Urban Air Mobility Overview – the European Landscape

Vadim Kramar
Oulu University of Applied Sciences
Oulu, Finland
vadim.kramar@oamk.fi

George Nikolakopoulos
Luleå University of Technology
Luleå, Sweden
george.nikolakopoulos@ltu.se

Juha Röning
University of Oulu
Oulu, Finland
juha.roning@oulu.fi

Filippo Tomasello
University Giustino Fortunato
Benevento, Italy
f.tomasello@unifortunato.eu

***Abstract*—Future small aircraft systems, including those having a pilot on-board, remotely operated or piloted, and fully autonomous, will be capable of operating in often unstructured and dynamic environments in a safe and efficient manner and simultaneously work towards assigned mission objectives without being extensively controlled or continuously supervised by human operators. Air is a third dimension to the traditional transportation modalities and mobility solutions that typically had not been earlier considered as a part of Smart City planning. And in order to foster its enabling this paper gives an introductory overview of Urban Air Mobility and its elements. The overview includes the historical retrospective, the observation of European initiatives and legislation, the statements on the standardisation effort, as well as clarification of relevant terms and key elements of Urban Air Mobility available at the time of work on this publication.**

I. Introduction

Unmanned Aircraft Systems (UAS) have proven their importance and efficiency in civil operations, including assistance to first responders in cases of emergency, environmental monitoring, border control, etc. The interest in their use for enabling the third dimension in Smart City design has grown significantly over time. One of the recent studies [1] defines ten application areas for UAS from which Smart Cities can benefit. Those are traffic monitoring and management, health emergency services, security and crowd monitoring, UAS-based infrastructure inspections, agriculture management and environmental monitoring, tourism support, UAS-based surveying, large-scale disaster management, merchandise order delivery and UAS-aided wireless communications. However, enabling these applications in populated areas requires air and urban spaces rules refinement and extension.

The European Legislator, through Articles 57 and 58 of Regulation 2018/1139 [2], so-called European Union Aviation Safety Agency (EASA) 'Basic Regulation', tasked the European Commission (EC) to promulgate implementing and delegated regulations on all aspects of Unmanned Aircraft Systems (UAS) including on UAS Traffic Management (UTM), which in the European Union (EU) is often nicknamed 'U-space'. EC, therefore initially promulgated Delegated Regulation EU 2019/945 [3] for putting UAS on the EU internal market and EU 2019/947 [4] on UAS operations in the 'open' and 'specific' category. These two regulations are performance-based and risk-based, as well as enabling the evolution of UAS technologies without legal impediments. They also cover UAS imported into the EU from anywhere in the world, maintenance aspects, competency of crew and how to operate UAS safely and securely. Safety and security are achieved through operational limitations and regulatory processes, more than dictating specific technical solutions.

Safety is obviously the primary concern for both manned (i.e. human pilot onboard) or unmanned aviation (i.e. no longer pilot on-board) [20],[21],[22],[23],[24]. In Europe, that is well seeing through the effort to maximise the safety of air operations by such European bodies like EASA, EUROCONTROL, Single European Sky ATM Research (SESAR) Joint Undertaking, and the European Commission itself.

Within the scope of this publication, the authors will primarily use terms specified in EU legal acts, such as RP, UA, UAS, and UAS operator. According to EU Basic Regulation and Delegated Regulation 2019/945 [3], these definitions have the following meaning:

(1) 'remote pilot' (RP) means a natural person responsible for safely conducting the flight of an unmanned aircraft by operating its flight controls, either manually or, when the unmanned aircraft flies automatically, by monitoring its course and remaining able to intervene and change the course at any time;

(2) 'unmanned aircraft' ('UA') means any aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board; i.e. only the aircraft in the air and not its station on the ground;

