Towards the 3rd dimension of urban transport: Is the upcoming model of advanced urban mobility just another aircraft network?

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List of Abbreviations

AAM	Advanced Air Mobility
AAM SG	Advanced Air Mobility Study Group
ACI	Airports Council International
AG	Aktiengesellschaft
Air OPS	Air Operations
AMC	Acceptable Means of Compliance
AN-Conf.	Air Navigation Conference
ANC	Air Navigation Commission
ANS	Air Navigation Services
AOC	Air Operator Certificate
Art.	Article
ATC	Air Traffic Control
ATM	Air Traffic Management
CAA	Civil Aviation Authority
CANSO	Civil Air Navigation Services Organisation
CATS	Complete Air Traffic System
CC44	Chicago Convention 1944
CE marking	Conformité Européenne marking
Ch.	Chapter
CISP	Common Information Provider
CITEJA	Comité International Technique d”Experts Juridique Aériens
CJEU	Court of Justice of the European Union
CTR	Control Traffic Region
D.L.R.	Deutsche Luft-Reederei
DLR	Deutsches Zentrum für Luft- und Raumfahrt
Doc.	Document

EASA	European Union Aviation Safety Agency
EC	European Community
ECJ	European Court of Justice
Ed./Eds.	Edition/Editions
EEC	European Economic Community
ELFAA	European Low Fares Airline Association
EPAS	European Plan for Aviation Safety
EU	European Union
EUROCAE	European Organisation for Civil Aviation Equipment
eVTOL	electric Vertical Take-Off and Landing aircraft
FAA	Federal Aviation Administration
FCL	Flight Crew Licensing
GANP	Global Air Navigation Plan
GASP	Global Aviation Safety Plan
GDP	Gross Domestic Product
GM	Guidance Material
GmbH	Gesellschaft mit beschränkter Haftung
IAM	Innovative Air Mobility
IAS	Innovative Air Services
IATA	International Air Transport Association
Ibid.	Ibidem
ICAN	International Commission for Air Navigation
ICAO	International Civil Aviation Organization
ICCAIA	International Coordinating Council of Aerospace Industries Associations

ICJ	International Court of Justice
ID	Identity Document
IFR	Instrument Flight Rules
IMF	International Monetary Fund
JFK	John F. Kennedy International Airport
KLM	Koninklijke Luchtvaart Maatschappij
MoC	Means of Compliance
MTOM	Maximum Take-Off Mass
NAM	New Air Mobility
NASA	National Aeronautics and Space Administration
No./Nos.	Number/Numbers
OECD	Organisation for Economic Co-operation and Development
OEMs	Original Equipment Manufacturers
OWE	Operating Weight Empty
PANS	Procedures for Air Navigation Services
PART-AR.UAS	PART Authority Requirements Unmanned Aircraft Systems
RMT.	Rule Making Task
ROA	Remotely Operated Aircraft
ROV	Remotely Operated Vehicle
RPA(s)	Remotely Piloted Aircraft
RPV	Remotely Piloted Vehicle
SARPS	Standards and Recommended Practices
SC-VTOL	Special Condition for Vertical Take-Off and Landing aircraft
SERA	Standardised European Rules of the Air

SES	Single European Sky
SUPPs	Supplementary Procedures
TFEU	Treaty on the Functioning of the European Union
U.N.	United Nations
U.S.	United States
U.S. CAB	United States Civil Aeronautics Board
U.S.A.	United States of America
UA	Unmanned Aircraft
UAE	United Arab Emirates
UAM	Urban Air Mobility
UAS	Unmanned Aircraft System(s)
UAV	Unmanned Aerial Vehicle
UIC2	Urban Air Mobility Initiative Cities Community
UNCLOS	United Nations Convention on the Law of the Sea
USSP	U-space Service Provider
UTM	Unmanned Traffic Management
v.	versus
VCA	VTOL-capable aircraft
VFR	Visual Flight Rules
VLOS	Visual Line of Sight
VTOL	Vertical Take-Off and Landing aircraft
WP	Working Paper
WWII	World War II

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INTRODUCTION

A. INTRODUCTORY REMARKS

Humanity has always sought to evolve, to break the boundaries set by nature, and to achieve greater heights. In this long evolutionary quest, humans became envious of birds and their ability to fly freely in the skies, seeing everything and everyone from above. This desire to emulate birds and their ability to roam in the skies is reflected in early stories of the human imagination, as seen in Greek mythology, where Daedalus and Icarus were portrayed as having managed to fly across the Aegean Archipelago. Tragically, Icarus flew too close to the sun and lost his life before reaching Athens, depicting the limitations and dangers brought by human arrogance. Leonardo da Vinci famously stated, *"Human subtlety will never devise an invention more beautiful, more simple, or more direct than nature, because in her inventions nothing is lacking and nothing is superfluous.*"[1] This verifies the above statements, highlighting the significance of biomimicry in humanity's study of nature's designs and patterns as it strives to evolve.

In 1783, humanity achieved what had previously been a mythological concept: the Montgolfier brothers launched the first successful manned hot air balloon in France, marking the beginning of manned flight and human air travel.[2] About 120 years later, the Wright brothers broke another barrier by accomplishing the first sustained powered flight. Their prototype aircraft, the Wright Flyer, flew for 12 seconds and 120 feet.[3] But the above was not the end. The 20th century was a ground-breaking era for aviation. Following the Wright brothers' achievement, the St. Petersburg–Tampa Airboat Line began the world's first scheduled fixed-wing airline service on January 1, 1914, operating

1 See, (HTTPS://WWW.LEONARDODAVINCI.NET/QUOTES.JSP), accessed (11-10-24).

2 See, Brinkhoff, *Introduction,* in Hobe, von Ruckteschell, and Heffernan (eds.), *Cologne Compendium on Air Law in Europe* (Carl Heymanns, 2013), at 5.

3 Ibid.

flights between St. Petersburg and Tampa, Florida.[4] Between 1920 and 1930, several air carriers were established, including KLM -Koninklijke Luchtvaart Maatschappij N.V. (founded in 1919)[5] and Deutsche Luft-Reederei -D.L.R. (founded in 1917)[6], both of which contributed to the growth of commercial air travel. This technological revolution reached its peak with the introduction of jet engines, which transformed air transport into the operational model present today. Aircraft such as the de Havilland Comet entered service in the early 1950s7, followed by the Boeing 707, making international travel faster and more accessible than ever before.[8]

In the present, aviation, despite the unprecedented challenges brought on by the SARS-CoV-2 pandemic, remains a vital sector of the EU economy. It supports approximately 5 million jobs and contributes €300 billion, representing 2.1% of the European GDP.[9] Although the COVID-19 pandemic (2019-2021) dealt a severe blow to the industry and even threatened its survival at times, European flights in 2024 reached 96% of 2019 levels, totalling 10.7 million flights in the region overseen by EUROCONTROL.[10] This significant recovery underlines the resilience of the aviation industry.

As portrayed in the aforementioned data, aviation is a robust sector that is crucial for various domains within states and for millions of people. It has drastically reduced travel times compared to older modes of transport, such as ground or maritime travel, with major financial and cultural implications.

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4 See, (HTTPS://WWW.IATA.ORG/EN/ABOUT/HISTORY/FLYING-100-YEARS/FIRSTAIRLINE-STORY), accessed (11-10-24).

5 See, supra note 2 at 6.

6 Ibid.

7 See, (HTTPS://WWW.BRITANNICA.COM/TECHNOLOGY/AEROSPACE-ENGINEERING#REF257005), accessed (11-10-24).

8 See, (HTTPS://WWW.BRITANNICA.COM/TECHNOLOGY/BOEING-707), accessed (11-10-24).

9 See, (HTTPS://TRANSPORT.EC.EUROPA.EU/TRANSPORT-MODES/AIR_EN), accessed (11-10-24).

10 See EUROCONTROL, European Aviation Overview (2024).

Aviation has made the world feel smaller by bridging distances and sparking human curiosity to reach even greater heights, introducing a new age of discovery concerning outer space and other planets.

Traditionally, the main aviation business model has focused on transporting people or cargo from point A to point B, whether within the same country or across different countries and continents. But what about the connections between points A and B within the same city or metropolitan area?

Urban traffic congestion constitutes a significant challenge in many cities across the European Union (EU), resulting in considerable economic losses (associated with time) and environmental issues. According to the European Commission's Joint Research Centre, the COVID-19 pandemic initially led to a decrease in urban transport activity; however, traffic levels are now rebounding and are expected to surpass the pre-pandemic numbers.[11] This traffic recovery can be attributed to increased car usage and a decline in usage of public transport, which remains 20-30% below 2019 levels in numerous cities.[12] Recent data highlights the severity of congestion in several EU capitals:

- Dublin, Ireland[13:] Commuters spend an average of approximately 41 minutes a day in traffic, which totals approximately 155 hours annually. This congestion results in an estimated financial loss of 6,587.50€ per driver each year, based on Ireland's hourly labour cost of €42.50[14];

11 See, (HTTPS://URBAN-MOBILITY-OBSERVATORY.TRANSPORT.EC.EUROPA.EU/NEWS-EVENTS/NEWS/JRC-PUBLISHES-REPORT-POST-PANDEMIC-TRENDS-URBAN-MOBILITY-2023-07-19_EN), accessed (11-10-24).

12 Ibid.

13 See, (HTTPS://WWW.TOMTOM.COM/TRAFFIC-INDEX/RANKING/), accessed (11-10-24).

14 See, (HTTPS://EC.EUROPA.EU/EUROSTAT/STATISTICS-EXPLAINED/INDEX.PHP?TITLE=HOURLY_LABOUR_COSTS), accessed (11-10-24).

- Paris, France[15]: Drivers lose about 101 hours a year due to traffic jams, equivalent to a financial impact of 4,413.70€ per driver, factoring in France's hourly labour cost of €43.7016;
- Brussels, Belgium[17]: Motorists experience around 118 hours of delays in traffic each year, leading to an estimated loss of 5,687.60€ per driver, based on Belgium's hourly labour cost of €48.20[18].

When connecting the dots from the above data, one question comes to mind: How can aviation help address the growing problem of traffic congestion in metropolitan, urban, and urbanised[19] areas in the EU? While helicopters can play a role in alleviating traffic congestion in these environments, they are often associated with high operational costs. As a result, they tend to be utilised mainly by wealthy individuals who can afford these expenses, rather than being accessible to the majority of the population.

The author believes that a potential solution to this issue lies in the concept of Urban Air Mobility (hereinafter referred to as UAM). This perspective is supported by the European Union Aviation Safety Agency (hereinafter referred to as EASA), which asserts that UAM could effectively tackle traffic congestion in urban areas. The expectation is that transporting goods and people via air at low altitudes and at scale in cities will soon become a reality in European urban environments.

By adding a new dimension to urban transportation -specifically, a third dimension- air mobility could enhance the movement of goods and individuals, contributing to the development of smarter, more sustainable cities. UAM is envisioned to provide environmental benefits, as most of the aircraft involved will be electrically powered by lithium-ion batteries, as well as advantages for

15 See, supra note 13.

16 See, supra note 14.

17 See, supra note 13.

18 See, supra note 14.

19 The term "urbanised" in this dissertation refers to human settlements that may be smaller in size than what is typically considered a city, but they possess the necessary infrastructure to sustain and accommodate UAM operations without issue.

citizens and businesses, particularly for commercial, emergency, or medical purposes.[20]

B. Main Research Focus and Collateral Research Objectives

The objective of this study is multifaceted; it will commence with the clear articulation and differentiation of the concept of Urban Air Mobility from other similar concepts that pertain to air mobility environments. The term UAM is emphasised in the introduction of this thesis because it is the term that appeared first chronologically, specifically created to address the mobility environments being examined, but without being the sole one. With the above taken into account, this study will focus on the following main research question: “Is the upcoming model of advanced urban mobility simply another aircraft network?”

In this context, and following addressing the question of whether “the upcoming model of advanced urban mobility simply constitutes another aircraft network”, this study aims to evaluate and assess various questions related to the entire spectrum of UAM’s nature and envisioned operation. It will first clarify the relationship between UAM, Unmanned Aircraft Systems (hereinafter referred to as UAS), and the electric Vertical Take-Off and Landing aircraft (hereinafter referred to as the eVTOL aircraft), as well as with industry-specific terms that lack legal definitions, such as “smart city." By untangling Ariadne’s thread surrounding UAM, legal questions related to certification, authorisation, standards, operations, and particularly pertaining to liability will be researched. While addressing the above does not constitute part of the main research question of this dissertation, their assessment aims to achieve a better understanding of its nature and the potential problems that may arise with the larger launch of UAM in the EU.

This dissertation aims to initiate a thorough discussion and raise awareness about the application of existing legal tools to UAM and its aircraft components. In addition, a critical perspective is adopted regarding the above, while

20 See, (https://www.easa.europa.eu/en/domains/drones-air-mobility/drones-air-mobility-landscape/urban-air-mobility-uam), accessed (11-10-24).

highlighting, in parallel, the innovative nature of UAM and its associated aircraft.

As far as legal frameworks are concerned, this dissertation primarily focuses on public international law and EU law. However, for comparative purposes, occasional references will be made to the U.S. legal and regulatory perspective on UAM. Given that the concept of Urban Air Mobility is still in its formative stages, it remains closely intertwined with not only policy-making but also strategic planning and various relevant stakeholder-driven initiatives. Accordingly, this study will analyse not only the positions of the EU but also the emerging business models envisioned by other key stakeholders involved in UAM development. In doing so, theoretical discussions and legal analysis will be complemented by an examination of current practices and real-world implementations, with the aim of presenting a comprehensive and up-to-date picture of UAM in both theory and practice. To bridge the gap between conceptual frameworks and practical realities, a critical case study of two EU cities will be undertaken. The aforementioned research model aims to provide a clear depiction of the current environment pertaining to UAM while clearly focusing on problematic aspects regarding legal instruments and operational aspects.

To satisfy the above pathway, the current study focuses on international aviation treaties and EU laws related to standardisation, authorisation, and various key operational aspects of UAM environments. However, this doctoral thesis is not equipped and does not aim to suggest any new legal regime(s) in the aforementioned domains due to the stage of infancy of UAM in the EU.

C. Structure and Methodology of the Study

The present study opens with an introduction that aims to provide a preliminary overview essential for understanding the nature of UAM environments that will be discussed. Furthermore, it sets the stage for addressing

important legal questions related to the constituent elements of UAM and its position within the current aviation landscape.

Chapter I

Chapter I focuses on the etymological evaluation, assessment, and clarification of the term UAM, which initially served as the mainstream term to describe the mobility environments under scrutiny during the early drafting phases of this dissertation, as well as during the genesis of the concept itself.

The analysis unfolds in a logical and chronological fashion, beginning with a clear distinction between the environment and the aircraft intended to operate within it. The author will differentiate between UAS and eVTOL aircraft from the environments initially labelled as UAM. Following this, the sub-terms that constitute UAM will be defined to better understand its positioning, true nature, and historical context.

Furthermore, alternative terms that describe the same air mobility environments will also be presented, along with a comparative analysis among them. This will facilitate a clearer understanding of UAM. The terms Advanced Air Mobility (hereinafter referred to as AAM), commonly used in the U.S. and in various International Civil Aviation Organization (hereinafter referred to as ICAO) documents, will be analysed alongside Innovative Air Services (hereinafter referred to as IAS) and Innovative Air Mobility (hereinafter referred to as IAM). The latter terms emerged after UAM and are now prevalent in EU policy and legal documents, positioning UAM as a subset of IAM. This ongoing evolution is reflected in Chapter I, prompting the author to adopt the EU's new perspective on the positioning of UAM. However, it should be noted that these terms are theoretical and lack at-scale practical applications; thus, their limits relative to one another remain unclear for now.

In this dissertation, the terms IAM and UAM will be used interchangeably to refer to the same environments, except in Chapter II, where AAM is the primary term utilised in ICAO documentation and initiatives.

The final term discussed in Chapter I aims to illustrate the overall concept of a “city” that can support UAM operations with the necessary infrastructure. In this dissertation, “city” is perceived as a settlement capable of accommodating both manned (and eventually unmanned) eVTOL aircraft and UAS at low altitudes on a large scale. This vision aligns with what is termed a “smart city” in EU policy papers and is treated in this dissertation as the culmination of the evolutionary analysis related to UAM. When UAM becomes feasible, cities will be closer to transforming into smart cities- the cities of the future. While this may be an unconventional viewpoint, Chapter I addresses the central question of whether the emerging model of advanced urban mobility is simply another aircraft network. It concludes that the new air mobility environments under study represent a holistic system that, to succeed, requires a multimodal approach. In other words, while UAM has an aerial component, it cannot be realised solely through air law or an aviation-centric perspective. The subsequent chapters of this dissertation aim to accomplish two goals: to substantiate this claim and to evaluate the existing legal, operational, and authorisation environments that will enable the realisation of UAM.

Chapter II

In Chapter II, this study examines the role and actions of ICAO concerning UAM/AAM.

The Chapter is divided into two sections. The first section provides a comprehensive analysis of ICAO’s origins, efforts, and governing bodies to clarify its significance within international civil aviation.

The second section discusses ICAO’s initiatives and position regarding the global standardisation of UAM, evaluating the potential for a unified UAM framework among its member states. In this context, various ICAO resolutions and working papers from the last three Assemblies are analysed (39th, 40th, 41st), aiming to illustrate not only ICAO’s stance on the issue but also the perspectives of multiple member states within this forum.

Finally, the chapter concludes with a discussion of ICAO's ambitious initiative to establish the Advanced Air Mobility Study Group, along with the author's insights regarding its value and role in the international standardisation of UAM/AAM.

Chapter III

Chapter III shifts its focus to the EU perspective regarding UAM, which is the primary basis and concern of this thesis.

This chapter will commence with an examination of the complex and comprehensive legal framework established by the EU and its main regulatory body, EASA. The focus will be on the certification, authorisation, and standardisation of UAS and eVTOL aircraft, as well as their operators. The goal is to provide a clear depiction of the EU system regarding UAM and its essential components, highlighting the dynamics of the sector.

To achieve this, the chapter will analyse a range of EU Regulations to clarify the current regulatory regime. With one of the most robust frameworks for the authorisation, certification, and standardisation domains of UAS and eVTOL aircraft operating in UAM environments, this chapter aims to present this elaborate framework in detail.

The final part of the third chapter will focus on the various stakeholders necessary for the realisation of UAM in the EU. Given the chapter's focus on the EU and EASA, it will include an evaluation of the 2019 EASA study on the ultimate stakeholder, namely, the public of the EU member states and their views on the implementation of UAM in their urban ecosystems. This will illustrate that even the most comprehensive regulatory environment may not be sufficient to ensure the success of a novel mobility framework, portraying once more the multifaceted nature of UAM.

Chapter IV

The analysis of the EU perspective on *inter alia* the authorisation of aircraft in UAM environments will take an operational shift. This shift is prompted by a concept introduced in Chapter II of this thesis, which was presented during the 41st ICAO Assembly and involves the idea of municipal airspace.

Starting from this premise, this chapter adopts a dual approach. Firstly, it will explore the international legal regime governing the operation of UAS and eVTOL aircraft, focusing on their access to foreign airspace. Particular consideration will be given to the Chicago Convention and the concept of municipal airspace, especially in relation to established legal principles such as airspace sovereignty. This includes a thorough examination of the evolution of airspace sovereignty and an assessment of whether "municipal airspace" carries any actual legal significance or is another colloquial term within the UAM context.

Secondly, Chapter IV will assess the EU regulatory framework concerning the operation and access of UAS and eVTOL aircraft to airspace within the EU in UAM environments. It will examine the legal and practical implications that arise in this context and evaluate relevant EU regulations. The aim is to highlight certain inconsistencies between existing EU regulations and the proposed operational model of UAM and its associated aircraft.

Finally, the chapter will conclude with an overview of the EU Unmanned Traffic Management system, known as U-Space, and its relationship with UAM environments in the EU. This presentation will follow the pattern introduced in the first chapter of this dissertation, illustrating both what UAM is not and how UAM, as a holistic environment, will incorporate various innovative projects to facilitate the transformation of current cities into their smarter versions.

Chapter V

Chapter V serves as the penultimate contextual chapter of this doctoral dissertation, focusing on the legal implications of aircraft operations in the air

mobility environments under scrutiny, particularly concerning potential damage to individuals both on board and on the ground.

The chapter begins with an analysis of international legal frameworks regarding carrier liability, tracing the evolution from the Warsaw Convention of 1929 to the Montreal Convention of 1999. Furthermore, it discusses the applicability of the Montreal Convention within the EU and explores the potential legal implications and/or dissonance that may arise from its application to aircraft operating in the EU UAM environments. The discussion then progresses to the most litigated EU regulation, Regulation 261/2004, and the legal issues that could stem from its application to UAM operations.

The chapter concludes with an evaluation of liability for damages to persons on the ground, with an assessment of the Rome Convention of 1952, highlighting significant concerns regarding its applicability to UAM environments.

Chapter VI

The final chapter of this thesis explores the practical aspects of UAM within the framework of smart city environments, using a case study of two distinct urban areas: Hamburg, Germany, and Astypalaia, Greece. The objective of this chapter is to illustrate different models of smart city development through the implementation of innovative mobility initiatives.

The case study begins with Hamburg, Germany’s largest harbour city, which processes a significant volume of goods annually and is home to a population of 5.3 million. Hamburg’s engagement with smart city initiatives began in 2017 with the "Windrove" project, which aimed to establish a drone network for commercial purposes. This project was followed by several other initiatives aimed at integrating UAM, including UAS and eVTOL aircraft operations, into the lower airspace above Hamburg.

The second example in the case study focuses on the green island of Astypalaia, which showcases its own model of smart transformation.

