from Leiden University (*cum laude*), and a PhD in Law from the University of Cologne (*magna cum laude*). Dr Scott's PhD thesis explores the regulatory approach taken at a European and international level to aviation cybersecurity. Dr Scott has a strong background in developing and emerging

transportation technologies, where he has concentrated on unmanned aircraft systems, urban air mobility, cybersecurity, artificial intelligence and unmanned traffic management. Here, Dr Scott has supported different stakeholder groups, presented at conferences, published journal articles and books, and lectured at different universities around the world. Finally, he is also a member of the Board of Editors of the *Air & Space Law* journal.

Andrea Trimarchi is an aviation law expert and consultant. He was awarded his PhD from the University of Cologne in 2021 and obtained an Adv. LL.M. in Air and Space Law from the International Institute of Air and Space Law, Leiden University in 2016, and an LL.M. from the University of RomaTre in 2014. Dr Trimarchi regularly delivers lectures and speaks at conferences. He is the author of numerous scientific publications in the areas of aviation law, competition law and public international law. His most notable publications are the textbook 'Fundamentals of International Aviation Law and Policy' (Routledge, 2020) and the monograph 'International Aviation Labour Law' (Routledge, 2022).