(3) 'equipment to control unmanned aircraft remotely' means any instrument, equipment, mechanism, apparatus, appurtenance, software, or accessory that is necessary for the safe operation of a UA other than a part and which is not carried on board that UA; this include the 'cockpit' of the remote pilot, usually on the ground, which is called 'Remote Pilot Station' (RPS) in International Civil Aviation Organization (ICAO), 'Command Unit' (CU) in EU Regulations or often 'Ground Control Station' (GCS) by industry;

(4) ‘unmanned aircraft system’ (‘UAS’) means a UA and the CU to control it remotely, from the ground or from another vehicle; this term also includes the ‘Command and Control’ (C2) data link between the two and any other element specified in the UAS design (e.g. catapult);

(5) ‘unmanned aircraft system operator’ (UAS operator) means any legal or natural person that is operating or intending to operate one or more UAS. This is typically a commercial company (the employer) in which the remote pilots are employees. In the simplest case (e.g. a photographer using a drone), the owner of the UAS, the operator holding the legal responsibilities and the remote pilot may be a single natural person.

In this paper, the following acronyms and terms are to be considered interchangeable as they all are used in reference literature: Unmanned Aerial Vehicle (UAV), UA, and drone. The term UAV is not officially used by ICAO, EASA or Federal Aviation Administration (FAA), because, based on Annex 7 to the Chicago Convention [5],[6], UAS are, in fact, ‘aircraft’ and not generically ‘vehicles’. The term UAV was promoted by industry around the year 2000 to escape the aviation regulations of the time, which were disproportionate to accommodate small UAS. Now, the mentioned EU Regulation accommodate any UAS, from a toy aircraft of fewer than 250 grams to a large Remotely Piloted Aircraft (RPA) of several tons, with administrative procedures proportionate to the risk perceived by society. The term UAV is hence no longer necessary, although it is still widely used, especially by the media.

In any case, interpreting UA as “lightweight aircraft” is not appropriate since some UA are heavy-duty drones able to carry a payload of thirty or more kilograms, e.g., GRIFF [7], and some of those are as heavy as conventional long-range aircraft, e.g., NATILUS [8] or Northrop Grumman MQ-4C Triton [9].

For the urban environment, and even the short-range transportation currently covered by traditional aviation, autonomous or semi-autonomous air taxis or electrified aircraft have already a good history of development and even successful demonstrations of their operations. Those kinds of transportation means are developed by manure companies, small and medium enterprises, and startups, including Airbus [10], EHang [11], Volocopter [12], Lilium [13], Ascendance [14], Pipistrel [15], Quantum Systems [16], Tecnalia [17], MOOG [18], and Uber [19].

To better understand the difference between the ‘remote pilot’ and the ‘operator’, it could be useful to briefly recall the history of aviation. When the Wright brothers first flew in 1903, there was no idea of any safety certification or oversight. A few years later (i.e. 1910), the need to attest the competency of a pilot through a ‘licence’ or similar attestation emerged in several States. The Certificate of Airworthiness (CofA) for the individual aircraft was introduced after the first world war, in the UK in 1919. These two attestations were included in the International Convention on Aerial Navigation (ICAN; the precursor of ICAO) signed in Versailles in the same 1919.

When, at the end of the second world war, a new Convention on international civil aviation was signed in Chicago on 7 December 1944, Articles 31 and 32 therein enshrined in fact the CofA and the pilot licence. These two were considered the essential elements contributing to aviation safety.

From 1944 to 1977, aviation safety dramatically improved, in fact focusing on technical aspects (i.e. aircraft design, production and maintenance, as well as aerodromes and Air Navigation Systems) and on methods to reduce the probability of error by the human, considered as a single individual.

But, on 27 March 1977, the most terrible aviation catastrophe, causing almost 600 fatalities, occurred at the Los Rodeos aerodrome on the Tenerife island. There, two Boeing B-747 (‘jumbo jet’) full of passengers and of fuel collided on the runway. The investigation found that the two aircraft were perfectly airworthy. And that the crew were properly trained, rated and medially fit, having made no mistakes when operating the controls in the cockpit. The accident was instead caused by poor communication and misunderstandings inside the various involved teams and in the relationship between different teams, such as between the pilots in the cockpit and the Air Traffic Control Officers (ATCO) in the control tower.