The analysis of these initiatives reveals that the paths to becoming “smart" vary significantly between the two locations. The term “smart city" holds entirely different meanings for the EU city of Hamburg compared to the EU island of Astypalaia. Consequently, the author concludes that the transformative process of each EU urban settlement will adhere to its own principles and perspectives regarding its future mobility development.

The final part of this study consists of a *conclusion in* which the author summarises the main findings and trends that have emerged from the extensive research conducted on the topic under scrutiny. In addition to restating the key messages presented in the summaries of each individual chapter of this dissertation, the conclusion serves as the unifying point of these summaries, aiming to highlight and emphasise key messages related to the primary and consequent questions of the thesis.

CHAPTER I- BACKGROUND AND DEFINITIONS: A DICTIONARY OF URBAN AIR MOBILITY AND ASSOCIATED TERMS

1.0. INTRODUCTION

The main aim of this chapter is to conduct an assessment of the concept of UAM since its inception and through recent developments. Additionally, this chapter shall present terms associated with UAM to clarify its differences with similar or perceived similar concepts. It is important to note that these terms will be explained from the perspective of public organisations, such as ICAO, and regional organisations, such as EASA, with brief parallel references to the Federal Aviation Administration (henceforth referred to as FAA) and the industry.

The section will include terms that provide clarity and understanding of the various aspects of UAM and its associated fields. These terms include, but are not limited to, AAM, IAS, IAM, eVTOL aircraft, and smart city.

The second purpose of this chapter is to familiarise the reader with the definitions presented here and to gain a deeper comprehension of the complexities of UAM, thus contributing to its acceptance as a concept. By providing a detailed explanation of UAM and its relevant terms, misconceptions about the scope of this complex system can be avoided, consequently creating a more transparent domain for assessing the legal issues that will be addressed in the following chapters of this dissertation.

1.1. JUST ANOTHER (UNMANNED) MOBILITY SYSTEM?

Before delving into a precise assessment of the etymology of the terms comprising the acronym UAM, it is important to first perform a relevant background assessment. Although the idea of UAM has evolved significantly since its inception, analysing its development and structure is crucial to understanding its defining characteristics. Acronyms have a central role in aviation culture, serving to simplify complex operational language and facilitate clear communication among professionals. From operational procedures to regulatory texts, acronyms form a specialised vocabulary that reflects the sector's unique nature. Regulatory documents such as Standards and Recommended Practices (SARPs) and Acceptable Means of Compliance (AMC) often include dedicated sections for definitions,[21] underlining the importance of transparency and precision.[22] While experienced aviation personnel are familiar with using many acronyms and terms, the rise of new technologies and flight-related innovations has introduced additional terms requiring clear definitions to prevent confusion. This is especially true in

21 See Chapter III, *The New Era of Urban Mobility under the International Air Law, the Perspective of ICAO.*

22 See, Andritsos, Scott, and Trimarchi, *What is in a Name: Defining Key Terms in Urban Air Mobility*, Journal of Intelligent & Robotic Systems, Vol. 105, Article 81 (2022), at 4.

unmanned aviation, where terms such as Drones[23], 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), Unmanned Aircraft System (UAS), and Unmanned Aerial Vehicle (UAV)[24] have emerged to categorise a growing range of systems and aircraft. While some of the above are used interchangeably, others distinguish between the aircraft and its supporting system, the level of human control, or operational contexts.

In this acronym-rich environment, the term "UAM" has arisen as a distinct concept, closely related to UAS yet separate and different. The following sections explore UAM in depth, examining its components and assessing its evolutionary process.

1.2. WHEN NECESSITY CREATES CONCEPTS

It is an indisputable fact that an increasing number of European Union citizens are subjected to regular traffic congestion in their streets, primarily due to the high volume of vehicles, which subsequently leads to a surge in pollution levels.[25] The above, coupled with the population increase in the EU, poses an imminent threat of a significant rise in pollution levels in urban areas across Europe.[26] In order to address the aforementioned pressing concerns of a

23 The term "drone" is commonly used both in the public and private domain to refer to "Unmanned Aircraft Systems" (UAS), as defined by the Drone Strategy 2.0 policy paper of the European Union (EU) Commission. As per the EU Commission's definition, UAS refers to an unmanned aircraft and its associated equipment to control it remotely. Throughout this dissertation, the term "drone" shall be utilised interchangeably with "UAS" to maintain consistency with the EU Commission's definition. It is important to note that this assertion reflects the view of the EU Commission and is adopted for the sake of consistency.

24 See, Scott & de Pinho Veloso, *Terminology, Definitions and Classifications* in *The Law of Unmanned Aircraft Systems*, Second Edition, ed. Scott (Wolters Kluwer, 2022) at 2.

25 EASA: Study on the Societal Acceptance of Urban Air Mobility in Europe, 19 May 2021, at 7.

26 Ibid.

substantial part of the EU population, multiple discussions have been held, and various approaches have been taken into consideration. One suggested direction is a holistic system encompassing sustainable, greener, smarter, and unified characteristics in urban transportation. This holistic system incorporates a new dimension, air, into the present urban transportation environment.[27] The modernisation of urban mobility has been an ongoing process for over a decade, with major players such as Uber and Lime operating in numerous metropolitan areas around the globe.[28] However, the air component is now being considered a viable addition to the present mobility network as it has the potential to mitigate the issues of pollution and traffic in European urban environments.

Within the EU, this emerging landscape of mobility is commonly referred to as UAM. This particular term, while addressing a concept that has existed for some time, is a relatively recent development,[29] and, as such, has yet to be defined in a universally accepted manner by the international legal community, aviation and mobility industry members, or other relevant stakeholders. As a result, a lack of consensus exists regarding the precise definition of UAM. The concept of UAM has been a subject of interest for over a century. Prior to the emergence of helicopters as a medium of short to medium-range urban transportation, there was an aspiration to integrate aviation in urban settings alongside other modes of transportation.

The City of London recognised the need for an inner-city airport in the early 1930s as a means of facilitating transportation for its citizens. This project, according to the author's research, marked the beginning of the aspiration for

27 Volocopter: "The Roadmap to Scalable Urban Air Mobility", Edition 2.0 (2021), at 7.

28 The term "urban mobility" encompasses various modes of transportation, including public transit, taxis, ride-hailing services, car rentals, personal cars, bicycles, bike-sharing programs, e-scooter sharing, and air mobility.

29 To the author's knowledge, the actual term of Urban Air Mobility was likely coined by Airbus Group in its FORUM Magazine No.88 (2016). See, Andritsos, Scott, and Trimarchi, *What is in a Name: Defining Key Terms in Urban Air Mobility*, Journal of Intelligent & Robotic Systems, Vol. 105, Article 81 (2022), at 4; See also, Urban Air Mobility and Sustainable Urban Mobility Planning, European Platform on Sustainable Mobility Plans, 2021, at 9; See also, Andritsos and Agouridas, *Urban Air Mobility*, in B. I. Scott (ed.), *The Law of Unmanned Aircraft Systems*, 2nd ed. (Wolters Kluwer, 2022), at 311.

UAM. The idea was envisaged in several ways, including the construction of a runway over Waterloo Station, from where seaplanes could take off from the River Thames docks. Another proposal involved building a rooftop airport on King's Cross Station, allowing aircraft to land from all directions, irrespective of the wind factor.[30] The aforementioned plans never materialised, leaving urban transportation to ground-based means throughout the following decade.

The initial origins of these mobility environments in urban settings can be traced back to the first half of the 20th century[31], with the first commercial use of a project similar to UAM taking place in the 1940s by Los Angeles Airways. The company utilised helicopters to transport individuals and mail between various locations in the Los Angeles area, including Disneyland and the International Airport, from 1947 to 1971.[32] Unfortunately, the company's future was jeopardised following two accidents in 1968 caused by mechanical malfunctions, which resulted in the tragic deaths of several crew members and passengers.[33] As a result, the company was forced to ground its helicopters, leading to its permanent closure due to the financial deadlock.[34] Similarly, New York Airways also employed helicopters to transport people between heliports in Manhattan and airports like LaGuardia, JFK, and Newark from 1949 to 1979.[35] However, as in the example mentioned in the previous paragraph, mechanical malfunctions caused several incidents, which halted its growth and ultimately led to the abandonment of this premature UAM project.[36] In an attempt to address the issue of traffic congestion in urban settings, Airbus

30 See, (https://darkestlondon.com/2011/10/23/kings-cross-airport-1931/), accessed (08-11-23).

31 See, supra note 29.

32 Thipphavong, Apaza, Barmore, Battiste, Burian, Dao, Feary, Go, Goodrich, Homola, Idris, Kopardekar, Lachter, Neogi, Ng, Oseguera-Lohr, Patterson, and Verma, *Urban Air Mobility Airspace Integration Concepts and Considerations* (National Aeronautics and Space Administration, 25 June 2018).

33See, (https://www.latimes.com/visuals/photography/la-me-fw-archives-airways-helicopter-overturn-20170221-story.html), accessed (14-09-23).

34 See, supra note 32.

35 Ibid.

36 Ibid.

undertook the Voom project in the early part of 2016. The project, which was initiated prior to the emergence of eVTOL aircraft, aimed to combat the problem in a sustainable and efficient manner.[37] *Voom* is the first UAM experiment that solely employs helicopters as a means of urban transportation using the air segment. According to the Airbus website, *Voom* is "the first-to-market helicopter booking platform (on-demand) that connects travellers with air taxi companies in Mexico City (Mexico), São Paolo (Brazil), and San Francisco (U.S.A)." The project was launched as an Acubed (Airbus' Silicon Valley innovation centre)[38] project with the goal of liberalising access to the skies and revolutionising the way people move in large city environments.[39]Airbus defined *Voom* as neither an airline nor a helicopter operator but as a mobile application that enables passengers to book a flight within seconds and reach their destination within minutes. After four years, Voom terminated its operations in April 2020, having amassed more than 150,000 active users, 15,000 helicopter passengers, and a repeat customer rate of 45%.[40]

As can easily be seen from the above, the helicopter transportation services offered by various projects in the last decades have been observed to have had limited success, either due to accidents causing short-lived operations or their provision of restricted services to specific markets or demographics, as previously portrayed. Though helicopters were once envisioned as a solution for urban air transportation as far back as 1965, the short-haul intracity or intercity flight services they offered were not generally successful for a number of reasons.[41] One of the primary reasons is the high cost of helicopter operation, with flight costs for standard passenger helicopters such as the Bell 206 reaching

37 See, (https://acubed.airbus.com/blog/voom/closing-this-chapter-our-learnings-on-transforming-how-people-move/), accessed (14-09-23).

38 See, (https://www.airbus.com/en/innovation/innovation-ecosystem/acubed), accessed (15-09-23).

39 See, (https://acubed.airbus.com/blog/voom/closing-this-chapter-our-learnings-on-transforming-how-people-move/), accessed (14-09-23).

40 Ibid.

41 United States Civil Aeronautics Board, Civil Aeronautics Board Reports: Volume 49, August to December 1968, at 373-376.

up to circa $600 per hour due to high fuel, maintenance, and variable costs. Further, the acquisition of a helicopter requires significant funding, a pilot, landing fees, and the cost of running a company to manage the helicopter. This results in the associated flight costs rising to several thousand dollars per flight, thereby making it an option primarily accessible to affluent individuals in specific markets (e.g., helicopter transportation from Monaco to Nice Côte d"Azur Airport, a service that diminishes the 45 to 60-minute drive to a 7-minute flight for €200 per passenger).[42] Thus, it is evident that the viability of an emerging concept, particularly one associated with mobility, is inseparably linked to its components and distinctive characteristics that can guarantee its successful and secure implementation. While the helicopter has demonstrated limitations in serving as the primary protagonist in a comprehensive urban aviation landscape, the emergence of Vertical Take-off and Landing aircraft (VTOLs) presents an encouraging outlook. The eVTOL is a distinctive aircraft that can hover, take off, and land without the need for traditional runways. This dissertation will primarily address the electric variant of the aforementioned aircraft, which has attracted significant attention due to the growth of the market in the past decade, attributed to notable advancements in electric propulsion technology.[43]

1.3. Aircraft and Ground Infrastructure in UAM Environments

1.3.1. A wild card appears. The eVTOL aircraft as an element of the new air mobility environments

42 See, (https://www.blade.com/nice-monaco-helicopter-charter?locale=en&utm_source=Google&utm_medium=cpc&utm_campaign=THELINE_EN&gclid=CjwKCAjwgZCoBhBnEiwAz35RwiRvq3GNdn5s1D58hZA5ES7iWVqEUC0X75eHoOzLa82IUcBIF6k4KxoCv5IQAvD_BwE) accessed (15-09-23).

43 Estimates by independent organisations predict the eVTOL aircraft market will grow at a CAGR of 23.13%, from $5.41 billion in 2021 to $23.21 billion in 2028. For more information, see (https://www.fortunebusinessinsights.com/evtol-aircraft-market-106298), accessed (14-11-23).

The history of VTOL aircraft and the associated technological innovations they bring is a significant aspect of aviation history. In 1877, the Italian inventor Enrico Forlanini successfully flew the world's first unmanned VTOL aircraft. This primitive helicopter managed to reach a height of 13 meters powered by steam and remained aloft for approximately 20 seconds.[44] Thirty years later, French engineer Paul Cornu achieved the first successful manned VTOL flight, using a twin-rotor helicopter powered by a 24hp engine.[45] Cornu's helicopter managed to reach a height of 1.5 meters and remained in the air for 20 seconds. The early efforts of both Forlanini and Cornu set the stage for the development of more advanced VTOL aircraft in the following decades.[46]

Almost two decades later, another attempt relevant to the previous two took place by Glenn Curtiss, a distinguished aviation pioneer who, back in 1917, created the "Curtiss Autoplane". This "Autoplane" can be considered a predecessor of the modern-day VTOL aircraft.[47] Despite the successful lift-off of the aforementioned aircraft, it failed to achieve full flight.[48] This setback, however, does not diminish the value of the Curtiss Autoplane, which, in the end, played a significant role in the development of VTOL technology due to its characteristics that made it unique.

Proceeding to the 1940s, a ground-breaking development took place. Sikorsky manufactured the R-4, which emerged as the world's first successfully launched mass-produced helicopter. The R-4 was utilised as a multi-mission

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44 See, (https://www.ueidaq.com/vertical-take-off-landing-vtol-evtol-reference-guide), accessed (10-11-23).

45 Ibid.

46 Ibid.

47 See, Bowers, *Curtiss Aircraft 1907–1947* (Putnam Aviation Series, 1st ed., 1979).

48 See, (https://www.flyingcarsandfoodpills.com/glenn-curtiss---a-first-flying-car), accessed (08-12-23). For more information about the concept of "Roadable Aircraft" see, Scott, "Roadable Aircraft: An Analysis of the Current Legal Environment", 40, Air and Space Law, Issue 3, 2015, at 259.

helicopter with both rescue and military applications worldwide.[49] Subsequently, in the 1950s, turbine engine technology was introduced, leading to the development of the modern vertical take-off and landing (VTOL) technology that is pervasive today.[50]

The inception of the electric variant of the VTOL aircraft (eVTOL) and its associated technology can be traced back to NASA's renderings release[51] of an experimental aircraft called the Puffin eVTOL in 2009.[52] In 2011, the first-ever commercial eVTOL flight materialised, named Project Zero by AgustaWestland (now Leonardo Helicopters). The following year, other relevant projects took off, as the first manned flights of the Solution F Electric helicopter and Opener SkyKar Rebel performed their inaugural operations, marking a significant milestone in the evolution of eVTOL technology.[53]

In the subsequent decade, the eVTOL market has expanded into a multi-billion-dollar industry, with the participation of leading players such as Airbus, Boeing, and Bell, as well as smaller companies such as Volocopter and Lilium, both of which have recently attained unicorn status.[54] The development of eVTOLs has diversified, with aircraft designed for civilian, air taxi, emergency medical services, recreational, delivery, and military applications.[55]

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49 See, (https://www.ueidaq.com/vertical-take-off-landing-vtol-evtol-reference-guide), accessed (10-11-23).

50 Ibid.

51 Conceptual rendering refers to the process of visually representing abstract ideas, concepts, or thoughts in an artistic or graphical form, according to (https://7cgi.com/blog/what-is-conceptual-rendering), accessed (08-12-23).

52 See, (https://www.ueidaq.com/vertical-take-off-landing-vtol-evtol-reference-guide), accessed (10-11-23).

53 Ibid.

54 Hirst and Kastiel, *Corporate Governance by Index Exclusion*, Boston University Law Review, Vol. 99 (2019), at 1270.

55 See, EASA, *Study on the Societal Acceptance of Urban Air Mobility in Europe*, 19 May 2021, at 22.

The author acknowledges that the Definitions chapter of this legal dissertation is not equipped to completely evaluate all types of eVTOL and VTOL aircraft alongside potential hybrid concepts. Nevertheless, it is critical to outline some examples of these aircraft to provide a non-exhaustive list. The graph below showcases some of the VTOL and eVTOL concepts that are currently available globally.

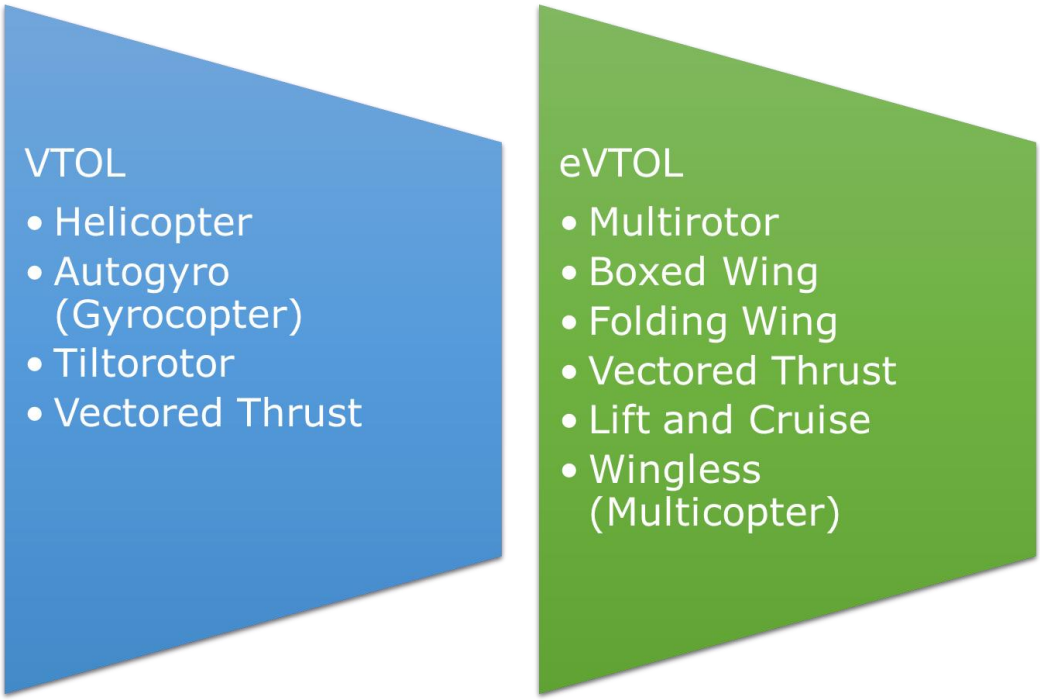

Figure 1[56]

EASA conducted an extensive study on the Societal Acceptance of Urban Air Mobility in Europe, which constitutes the primary domain of analysis for this doctoral thesis. EASA's research has identified three principal categories of eVTOL and UAM vehicles. These are the following:

- Vectored-Thrust aircraft - These aircraft can change between vertical lift and horizontal thrust as their propulsion units are mounted rotatably. During cruise flight, the lift is generated by wings.[57]

56 See, (https://www.ueidaq.com/vertical-take-off-landing-vtol-evtol-reference-guide), accessed (10-11-23).

57 See, supra note 55, at 22. See also, Urban Air Mobility and Sustainable Urban Mobility Planning- Practitioner Briefing, December 2021, at 11.

- Lift and Cruise aircraft - In this type of aircraft, separate propulsion units are used for vertical take-off and landing, as well as the cruise phase. Additional lift is created by wings during the cruise phase.[58]
- Wingless (Multicopter) - Similar to helicopters, this design does not have wings. The propulsion units create lift and thrust at the same time by varying the relative speed of each rotor.[59]

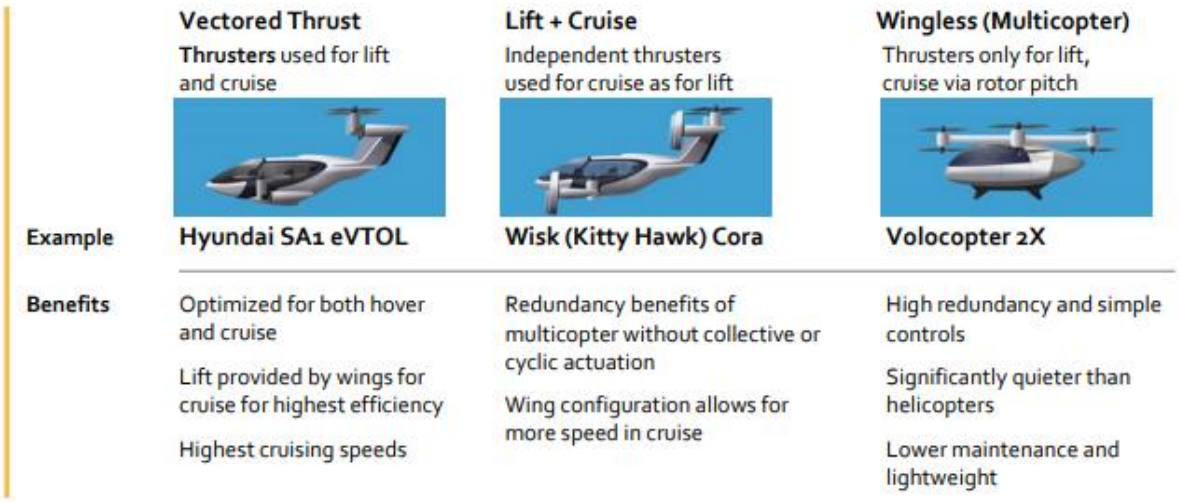

Figure 2[60]

EASA has undertaken extensive efforts to assess terminologies that are relevant to UAM, which will be comprehensively unfolded later in this chapter. The recent EASA Opinion No. 03/2023[61] introduces a noteworthy term associated with VTOL aircraft and their electric variants. The term *VTOL-capable aircraft* (hereinafter referred to as VCA*)* is cited, and EASA has deemed it necessary to establish a corresponding definition to cover certain regulatory

58 Ibid.

59 See, supra note 55, at 22. See also, Urban Air Mobility and Sustainable Urban Mobility Planning- Practitioner Briefing, December 2021, at 11.