After a long debate, the community hence concluded that also the ‘organisations’ were relevant to ensure aviation safety. In 1990 the standard to certify the operators of commercial air transport (i.e. the organisation of the airlines) was consequently introduced in Annex 6 to the Chicago Convention. This was later applied also to the operators of aerodromes and, in the EU, to the providers of Air Traffic Management/Air Navigation Services (ATM/ANS).

The focus on the ‘organisations’ allowed to improve the safety of international civil aviation further. However, now aviation is progressing towards ‘digitalisation’ not only in the case of UAS but also in traditional ‘manned’ aviation. This means that safety will depend not only on one organisation but, more and more, on several interconnected organisations exchanging in real-time among them data relevant for safety.

This evolution is depicted in Fig. 1, extracted from the 4th edition (2018) of the ICAO Safety Management Manual (Doc 9859) [25].

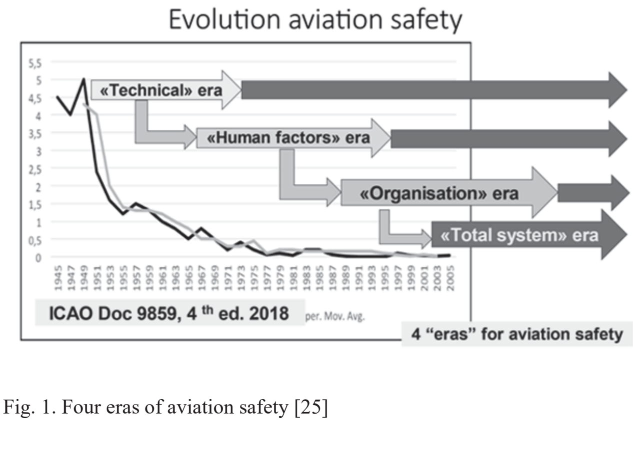

Fig. 1. Four eras of aviation safety [25]

According to the vision developed by one of the authors of this paper, the 'total system' has to be seen not only in terms of exchange of digital data but also in terms of interface among the safety management systems of several organisations, as depicted in the taxonomy of safety rules, also known as 'Pyramid of Tomasello', see Fig. 2.

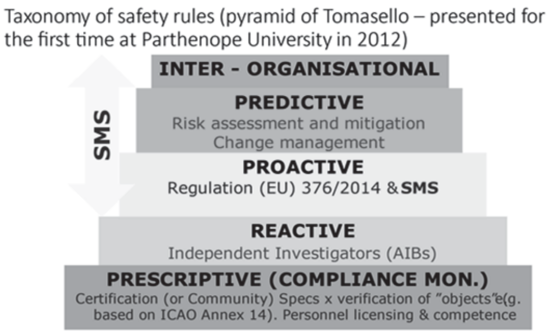

Fig. 2. Taxonomy of safety rules

Nevertheless, due to such challenging safety factors as high density of people per every square measure, complicated construction, obstacle and infrastructure elements of the city landscapes, and sharing the same airspace with traditional aviation at the airport areas and helipads, operations of UAS in the urban environment at lower altitudes are more complicated than anywhere else [26]. Here, the concept of Urban Air Mobility (UAM) applies.

II. Urban Air Mobility

According to EASA, "UAM is a new safe, secure and more sustainable air transportation system for passengers and cargo in urban environments, enabled by new technologies and integrated into multimodal transportation systems [27]. The transportation is performed by electric aircraft taking off and landing vertically (i.e. VTOL), remotely piloted or with a pilot on board." UAM, in the EASA vision, is part of 'Innovative Air Services' (IAS) [28] which also include aerial work using drones, still at a very low level and possibly over urban areas, hence posing the same safety risks of drones used for transportation.

Indeed, paragraph 60 of the Sustainable and Smart Mobility Strategy adopted by the EC states that "The Commission fully supports the deployment of drones and unmanned aircraft, and will further develop the relevant rules, including on the U-space, to make it fit for enhancing safe and sustainable mobility. The Commission will also adopt a 'Drone Strategy 2.0' setting out possible ways to guide the further development of this technology and its regulatory and commercial environment." [29]. It is even specified that the "Further development of the regulatory framework for drones and unmanned aircraft, including U-Space" and the adoption of the European Drone Strategy 2.0 [30] will be finalised by 2023.

But what is U-space, then? Let's go back to history as it is reflected by the European Commission [31].

In 2015, Aviation Strategy for Europe [32] called for the development of a basic legal framework for safe drone operations in the EU, as well as the development of detailed rules and related industry standards. The latter is in fact, an essential element of performance-based Regulation, launched by the ICAO General Assembly in 1998 [33].

In 2016, the Warsaw Conference on Drones further called for urgent action on the airspace dimension. That was the time when the concept of the U-space started to emerge. The demand for a range of digital services enabling the safe scaling up of routine drone operations was set. In fact, according to ISO 23629-12 UTM (U-space) is: "A set of traffic management and air navigation services aiming at safe, secure and efficient integration of multiple manned and unmanned aircraft flying inside the respective Designated Operational Coverage (DOC) of each service." [34].

In 2018, the European Council and the Parliament adopted a new EASA Basic Regulation 1139 [2], establishing a performance-based (i.e. reliance on standards developed by industry), risk-based (i.e. more declarations and fewer approvals, as well as notified bodies and qualified entities to verify compliance) and operations-centric (i.e. the operator is the main legal actor) approach to legislating in the field of aviation safety, both manned and unmanned. This Regulation also extended EU competence to all drones, regardless of weight and size [2], since before it, such competence was only for drones above 150 kg.

As already mentioned, in 2019, the European Commission adopted the first set of detailed requirements applicable to the unmanned aircraft systems (Delegated Regulation 2019/945 [3]) and the rules and procedures for the operation of unmanned aircraft (Implementing Regulation 2019/947 [4]). Both regulations are currently in force, and the community is transitioning towards their complete applicability. A transitional period, in fact, applies until 02 December 2025, after the last postponement (i.e. Implementing Regulation 2021/1166 [35]).

Thereafter, in 2021, the Commission adopted a regulatory framework for the U-space (Implementing Regulation 2021/664 [36]) along with modifications of the Implementing Regulation 2017/373 regarding the common requirements for air traffic management (ATM), air navigation service (ANS) providers and other functions of the ATM network in designated U-Space airspace in controlled airspace (Implementing Regulation 2021/665 [37]) and amendments to the Standardised European Rules of the Air (SERA; Regulation 923/2012) as regards the requirements for manned aviation operating in U-Space airspace (Implementing Regulation 2021/666 [38]). From that time on, the era of UAM in Europe took its shape. The regulatory package is expected to become applicable on 26 January 2023 [36].

The standards to be developed by industry, which are an essential component of performance-based Regulation, yet lag behind, but they are being progressed by several Standard Development Organisations (SDOs) to complement the regulations. For example, AeroSpace and Defence Industries Association of Europe, ASD-STAN, Domain D05 Autonomous Flying, Working Groups of D05, particularly the Working Group 08, Unmanned Aircraft Systems contributes to the development of standards covering the requirements imposed on the consumer drones intended to be operated in the 'open' category of operations (such as EN 4709 series of standards [39],[40],[41],[42]). Furthermore, ASD-STAN is also initiating standardisation of drones in 'Classes' C5 and C6 for standard scenarios in the 'specific' category. ASD-STAN has been tasked to draft the series of EN 4009-XXX standards by the European Committee for Standardization (CEN) since CEN has received a mandate for this purpose by the European Commission. In the end CEN will publish the European Norms (ENs), which, in Europe, have the same status of International Organization for Standardization (ISO) standards and hence, the accredited Notified Bodies would be enabled to verify conformity of UAS products.