60 See, supra note 55, at 23.

61 See European Union Safety Agency Opinion 03/2023, Introduction of a regulatory framework for the operation of drones, Enabling innovative air mobility with manned VTOL-capable aircraft, the initial airworthiness of unmanned aircraft systems subject to certification, and the continuing airworthiness of those unmanned aircraft systems operated in the "specific" category, RMT.0230 — SUBTASK C#1.

domains.[62] The definition cited below retains the distinction based on the lift generation design principle[63] while explicitly defining a new category of aircraft that is distinct from aeroplanes and rotorcraft.[64] With this move, EASA attempts to provide clarity in the aviation industry and facilitate the safe and efficient operation of the VCA.

VTOL-capable aircraft (VCA) are defined as: a power-driven, heavier-than-air aircraft, other than aeroplane or rotorcraft[65], capable of performing vertical take-off and landing by means of lift and thrust units used to provide lift during take-off and landing.[66]

Before commenting on the definition above, it's important to note that EASA considers the machines in question to be "aircraft". ICAO has defined this term in various Annexes as

"Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface."[67]

The EU legal system has adopted the same definition, as seen in EU Regulation 2018/1139.[68]It is clear from the aforesaid definition of the VCA that the

62 "VCA" is recognised as the standard term within the EU regulatory framework for the aircraft under evaluation. Chapter III will present further analysis of the legal documents that have integrated the term "VCA" into the EU regulatory sphere.

63 For information about the lift generation design principle, see, (https://www.easa.europa.eu/document-library/product-certification-consultations/special-condition-vtol), accessed (14-11-23).

64 See supra note 61, at 9.

65EASA published a document in March 2022 called "Vertiports: Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category". In this document, the term "helicopter" was used in the definition of the VTOL-capable aircraft. However, in Opinion 03/2023, the EASA now prefers to use the term "rotorcraft" instead and has provided an explanation for this change.

66 See, supra note 61 at 9. See also, See also, EASA, Vertiports: Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category, at 19 (PTS-VPT-DSN) (Mar. 2022), (Prototype Technical Design Specifications for Vertiports | EASA (europa.eu)), accessed (05-12-23).

67 See Annexes 1,2,3,7,8,11,13,16, and 17 of the Chicago Convention.

68See, 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

Organisation has sought to ensure consistency in the classification of different aircraft designs. To this end, EASA has recently revised the definition of "rotorcraft" to encompass designs with a maximum of two rotors that generate lift during flight. This amendment aims to foster coherence and enhance regulatory oversight across the aviation industry.[69] During the aforementioned assessment, EASA evaluated the possibility of adopting the existing definition of powered-lift[70] aircraft provided by the ICAO as an alternative to the VCA definition. However, this approach was abandoned due to the following reasons: ICAO's definition of powered-lift aircraft is limited in scope and does not encompass all conceivable aircraft configurations, particularly those which rely on lift mechanisms beyond non-rotating aerofoil(s) during horizontal flight. Notably, this includes aircraft that employ thrust vectoring and direct lift. While not currently accounted for under the ICAO definition, such configurations represent a significant and growing segment of the UAM vehicles and warrant further consideration and regulatory attention to ensure that regulatory frameworks remain current and effective.[71]

The ICAO framework governing powered-lift aircraft is, in effect, restricted to the requirements set out in Annex 1, which exclusively addresses flight crew licensing. Regrettably, this framework is deficient in terms of requirements for domains pertaining to certification and operational activities vis–a–vis the aircraft in question.[72] Thus, it is evident that EASA has undertaken a comprehensive evaluation of urban aviation environments and other associated

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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.

69 See, supra note 61 at 9.

70 ICAO defines powered-lift aircraft as: A heavier-than-air aircraft capable of vertical take-off, vertical landing, and low-speed flight, which depends principally on engine-driven lift devices or engine thrust for the lift during these flight regimes and on non-rotating aerofoil(s) for lift during horizontal flight.

71 See, supra note 61 at 9.

72 Ibid.

matters. In this regard, EASA has introduced the new term above to facilitate a more thorough assessment of the researched topic. It is noteworthy that the Agency has identified the aforementioned specific eVTOL concepts as suitable for particular use cases. For instance, the vectored thrust eVTOL aircraft concept is recommended for passenger transportation, whereas the lift and cruise eVTOL concept is preferred by original equipment manufacturers (OEMs)[73] for cargo transport, followed by the wingless concept.[74] In emergency situations, such as the transportation of medical personnel to accident sites, wingless vehicles are considered the optimal choice.[75]

For a comprehensive understanding of EASA's endeavours regarding (e)VTOL/VCA and generally the suggestions of the EU administration and the Agency for the development of an all-encompassing regulatory framework that takes into account the safety, security, and environmental dimensions of UAM and its associated terms and concepts, the chapter on *The European Union's Vision and Legislative Actions for UAM/IAM: Policies, Innovations, and Public Engagement* will provide further clarity.

1.3.2. LANDING INFRASTRUCTURE FOR EVTOL

Prior to delving into the complex elements of UAM and other terms linked to the same concept and context, it is imperative to evaluate another crucial element that has emerged for these environments. The ground infrastructure that will facilitate the landing requirements of eVTOL aircraft and potentially other smaller unmanned aircraft is of equal significance to the aircraft themselves for the feasibility and equilibrium of these forthcoming urban environments.

The landing infrastructure that will accommodate both the eVTOL aircraft and other uncrewed aircraft has been named as "vertiports". In 2019, EASA

73 Abbreviation for: Original Equipment Manufacturer(s).

74 See, EASA, *Study on the Societal Acceptance of Urban Air Mobility in Europe*, 19 May 2021, at 22. See also, Urban Air Mobility and Sustainable Urban Mobility Planning- Practitioner Briefing, December 2021, at 23.

75 Ibid.

provided a definition for the term "vertiport" in its Special Condition.[76] According to EASA, a vertiport is "an area of land, water, or structure used or intended to be used for the landing and take-off of VTOL capable aircraft." This definition is also present in the 2022 Vertiport Manual,[77] with a minor alteration where EASA uses the term "VTOL capable aircraft" instead of "VTOL aircraft".

In EASA's recent Opinion No. 03/2023, the definition presented in 2019 is used, with "VTOL aircraft" possibly being a general term that encompasses both electric and unmanned smaller aircraft capable of using the aforementioned infrastructure to take-off and land vertically. However, in that exact text, the term VCA (Vertical-capable aircraft) is used interchangeably with the term VTOL, bridging consequently the two terms and their associated concepts. Furthermore, EASA explicitly acknowledges that vertiports are essential for developing the concept of urban air mobility and that they will play a crucial role in integrating unmanned aircraft and VTOL-capable aircraft into the existing aviation systems.

The wording used in the aforementioned definition seems to have been adopted by ICAO's Annex 14 on Aerodromes[78] and the EASA Basic Regulation[79]. In particular, the term "terra" pertains to the entirety of the

76 EASA, Special Condition for Small-Category VTOL Aircraft, at 7, Doc. No. SC-VTOL-01 (July 2, 2019), (SC-VTOL-01.pdf (europa.eu)), accessed (05-12-23). "This Special Condition prescribes airworthiness standards for the issuance of the type certificate, and changes to this type certificate, for a person-carrying vertical take-off and landing (VTOL) heavier-than-air aircraft in the small category. This Special Condition is applicable to aircraft with lift/thrust units used to generate powered lift and control and with more than two lift/thrust units used to provide lift during vertical take-off or landing.".

77 EASA, Vertiports: Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category, March 2022, at 18, (PTS-VPT-DSN), (Prototype Technical Design Specifications for Vertiports | EASA (europa.eu)), accessed (05-12-23).

78 See, International Civil Aviation Organization (ICAO), Annex 14 to the Convention on International Civil Aviation: Aerodromes, 8th ed., July 2018 at 1-2.

79 See, 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

landmass, while “water” is attributed to the vast expanses of oceans, seas, rivers, and lakes. The term “structures” encompasses fictious areas that include buildings, offshore platforms, and boats.[80]

In reference to the second segment of the definition of “Vertiports”, the phrase "used or intended to be used" is a comprehensive construct that is frequently employed in UAS regulations. It encompasses the full spectrum of utilisation, including successful usage, attempted usage, and usage that failed to materialise.[81] The term "landing and take-off" is also a broad concept and is not confined to commercial operations. Importantly, it does not necessitate the embarkation or disembarkation of passengers, baggage, cargo, or mail. Instead, it refers to the aircraft’s physical contact with land, water, or any other structure.[82]The ultimate term of the “Vertiport” definition underlines the usage of the acronyms VTOL or VCA, which is intended to differentiate “Vertiports” from other relevant concepts such as aerodromes[83], airports, and heliports. The objective of incorporating the VTOL or VCA terminology is to impose a limitation on the type of aircraft that may perform take-off and landing operations within the confines of a Vertiport. Nevertheless, the EASA Opinion 03/2023 clarifies that a Vertiport is not a distinct category of ground

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).

80 See, supra note 77. See also, Scott, *Vertiports: Ready for Take-off ... And Landing*, *Journal of Air Law and Commerce*, Vol. 87 (2022), at 503, (https://scholar.smu.edu/jalc/vol87/iss3/6), accessed (06-12-23).

81 See, European Union Safety Agency Opinion 03/2023, Introduction of a regulatory framework for the operation of drones, Enabling innovative air mobility with manned VTOL-capable aircraft, the initial airworthiness of unmanned aircraft systems subject to certification, and the continuing airworthiness of those unmanned aircraft systems operated in the “specific” category, RMT.0230 — SUBTASK C#1, at 30.

82 See, supra note 79.

83 In the EU Basic Regulation 2018/1130 the term aerodrome is defined as: “a defined area, on land or on water, on a fixed, fixed offshore or floating structure, including any buildings, installations and equipment thereon, intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.”

infrastructure; instead, it represents a type of aerodrome that can support and sustain VCA movements.[84]

It is imperative to underscore that the definitions of VCA and Vertiport, as stated in EASA's official documents above, such as Special Condition and Opinion, are not legally binding. These definitions serve either as part of the Agency's certification process or as non-binding legal instruments of the European Union. As such, they do not impose a mandatory legal framework and have limited legal effect.[85] It is noteworthy that these definitions are not enshrined in any EU regulation yet.

1.4. BUT WHAT EXACTLY IS UAM?

Having conducted a comprehensive historical background assessment of the predecessing projects associated with the upcoming holistic urban aviation environments, the vehicle that allegedly will play a central role in them, and their ground infrastructure for landing, it is now imperative to dive into some of the fundamental questions of this dissertation, namely, what exactly the physis of Urban Air Mobility? Is UAM the only terminology employed in the regulatory and policy domain to describe these environments? What categories of vehicles fall within its spectrum, and what regulatory frameworks govern their operations?

In the following lines, the author shall endeavour to address the aforementioned queries while establishing the context for the ensuing chapters

84 See, supra note 61 at 30. The definition of the term "Vertiport" was included in secondary EU law through the COMMISSION IMPLEMENTING REGULATION (EU) 2024/1111, issued on April 10, 2024. This regulation features a slight modification from what was presented in Opinion 03/2023. It defines a "vertiport" as an area of land, water, or structure used or intended for the landing and take-off of vertical take-off and landing aircraft (VCA) and for their movement. The addition of the concept of movement means that the definition encompasses not just take-off and landing but also the movement of VCA, although this change does not significantly alter the concept presented in the aforementioned Opinion.

85 See, Scott and Sousa Uva, *The Role of Aviation Safety "Soft Law" in the European Union Regulatory Landscape*, Zeitschrift für Luft- und Weltraumrecht, Vol. 69, No. 4 (2020), at 604.

of this thesis, which will evaluate policy, legal/regulatory aspects, and indubitably practical case studies.

1.4.1. URBAN

In continuation of the author's previous works on these encompassing urban air environments, a step-by-step approach will be undertaken to explicate the sub-terms that together comprise the acronym UAM. This comprehensive approach will allow the readers to gain a deeper understanding of the various underlying elements that contribute to the complex nature of these environments.

The term "urban" is derived from the Latin word "urbs," which refers to a city or a space enclosed by walls.[86] In the context of UAM, it refers to the encompassing various airborne operations, including intra-city, peri-city, inter-city, and rural-urban-rural.

- Intra-city operations refer to services within a single city, such as short-distance taxi services from one end of the city to the other.
- Peri-city operations refer to services between a city and a location outside the city, such as a ride between downtown and the airport.
- Inter-city operations refer to services between multiple urban areas, such as a ride between two cities.
- Rural-urban-rural operations refer to services between two points that cross or circumnavigate an urban area and connect rural areas.[87]

The defining characteristic of UAM environments is their association with populated areas, as the airborne segment is guaranteed to involve them in some capacity. While the term "urban" is emphasised in the researched term, an

86 See, Online Latin Dictionary: Urbs. (https://www.online-latin-dictionary.com/latin-english-dictionary.php?parola=urbs), accessed 16-11-23.

87 See, supra note 22 at 4. See also, Andritsos and Agouridas, *Urban Air Mobility: Legal and Societal Stakes of an Upcoming Mobility Network*, in Scott (ed.), *The Law of Unmanned Aircraft Systems*, 2nd ed. (Wolters Kluwer, 2022), at 310.

"urban" or "urbanised" area is not necessarily a requisite component. What is critical, however, is that UAM has the potential to create a more integrated and accessible transportation network by connecting cities, bridging rural-urban boundaries, and providing efficient intra-city services. This, in turn, will benefit the inhabitants of these areas by introducing the third dimension, i.e., parts of airspace, to the mobility sector.[88]

The author's interpretation of the term "urban" and its scope is consistent with that of EASA. In its "Study on the societal acceptance of Urban Air Mobility in Europe", EASA has defined the term "urban" in accordance with the functional urban area concept used by Eurostat. According to Eurostat, a functional urban area is inclusive of a city and its commuting zone. The city constitutes a densely populated area, whereas the commuting zone consists of a less densely populated area. However, the labour market of the commuting zone is highly integrated with the city, as per the Organisation for Economic Co-operation and Development[89] (OECD, 2012).[90]

1.4.2. AIR

To explore the second sub-term of UAM, a hybrid method must be adopted, as has been done previously. This methodology comprises two approaches. The first approach is a purely linguistic one that evaluates the term "Air" independently. The second approach involves assessing the term "Air" as part of a whole that defines and is defined by other sub-terms.

88 Ibid.

89 See, U-space ConOps and architecture (edition 4), 20 July 2023, at 18.

90 See, supra note 55, at 22. See also, Urban Air Mobility and Sustainable Urban Mobility Planning- Practitioner Briefing, December 2021, at 8; See also, Gollnick, Niklass, Swaid, Berling, and Dzikus, *A Methodology and First Results to Assess the Potential of Urban Air Mobility Concepts*, Aerospace Europe Conference 2020, 25–28 February, Bordeaux, France; See also, Becker, Terekhov, Niklaß, and Gollnick, *A Global Gravity Model for Air Passenger Demand Between City Pairs and Future Interurban Air Mobility Markets Identification*, AIAA AVIATION Forum, 25–29 June 2018, Atlanta, Georgia, USA.

In a literal sense, the term “Air” refers to the "invisible gaseous substance surrounding the Earth, a mixture mainly of oxygen and nitrogen."[91] However, in a legal context, “air” refers to the legal concept of “airspace,” which identifies the geographical and physical location where specific flying activities take place (more information on airspace will be provided in the Operations chapter).[92]

In the context of air mobility, the term “air” seems to assume a different implication, which must be read together with other terms and adjectives such as “urban,” “advanced,” and “innovative.”[93] When considering UAM, the term “air” refers to the environment in which such mobility occurs, i.e., the urban airspace, which is the third dimension of urban mobility. This third dimension adds a new vertical dimension to mobility in the foresaid settings, utilising the airspace above urban areas to ensure faster, more efficient, cost-effective, and green mobility.[94]

1.4.3. MOBILITY

The topic of mobility is pivotal in the context of UAM and other associated concepts, as it transcends the legal and technical/technological domains and encompasses sociological considerations. The use of the term “mobility” in lieu of the more commonly employed “transportation”[95] in the aviation field may

91 See, Oxford Dictionaries: Air. (https://www.oxfordlearnersdictionaries.com/definition/english/air_1), accessed (20–11-23).

92 There are different ways to refer to a specific branch of law, such as “aviation law” or “air law”. This depends on whether the regulation focuses on the activity and the machine involved or on the location where the activity takes place. For more information, see Scott and Trimarchi, *Fundamentals of International Aviation Law and Policy*, (Routledge 2020), at 2.

93 More information about how the term “Air” correlates with the terms “Innovative” and “Advanced” under the prism of “Mobility” will be given below in this chapter.

94 See supra note 22 at 4. See also, Andritsos and Agouridas, *Urban Air Mobility*, in Scott (ed.), *The Law of Unmanned Aircraft Systems*, 2nd ed. (Wolters Kluwer, 2022)., at 310-311.

95 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.

provoke readers to question the choice of terminology. However, an etymological examination of the two terms provides insight into the matter. The term "transportation" on the one hand, is derived from the Latin term "transportare", which signifies "carry over" or "take across",[96] and refers to the conveyance of persons or things from one point to another,[97] thus, from point A to point B.[98]

The term "mobility" has its etymological roots in the Latin term "mobilitas" and denotes "the ability to move or be moved".[99] The term has a broader scope than "transportation" as it encompasses the ability of people to travel securely and affordably between their place of residence, workplace, and leisure destinations.[100] The notion of mobility implies the ability to move freely by harnessing a complex network of transportation modes. It suggests the availability of multiple, high-quality transportation options with seamless integration between them.[101] Therefore, mobility is not merely limited to transportation; rather, it embodies the capacity to move around freely, efficiently, effortlessly, and safely, having access to a variety of potential quality options in an integrated digitalised environment.[102] In the context of the researched concept, the term "transportation" refers to the capacity to move goods or people, while "mobility" denotes how goods and people are able to

96 See, Online Etymology Dictionary, (transportation | Etymology, origin and meaning of transportation by etymonline), accessed (21-11-23).

97 Ibid.

98 See, supra note 22 at 4.

99 See, Oxford English Dictionary, (mobility, n.¹ meanings, etymology and more | Oxford English Dictionary (oed.com)), accessed (21-11-23).

100 See, McKay, *Transport or Mobility: What's the Difference and Why Does It Matter?* (Forum for the Future, 13 November 2019), (Transport or Mobility: What's the difference and why does it matter? | Forum for the Future), accessed (21-11-23).

101 Ibid.

102 See, Urban Air Mobility and Sustainable Urban Mobility Planning- Practitioner Briefing, December 2021, at 11.

move around.[103] The former can be regarded as a technological aspect, whereas the latter encompasses the impact of technology. To put it simply, transportation is centred on the ability to transport goods or people, whereas mobility is focused on the ease and effectiveness of that transportation.[104]

In summary, the term presented in the title of this doctoral dissertation, UAM, according to the author, refers to a comprehensive mobility system that operates within urban areas possessing the requisite infrastructure to support its functions. The system engulfs all conventional modes of transportation, including manned and unmanned aircraft, buses, subways, and electric vehicles, with innovative alternatives such as eVTOL aircraft. The system aims to provide citizens with faster, greener, and safer mobility services in the context of a smart city via the *digitalisation of airspace*.

It is imperative to note that the combination of the aforementioned terms does not represent a fabrication of concepts resulting from the author's perception of the prerequisites for the materialisation of UAM. Rather, it is the path that the European Union (EU) has chosen through the introduction of relevant projects such as U-space.[105] While the details of U-space will be further assessed in the *Aviation Safety* chapter, it is worth noting that, according to EU Regulation 2021/664[106], U-space refers to a UAS geographical zone designed by a Member State where UAS operations are only allowed to take place with the support of U-space services.

In light of this thesis' focus on the EU, it is imperative to present EASA's definitions on UAM in conjunction with the author's own approach on UAM. It is worth noting that EASA has yet to incorporate an official legal definition of UAM in any of its recent Regulations. Nevertheless, the Agency proceeded to

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103 See, Guidebook for Urban Air Mobility Integration, AiRMOUR Deliverable 6.4, November 2023, at 14.

104 Ibid.

105 See, Huttunen, *U-space: European Union's Concept of UAS Traffic Management*, in Scott (ed.), *The Law of Unmanned Aircraft Systems*, 2nd ed. (Wolters Kluwer, 2022) at 97-112.

106 See, Commission Implementing Regulation (EU) No 2021/664 of 22 April 2021 on a Regulatory Framework for the U-space, OJ L 139, 23 April 2021, pp. 161-183, Preamble 3.

define the term on its official website on multiple occasions and most recently in its relevant Opinion 03/2023.