In addition, the European Organisation for Civil Aviation Equipment (EUROCAE), Working Group 105, is developing a range of standards and guidance documents related to the safe operation of UAS within all types of airspaces. Several other SDOs are involved (e.g. ASTM, RTCA, etc.), among which the ISO, which is developing ISO 5491 [43] for the 'vertiport' infrastructure through its Sub-Committee (SC) 17 of Technical Committee TC 20 [44]. The scope of TC 20 (Aircraft and space vehicles) is quite wide, spanning from satellites to ground equipment at airports and aircraft components (alloys, piping, connectors, etc.). The work is hence progressed through several SCs. Among them, in our case, the most relevant is SC 16 on UAS, which has already produced five ISO standards [44] and which is developing 25 more.

In particular, the series 23629-XX is a set of standards specifying a variety of aspects relevant to UTM. This series, 23629-12 [34], contains a list of thirty UTM digital services, classified as safety-critical, safety-related or operation support. For each category of safety criticality, more or less stringent standards are applicable to the responsible service provider, including for safety, security, privacy, liability, competency of personnel, maintenance, contingency and emergency plans and so on. Worthy of mentioning is 23629-5 standard that defines the functional structure of UTM [45], 23629-7 standard that data model for UTM spatial data [46], and 23629-8 standard that defines remote identification for UAS utilising UTM [47].

The U-space project was launched by EASA in 2018 [48]. The important considerations developed during the recent years are regarding the traffic of UAS were the provision of services, the volume of airspace, the information exchange, and connectivity. A combination of safety means included airspace design, dynamic reconfiguration of the U-space, electronic conspicuity of manned aircraft operating in U-space airspace, the area of traditional aviation, or controlled airspace, which is the subject of Air Traffic Management. Also, it includes the certification of providers of safety-critical U-space services. Importantly, the availability of the common information was considered and information exchange among- and communication between the different elements of airspace [48].

Many confuse U-space and UTM. They are not exactly the same. UTM is in fact, the UAS Traffic Management [49],[50],[51],[52]. That is the system designed and implemented to manage the traffic of Unmanned Aircraft Systems. Concept of Operations for EuRopean UTM Systems (CORUS) project [53] made the most significant contribution into the development of UTM concept [49],[50],[51]. UTM systems may be developed by UTM vendors. National Aviation Authorities or Civil Aviation Authorities in different European countries may decide that only one UTM system will be adopted in the country or several from different vendors. Vendors of hardware and/or software, however, do not provision the UTM systems. U-space Service Providers do.

U-space Service Providers (USSP) [36], [50] acquire from Aviation Authorities licence or other permission or certification to provide safety-critical or safety-related UTM services, come to contractual agreements with UTM vendors and offer UTM services to UAS Operators on a commercial basis. UAS Operators are organisations and private individuals that are registered as such, have registered their UAS fleet, underwent the required education and, whenever needed – certification, and perform actions compliant with the current regulations at any stage of the UAS operation.

Air Navigation Service Provider (ANSP) [37],[38], [49],[50],[54], by being accountable for controlled airspace, is responsible for the dynamic reconfiguration of the airspace to ensure the segregation of unmanned aircraft traffic from manned aircraft[55].

Common Information Service (CIS) Provider [34],[36] ensures the exchange of static and dynamic information among all involved UTM service providers, vertiport operators and other Air Navigation Service Providers, as necessary for safe operations in a volume of airspace where manned and unmanned aviation coexist. USSP cannot be the CIS provider and vise-versa to avoid the conflict of interests.

Civil Aviation Authority (CAA) [49],[50] oversees the entire ATM-UTM ecosystem and is responsible for the certification and continuous supervision of the UAM actors. In addition to the already mentioned, a long list of UAM actors includes a variety of other service providers and UTM data suppliers, manufacturers, aviation users and other stakeholders.

As UTM is the central element of UAM, there is a broad range of UTM services. More than 30 services are specified by Implementing Regulation 2021/664 [36] and ISO 23629-12 [34]. Six of those are worthy of mentioning.

Flight Authorisation or Clearance Service, FCS

Provides means for:

- UAS operators to enter respective operation plans through web-based tools;
- Confirmation of completeness and acceptability of the operation plan; and
- Before take-off, authorisation to the UAS operator to enter the UTM airspace under the terms and conditions specified by the FCS Provider in the clearance.

This is a mandatory service according to the Implementing Regulation 2021/664 [36].

Geo-Awareness Service, GAW:

Provides to UAS operators and their crews during the flight, including the pre-flight phase:

- information related to geographical zones in which UAS operations are permitted, subject to certain conditions or prohibited, based on decisions by the competent authorities; and
- relevant data from the AIMU (Aeronautical Information Management for UAS) to support the UAS geo-awareness functions.

This is a mandatory service according to the Implementing Regulation 2021/664 [36].

Traffic Information Service, TIS:

Provides the UAS operator with information on other known or observed manned or unmanned air traffic which may be in proximity to the position or intended route of the UA flight to alert and to help the UAS remote crew to avoid a collision.

This is a mandatory service according to the Implementing Regulation 2021/664 [36].

Network Identification Service, NIS:

Continuously receive and process the information transmitted by the (direct) remote (electronic) identification (E-ID) function of the UAS throughout the whole duration of the UA flight and distribute it to authorised UTM users or other UTM SPs for security and enforcement purposes.

This is a mandatory service according to the Implementing Regulation 2021/664 [36].

Conformance Monitoring Service, CMS

- ensures that the aircraft to be operated in the UTM DOC have adequate technical capabilities for utilising the necessary UTM services and for exchanging the required information within the airspace being flown; and
- ensures that UA, during their operations, comply with the clearances received through FCS (Flight Clearance Service).

This is an optional service according to the Implementing Regulation 2021/664 [36].

Weather Information Service, WIS

Collects, store and process weather information from trusted sources and distributes relevant information on forecast and actual weather to support operational decisions by:

- other UTM actors, including UTM SPs and vertiport operators; and
- UAS operators either before or during the flight.

This is an optional service according to the Implementing Regulation 2021/664 [36].

The other services [34],[49],[50] will be implemented in the future as well.

The other important element of UAM is the Concept of Operations, or ConOps [49],[50], and Specific Operations Risk Assessment, SORA [56] by Joint Authorities for Rulemaking on Unmanned Systems, JARUS. As stated in the Easy Access Rules for Unmanned Aircraft Systems [57] developed by European Union Aviation Safety Agency, the applicant must collect and provide the relevant technical, operational and system information needed to assess the risk associated with the intended operation of the UAS, and the SORA (AMC1 Article 11 of the UAS Regulation) provides a detailed framework for such data collection and presentation. The ConOps description is the foundation for all other activities and should be as accurate and detailed as possible. The ConOps should not only describe the operation but also provide insight into the UAS operator's operational safety culture. It should also include how and when to interact with the air navigation service provider when applicable.

The final part of Urban Air Mobility consists of other elements required for safe UAS operations. Those elements include Internet fo Things (IoT) architecture and Digital Twin implementation, security systems, server and computing infrastructure, graphical user interfaces and visualisation, fixed sensors and other transportation modalities, including autonomous vehicles. Possible, it may include multimodal adaptive and pursuative end-user devices, gadgets, as well as generic and specific infrastructure elements [58].

III. Discussion

The outdated perception of UAM as the subject of passenger transportation [59] involved significantly in recent years. The recently given by EASA perspective of UAM development is that among the first commercial operations, the delivery of goods by drones and the transport of passengers are expected [60]. Initially, that is likely to happen with a pilot on board, while later on, remote piloting or even autonomous services could follow [60].

National Aeronautics and Space Administration (NASA) of the United States introduced the concept of Advanced Air Mobility that is solely based on UAM [61]. The initiative aims to help the development of "an air transportation system that moves people and cargo between places previously not served or underserved by aviation – local, regional, intraregional, urban" [61].