In one instance, EASA defined UAM as "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. The transportation is performed by electric aircraft taking off and landing vertically, remotely piloted, or with a pilot on board."[107] In another instance, it defines UAM as "a new air transportation system for passengers and cargo in and around densely populated and built-up environments, made possible by VTOL aircraft equipped with new technologies, such as enhanced battery technologies and electric propulsion. These aircraft will have a pilot on board or be remotely piloted."[108]

As it is transparent by the comparison of the definitions of the term UAM, the author accords with the Agency's perception. However, he raises some concerns regarding the use and significance of the term eVTOL in shaping the UAM environments. While eVTOL holds considerable importance for the materialisation of UAM in the smart city of the near future, overemphasising it may overshadow its actual meaning. It is essential to note that this experiment encompasses all existing means of transport to cater to the needs of urban citizens. The inclusion of eVTOLs will not replace the existence of auto vehicles but rather complement them. By adding a third dimension to urban transportation, UAM aims to reduce traffic congestion and the environmental impact of transportation in the long run, provided it is implemented appropriately. Thus, UAM is not an alternative to the term eVTOL; neither is the system that accommodates only these aircraft. The Venn diagram depicted below succinctly illustrates the placement of UAM and the specific aircraft it encompasses.

107 See, (What is UAM | EASA (europa.eu)), accessed (23-11-23).

108 See, (uam_-_faqs.pdf (europa.eu)), accessed (23-11-23).

Figure 3[109]

The present chapter endeavours to explicate the relevant terms employed in the title of this dissertation. However, the comprehensive description of the term UAM does not conclude this chapter. There are other terms that have been coined subsequent to or in conjunction with UAM. These terms endeavour to describe the same or nearly the same concept. To provide an equitable analysis, the author will present these terms below and will provide a contextual comparison between them and UAM.

1.5. ADVANCED AIR MOBILITY (AAM)

While this dissertation's title explicitly refers to UAM, this term is not the sole one utilised to denote the same or almost identical concept. The term AAM is an alternative term that is conceptually related to UAM but presents a broader scope of application.[110]

The term AAM is primarily utilised within the United States and is explicitly defined in the AAM Coordination and Leadership Act (P.L. 117-203, 136 Stat. 2227) as "a transportation system that employs advanced technologies,

109 See, U-space ConOps and architecture (edition 4), 20 July 2023, at 18.

110 See, International Forum for Aviation Research, Scientific Assessment for Urban Air Mobility (UAM), March 1, 2023, at 6. See also, supra note 22 at 5-6.

including electric aircraft or electric vertical take-off and landing (eVTOL) aircraft, to convey people and goods between two points within the U.S. airspace, whether controlled or uncontrolled."[111] Nevertheless, in the AAM Implementation Plan, published in July 2023, the scope of AAM is restricted to those operations which involve the transportation of passengers or cargo with a pilot on board.[112]

The definition presented above makes it evident that the scope of application for AAM extends beyond the boundaries set for UAM. It is worth noting that while the European Union uses the term UAM to refer to the same, if not an identical, concept, it is explicitly recognised that AAM encompasses a broader range than UAM. Therefore, the term AAM carries a more comprehensive meaning than UAM, as it encompasses a wider range of applications.[113] The graph below depicts a comprehensive comparative view of UAM and AAM as presented by EASA. The graph provides a clear representation of the differences between UAM and AAM, highlighting their respective features and capabilities according to significant stakeholders from either the public or private sectors.

111 See, Advanced Air Mobility Coordination and Leadership Act, 49 USC 40101, Oct. 17, 2022. (https://www.congress.gov/bill/117th-congress/senate-bill/516/all-info?r=33&s=1), accessed (08-12-23).

112 See, Federal Aviation Authority, Advanced Air Mobility (AAM) Implementation Plan, Near-term (Innovate28) Focus with an Eye on the Future of AAM, Version 1.0, July 2023 at 1.

113 See, supra note 55, at 8.

Included scope in AAM and UAM definitions

(✓) No explicit mention (✓) Explicit mention

		Use cases			Geographic reach		
		Passenger	Cargo	Operations	Urban	Regional	Interregional
AAM	FAA	✓	✓	✓	✓	(✓)	✓
	NASA	✓	✓		✓	✓	
	NASA	✓	✓	✓	✓	✓	
	Deakin Uni.	✓	✓		✓	✓	
UAM	NASA	✓	✓		✓		
	SESAR JU	✓			✓		
	FAA	✓	✓		✓	✓	
	Deakin Uni.	✓			✓		
	Jonkoping Uni.	✓	✓		✓		
	MITRE Corp	(✓)	(✓)		(✓)	(✓)	(✓)
	UC Berkley	✓	✓		✓		
	TU Munich	✓			✓		

Figure 4[114]

As per EASA, although the terms AAM and UAM are both commonly used, the former seems to have a more comprehensive range of applications and a broader geographic scope. It encompasses passenger and cargo missions, as well as other types of operations, across urban, regional, and interregional domains. Consequently, EASA explicitly states that UAM is a subset of AAM.[115]

The author, in consideration of the definition provided for UAM, posits that the scope of its application is based on the interpretation of the sub-term "urban". In the strictest sense, if we understand "urban" with the narrow meaning of the term, then AAM appears to be a broader definition as it encompasses interregional transportation. However, if we interpret "urban" as a region where there is adequate infrastructure to sustain the function of eVTOL and unmanned aircraft in the lower airspace, then there is no significant

114 See, supra note 55, at 9.

115 Ibid.

difference between the two concepts. This is particularly so when the used cases that are covered by these two systems are determined by the types of aircraft that are permitted to operate within them.

The present study refrains from further investigation of the term AAM as it is predominantly employed by institutions in the United States, such as FAA and the National Aeronautics and Space Administration (NASA)[116]. Despite EASA's limited use of the term, countries within the EU and the European Continent appear to refer to holistic mobility environments as AAM. Italy, for example, has published its AAM Strategic National Plan (2021-2030)[117], which outlines a national roadmap for the implementation of these mobility environments in the country.[118] Similarly, the United Kingdom has launched an AAM challenge via its National Aviation Authority (CAA) and the Department for Transport.[119] The challenge aims to ensure the appropriate public and consumer safety protections are in place, develop a clear understanding of the necessary regulatory policies and support required to enable initial commercial passenger-carrying eVTOL operations by 2026 and beyond and provide stakeholders with a clear sense of what is achievable from a regulatory perspective. The challenge also aims to imbue relevant stakeholders with confidence that the regulatory bodies will deliver on their commitments.[120]

1.6. NEWER TERMS

116 See, NASA's Advanced Air Mobility Community Integration Considerations Playbook, May 2023, at 4-5.

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

118 See, supra note 22 at 6.

119 See, (https://www.caa.co.uk/our-work/innovation/advanced-air-mobility-challenge/), accessed (08/12/23).

120 Ibid.

One of the challenges encountered with emerging and evolving concepts, particularly in the areas of law, policy, and innovative technologies, is their constant evolution. This phenomenon makes assessments and terminologies that were applicable one or two years ago obsolete, or they may coexist alongside "updated", more comprehensive assessments that aim to provide a deeper understanding of the matters in question. As a result, to remain relevant, it is essential to evaluate and re-evaluate these concepts frequently and adapt them to the changing landscape accordingly.

The term UAM attempts to efficiently address certain urban environments, as described above. However, due to the rapid and continuing advancements in technology, a numerous set of factors, such as legal and policy considerations, societal norms, and feedback provided by relevant stakeholders, have led to the fabrication of newer terms. These terms aim to better understand the comprehensive context of these urban environments. Through the incorporation of stakeholder feedback, these terms strive to capture the evolving components and context of these holistic environments.

In accordance with the practice adopted in this chapter, the author endeavours to analyse EASA's contributions vis-à-vis current terms that define the third dimension of mobility. In January 2023, EASA has released its annual 3-year rulemaking program, entitled "European Plan for Aviation Safety (EPAS)[121]."[122]It is worth noting that while EASA has incorporated the term "UAM" within its official documentation and procedures, the aforementioned

121 According to EASA's European Plan for Aviation Safety (EPAS) 2023-2025, Volume 1 Strategic Priorities, 17 Jan. 2023, at 9, "The EPAS constitutes the regional aviation safety plan (RASP) for EASA Member States, setting out the strategic priorities, main risks affecting the European aviation system, and the necessary actions to mitigate those risks to further improve aviation safety. The main objective of the EPAS is to further improve aviation safety and the environmental performance of the aviation system throughout Europe, while ensuring a level playing field, as well as fostering efficiency and proportionality in regulatory processes. Accordingly, while EPAS actions may be triggered by an EPAS driver other than safety, namely efficiency/proportionality, level playing field or environmental protection, the primary objective of any such action is to ensure that the intended changes in the aviation system do not adversely impact aviation safety."

122 EASA's European Plan for Aviation Safety (EPAS) 2023-2025, Volume 1 Strategic Priorities, 17 Jan. 2023. See, (https://www.easa.europa.eu/en/document-library/general-publications/european-plan-aviation-safety-epas-2023-2025), accessed (11-12-23).

document uses a new term to address this new form of air mobility. The current issue of EPAS, as well as the two preceding ones, references the Rulemaking Task (RMT.0731, *New Air Mobility*)[123]. This task was established due to the present European regulatory framework for civil aviation safety being initially designed for conventional fixed-wing aircraft, helicopters, balloons, airships, and sailplanes.[124] The existing framework relies on human participation and increasing automation assistance both on board and on the ground, with propulsion mainly provided by piston or turbine engines that utilise fossil fuels.[125]

The advent of new technologies and air transport concepts, including autonomous and multimodal vehicles, necessitated the reassessment of this framework. The RMT.0731's primary objective is "to address new technologies and operational air transport concepts by adapting the regulatory framework, as required."[126] A fundamental principle guiding this RMT is that future requirements should be technology-neutral, where feasible, for example, performance-based rather than prescriptive, while also ensuring legal certainty.[127]

It is visible that EASA does not seek to supplant the term UAM with the term "New Air Mobility" (NAM). Rather, the aim of EASA is to establish a regulatory framework that governs the safety of novel aircraft designs and their corresponding operations within EASA's purview. Thus, the term NAM is utilised to evaluate innovative aircraft designs within the broader context of

123 EASA is responsible for assigning rulemaking tasks, which entail the drafting of secondary EU legislation such as EU Commission Regulations, or the preparation of soft law materials such as AMC, Guidance Materials, and Certification Specifications. These measures are integral to ensuring the safety and efficiency of aviation operations within the EU. More information about the rulemaking procedure of EASA will be provided in *Chapter III- The European Union's Vision and Legislative Actions for UAM/IAM: Policies, Innovations, and Public Engagement.*

124 See, (https://www.easa.europa.eu/en/document-library/terms-of-reference-and-rulemaking-group-compositions/tor-rmt0731), accessed (11-12-23).

125 Ibid.

126 Ibid.

127 Ibid.

urban air mobility.[128] This assertion is substantiated by the fact that the last three EPAS documents make reference to both NAM and UAM.[129]

The multiplication of terms that attempt to articulate the same or similar concepts, as portrayed above, can be a source of confusion for stakeholders involved in the aviation sector. Nevertheless, the recent emergence of two novel terminologies, namely Innovative Aerial Services (IAS) and Innovative Air Mobility (IAM),[130] may serve to bring forth a measure of clarity. EASA has endeavoured to imbue these terms with a more precise meaning that better aligns with the proposed concept rather than solely relying on the previously established term UAM. EASA's Opinion 03/2023 not only defined IAS and IAM but also elucidated their positioning vis-à-vis the UAM term. This positive development offers clear definitions and mitigates confusion within the industry.[131]

According to the Agency, the introduction of these new terms occurred in order to standardise communication on a European level and facilitate the development of future rules and regulations.[132] EASA defines Innovative Airborne Services (IAS) as a "set of operations and/or services that are of benefit to the citizens and to the aviation market, and that are enabled by new airborne technologies; the operations and/or services include both the transportation of passengers and/or cargo and aerial operations (e.g. surveillance, inspections, mapping, telecommunications networking, etc.)."[133] EASA's definition of "innovative" does not solely rely on aircraft design or propulsion systems. Instead, it emphasises the inclusion of new airborne technologies to provide

128 See, supra note 22 at 6-7.

129 See, (https://www.easa.europa.eu/en/document-library/general-publications?publication_type%5B0%5D=2467), accessed (11-12-23).

130 See, supra note 22 at 6-7.

131 Article 3 of COMMISSION IMPLEMENTING REGULATION (EU) 2024/1111 defines "innovative air mobility (IAM) operations" as any operation involving vertical take-off and landing (VTOL)-capable aircraft in both congested and non-congested areas, thereby incorporating the term IAM into secondary EU law.

132 See supra note 61, at 6.

133 Ibid.

these services. For instance, even a conventionally propelled aeroplane or helicopter with a C2 link that enables remote-piloting capability can be classified as "innovative" and not only UAS and/or eVTOLs.[134] The regulatory framework in the EU is operation-centric and primarily focuses on performance-based criteria. Thus, the usage of terms such as "innovative" does not carry any legal implications at present within this framework.

The term Innovative Air Mobility (IAM) refers to “the safe, secure and sustainable air mobility of passengers and cargo enabled by new-generation technologies integrated into a multimodal transportation system”.[135]One of the most notable aspects of this section contained within the 03/2023 Opinion pertains to the definition of the term UAM, which is set in reference to the two aforementioned terms. In this context, UAM is defined as "the subset of IAM operations conducted in, to, within or out of urban environments".[136] This definition is particularly significant as it provides a clear understanding of the scope of UAM operations and its relationship to IAS/IAM as a whole.

It is comprehended that a parallel is established through the same means as the approach undertaken by the U.S. institutions to present UAM as an urban application of AAM and, thus, a constituent of AAM. The graph portrayed below provides a depiction of the interpretation of the scope of application of the assessed terms by EASA and their dynamics in relation to one another.

134 Ibid.

135 See, supra note 61 at 6.

136 Ibid.

Figure 5[137]

According to EASA's perception, IAM falls under the subcategory of IAS. Furthermore, UAM, which encompasses both regional and international air mobility within urban settings, is a sub-class of IAM. The following graphs portray examples of IAS and some of the engulfed concepts of IAM, as these are presented by EASA.

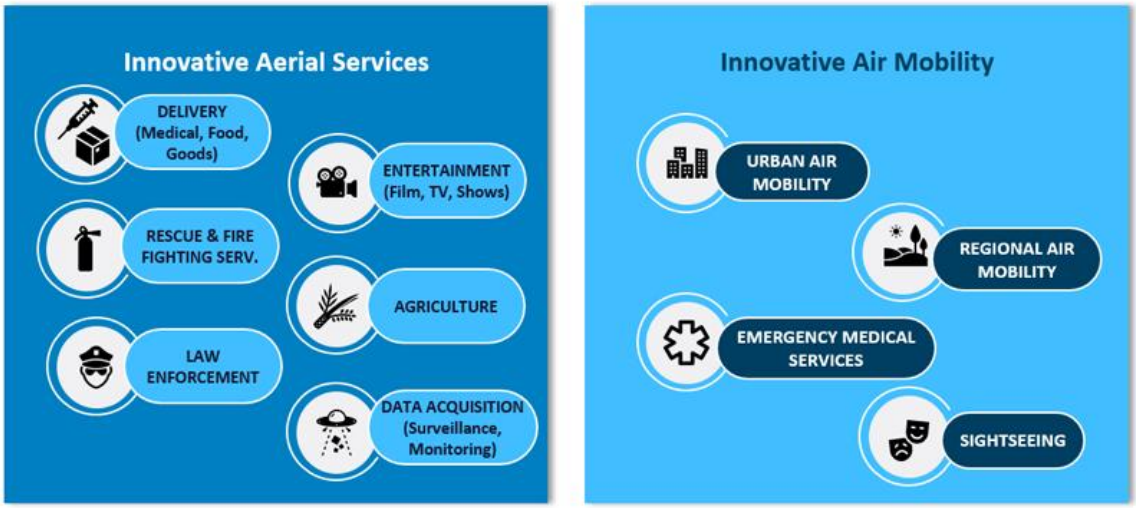

Figure 6[138]

137 Ibid., at 7.

138 See, (https://www.easa.europa.eu/en/domains/drones-air-mobility/drones-air-mobility-landscape/basics-explained)m accessed (17-03-24).

The author initially expressed reservations regarding the categorisation of UAM as a subset of another concept, such as AAM. However, upon reviewing EASA's new perspective, the author is inclined to accept UAM as a sub-category of IAM. EASA's aforementioned view is not based on a narrow interpretation of the term "urban" and does not differentiate between IAM-UAM on this basis. The definitions and graph presented above reveal that IAM and UAM are distinguished by the term "innovative" rather than the limits of the term "urban." Therefore, UAM, as a sub-category of IAM, encompasses both international and regional air mobility, extending beyond the strict confines and borders of a city.[139]

1.7. SMART CITY

The term "smart city" is the final concept that will undergo evaluation in this chapter, and while it has not been introduced as a key element in this dissertation's title, it was implied, nevertheless. At first glance, this term may seem to exist only as a marketing flagship and layman's term in various projects and not within the legal sphere. However, while this interpretation may indeed be valid, the use of the term "smart city" extends beyond the works of private stakeholders.

The aforementioned statement is supported by the body of work initiated by the EU Commission, which includes comprehensive research and development programs, innovative technology installations, and sustainable infrastructure projects.[140] These initiatives intend to foster a more interconnected and efficient urban environment, with a particular emphasis on the use of digital technologies to enhance the quality of life for citizens and promote economic growth.

139 Ibid.

140 See *inter alia*, REPowerEU, (https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en), accessed (12-05-25), Green City Accord (https://environment.ec.europa.eu/topics/urban-environment/green-city-accord_en), accessed (12-05-25), the European Green Capital/Green Leaf Awards, (https://environment.ec.europa.eu/topics/urban-environment/european-green-capital-award_en), accessed (12-05-25), CIVITAS, (https://transport.ec.europa.eu/transport-themes/urban-transport/civitas_en), accessed (12-05-25) and (Living-in.eu), accessed (12-05-25).

Through these projects, the EU Commission seeks to create a new era of urban development that is both sustainable and responsive to the needs of residents and the broader community.

According to the EU Commission, a smart city is a "place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and businesses. A smart city goes beyond the use of digital technologies for better resource use and fewer emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It also means a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population."[141]Thus, a smart city is characterised by several key elements that set it apart from traditional cities. The primary among these is a high level of digitalisation that defines many aspects of the city's functions. In addition, smart urban transportation and energy efficiency achieved through the use of renewable energy sources are essential components of a smart city. Finally, efficient administration in urban environments is necessary for realising a smart city's full potential. The same approach seems to be shared by the Federal Republic of Germany with a particular emphasis on digitalisation, as is visible by its "smart City Charter Making digital transformation at the local level sustainable" policy document.[142]

The information above clarifies the relationship and relevance of the concept of "smart city" in relation to UAM. The EU administration, in conjunction with key member states, posit that the transformation of existing EU cities necessitates the implementation of "smarter urban transport networks." UAM, as a holistic mobility environment that introduces a third dimension to

141 See, (https://commission.europa.eu/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en), accessed (15-12-23).

142 See, Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and Federal Institute for Building, Urban Affairs and Spatial Development (BBSR) Division I 5 – Digital Cities, Risk Prevention and Transportation, "smart City Charter Making digital transformation at the local level sustainable, May 2017, at 24.

urban mobility, is anticipated to play, alongside other initiatives, a crucial role in this transition.

The definition of a smart city, as established by the EU Commission and also by the perception of the Federal Republic of Germany, highlights the persistent emphasis on digitalisation. This concept is regarded not only as a fundamental prerequisite for the successful creation of the smart cities of tomorrow in the EU but also for the effective implementation of UAM, as previously stated in this chapter.

In conclusion to the evaluation of the term “smart city," it is imperative to note that this term has yet to be incorporated into any legal framework within the European Union. Presently, it is predominantly utilised in policy documents and evaluations drafted by public and private stakeholders. Therefore, it is evident that the term lacks legal standing. However, given its presence at the national and supranational (EU) level, it is highly probable that the term may eventually be defined in the appropriate fashion and subsequently assimilated into EU regulations or national legislation.

1.8. CONCLUSION

The primary objective of this chapter was to introduce critical terms relevant to this dissertation, such as eVTOLs/VCA, UAM, AAM, and IAM/IAS, and provide a parallel presentation of their origins. While the list of terms mentioned above is not exhaustive, other more well-known terms related to urban aviation environments (for instance, UAS, RPAS) will be evaluated in the following chapters without the requirement for an etymological approach, as their definitions already exist in the legal documents of the European Union and international organisations like the ICAO.

It is important to note that when this chapter was written, none of the terms discussed were legal terms defined in any EU treaty or regulation. Therefore, as previously mentioned, they did not have a binding effect on member states. However, because these terms reflect the perspectives of the EU’s primary

regulatory body, they represent collaborative efforts between the Agency and key public and private stakeholders. This implies that the terminology could eventually be integrated into binding EU law. Indeed, this is what happened with the 2024 regulatory package, which officially recognised the term "IAM" and "VCA" as a legal concept within EU secondary legislation.[143]

The author attempted to disentangle numerous misconceptions related to terms such as UAM-AAM-IAS/IAM, with references to updated sources and comparisons between them. Policymakers, private stakeholders, and professionals must comprehend these distinctions and work together to develop UAM services that satisfy the needs of diverse communities.