Nevertheless, the UAM concept is not relevant to transportation only where the air brings a third dimension to the traditional transportation modalities, such as those based on ground and water. The concept of UAM is much broader than that. It covers all the operations of UAS in the urban environment as well as UAS operations in sub-urban, peri-urban and inter-urban environments [62]. As it is seen from the observations presented above, the concept of UAM ranges beyond the urban environments. Therefore, the majority of safety considerations of Urban Air Mobility are valid for Rural Air Mobility as well.

Even though there is a lot of discussions about the UTM systems, there is no clear common understanding of this concept. The earlier vision was that UTM is to support UAS operations Beyond Visual Line of Sight (BVLoS) [63], while the recent understanding implies any application of UAS [64], including those within Visual Line of Sight (VLoS). In the Final Operations & UTM requirements by CORUS [51], nine scenarios are described. Among those two are the VLoS applications, such as photo activity and recreational activity, and six are the BVLoS applications, such as farming activity, building inspection, vineyard fungicide spraying, seed sowing, police surveillance, and runway inspection. Instrument Landing Systems (ILS) measurement though was considered as the subject of both the VLoS and BVLoS UAS operations.

Just recently, EASA conducted an extensive study on the societal acceptance of Urban Air Mobility in Europe [65], which unveiled the important opportunities and benefits for the European citizens, such as faster, cleaner and extended connectivity provided by UAM. At the same time, the study recognised particular challenges, such as the willingness of the EU citizens to limit their own exposure to safety, noise, security and environmental impact [65]. It had also been found that the expected "integration of UAM into the existing air and ground infrastructure must respect residents' quality of life and the cultural heritage of old European cities" [65].

About a decade ago, the EC introduced the concept of Sustainable Urban Mobility Plan (SUMP), which is "a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life. It builds on existing planning practices and takes due consideration of integration, participation and evaluation principles" [66],[67]. The recently updated guidelines and the community effort to plan and implement SUMPs [68], particularly concerning UAM, may be expected to respond to the discovered challenges.

IV. Conclusion

Currently, several international projects funded by the European Commission through the Horizon 2020 Framework Programme contribute to the development of UAM in Europe. Those are Flying Forward 2020 [69], AiRMOUR [70], and Aurora [71] projects funded under MG-3-6-2020 topic [62], and Assured UAM project [72] funded under LC-MG-1-12-2020 topic. In addition to that, several earlier funded through a variety of European funding instruments international projects such as 5G!Drones [73] and AW-Drones [74], and national projects in many European countries contribute to the development of the UAS and UAM domains. For example, in Finland, those are FUAVE project [75] funded by the Academy of Finland and DroLo project [76] funded by Business Finland.

UAM Initiative Cities Community (UIC2) initiative [77] unites the key stakeholders that have to be involved in the arranging of U-space operations. Those are European cities. The initiative members discuss social, organisational, financial, implementational, and many other aspects relevant to UAM as city-centric and citizen needs-driven. Among the investigated challenges are urban planning and ground infrastructure for UAM, planning the U-space operation zones and implementation of the UTM concept, interfaces with other transportation modalities and interoperability of UAM elements and their integration into the existing business processes, supply chain and ICT systems, legislative challenges and lack of widespread understanding of benefits the UAM may bring to the European citizens, development and implementation of SUMPs.

Even in the case of Urban Air Mobility, one should not forget that to ensure sufficient safety we need to look not only at technology, but also to the involved organisations and mutual interfaces into a comprehensive 'ecosystem'. Horizon 2020 Framework Programme -funded project Flying Forward 2020 [69] is contributing to develop such ecosystem, whose boundaries extend beyond aviation.

UAM is a complex domain, and we are yet at the very beginning of our journey. During the following years, we will observe the rapid development of this domain. To make the successful operations of UAS within the UAM concept happen, a lot of effort has to be devoted to resolving the current challenges and those that we are still to recognise.

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