In an effort to accurately define the terms at play, the author sought to challenge the unnecessary focus placed solely on either eVTOLs or UAS when discussing urban aviation environments under examination. This approach directly addresses the central question of the dissertation: whether the emerging advanced urban mobility network(s) constitute merely another aircraft network designed exclusively for unmanned aircraft or for eVTOLs. As demonstrated in the preceding sections, UAM is not merely an aircraft network; rather, it represents an entirely new mobility cosmos above urban or urbanised areas. It is a comprehensive and multimodal air transportation system for both passengers and cargo operating within and around densely populated, built environments- as articulated by EASA.[144] Within these ecosystems, UAS, eVTOLs, and conventional aircraft such as helicopters (probably in smaller numbers) are expected to operate in coordination, coexisting and contributing to a new, third (vertical) dimension of urban mobility. This system is inherently more complex than the more limited airspace currently designated for UAS operations.

In the following sections of this dissertation, having addressed the main question from an etymological perspective, the study will explore several additional issues. These include, among other things, the position of ICAO regarding UAM. It will also examine the certification and standardisation

143 More information about the said package will be provided in Chapter III of this dissertation.
144 See, (https://www.easa.europa.eu/en/light/topics/urban-air-mobility-uam), accessed (24-04-24).

challenges related to eVTOLs and UAS operating within UAM environments. Additionally, the study will discuss the synergy and compliance of UAM environments and their components with existing legal frameworks, whether they are international or supranational.

CHAPTER II- THE NEW ERA OF URBAN MOBILITY UNDER THE INTERNATIONAL AIR LAW, THE PERSPECTIVE OF ICAO

2.0. INTRODUCTION

As stressed in the previous chapter, UAM is part of a broader mobility concept in current and future urban environments. This new model of mobility, as the name implies, requires and depends on air law principles. The significance and role of international law in aviation date back to the early 20th century when a crucial attempt to codify air navigation principles took place.[145] As will be further analysed in Chapter IV, it was then when the French Government expressed the opinion that, for safety purposes, they should reach an agreement with Germany vis-a-vis the operation of balloons of the latter over French territory.[146] The above led to the drafting of the Paris Conference of 1910, which, despite its failure to provide tangible legal results, constituted the first attempt of two major states to create a forum of discussion over an already extremely crucial legal domain with international aspects.[147]

The end of World War I, on 8 February 1919, marked the first documented air service between Paris and London. The necessity to gather all the existing laws into an International Convention intensified. The international legal community had to choose between two paths in the drafting phase: That of Maritime Law, where the concept of complete freedom on the high seas was prevalent and the other one that envisioned the national airspace as a part of the

145 In 1899, at the Hague Peace Conference, the topic of aerial warfare was the first to be subjected to international legal codification.

146 See, Andritsos and Djakovic, Balloons Challenging Sovereignty, *An Aviation Story Older Than You May Think*, Zeitschrift für Luft- und Weltraumrecht, Vol. 72, No. 4 (2023), at 541–543.

147 Mendes de Leon, *Introduction to Air Law*, 11th ed. (Wolters Kluwer, 2022), at 3.

states' sovereignty. The aftermath of the War and the consequent socio-political developments led to the adoption of the second legal perspective.[148]

The above lengthy process led to the creation of International Air Law, which can be defined as" the body of rules that governs the utilisation of airspace and its advantages for aviation, the travelling public, undertakings, and the nations of the world."[149] The proper development of this chapter requires a critical understanding of the particular rules that constitute air law and the critical documents that have contributed to its development. Air Law encompasses a comprehensive set of regulations that are derived from a variety of sources. These include:

- Multilateral conventions;
- Bilateral and other international Air Services Agreements (ASAs);
- General principles of international law;
- Standards and Recommended Practices (SARPs) and other norms formulated by ICAO;
- National laws and regulations;
- Judicial rulings;
- Regional arrangements such as the European Union (EU) and other regional regimes;
- Resolutions and conditions established by private entities such as the International Air Transport Association (IATA), and;

148 Ibid.

149 See, supra note 147, at 1. An alternative, more succinct definition of air law was provided by Prof. Cheng, who defined air law as "*The body of law directly or indirectly concerned with civil aviation."* For more information see, (Air law | Aviation Regulations & International Agreements | Britannica), accessed (19-12-23).

- Contracts between airline companies, airlines and passengers, and other parties that are involved in air transport and navigation. [150]

This chapter will focus *inter alia* on ICAO and its position in the new urban air environments. Prior to examining ICAO's stance on urban mobility and the associated addition of the 3rd dimension, it is imperative first to revisit the fundamental principles enshrined in the international civil aviation's foundational document.

The Chicago Convention of 1944[151] (hereinafter referred to as the Chicago Convention or the Convention, or CC44) is widely recognised as the *sine qua non* of contemporary international civil aviation. This convention has been extensively cited in academic literature as the *"Magna Carta"*[152] of aviation. The Chicago Convention of 1944 was initially signed by 52 states but has since become a success story among international legislations, boasting 193 Member States.[153] Its primary objective was to establish a systematic approach to the control of international civil aviation activities, characterised by the fundamental principle of sovereignty over the airspace, in order to facilitate the peaceful and fruitful development of aviation between states.[154]

Article 1 of CC44, which reintroduces the principle of *complete and exclusive sovereignty over the airspace* above their territory,[155] previously

150 See, supra note 147, at 4.

151 Convention on International Civil Aviation.

152 See, among others, Hobe, *Sovereignty as a Basic Concept of International Law and a Core Principle of Air Law*, in Mendes de Leon and N. Buissing (eds.), *Behind and Beyond the Chicago Convention: The Evolution of Aerial Sovereignty* (Kluwer Law International, 2019), at 38; Jakhu and Dempsey (eds.), *Routledge Handbook of Public Aviation Law* (Routledge, 2017), at 1.

153 See (chicago.pdf (ICAO. int)), accessed (07-09-23). The last State to ratify the Chicago Convention was the Dominican Republic.

154 The cruciality of such an objective is further stressed in the Preamble of the Chicago Convention 1944 as *"the future development of international civil aviation can greatly help to create and preserve friendship and understanding among the nations and the peoples of the world, yet its abuse can become a threat to the general security"*. Preamble to the Chicago Convention 1944.

155 Article 1 of the Chicago Convention.

introduced in the Paris Convention of 1919[156], serves as the foundation of contemporary international civil aviation.[157] The phrasing employed in Article 1 of the Chicago Convention bears a resemblance to the well-known Middle Ages adage *"cuius est solum eius est usque ad coelom et ad inferos."*[158] Additionally, it employs the same terminology as the preceding Paris Convention of 1919 and firmly establishes[159] one of the fundamental principles of customary international law.[160]

Furthermore, Article 38 (1) of the Statute of the International Court of Justice (ICJ) designates conventions as a significant source of public international law,[161] thereby establishing CC44 as the fundamental basis for regulating commercial aviation and its associated technical, economic, and social activities that possess an international dimension.

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156 See, Convention Relating to the Regulation of Aerial Navigation, signed at Paris, 13 Oct 1919, 58 LNTS 346.

157 See, supra note 146 at 545; See also, Milde, *International Air Law and ICAO* (Essential Air and Space Law, Vol 4, Eleven International Publishing, The Hague, 3rd ed., 2016), at. 11.

158 More information about this maxim is presented in the Operations Chapter of this dissertation.

159 In other words, customary international law would remain applicable in the absence of adherence to the Convention. See Cassar, *The Resurgence of Sovereignty Versus the Freedom of Flight*, in Mendes de Leon and Buissing (eds.), *Behind and Beyond the Chicago Convention: The Evolution of Aerial Sovereignty* (Kluwer Law International, 2019), at 372. For a general reference to the notion of customary international law, see Evans (ed.), *International Law*, 5th ed. (Oxford University Press, 2018), at 92-94.

160 The International Court of Justice (ICJ) has expressly recognised this provision as one of the "firmly established and longstanding tenets of customary international law". See, for instance, ICJ, Military and Paramilitary Activities in and Against Nicaragua (Nicaragua v. United States), ICJ Rep. 14, 111 (1986).

161 According to Article 38 (1) of the Statute of the International Court of Justice (ICJ), the sources of public international law are: "[...] (a) international conventions, whether general or particular, establishing rules expressly recognized by the contesting States; (b) international custom, as evidence of a general principle accepted as law; (c) the general principles of law recognized by civilized nations; (d) [...J judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law. "

Although the Convention has a significant impact on various aspects of international civil aviation, several of its core provisions pertain specifically to the establishment and operation of ICAO.

2.1. ICAO, STATUS AND ROLE FOR INTERNATIONAL AVIATION

The formation of ICAO is founded in Article 43 of the Chicago Convention[162], with the parallel listing of its constituting bodies, such as the Assembly, the Council and other bodies deemed necessary for the Organisation's appropriate function to serve better its purpose to safeguard international civil aviation. ICAO's principal role as one of the central organisations vis-a-vis international civil aviation is verified *inter alia* by the fact that it became a Specialised Agency of the United Nations Organisation on 13 May 1947 with special powers, as portrayed in Article 64 of the Chicago Convention.[163] The objectives of ICAO have been stressed in Article 44 of the Convention with a clear orientation on the "promotion of safety and the orderly development of civil aviation throughout the world, the contribution to adopting measures aiming for a more secure aviation world and sustainable environment."[164] For the above goals to materialise, ICAO, as the organisation responsible, laid down 19 Annexes attached to the Chicago Convention, which encompass specific Standards and Recommended Practices (henceforth referred

162 See Article 43 of the Chicago Convention.

163 See, supra note 147, at 48. See also, Article 64 of the Chicago Convention.

164 See Article 44 of the Chicago Convention. See also, the ICAO Business Plan 2020-2022, in which five Strategic Objectives have been set to help the Contracting States provide a safe, secure, efficient, economically viable and environmentally responsible air transport network. The five Strategic Objectives are: Safety, Air Navigation Capacity and Efficiency, Security and Facilitation, Economic Development of Air Transport and Environmental Protection. See additionally, ICAO, "strategic Objectives", (www.icao.int/about-icao/Council/Pages/Strategic-Objectives.aspx.), accessed (07-09-23).

to as SARPS)[165] as it is indicated by Article 37 of the Convention.[166] The SARPS are technical specifications with the mission to implement the articles of the Convention accurately and to achieve "the highest practicable degree of uniformity in regulations, standards, procedures and organisation in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation[167]". However, despite having the same goals, these two tools differ in certain aspects, as is evident by the relevant definitions provided by ICAO. According to ICAO's literature, a Standard is defined as:

- "Any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention".[168]

- While a Recommended Practice is defined as "any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognized as desirable in the interest of safety, regularity or efficiency of international air navigation and to which Contracting States will endeavour to conform in accordance with the Convention".[169]

Thus, the main difference between these two tools is the level of compulsion attached to adopting the Standard or the Recommended Practice, respectively. The SARPs that ICAO publishes as Annexes are living legal entities that get updated when a particular necessity arises in the domains of technology, policy,

165 See, Huang, *Aviation Safety and ICAO* (Meijers-reeks, Kluwer Law International, Alphen aan den Rijn, 2009) [thesis], at 43-49 (https://hdl.handle.net/1887/13688), accessed (07-09-23).

166 See Article 37 of the Chicago Convention.

167 Ibid.

168 ICAO, "Making an ICAO Standard", (www.icao.int/safety/airnavigation/Pages/standard.aspx.), accessed (07-09-23).

169 Ibid.

commerce, etc.[170] The integration of SARPs in the national legislation of each contracting state to the Chicago Convention materialises with the adoption of national legislations via which the SARPs are implemented and enforced.

The legal status of the Annexes has been a subject of discussion for many years in courts[171], literature[172] and practice amongst professionals and academics, with the consensus being that the SARPS incorporated into the Annexes as attachments to the Chicago Convention do not have treaty status themselves and consequently are not legally binding[173].[174] However, despite this ambivalence in reference to the legal status of the SARPs incorporated into the Annexes of the Convention, the global implementation of these standards in the respective national legislations is considered by ICAO as a necessary measure.[175] Additionally, the Chicago Convention recognises, via Article 38[176], that if a State fails to comply with the ICAO standards or wishes to *"adopt regulations or practices differing in any particular respect from those established by an international standard"*, it should notify ICAO of the above difference(s).[177] Thus, despite the aforementioned ambiguous legal nature of the

170 See, supra note 147, at 25-29.

171 See, Weber, *Convention on International Civil Aviation – 60 Years*, Zeitschrift für Luft- und Weltraumrecht, Vol. 53 (2004), at 298.

172 See, Milde, *International Air Law and ICAO*, Eleven International Publishing (2016), at 71–73.

173 According to the wording of the Chicago Convention in Article 37, each contracting State "undertakes to collaborate(...) uniformity". Thus, in the Chicago Convention itself, there is no definite wording forcing the member-state to comply with those standards.

174 See, supra note 147 at 356.

175 Ibid.

176 See Article 38 of the Chicago Convention.

177 Article 38 of the Chicago Convention stipulates that: *"Any State which finds it impracticable to comply in all respects with any such international standards or procedure, or to bring its own regulations or practices into full accord with any internatinal standard or procedure after amendment of the latter, or which deems it necessary to adopt regulations or practices differing in any particular respect from those established by an international standard, shall give immediate notification to the International Civil Aviation Organization of the differences between its own practice and that established by the international standard. In the case of amendments to international standards, any State which does not make the appropriate amendments to its own regulations or practices shall give notice to the Council within sixty days*

SARPs, it seems that an element of "conditional binding" force is present.[178] The obligation to notify featured in Article 38 (deviations from the existing international standards) of the Convention does not exempt the concerned State party from its obligations stemming from the Chicago Convention. Even though the provisions of the Article (notification obligation) mentioned above refer explicitly to Standards and not Recommended Practices, ICAO supports that the latter is also crucial for international civil aviation's safe and efficient function of international civil aviation.[179] Consequently, it is the ICAO Assembly's view that the Council has to urge the States to notify about any possible deviation from the SARPs, in addition to the date by which the said State will comply/adopt them.[180]

Following this brief analysis of the SARPs, the author deems necessary before digging into ICAO's perspective in reference to UAM/AAM environments to present the stratification of ICAO, with a parallel reference to other material existing in the Annexes or other documents that the organisation develops to achieve its goals as they are stressed in the Chicago Convention.

2.2. ICAO'S STRUCTURE AND POSITION IN THE AVIATION WORLD

As explicated above and in concurrence with Article 43 of the Chicago Convention, a governing body known as ICAO has been established by the

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of the adoption of the amendment to the international standard, or indicate the action which it proposes to take. In any such case, the Council shall make immediate notification to all other States of the difference which exists between one or more features of an international standard and the corresponding national practice of that State."

178 ICAO AN 13/1.1-12/19 10 April 2012 Subject: Adoption of Amendment 43 to Annex 2, para. 7. See also, ICAO DGP/19-WP/42 29/9/03, para. 2.3.3., (https://www.icao.int/safety/DangerousGoods/DGP19/DGP.19.wp.042.en.pdf.), accessed (07-09-23).

179 See, supra note 147 at 358.

180 ICAO AN 13/1.1-12/19 10 April 2012 Subject: Adoption of Amendment 43 to Annex 2, para. 7. See also, supra note 178.

Convention. This organisation is composed of various complementary components, which include:

- The Assembly

- The Council

- Additional bodies deemed requisite, such as:

- The Secretariat

- The Air Navigation Commission (ANC)

Each of these bodies plays a crucial role in the function and goals of the organisation. The assessment of the recent findings of the 41st Session of the ICAO's Assembly vis-a-vis the emerging air mobility environments requires a short presentation of the vital organs of the ICAO before the author briefly explains their role, structure and mission.

The Assembly is a sovereign body of ICAO, constituted by all the 193 member states of ICAO. Its function is regulated according to:

➔ Article 46 First Meeting of Assembly;

➔ Article 48 Meetings of the Assembly and Voting;

➔ Article 49 Powers and Duties of the Assembly.[181]

The Assembly has a multifaceted role with certain powers and duties, which are described in Article 49 of the Chicago Convention.[182]Each Contracting State of the ICAO has one voting right at the Assembly, which is equal to all the others[183], while for decisions to be adopted at the Assembly, a majority of the votes is required.[184] Furthermore, the Assembly can refer to the Council, subsidiary commissions or any other body matters within its

181 See, ICAO, *Standing Rules of Procedure of the Assembly of the International Civil Aviation Organization*, Doc 7600/6.

182 See, Article 49 of the Chicago Convention.

183 See, Chicago Convention 1944, Art. 48(b).

184 See, Chicago Convention 1944, Art. 48(c).

jurisdiction.[185] Right of participation in the Assembly has, apart from the ICAO's Member-States, other international organisations such as the International Air Transport Association (hereinafter referred to as IATA) and Airports Council International (hereinafter referred to as ACI), following an invitation, to contribute to discussions over important aviation matters.[186]

The Council is the governing body of ICAO and is led by its President. It is shaped by thirty-six state members, who are elected every three years for the same period by the Assembly. Its functions exist in the legislative, administrative and judicial spectrum[187] and are regulated per:

- ➔ Article 50 Composition and Election of Council;
- ➔ Article 51 President of Council;
- ➔ Article 52 Voting in Council;
- ➔ Article 53 Participation Without a Vote;
- ➔ Article 54 Mandatory Functions of Council;
- ➔ Article 55 Permissive Functions of Council of the Chicago Convention.

In parallel to the Assembly, the decisions of the Council are also approved by the majority of its members with respective voting rights.[188]

In reference to the structural components of ICAO, a crucial role is played by the Secretariat, which is led by its Secretary-General, who serves as the Chief-Executive officer, shaping this organ's direction and work.[189] Five permanent administrative offices constitute the ICAO Secretariat:

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185 Scott and Trimarchi, *Fundamentals of International Aviation Law and Policy* (Routledge, 2020), at 68.

186 Ibid.

187See, supra note 168.

188 Chicago Convention 1944, Art. 52.

189 See, supra note 185 at 62.

- ➔ The Air Navigation Bureau[190], in conjunction with the relevant stakeholders, administrates policies on air navigation safety and infrastructure, maintaining the Global Air Navigation Plan (GANP)[191] and the Global Aviation Safety Plan (GASP)[192].

- ➔ The Air Transport Bureau[193] aids the implementation of the Strategic Objectives on Security and Facilitation, Economic Development of Air Transport, and Environmental Protection. In addition, it supports the concept of Safety in the air transport domain.

- ➔ The Legal Affairs and External Relations Bureau[194], which, as the name implies, provides legal consultation to the Secretary-General, to other bodies of the ICAO and State-Members, on matters associated with *inter alia* administrative, procedural and constitutional domains and, of course, Public International Law.

190 See, ICAO, "Air Navigation Bureau", (www.icao.int/safety/airnavigation/Pages/default.aspx.), accessed (09-09-23).

191 The concept of the GANP is defined as: "the strategy to achieve a global interoperable air navigation system, for all users during all phases of flight, that meets agreed levels of safety, provides for optimum economic operations, is environmentally sustainable and meets national security requirements. The GANP is being evolved to serve as a worldwide reference to transform the air navigation system in an evolutionary manner so that no State or Stakeholder is left behind." See, ICAO, Global Air Navigation Plan (GANP), (www.icao.int/airnavigation/Pages/GANP-Resources.aspx.), accessed (09-09-23).

192 Similarly, the concept of GASP is defined as: "the strategic approach that measures progress in the area of safety. The Global Aviation Safety Plan (GASP) specifically establishes targeted safety objectives and initiatives while ensuring the efficient and effective coordination of complementary safety activities between all stakeholders." See, ICAO, "GASP", (www.icao.int/safety/SafetyManagement/Pages/GASP.aspx.), accessed (09-09-23).

193 See, ICAO, "Air Transport Bureau", (www.icao.int/secretariat/air-transport/Pages/default.aspx.), accessed (09-09-23).

194 See, ICAO, "Legal Affairs and External Relations Bureau", (www.icao.int/secretariat/legal/Pages/default.aspx), accessed (09-09-23).

- ➔ The Bureau of Administration and Services[195], is a sub-body of the Secretariat, competent in providing "high-quality human resources, business acumen, multilingual support, event and venue management, and revenue-generating activities".[196]

- ➔ The Technical Cooperation Bureau[197] advises and co-operates with the Member States in developing and materialising their civil aviation projects. In particular, it can assist the Member States through the process of applying the ICAO Annexes, support the respective civil aviation authorities, and provide training and relevant infrastructure.[198]

The Directors of the Bureaus mentioned above report directly to the Secretary-General[199], who is also the secretary of the ICAO Council and the Assembly.

Finally, the Air Navigation Commission (ANC)[200], with managerial powers over its technical work programme, is vital to ICAO, with Articles 56-57 of the Chicago Convention[201] regulating this body's composition and relevant duties. Apart from the Commission members mentioned in Articles 56-57 of the Convention, persons from the state parties and industry stakeholders can participate in the ANC as observers. The ANC's task stressed above includes the consideration and recommendation of SARPs and the Procedures for Air Navigation Services (PANS) for adoption or approval by the ICAO Council. The

195See, ICAO, "Bureau of Administration and Services", (www.icao.int/secretariat/Administration/Pages/default.aspx.), accessed (09-09-23).

196 Ibid.

197See, ICAO, "Technical Cooperation Bureau", (www.icao.int/secretariat/TechnicalCooperation/Pages/default.aspx.), accessed (09-09-23).

198 Ibid.

199 See, for the rules on personnel, Chicago Convention 1944, Articles 58–60.

200 See, ICAO, "Air Navigation Commission", (www.icao.int/about-icao/AirNavigationCommission/Pages/default.aspx.), accessed (10-09-23).

201 See Articles 56-57 of the Chicago Convention on *the Nomination and appointment of Commission* and *Duties of Commission,* respectively.

challenges for the aforementioned mission are stipulated in Article 57 of the Convention.[202]

With the completion of this analysis on the composition of ICAO's vital organs, their role and missions, this chapter will resume, as was underlined above, with the assessment of the different materials presented in the Annexes of the Chicago Convention, as well as, other kinds of documents that are drafted, their legal value and role.

The first part of this chapter was dedicated to the SARPS, their role and value; however, ICAO does not only use SARPS to attain its goals as these are presented in the Chicago Convention. Since their inception, the Annexes of the Convention have also contained other material, as is underlined below.

1. The Appendices are "material grouped separately for convenience but forming part of the Standards and Recommended Practices adopted by the Council."[203]

2. The Definitions are "terms used in the Standards and Recommended Practices that are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have independent status but is an essential part of each Standard and Recommended Practice in which

202 The Air Navigation Commission shall:

- Consider, and recommend to the Council for adoption, modifications of the Annexes to this Convention;
- Establish technical subcommissions on which any contracting State may be represented, if it so desires;
- Advise the Council concerning the collection and communication to the contracting States of all information which it considers necessary and useful for the advancement of air navigation.

203 AN-Conf/11-WP/142 Appendix, "APPENDIX SARPs "NOTIFICATION OF DIFFERENCES" PROCEDURES AND PANS STATUS", (https://www.icao.int/Meetings/AMC/MA/Eleventh%20Air%20Navigation%20Conference%20(ANConf11)/anconf11_wp142_app_en.pdf), (accessed 22-07-23).

the term is used since a change in the meaning of the term would affect the specification."[204]

3. Tables and Figures are material that "add to or illustrate a Standard or Recommended Practice and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status."[205]

4. Other Materials: ICAO Annexes may additionally contain: Forwards, Introductions, Notes and Attachments.[206]

Apart from the Annexes and the material above contained in them, ICAO may also draft documents such as:

1. The Procedures for Air Navigation Services (PANS): These "comprise operating practices and material too detailed for Standards or Recommended Practices – they often amplify the basic principles in the corresponding Standards and Recommended Practices."[207]

2. The Regional Supplementary Procedures (SUPPs) "have application in the respective ICAO regions. Although the material in Regional Supplementary Procedures is similar to that in the Procedures for Air Navigation Services, SUPPs do not have the worldwide applicability of PANS."[208] The Council approves both these documents.

3. The Guidance Material (GM): "is produced to supplement the SARPs and PANS and to facilitate their implementation. Guidance material is issued as Attachments to Annexes or in separate documents such [as] manuals, circulars and lists of designators /addresses. Usually, it is

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204 AN-Conf/11-WP/142 Appendix, "APPENDIX SARPs "NOTIFICATION OF DIFFERENCES" PROCEDURES AND PANS STATUS", (https://www.icao.int/Meetings/AMC/MA/Eleventh%20Air%20Navigation%20Conference%20(ANConf11)/anconf11_wp142_app_en.pdf), (accessed 22-07-23).

205 Ibid.

206 See, supra note 185, at 73.

207 Ibid.

208 Ibid.

approved at the same time as the related SARPS are adopted." The GM needs the Secretary-General's approval and is issued under his/her authority.[209]

4. The Manuals are supplementary documents tailored to "provide information to supplement and/or amplify the Standards and Recommended Practices and Procedures for Air Navigation Services. They are specifically designed to facilitate implementation and are amended periodically to ensure their contents reflect current practices and procedures."[210]

5. The Circulars make "specialized information of interest available to Contracting States. Unlike manuals, circulars are not normally updated."[211]

ICAO does not publish documents only in the SARPs sphere. It drafts other kinds of documents, such as

- The ICAO Journal, which constitutes a summary of ICAO's activities, featuring in parallel information that could be helpful to the Contracting States.[212]

- The Annual Reports of the Council form the regular summary of the application of the decisions taken by ICAO's highest body (the Council), which the Assembly reviews when it is reconvened.[213]

209 See, supra note 185, at 73.

210 Ibid.

211 See, ICAO, "Making an ICAO Standard", (www.icao.int/safety/airnavigation/Pages/standard.aspx.), (accessed 24-07-23).

212 See, ICAO, "ICAO Journal", (www.icao.int/publications/Pages/ICAO-Journal.aspx?year=2018&lang=en), (accessed 24-07-23).

213 See, ICAO, "Annual Reports of the Council", (www.icao.int/publications/Pages/annual-reports.aspx), (accessed 24-07-23).

- Assembly Documentation, among other things, includes Working Papers presented by Stakeholders during the Assembly and the relevant resolutions adopted.[214]

- The Doc Series are a set of ICAO publications covering various topics from regulation to guidance.[215]

- Free Publications. These publications include *inter alia* the ICAO Journal and the TRIP Magazine.[216]

While the above documents are not legally binding for the Chicago Convention Contracting States, they nevertheless indicate the view of ICAO on specific topics, its directives, and the opinion of the relevant civil aviation stakeholders.

2.3. URBAN AIR MOBILITY AND ICAO, A DISCUSSION OVER AN INDUSTRY-MADE CONCEPT

While the provision referring to the "pilotless aircraft" presented in Article 8 of the Chicago Convention[217] has existed since 1944 and has been a topic of multiple discussions within the ICAO till today, the concept of Urban Air

214 See, ICAO, "About the Assembly", (www.icao.int/Meetings/a39/Pages/default.aspx.) , (accessed 24-07-23).

215 See, "ICAO Annexes and Doc Series", (https://skybrary.aero/articles/icao-annexes-and-doc-series), (accessed 24-07-23).

216 See, ICAO, "Free Publications", (https://www.icao.int/publications/Pages/default.aspx), (accessed 24-07-23).

217 Article 8 of the Chicago Convention stipulates that: "No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft." The above Article constitutes the first provision for unmanned aviation 80 years ago.

Mobility was discussed for the first time during the 39th Assembly (2016)[218] and named as such during the 40th (2019)[219].

The author establishes here a connection between unmanned aviation and Article 8 of the Convention by means of the concept of Urban Air Mobility, with the aim of refute the widespread misconception that UAM is simply another UTM traffic management network similar to U-Space. According to Chapter I, UAM is an all-encompassing mobility network that caters to conventional aircraft, whether manned or unmanned, as well as eVTOL, above urban environments or environments that possess the capability to sustain urban infrastructure.

This preference for linking UAM with unmanned aviation seems to be featured in the context of the 40th Assembly of ICAO, and in particular in the A40-WP/292, presented by the United Arab Emirates, where they invite the aforementioned body to *inter alia* "direct ICAO to consider potential unmanned operations (Remotely piloted) while developing the SARPs and guidance for Urban Air Mobility."[220] The Committee, in its Report on Agenda Item 26, agreed for the first time to consider the information presented by the UAE and assess its procedures to achieve the request.[221] The information above may seem unimportant in the standardisation of UAM by ICAO, but it marks the first clear commitment by the Organisation to develop SARPs for UAM.

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218 See, (https://ec.europa.eu/commission/presscorner/detail/fr/MEMO_16_3332), (accessed 01/08/23); See also, A39-WP/530 P/59 6/10/16, ASSEMBLY — 39TH SESSION REPORT OF THE EXECUTIVE COMMITTEE ON AGENDA ITEM 22 (Presented by the Chairman of the Executive Committee).

219 See, A40-WP/292 EX/122 27/7/19, ASSEMBLY—40TH SESSION EXECUTIVE COMMITTEE on Agenda Item 26: Other high level policy issues to be considered by the Executive Committee, Urban Air Mobility, (Presented by the United Arab Emirates).

220 See, A40-WP/292 EX/122 27/7/19, ASSEMBLY—40TH SESSION EXECUTIVE COMMITTEE on Agenda Item 26: Other high level policy issues to be considered by the Executive Committee, Urban Air Mobility, (Presented by the United Arab Emirates).

221 See, A40-WP/634 P/61 2/10/19, ASSEMBLY — 40TH SESSION REPORT OF THE EXECUTIVE COMMITTEE ON AGENDA ITEM 26.

During its 40th Assembly, the ICAO passed Resolution A40-27[222], acknowledging the potential of aviation innovation to enhance safety, efficiency, security, facilitation, sustainability, and economic development. Furthermore, the resolution highlights the capacity of innovation to simplify regulatory processes.[223] ICAO, with the above, portrays its determination to remain dedicated to fostering a closer working relationship with innovators to further its strategic objectives in the field of air transport. By strengthening its collaboration with innovators, ICAO aims to capitalise on the latest advancements in research, development, and innovation to address the intricate challenges confronting the aviation industry and promote its continued growth and prosperity.

Resolution A40-27 seeks to evaluate the necessity and essential resources required to advance the processes of the Organisation, establish a strategic dialogue with relevant entities, and formulate high-level policies to enhance overall performance.[224] The successful attainment of the objectives set forth in the Resolution is established via addressing four distinct innovation dimensions. As depicted in the graph below, these dimensions must be addressed to facilitate the effective implementation of the Resolution's goals.[225]

222 See, RESOLUTIONS ADOPTED BY THE ASSEMBLY, ASSEMBLY – 40th SESSION Montréal, 24 September—4 October 2019 INTERNATIONAL CIVIL AVIATION ORGANIZATION, at 127-128.

223 See, (Innovation (icao.int)), (accessed 15-08-23).

224 Ibid.

225 See, A41-WP/42 EX/20 11/7/22, ASSEMBLY—41ST SESSION EXECUTIVE COMMITTEE, Agenda Item 23 Innovation in Aviation, REPORT ON THE IMPLEMENTATION OF ASSEMBLY RESOLUTION A40-27 INNOVATION IN AVIATION, (Presented by the Council of ICAO).

Figure 7

In the context of A41-WP/42, the implementation of Resolution A40-27 involves utilising materialisation tools within four dimensions. Additionally, two supplementary dimensions warrant consideration. The first pertains to the "Awareness and Promotion" of innovation among various entities, including States, industry partners, and the wider aviation community.[226] The second dimension relates to "Engagement with Academia," which serves to foster innovative studies and projects.[227] By incorporating these dimensions into the resolution's framework, ICAO can effectively promote and facilitate innovation in the aviation industry.

Additional details about AAM/UAM and eVTOL aircraft were presented at the last ICAO Assembly (41st Assembly, 2022). During the Assembly, two agenda items - Item 31[228] on aviation safety and air navigation standardisation

226 See, supra note 223.

227 Ibid.

228 See, (https://www.icao.int/Meetings/a41/Pages/WP_Agenda.aspx?Category=(LE), (accessed 01-08-23).

and Item 23[229] on innovation in aviation - discussed aspects of advanced air mobility in urban settings.

During the 41st Assembly of ICAO, recommendations from both ICAO member states and the aviation industry were subject to a comprehensive evaluation. This process led to the development of a clear roadmap for future activities related to AAM/UAM applications. The evaluation process was conducted in depth, and the outcomes reflect a detailed plan for future endeavours in this field. It is noteworthy that ICAO seems to use both terms interchangeably; however, AAM appears to be the broader term, while UAM denotes the urban applications of AAM.[230]

The A41-WP/245, which the United States presented (co-sponsored by Japan) and A41-WP/160, presented by Japan, respectively, aimed to propose measures for AAM in the form of SARPs. The first of these documents suggests the establishment of an Advisory Group to coordinate relevant ICAO panels and amend the SARPs and guidance materials, thereby ensuring better cooperation and more effective implementation of the AAM-associated rules.[231] The WP/245 introduces a compact definition of AAM, bringing the eVTOL aircraft at its centre and underlining its inclusive nature referring to other manned and unmanned aircraft in parallel. The WP above stresses that AAM environments and their urban applications are not far-away projects but constitute an oncoming business model already in testing phases around the globe.[232] That creates according to the WP, the urgent need for an Advisory Group tasked with the aforementioned role since the concept of AAM has started to make its way into multiple Air Navigation Commission Panels, including but not limited to the Accident Investigation Panel, Airworthiness Panel, Air Traffic Management

229 See, (https://www.icao.int/Meetings/a41/Pages/WP_Agenda.aspx?Category=(LE), (accessed 01-08-23).

230 For more information about this matter, see Chapter I.

231 ASSEMBLY—41ST SESSION TECHNICAL COMMISSION, Agenda Item 31: Aviation Safety and Air Navigation Standardization, ICAO ADVANCED AIR MOBILITY ADVISORY GROUP (Presented by the United States and co-sponsored by Japan).

232 Ibid.

(ATM) Operations Panel, and Remotely Piloted Aircraft Systems (RPAS) Panel.[233]

In the same sequence, Japan emphasises in its 160/WP its intention to operate eVTOL aircraft for sightseeing purposes at the Yumeshima Expo venue in 2025, with a frequency of 20 flights per hour (urban application of AAM).[234] The document also acknowledges that many countries with private applications of AAM have established or will soon establish their own airworthiness standards and vertiport requirements. In agreement with A41-WP/245, Japan pinpoints the unique nature of eVTOL, quoting that it has not been treated consistently in any ICAO Annex so far, reaching the same conclusion that ICAO needs to establish globally harmonised standards and systems for the eVTOL operation.[235]

The report on Agenda Item 31 by ICAO (presented by the Chairperson of the Technical Commission) recognises the necessity for a proficient team to formulate a consolidated strategy and operational plan for AAM and investigate the creation of guidelines and materials for eVTOL aircraft.[236] AAM, here, refers to a set of innovative and emerging technologies implemented within the aviation ecosystem.[237]

Upon review of the Technical Commission's report and the Member-States' Working Papers, it is evident that AAM is perceived as an aviation concept that necessitates coordinated global regulations, particularly for interurban travel between neighbouring states. The notion that AAM solely pertains to aviation, as presented in Item 31, has been called into question during the discussion of Agenda Item 23. Notable industry stakeholders have voiced

233 Ibid.

234 ASSEMBLY—41ST SESSION TECHNICAL COMMISSION, Agenda Item 31: Aviation Safety and Air Navigation Standardization, PROPOSAL TO ICAO FOR TAKING LEADERSHIP TOWARD GLOBAL HARMONIZATION ON EVTOL, (Presented by Japan).

235 Ibid.

236 See, ASSEMBLY—41ST SESSION, REPORT OF THE TECHNICAL COMMISSION ON AGENDA ITEM 31 (Presented by the Chairperson of the Technical Commission).

237 Ibid. See also Chapter I.

their stance on the matter, underlining the necessity for a multi-layered approach vis-a-vis the regulation of AAM/UAM matters.

In document A41-WP/356[238], the Civil Air Navigation Services Organisation (CANSO), representing industry members, presented their "CATS Global Council Vision". The purpose of the presentation was to share their vision of the future of skies and suggest the role that the ICAO could play in making it a reality. In this Working Paper, CANSO underscores the critical role of the aviation industry in the development of upcoming air transportation systems on a global scale. Nevertheless, the imperative nature of ICAO's involvement is recognised, but necessary revisions to their work programme are advised to be made.[239]

The Working Paper produced by CANSO provides crucial insights into the industry's perspective on the allocation of responsibilities between ICAO/states and the industry regarding the development of new air transportation systems. The roadmap[240] outlined by the CATS Global Council serves as a foundation for constructive collaboration among ICAO, states, and the industry. Nonetheless, it is worth noting that various industry stakeholders tend to devise their own analyses and methodologies periodically in reference to the upcoming models of air transport.[241] In adherence to the established norms of the industry, this roadmap adopts a comprehensive approach that encompasses various aspects of political, economic, legal, social, operational, and environmental considerations.[242] It is centred on seven fundamental building blocks, which serve as the foundation for its strategic implementation.

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238 See, A41-WP/356, EX/155, 2/8/22, ASSEMBLY—41ST SESSION, EXECUTIVE COMMITTEE, Agenda Item 23: INDUSTRY ROADMAP FOR FUTURE SKIES (Presented by the Civil Air Navigation Services Organization (CANSO), ACI, IATA, IBAC, ICCAIA and IFALPA).

239 Ibid.

240 See, (CATS Vision Roadmap 20220615.pdf (canso.fra1.digitaloceanspaces.com)), (accessed 24-08-23).

241 See, Urban Air Mobility Initiative Cities Community (UIC2), Manifesto on the Multilevel Governance of the Urban Sky (CIVITAS Initiative, 2020).

242 See, supra note 238.

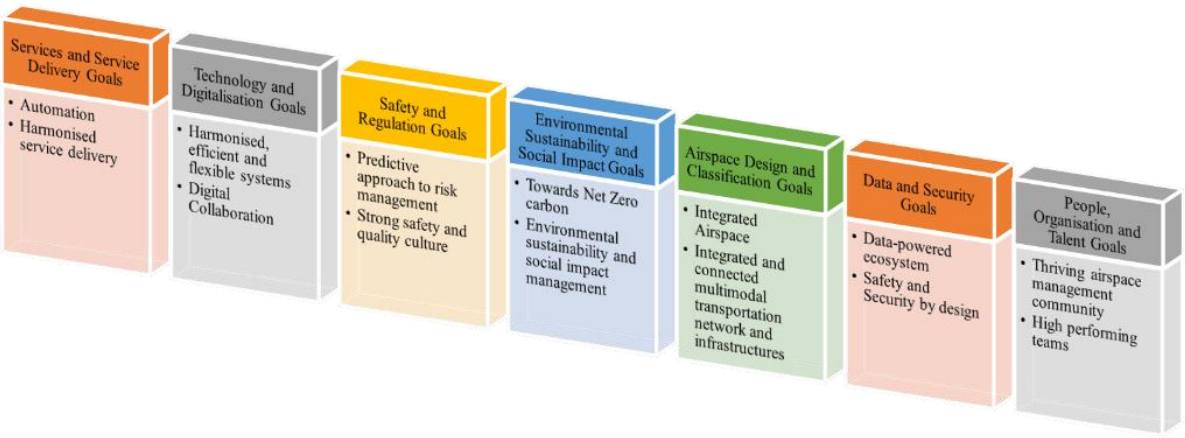

Figure 8[243]

It is apparent that the seven actions presented lack specificity (in the WP context) and are inadequate when considered in isolation. Therefore, ICAO's distinctive position can provide crucial elements and lead the drive for global harmonisation as outlined in the CATS roadmap.[244] Industry representatives continue by highlighting a series of measures that ICAO can undertake to accomplish their shared objective for the new era of air mobility. As per the recommendations of the CATS Global Council, the aviation industry is willing to offer its technical expertise and invites the ICAO to spearhead the development of a framework that comprehensively addresses various aspects such as liability, security, regulatory, political, and financial issues related to the decentralised management of sovereign airspace.[245] This collaborative effort aims to establish a robust system that ensures safe and efficient operation in the airspace while accommodating the increasing demand for air travel.

243 Ibid.

244 Ibid.

245 Ibid.

One of the most fascinating elements of this WP, aside from the industry's expression of their views regarding a complex matter that demands a multi-dimensional approach, is their recognition of ICAO's crucial role in a particular area of AAM (although the term is not mentioned explicitly in the paper; rather, it is described through their roadmap) and the utilisation of ICAO as a platform to communicate their perspectives. The industry appears to distinguish the development of AAM, and consequently, UAM, into distinct components, wherein the industry creates the technical aspects of the new mobility systems, while ICAO acts as an intermediary between them and the state parties, establishing legal standards that encompass the minimum requirements that most states can easily comply with and laying the groundwork for an interoperable system between them. The subsequent working paper, which will be evaluated under Agenda Item 23, appears to endorse the same principles that are present in the aforementioned paper (in reference to the multi-dimensional approach of AAM) but with significant additions, among other things, regarding the involved stakeholders in AAM.

The A41-WP/110[246] represents a significant contribution to the literature on UAM/AAM, being the first paper presented by the industry in the Assemblies' history to provide such a comprehensive overview of the nature of AAM and its urban applications. This paper's unique focus on the urban application of AAM highlights four main pillars:

- unmanned aircraft system technologies;
- eVTOL aircraft;
- digitalised air traffic management;
- and non-legal or technical aspects such as societal acceptance.[247]

Notably, this paper is the first to present non-aviation prerequisites, such as public acceptance, for the success of UAM in an aviation forum. The majority

246 See, A41-WP/1101 EX/50 27/7/22, ASSEMBLY — 41ST SESSION, EXECUTIVE COMMITTEE, Agenda Item 23: Innovation in Aviation, LEGAL AND SOCIETAL STAKES FOR THE EMERGING AIR MOBILITY IN METROPOLITAN AREAS (Presented by the International Coordinating Council of Aerospace Industries Associations (ICCAIA) and the Airports Council International (ACI)).

247 Ibid.

of Working Papers produced by the ICAO concentrate on the involvement of contracting states in the discussion surrounding AAM. However, this paper presents the perspective of industry experts who advocate for the inclusion of cities and local authorities in the dialogue, as they perceive the management of very low airspace[248] as an extension of public space.[249]

As per the author's view, the arguments put forth by industry members at ICAO, play a vital role in facilitating coordination between aviation and non-aviation authorities (stakeholders).[250] Furthermore, this paper establishes a connection between eVTOL aircraft and its positive impact on urban life, particularly in areas such as economy, environment, health, and well-being.[251] The authors of the WP emphasise that AAM is not just an aviation matter or concept but one with broader implications for society.[252]

This WP resumes in the same tone, emphasising that the application UAM is a comprehensive solution that encompasses the entirety of the urban mobility ecosystem, including both air and surface segments, integrated traffic management, energy network, intermodal hubs (sea-air-surface), information systems, and ticketing. This system offers a unique approach to managing urban transportation, providing a coherent and interconnected framework that optimises efficiency for cargo transportation and convenience for the citizens. With its focus on integrating various modes of transportation and utilising cutting-edge technology, UAM represents a significant step forward in the field

248 The 41st Assembly brought forth the concept of very-low airspace, also known as municipal airspace, as a novel idea in contrast to the "national airspace" as defined in Article 1 of the CC44. Although municipal airspace is regarded as a component of a nation's airspace, its evaluation at this level concerning AAM represents a new development.

249 See, supra note 246.

250 For more information about the stakeholders of UAM/AAM/IAM environments, see Chapter III.

251 See, supra note 246.

252 Ibid.

of urban mobility, offering a more sustainable and accessible future for cities worldwide.[253]

It should be stressed that the WP above significantly emphasises the importance of UAM beyond its aviation identity. An exclusively aviation-focused approach impedes its potential. Establishing a clear legal framework for modernising airspace management necessitates the involvement of non-aviation stakeholders (e.g. local authorities[254]), given the nature of the airspace, particularly the very-low airspace above cities.[255] To this regard, the International Coordinating Council of Aerospace Industries Associations (ICCAIA) and Airports Council International (ACI) have cited the multi-level governance of the urban Sky Manifesto[256], as well as the publications of the World Economic Forum's Advanced and Urban Air Mobility Cities and Regions, as valuable resources.

The aforementioned elucidates once again that, according to these members of the industry, UAM/AAM is not confined to the borders of aviation but constitutes instead a novel transportation system in urban areas, which necessitates the involvement of non-aviation policies and stakeholders. Additionally, it is vital to underline that the lack of consideration for UAM in urban and mobility planning activities can obstruct the sustainable and responsible integration of UAM services in urban regions.[257]

Despite the somewhat unorthodox views expressed, from a purely aviation perspective, by the members of the industry that drafted this WP, the Council of

253 See, supra note 246.

254 It is important to cite that the role of local authorities has been recognised in the EU; See, Article 18(f) of EU 2021/664 and the accompanying Guidance Material and AMCs to be approved by EASA/EU in Q2-Q3 2022.

255 See, supra note 246.

256 See supra note 241. See also, (https://civitas.eu/urban-air-mobility), accessed (24-08-23).

257 See, supra note 246.

ICAO and the Executive Committee in the A41-WP/42[258] and the A41-WP/633[259], respectively, have expressed support for their positions. Consequently, measures have been announced to ensure future air mobility and its urban applications are harmonised on a global level.

The Council of the ICAO invites the Assembly, as stipulated in A41-WP/42[260], to acknowledge the paramount importance of fostering innovation in working methods, systems, and technology. Such an endeavour is expected to facilitate the effective implementation of Resolution A40-27[261] while simultaneously enhancing the resilience and stability of the aviation system. The four dimensions of innovation[262] are also reflected in the ICAO Business Plan for 2023-2025[263], verifying that way that for the Organisation, the engagement with innovators and the incorporation of innovation and associated systems in ICAO's standards and procedures is considered a priority.

This commitment to innovation in the aviation industry has also been recognised by the Executive Committee, as stated in A41-WP/633[264]. The Committee has acknowledged the suggestions presented in WP/110 regarding

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258 See, A41-WP/42 EX/20 11/7/22, ASSEMBLY — 41ST SESSION, EXECUTIVE COMMITTEE Agenda Item 23: Innovation in Aviation, REPORT ON THE IMPLEMENTATION OF ASSEMBLY RESOLUTION A40-27 INNOVATION IN AVIATION, (Presented by the Council of ICAO).

259 See, A41-WP/633 P/41 6/10/22, ASSEMBLY—41ST SESSION, REPORT OF THE EXECUTIVE COMMITTEE ON AGENDA ITEM 23 (Presented by the Chairperson of the Executive Committee).

260 See, A41-WP/42 EX/20 11/7/22, ASSEMBLY — 41ST SESSION, EXECUTIVE COMMITTEE Agenda Item 23: Innovation in Aviation, REPORT ON THE IMPLEMENTATION OF ASSEMBLY RESOLUTION A40-27 INNOVATION IN AVIATION, (Presented by the Council of ICAO).

261 See, RESOLUTIONS ADOPTED BY THE ASSEMBLY, ASSEMBLY – 40th SESSION Montréal, 24 September—4 October 2019 INTERNATIONAL CIVIL AVIATION ORGANIZATION, at 127-128.

262 See Figure 7.

263 See, ICAO Business Plan 2023-2025, Version 1.0 - 25 July 2022.

264 See, A41-WP/633 P/41 6/10/22, ASSEMBLY—41ST SESSION, REPORT OF THE EXECUTIVE COMMITTEE ON AGENDA ITEM 23 (Presented by the Chairperson of the Executive Committee).

the crucial role of non-aviation stakeholders in the success of UAM and public acceptance. Furthermore, it emphasised ICAO's responsibility as a platform for discussion for all associated stakeholders, encompassing aviation and non-aviation. Additionally, the proposal by the Technical Commission has been endorsed by their end, aiming to establish an expert group for working on AAM, utilising the mechanisms listed in WP/42.

ICAO, via the works of its organs, assumes a critical role in the development of standards and the provision of guidance for a unified international system governing air-operation. In light of the rapid technological advancements and the emergence of new players in the aviation industry, the establishment of the Advanced Air Mobility Study Group (AAM SG) was deemed imperative, as underlined above, to assist the Secretariat in devising a comprehensive plan and structure for AAM. The AAM SG's objective is to facilitate the proactive development of upcoming AAM ecosystems worldwide while ensuring a safe, secure, efficient, and environmentally sustainable integration of these operations.

2.4. THE AAM SG, ICAO'S FIRST ATTEMPT AT UAM'S WORLDWIDE HARMONISATION

It is noteworthy that the preceding three ICAO Assemblies, with a specific focus on the 41st Assembly, marked the commencement of ICAO's active engagement in the advancements of AAM and UAM. This engagement has resulted in a more involved role in coordinating and collaborating with other Standards Making Organisations in reference to AAM.[265] The Study Group has been tasked with providing counsel on all AAM-related endeavours to be undertaken by ICAO in preparation for the First Advanced Air Mobility Symposium (AAM 2024)[266] and the upcoming Assembly, where tangible actions by ICAO are anticipated.

265 See, (ICAO AAM Study Group meets to discuss harmonised standards with international agencies - Unmanned airspace), (accessed 30-08-23).

266 See, (Unmanned Aviation and Advanced Air Mobility (icao.int)), (accessed 30-08-23).

While the establishment of the SG is a positive message for the Organisation and the future of AAM on a global scale, the author is currently unable to assess this development in this dissertation due to the absence of information or documents for evaluation purposes. Consequently, the author will evaluate the formation of the SG based on its expected outcomes, what it should avoid, and whether its proposals will have a significant impact on the regulation of AAM/UAM environments worldwide.

The AAM SG, along with other study groups within the ICAO, is constituted of aviation professionals, organisations, and industry stakeholders who present their expert viewpoints on matters related to international civil aviation. As a consequence of the 41st ICAO Assembly, the establishment of the AAM SG represents the initial phase in a protracted process that culminates in the publication of pertinent SARPs. While the creation of the SG is an encouraging signal for the development of coherent international standards for AAM, it is unlikely to produce any immediate, concrete results. For the foreseeable future, it will only discuss the issues related to AAM and UAM.

With regard to the objectives of the SG, the author raises a secondary consideration that is closely tied to the above point and is no other than the established protocols of the ICAO. Once the SG has successfully achieved its goals, the Panel will progress to the final phase, which involves making Decisions. As such, it is evident that the release of SARPs and/or model regulations, such as the ICAO Model UAS Regulations[267], is anticipated to occur circa 2030.

As analysed above, it is valid that the Organisation has acknowledged that the AAM/UAM is an intricate issue that requires a multilevel governance assessment. However, the author is concerned that despite these acknowledgements, it will be evaluated solely as an aviation matter due to the limited focus (aviation-oriented nature) of the ICAO. While the invitation to the UIC2 is a positive development, it remains doubtful whether their opinion and perspectives will be given due consideration in an aviation forum such as the

267 See, (https://www.icao.int/safety/UA/Pages/ICAO-Model-UAS-Regulations.aspx), (accessed 31-08-23).

ICAO. It is possible that the relevance of UIC2 within the AAM SG may diminish in the later stages of the SG. The reason for this is that the perspectives of UIC2 may prove challenging to integrate into the SARPs, owing to the state-centric approach adopted by the ICAO.

The final concern that the author endeavours to express regarding to the Study Group is once again time-oriented. The author observes that the United States and the European Union have already taken significant steps in the AAM/UAM realm and will likely have made further progress by the time the ICAO issues the SARPs, rendering them outdated. Nonetheless, it is worth bearing in mind that not all state parties of ICAO will have reached the same level of development in the AAM/UAM domain; hence, the SARPs will still have value for such countries, as they will guarantee the adherence to the minimum level of standards necessary for the realisation of such environments. The above statement of the author aligns with the ICAO's "No Country Left Behind" initiative.[268]

2.5. CONCLUSION

The present chapter introduced ICAO as the competent authority for international civil aviation. It provided a thorough explanation of the organisation's structure, competencies, and contributions to the aviation literature.

ICAO serves as a forum to address significant issues in the field of aviation, with a particular focus on upcoming topics that affect the international aviation community. The Organisation collaborates with relevant stakeholders, both private and public, with the aim of achieving its goals.

Following the aforementioned, this chapter delved into the views of both ICAO and its member states on AAM/UAM, as presented in the Working Papers and relevant documents from the last three Assemblies. It is essential to note that the Working Papers presented by member states or by ICAO within its

268 See, (https://www.icao.int/about-icao/nclb/Pages/default.aspx), (accessed 31-08-23).

Assemblies do not hold any binding legal effect. Instead, they are documents that reflect either a state's or ICAO's perception of a specific matter. For the contents of such Working Papers to be included in an ICAO Annex or national legislation, various steps must be taken beforehand. Nonetheless, the author strongly believes that every step towards achieving a goal is a valuable action and, as such, endorses the creation of the AAM SG and assesses its objectives and potential impact on the success of advanced air mobility and its applications in urban settings.

Moreover, the author emphasises ICAO's critical role as a leading aviation forum worldwide in the new era of urban mobility. The Organisation, via its AAM SG, brings together a diverse set of stakeholders to discuss and incorporate their views on proposed upcoming standards that make the practical application of AAM/UAM more efficient. Finally, the author highlighted that due to its multimodal nature, the practical application of AAM/UAM requires a collective effort from all relevant stakeholders, both aviation and non-aviation ones, making the role of ICAO indeed crucial stakeholder in the international domain but not the sole actor responsible for such a complex system.

CHAPTER III- THE EUROPEAN UNION'S VISION AND LEGISLATIVE ACTIONS FOR UAM/IAM: POLICIES, INNOVATIONS, AND PUBLIC ENGAGEMENT

3.0. INTRODUCTION

Following the analysis conducted in the preceding chapter concerning the role of UAM/AAM[269] within the framework of international air law, and in particular the perspectives of ICAO on the subject matter, this chapter will adopt a supranational focus by examining the EU and its principal agency responsible for civil aviation safety, EASA.

Since its establishment in 2003, EASA has played an instrumental role in various domains, including regulation, standardisation, certification, compliance, and guidance pertaining to aviation safety and security. This chapter aims to illustrate the works of EASA concerning the evolving urban air mobility environments and to articulate the EU's vision in general regarding unmanned aviation across its 27 member states.

The analysis will commence with an overview of the regulatory landscape governing civil aviation within the EU, beginning with Council Regulation (EEC) No 3922/91 and continuing with subsequent regulations that facilitated the transfer of regulatory competencies from EU member states to EASA. The discussion will then progress to more recent regulations pertinent to the sphere of low-altitude urban aviation, including Regulation (EU) No 2018/1139, which extends EASA's oversight to new and emerging aviation technologies, such as UAS. In addition to the above, Regulation (EU) 2019/945 will be assessed as the one that establishes technical requirements and

269 Given that the term AAM is predominantly utilised by ICAO and that the term UAM was initially introduced in the EU and utilised by EASA, the recent introduction of the terms IAM and IAS create a potential discrepancy. To avoid discrepancies concerning concepts that do not have clear practical differences- given that the concepts under evaluation currently have limited real-world application- the author will employ the terms IAM/UAM to refer to the same concept of low-altitude aircraft operations- whether innovative or traditional, manned or unmanned aircraft are involved-within the airspace above urban areas.

certification rules for UAS and their operators, encompassing CE marking and design standards, and Regulation 2019/947 which delineates operational rules for UAS, addressing categories of operations (open, specific, and certified), remote pilot responsibilities, and registration requirements within the EU. The analysis will further assess the 2024 European Commission's legislative package on drones and VCA[270], which puts the final rules in place for the launch of IAM in the EU, including air taxi services.[271]

The chapter will conclude with a presentation of a particular non-regulatory endeavour of EASA regarding the acceptance of UAM/IAM concepts within its borders.

3.1. ROADMAP TO EU CIVIL AVIATION

In this chapter an overview of the EU civil aviation environment will take place.

3.1.1. GENESIS OF EU CIVIL AVIATION AND TOWARDS THE BASIC REGULATION

The foundational legal framework of the EU, known as the Treaty on the Functioning of the EU (hereinafter referred to as the TFEU), expressly identifies air transport as a domain of shared competence between the EU and its member states in Article 4 (2) (g).[272] Consequently, this designation necessitated a coordinated regulatory approach to air transport, resulting in a distinctive model of civil aviation within the EU. The initial regulatory instrument that established

270 As already discussed in Chapter I, the term "VCA" covers the (e)VTOL aircraft and is the official term utilised in the EU legal documents.

271 See, (https://www.easa.europa.eu/en/newsroom-and-events/news/european-commission-adopts-regulatory-package-giving-go-ahead-vtol), accessed (30-09-2024).

272 Article 100 (2) of the TFEU states that *"The European Parliament and the Council, acting in accordance with the ordinary legislative procedure, may lay down appropriate provisions for sea and air transport. They shall act after consulting the Economic and Social Committee and the Committee of the Regions."*

common requirements for civil aviation in the EU was Council Regulation (EEC) No 3922/91.[273]

The establishment of the internal aviation market within the EU was completed in 1997 through the implementation of the third liberalisation package.[274] The first regulation that focused exclusively on aviation safety rules was Regulation (EC) No 1592/2002.[275] This regulation marked a significant milestone by assigning specific competencies related to airworthiness and environmental certification from the member states to the EU while also serving as the foundational document for EASA. Subsequently, Regulation (EC) No 216/2008 succeeded the initial aviation safety regulation, thereby enhancing EASA's regulatory and oversight authority in the areas of aircrew licensing and air operations.[276]

Regulation (EC) No 216/2008 was further amended by three additional regulations, specifically Commission Regulation (EC) No 690/2009[277] and Regulation (EC) No 1108/2009, which broadened EASA's competencies in the fields of Air Traffic Management, Air Navigation Services, and aerodromes.[278]

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273 Council Regulation (EEC) No 3922/91 of 16 December 1991 on the harmonization of technical requirements and administrative procedures in the field of civil aviation, OJ L 373, 31.12.1991, p. 4–8.

274 The internal EU aviation market was completed approximately in 1997 with the third liberalisation package which contained 3 Council Regulations: Council Regulation (EEC) No 2407/92 of 23 July 1992 on Licensing of Air Carriers, 0J L 240, 24 August 1992, p. 1; Council Regulation (EEC) No 2408/92 of 23 July 1992 on Access for Community Air Carriers to Intra-Community Air Routes, OJ L 240, 24 August 1992, p. 8; and Council Regulation (EEC) No 2409/92 of 23 July 1992 on Fares and Rates for Air Services, OJ L 240, 24 August 1992, p. 15.

275 Regulation (EC) No 1592/2002 of the European Parliament and of the Council of 15 July 2002 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, OJ L 240, 7.9.2002, p. 1–21.

276 Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC, OJ L 79, 19.3.2008, p. 1–49.

277 Commission Regulation (EC) No 690/2009 of 30 July 2009 amending Regulation (EC) No 216/2008 of the European Parliament and the Council on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC OJ L 199, 31.7.2009, p. 6–6.

278 Regulation (EC) No 1108/2009 of the European Parliament and of the Council of 21 October 2009 amending Regulation (EC) No 216/2008 in the field of aerodromes, air traffic management and air navigation services and repealing Directive 2006/23/EC, OJ L 309, 24.11.2009, p. 51–70.

Additionally, Commission Regulation (EU) No 6/2003 and Commission Regulation No 2016/4 contributed to this expansion of authority.[279] EASA's scope of competencies was further enriched by Regulation (EU) No 2018/1139, which introduced new regulatory, certification, and enforcement powers in various domains, including unmanned aircraft, aviation security, and cybersecurity.[280] Thus, the enactment of Regulation (EU) No 2018/1139 has effectively consolidated the scope of EU competence, encompassing the entire spectrum of the aviation landscape and strengthening the overall European aviation system.[281]

This leads to the inquiry regarding the relationship between the mobility systems under examination and Regulation (EU) No 2018/1139, commonly referred to as the "Basic Regulation." Although this regulation is not the inaugural EU legal instrument governing unmanned aircraft,[282] it represents the first to regulate all unmanned aircraft without regard to their operating mass.[283] This legislation establishes the foundation for a risk-based approach to unmanned aircraft operations,[284] which was subsequently further regulated in Commission Delegated Regulations (EU) No 2019/945 and No 2019/947. Consequently, since unmanned aircraft will play a significant role in the UAM/IAM environments, the Basic Regulation establishes their official starting regulatory point in the EU. However, the importance of the Basic Regulation and its relationship with UAM extends beyond unmanned aviation; it also

279 See, Commission Regulation (EC) No 6/2003 of 30 December 2002 concerning the dissemination of statistics on the carriage of goods by road, OJ L 1, 4.1.2003, p. 45–49, and Commission Regulation (EU) 2016/4 of 5 January 2016 amending Regulation (EC) No 216/2008 of the European Parliament and of the Council as regards essential requirements for environmental protection, OJ L 3, 06/01/2016, p. 1–2.

280 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, PE/2/2018/REV/1, OJ L 212, 22.8.2018, p. 1–122.

281 See, (https://www.easa.europa.eu/en/the-agency/faqs/basic-regulation), accessed (08-08-23).

282 See, Annex II point i, of Regulation (EC) No 216/2008.

283 See point 26 of Regulation (EU) 2018/1139.

284 See point 27 of Regulation (EU) 2018/1139.

encompasses manned aircraft, including the initial eVTOL projects (e.g., Volocity, Lilium Jet, etc.), which will fall under this category.[285] This relevance is particularly pronounced in the context of standardisation, certification and Air Traffic Management (hereinafter referred to as ATM) and Air Navigation Services (hereinafter referred to as ANS) within the airspace of the Single European Sky.[286]

Having established the central position of UAS alongside the other aircraft, innovative and conventional, manned and unmanned in the UAM/IAM environments, EASA's endeavours pertaining to UAS were further evolved with Commission Delegated Regulations (EU) No 2019/945 and No 2019/947.

3.1.2. EU UAS REGULATIONS UNPACKED: THE EMERGENCE OF REGULATIONS 945 AND 947 OF 2019

Regulation (EU) 2019/945 introduces a plexus of requirements pertaining to the design and manufacturing of UAS and remote identification add-ons, aligning with the operational rules defined in Implementing Regulation (EU) 2019/947. It further specifies which UAS require certification based on their design, production, and maintenance. In addition, the Regulation establishes rules for marketing UAS in the "open" category, ensuring their free movement within the EU while outlining the precise requirements for third-country UAS operators conducting operations in EU airspace under Regulation (EU) 2019/947.[287]

Regulation (EU) 2019/947 shifts the focus from the (product) requirements pertaining to UAS to the operational domain, thereby introducing a risk-based operational framework for UAS within the EU. This concept of risk-based

285 Further details regarding the operational requirements for manned eVTOLs in the context of UAM/IAM will be provided in subsequent sections of this Chapter, along with an analysis of Commission Implementing Regulation (EU) 2024/1111 of 10 April 2024.

286 See, Article 2 (1) (g) of Regulation (EU) 2018/1139.

287 See, Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems, C/2019/1821, OJ L 152, 11.6.2019, p. 1–40.

operations is particularly relevant, as prospective eVTOL projects will be classified into one of three categories, which will be examined in detail below. Article 3 of the Regulation delineates these three categories of UAS operations: the "open", “specific", and "certified" categories.[288]

The "open" category pertains to UAS operations characterised by a lower risk level, wherein neither prior operational authorisation nor a declaration by the respective operator is necessitated prior to flight.[289] Operations classified under this category must adhere to specific criteria: they must be conducted within visual line of sight (VLOS), maintain an altitude below 120 meters, and involve UAS with a maximum take-off mass (MTOM) of less than 25 kg while conforming to the stipulations delineated in Delegated Regulation (EU) 2019/945. Additionally, the remote pilot is responsible for ensuring that the UAS does not operate over assemblies of people and does not transport dangerous goods or drop any material.[290] To demonstrate compliance with the aforementioned, UAS operating within the open category must display a class identification label. The open category is further divided into three subcategories, namely A1, A2, and A3, determined by operational limitations, remote pilot requirements, and technical specifications for the UAS.[291]

The second category, “specific," refers to UAS operations that do not meet at least one of the requirements outlined in Article 4 of the Regulation.[292] This category includes UAS operations that carry higher risk factors. To ensure safety, UAS operators must obtain operational authorisation from the competent national aviation authority of the Member State where they reside (if they are individuals) or where their principal place of business is located (if they are legal

288 See, Article 3 of Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft, C/2019/3824, OJ L 152, 11.6.2019, p. 45–71.
289 Ibid. Article 4.
290 Ibid.
291 Ibid. Annex A.
292 See, Article 5 (1) of Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft, C/2019/3824, OJ L 152, 11.6.2019, p. 45–71.

entities).[293] To obtain this authorisation, operators are required to conduct a risk assessment, which must be submitted alongside their application. This assessment should include appropriate mitigation measures to ensure the safe operation of the UAS.[294]

Article 6 of the Regulation delineates the final risk-based category for UAS operations in the EU, designated as the "certified" category. This category represents the highest risk level within the EASA classification and necessitates the certification of both the UAS operator and the UAS itself, as well as the licensing of the remote pilot, to ensure operational safety. In accordance with Article 6 (1) of the Regulation, an operation is classified under the "certified" risk category if it meets any of the following conditions:

1. The operation occurs above assemblies of people;
2. The operation involves the transportation of people;
3. The operation includes the carriage of dangerous goods that may pose a high risk to third parties in the event of an accident.[295]

Moreover, Article 6 (2) stipulates that UAS operations shall be categorised as "certified" where the relevant authority, following the risk assessment outlined in Article 11, determines that the risks associated with the operation cannot be sufficiently mitigated without the requisite certification of the UAS and the UAS operator, and, where applicable, without the licensing of the remote pilot.[296]

As of mid-2024, all unmanned aircraft requiring certification were mandated to adhere to standards designed for manned aircraft, specifically those

293 See, Sousa Uva and Rebane, *EASA Regulations and the Operation of Unmanned Aircraft: An Overview*, in Scott (ed.), *The Law of Unmanned Aircraft Systems*, 2nd ed. (Wolters Kluwer, 2022), at 90.

294 See, Article 5 (2) of Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft, C/2019/3824, OJ L 152, 11.6.2019, p. 45–71.

295See, Article 6 (1) (b) of Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft, C/2019/3824, OJ L 152, 11.6.2019, p. 45–71.

296 See, Article 6 (2) of Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft, C/2019/3824, OJ L 152, 11.6.2019, p. 45–71.

outlined in Commission Regulations (EU) Nos. 748/2012[297], 1321/2014[298], and 2015/640[299]. However, in the second quarter of 2024, the European Union enacted a comprehensive package of new regulations pertaining to UAS and VCA. According to EASA, this regulatory framework establishes the definitive rules necessary for the initiation of IAM,[300] including services related to air taxis[301]. This legislative package is grounded in regulatory proposals formulated by EASA and published in Opinion No. 03/2023 in August 2023.[302] The regulations introduce an extensive array of requirements for piloted electric air taxis, encompassing the fields of Air Operations (Air OPS), Flight Crew Licensing (FCL), Standardised European Rules of the Air (SERA), and Air Traffic Management (ATM). Furthermore, it delineates the criteria and processes essential for the certification and maintenance of UAS.[303]

The package mentioned above builds on and finalises previous efforts regarding UAS in accordance with the EU Regulations discussed earlier. Additionally, it completes the substantial work done in 2019 on the certification domain of manned VCA, specifically through the Special Condition for small-category VTOL aircraft (hereinafter referred to as SC-VTOL-01).[304] This document, along with its successor, the Special Condition for Small-Category

297 Commission Regulation (EU) No 748/2012 of 3 August 2012 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations (recast), OJ L 224, 21.8.2012, p. 1–85

298 Commission Regulation (EU) No 1321/2014 of 26 November 2014 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks. OJ L 362, 17.12.2014, p. 1–194

299 Commission Regulation (EU) 2015/640 of 23 April 2015 on additional airworthiness specifications for a given type of operations and amending Regulation (EU) No 965/2012, C/2015/2564, OJ L 106, 24.4.2015, p. 18–22.

300 See, (https://www.easa.europa.eu/en/newsroom-and-events/news/european-commission-adopts-regulatory-package-giving-go-ahead-vtol), accessed (30-09-2024).

301Although the term "air taxi" is not explicitly mentioned in any of the regulations of the latest package, EASA refers to it on its official website. However, this term does not carry any legal implications and appears to be more of a colloquial expression intended for public understanding.

302 See, EASA's Opinion No 03/2023.

303 See, (https://www.easa.europa.eu/en/newsroom-and-events/news/european-commission-adopts-regulatory-package-giving-go-ahead-vtol), accessed (30-09-2024).

304 See, EASA, *Special Condition for Vertical Take-Off and Landing (VTOL) Aircraft*, Doc. No: SC-VTOL-01, Issue 1, (2 July 2019).

VTOL-Capable Aircraft Issue 2 (hereinafter referred to as SC-VTOL-02)[305], outlines the airworthiness standards in the EU for VTOL aircraft and their electric variants. This document introduces, for the first time, a risk-based operational distinction for manned VTOL/VCA, following the same reasoning as Regulations 2019/945 and 2019/947. SC-VTOL-01 categorises the certification of manned VTOL/VCA into two groups: "Basic" and "Enhanced," as opposed to the three categories used for UAS.[306] SC-VTOL-02, in the same manner as its preceding version, is supported by multiple Means of Compliance (hereinafter referred to as MoC), providing comprehensive technical guidance to ensure the safety and technical compliance for the operation of VCA/eVTOLs within the EU.

In the subsequent sections, the regulations encompassed within this package will be analysed and their effects on the mobility environments under consideration.

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305 EASA, *Special Condition for Small-Category VTOL-Capable Aircraft*, Issue 2, Doc. No: SC-VTOL-02, (10 June 2024). In this document, EASA clearly states that "in the absence of certification specifications for the type certification of this type of product, a complete set of dedicated technical specifications in the form of a special condition for VTOL-capable aircraft has been developed. This special condition addresses the unique characteristics of these products and prescribes airworthiness standards for the issuance of the type certificate, and changes to this type certificate, for a person-carrying VTOL-capable aircraft in the small category, with lift/thrust units used to generate powered lift and control." For more information, see also, (https://www.easa.europa.eu/en/document-library/product-certification-consultations/special-condition-vtol), accessed (20-07-24).

306 See, EASA, *Special Condition for Vertical Take-Off and Landing (VTOL) Aircraft*, Doc. No: SC-VTOL-01, Issue 1, (2 July 2019), at 7-8. According to SC-VTOL-01, certification with this small category's Special Condition applies to aircraft that have a passenger seating configuration of nine or fewer and a maximum certified take-off mass of 3,175 kg or less. The aircraft must be certified in one or both of the following categories:

i. Category Enhanced: This category requires the aircraft to be capable of continued safe flight and landing while meeting all applicable requirements. Aircraft intended for operations over congested areas or for commercial air transport of passengers must be certified in this category;

ii. Category Basic: This category requires the aircraft to be capable of a controlled emergency landing and to meet all applicable requirements.

The SC-VTOL-02 introduces a notable enhancement over its predecessor through the modification of the maximum certified take-off mass (MCTOM), which has been increased from 3,175 kg (7,000 lbs), as stipulated in requirement VTOL.2005 of the initial edition of the Special Condition (SC-VTOL-01), to 5,700 kg. It is important to note that the maximum passenger seating configuration (MPSC) remains unchanged at 9 seats. For more information, see EASA, *Special Condition for Small-Category VTOL-Capable Aircraft*, Issue 2, Doc. No: SC-VTOL-02, (10 June 2024), at 4.

3.2. CLEARING THE SKIES FOR URBAN AIR MOBILITY: EASA'S LATEST REGULATORY PACKAGE FOR VTOLS AND UAS

a. Commission Delegated Regulation (EU) 2024/1107.[307] This Regulation as seen in its Article 1, positions its scope of application around the establishment of "common technical requirements and administrative procedures to ensure the continuing airworthiness of UAS[308], including any component for installation thereto, where the unmanned aircraft is, or will be, registered in a Member State, and is intended to be operated in the "specific" category as defined in Article 5 of Implementing Regulation (EU) 2019/947 and a certificate of airworthiness or a restricted certificate of airworthiness has been or will be issued to the unmanned aircraft."[309] In other words, this Regulation supplements the Basic Regulation (2018/1139) by introducing continuing airworthiness standards (maintenance and repair) specifically designed for UAS as well as the organisations and personnel responsible for maintaining the airworthy status of these aircraft systems. While UAS were previously required to align their continuous airworthiness standards with the regulations set forth in Commission Regulation (EU) No 1321/2014[310], which applies to light aircraft but in manned aviation, Regulation 2024/1107 introduces adapted and detailed requirements

307 Commission Delegated Regulation (EU) 2024/1107 of 13 March 2024 supplementing Regulation (EU) 2018/1139 of the European Parliament and of the Council by laying down detailed rules for the continuing airworthiness of certified unmanned aircraft systems and their components, and on the approval of organisations and personnel involved in these tasks, C/2024/1569, OJ L, 2024/1107, 23.5.2024.

308 According to Commission Regulation (EU) No 1321/2014, the term "continuing airworthiness" is defined as "all of the processes ensuring that, at any time in its operating life, the aircraft complies with the airworthiness requirements in force and is in a condition for safe operation."

309 Article 1 of Regulation 2024/1107.

310 Commission Regulation (EU) No 1321/2014 of 26 November 2014 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks Text with EEA relevance, OJ L 362, 17.12.2014, p. 1–194.

specifically tailored to the unique nature of UAS operations and the associated risks.[311]

b. Commission Delegated Regulation (EU) 2024/1108.[312] The Commission Delegated Regulation (EU) 2024/1108 amends Regulation (EU) No 748/2012, which pertains to the initial airworthiness of unmanned aircraft systems (UAS) that require certification, as well as Delegated Regulation (EU) 2019/945 related to UAS operations and third-country operators. This regulation introduces requirements ensuring that UAS, including their control and monitoring units (CMUs), meet essential safety and environmental standards through certification processes. Article 1 presents amendments to Regulation 748/2012, while Article 2 of the Regulation presents amendments to Regulation 2019/945. Article 2(2)(a) outlines specific criteria for UAS certification. These criteria include having a characteristic dimension of three meters or more for operations over assemblies of people, being designed to transport people, transporting dangerous goods that require enhanced robustness, or when certification is mandated based on a risk assessment in "specific" category operations.[313] Additionally, the regulation includes an exemption for UAS that are designed or modified for research, experimental, or scientific purposes, allowing them to operate with a permit to fly rather than a full type certificate, as long as they are produced in very limited numbers.[314] Furthermore, Annex I amends the Annex (Part 21) of Regulation 748/2012 to include *inter alia* rules explicitly for the certification of CMUs, which are essential for remote control of unmanned aircraft.[315] Overall, these provisions aim to align UAS certification requirements with established aviation safety

311 According to the text of Commission Delegated Regulation (EU) 2024/1107, it is not stated that it replaces or directly amends Regulation (EU) No 1321/2014. Instead, it adds specific rules tailored for UAS.

312 Commission Delegated Regulation (EU) 2024/1108 of 13 March 2024 amending Regulation (EU) No 748/2012 as regards the initial airworthiness of unmanned aircraft systems subject to certification and Delegated Regulation (EU) 2019/945 as regards unmanned aircraft systems and third-country operators of unmanned aircraft systems, C/2024/1570, OJ L, 2024/1108, 23.5.2024.

313 See Article 2 (2) (a) (1) of Regulation 2024/1108.

314 See Article 2 (2) (a) (1a) of Regulation 2024/1108.

315 Ibid. Annex I.

standards, thereby ensuring high levels of safety and environmental protection.

c. **Commission Delegated Regulation (EU) 2024/1109.**[316] Regulation 2024/1109 establishes the rules for applying Regulation (EU) 2018/1139 concerning the responsibilities, requirements, and procedures of competent authorities related to the certification, oversight, and enforcement of continuing airworthiness for certified UAS. Additionally, it amends Implementing Regulation (EU) 2023/203[317]. According to Article 1, this regulation sets forth specific rules and procedures that competent authorities must follow to assess compliance with the detailed continuing airworthiness requirements outlined in Regulation 2024/1107, thereby directly supplementing that Regulation.[318] 2024/1109 includes an Annex with two sub-parts and an Appendix. The Annex, titled "UAS Continuing Airworthiness - Authority Requirements" (PART-AR.UAS), specifies the conditions for carrying out certification, oversight, and enforcement tasks. It also outlines the administrative and management system requirements that must be met by the competent authority responsible for implementing and enforcing Delegated Regulation (EU) 2024/1107.[319]

316 Commission Implementing Regulation (EU) 2024/1109 of 10 April 2024 laying down rules for the application of Regulation (EU) 2018/1139 of the European Parliament and of the Council as regards competent authority requirements and administrative procedures for the certification, oversight and enforcement of the continuing airworthiness of certified unmanned aircraft systems, and amending Implementing Regulation (EU) 2023/203, C/2024/2000, OJ L, 2024/1109, 23.5.2024.

317 Commission Implementing Regulation (EU) 2023/203 of 27 October 2022 laying down rules for the application of Regulation (EU) 2018/1139 of the European Parliament and of the Council, as regards requirements for the management of information security risks with a potential impact on aviation safety for organisations covered by Commission Regulations (EU) No 1321/2014, (EU) No 965/2012, (EU) No 1178/2011, (EU) 2015/340, Commission Implementing Regulations (EU) 2017/373 and (EU) 2021/664, and for competent authorities covered by Commission Regulations (EU) No 748/2012, (EU) No 1321/2014, (EU) No 965/2012, (EU) No 1178/2011, (EU) 2015/340 and (EU) No 139/2014, Commission Implementing Regulations (EU) 2017/373 and (EU) 2021/664 and amending Commission Regulations (EU) No 1178/2011, (EU) No 748/2012, (EU) No 965/2012, (EU) No 139/2014, (EU) No 1321/2014, (EU) 2015/340, and Commission Implementing Regulations (EU) 2017/373 and (EU) 2021/664, C/2022/7215, OJ L 31, 2.2.2023, p. 1–40.

318 See Article 1 of Regulation 2024/1109.

319 Ibid. Annex.

d. Commission Implementing Regulation (EU) 2024/1110.[320] Regulation 2024/1110 amends Regulation (EU) No 748/2012 and Implementing Regulation (EU) 2019/947, focusing specifically on the initial airworthiness and operational rules of UAS subject to certification. It introduces explicit amendments to Annex I (Part 21) of Regulation 748/2012, ensuring that the initial airworthiness certification process includes control and monitoring units (CMUs) and their components, thus maintaining high safety operational standards.[321]

e. Commission Implementing Regulation (EU) 2024/1111.[322] Regulation 2024/1111 sets forth comprehensive requirements specifically for the operation of manned aircraft with vertical take-off and landing capabilities. This regulation serves as an amendment to the existing EU aviation rules, facilitating the integration of manned VTOL operations within the current aviation system. Notably, it amends Regulation (EU) No 1178/2011 (Part-FCL) to recognise VCA aircraft in pilot licensing.[323] Additionally, it amends the Standardised European Rules of the Air (SERA, Regulation [EU] No 923/2012) to include operating rules for VTOLs.[324] Furthermore, it amends the Air Operations Regulation (EU No 965/2012)[325] by introducing a new Annex

320 Commission Implementing Regulation (EU) 2024/1110 of 10 April 2024 amending Regulation (EU) No 748/2012 as regards the initial airworthiness of unmanned aircraft systems subject to certification and Implementing Regulation (EU) 2019/947 as regards the rules and procedures for the operation of unmanned aircraft, C/2024/2001, OJ L, 2024/1110, 23.5.2024.

321 Ibid. Annex I.

322 Commission Implementing Regulation (EU) 2024/1111 of 10 April 2024 amending Regulation (EU) No 1178/2011, Implementing Regulation (EU) No 923/2012, Regulation (EU) No 965/2012 and Implementing Regulation (EU) 2017/373, as regards the establishment of requirements for the operation of manned aircraft with a vertical take-off and landing capability, C/2024/2268, OJ L, 2024/1111, 23.5.2024.

323 Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council, OJ L 311, 25.11.2011, p. 1–193.

324 Commission Implementing Regulation (EU) No 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation and amending Implementing Regulation (EU) No 1035/2011 and Regulations (EC) No 1265/2007, (EC) No 1794/2006, (EC) No 730/2006, (EC) No 1033/2006 and (EU) No 255/2010, OJ L 281, 13.10.2012, p. 1–66.

325 Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council, OJ L 296, 25.10.2012, p. 1–148.

specifically for VTOL operations and also the ATM/ANS Regulation (EU 2017/373)[326] to ensure that air traffic services can effectively integrate these flights.

Together, these five regulations form a cohesive framework for UAM/IAM in the EU, finalising, connecting and complementing all the preceding works and efforts. They ensure that any UAS and (manned) VCA is designed, certified, maintained, and operated under clear rules and proper oversight. Importantly, these regulations are comprehensive; they cover aspects from technical airworthiness standards to flight operations and pilot training, mirroring the established structure used for conventional aircraft. This EU approach is among the first of its kind in the world, aiming to integrate UAS and manned VCA safely into urban airspace while upholding the Union's high aviation safety standards.

Although the EU's regulatory efforts pertaining to UAS and VCA in UAM/IAM environments are not concluded in this chapter, further examination of other legal documents will be addressed in Chapter IV, focusing on operational aspects. At this point, it is crucial to consider a non-legal aspect evaluated by EASA regarding the success of UAM and IAM environments, as well as their relevant aircraft operations over urban areas in the EU.

3.3. BEYOND REGULATIONS: EU'S NON-LEGAL INITIATIVES FOR UAM/IAM – THE PUBLIC ACCEPTANCE CHALLENGE

In previous works, the author of this doctoral dissertation identified six main stakeholders (plus one) essential for the effective implementation of UAM/IAM in the EU. These stakeholders include:

326 Commission Implementing Regulation (EU) 2017/373 of 1 March 2017 laying down common requirements for providers of air traffic management/air navigation services and other air traffic management network functions and their oversight, repealing Regulation (EC) No 482/2008, Implementing Regulations (EU) No 1034/2011, (EU) No 1035/2011 and (EU) 2016/1377 and amending Regulation (EU) No 677/2011, C/2017/1313, OJ L 62, 8.3.2017, p. 1–126.

1. The EU authorities (specifically the Commission and Parliament) through EASA;

2. The 27 National Aviation Authorities of each member state;

3. Aviation standardisation organisations, such as the European Organisation for Civil Aviation Equipment (EUROCAE);

4. The industry associated with VTOL aircraft and their electric variants;

5. Entities involved in urban planning and development;

6. The public.[327]

The additional stakeholder is the cities (municipalities), which play a crucial role in the integration of UAM/IAM- a fact acknowledged by EASA.[328] While the EU and EASA have initiated and funded (or co-funded) various projects to foster better communication and engagement among these stakeholders, they seem to have focused particularly on the non-legal or industry-related stakeholder, which is the public.[329]

The success of UAM/IAM undoubtedly depends on technological innovation, strategic legislative foresight, and effective initiation and implementation by the EU authorities and all relevant stakeholders. However, these efforts would be in vain if the public- the people of the EU- are not positively inclined toward the realisation of these projects. Thus, to transition from simple experiments with limited application areas to broader implementations and achieve a new mobility reality, positive public opinion is necessary.[330] EASA conducted a comprehensive study on the societal acceptance of UAM operations across the European Union. This study took

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327 See, Andritsos and Agouridas, *Urban Air Mobility*, in Scott (ed.), *The Law of Unmanned Aircraft Systems*, 2nd ed. (Wolters Kluwer, 2022), at 316-317.

328 Ibid. at 315-316. See also, (https://www.easa.europa.eu/en/domains/drones-air-mobility/drones-air-mobility-landscape/IAM-for-City-Transport-Ecosystems), accessed (30-09-24) and (https://www.easa.europa.eu/en/domains/drones-air-mobility/drones-air-mobility-landscape/innovative-air-mobility-hub), accessed (30-09-24).

329 See, (https://www.easa.europa.eu/en/light/topics/urban-air-mobility), accessed (30-09-24).

330 See, supra note 327 at 321.

place over six months, from November 2020 to May 2021, and included extensive research, a literature review, an urban market analysis, a quantitative survey, a qualitative survey, and detailed noise tests.[331] Approximately 4,000 residents from six major cities and regions participated in the study: Barcelona, Spain; Budapest, Hungary; Milan, Italy; the Öresund region in Denmark and Sweden (including Copenhagen, Hillerød, Helsingør, Malmö, and Lund); Paris, France; and Hamburg, Germany, which serves as the case study for this doctoral dissertation.[332]

The results of the study were very encouraging, with 83% of respondents expressing a positive attitude towards UAM in general.[333] Nearly half of the participants (49%) indicated that they are ready to use VCA, which the study referred to as air taxis.[334] These high numbers can be attributed to the use cases of UAM/IAM that were presented to the participants, revealing a strong preference for applications related to medical and emergency transport.[335] These were often selected as the most valuable options, suggesting that use cases serving the public interest, particularly in health and safety, are more likely to be accepted than those catering to private or individual needs, such as sightseeing.[336] Respondents, however, emphasised that medical and emergency applications should adhere to the same safety and security standards as other use cases.[337] Henceforth, while the overall public perception of UAM was positive, the EU citizens participating in the study also expressed caution regarding potential issues related to safety, security, and the environment.[338]

331 See, (https://www.easa.europa.eu/en/light/topics/urban-air-mobility-uam), accessed (30-09-24).
332 Ibid.
333 Short Report on EASA's, Study on the Societal Acceptance of Urban Air Mobility in Europe, 19 May 2021, at 7.
334 See, (https://www.easa.europa.eu/en/light/topics/air-taxis-urban-transport), accessed (30-09-24).
335 Short Report on EASA's, Study on the Societal Acceptance of Urban Air Mobility in Europe, 19 May 2021, at 8.
336 Ibid.
337 Ibid.
338 Ibid. at 10.

Guided by the philosophy above and with the active involvement of municipalities in UAM and IAM initiatives[339], the EU authorities, and EASA in particular, are moving forward with legislative preparations for the careful roll-out of UAM/IAM environments in EU airspace. While many legislative, certification and other challenges related to standards have been evaluated or are currently being assessed, a mobility revolution occurring above the heads of EU citizens in lower airspace cannot succeed without their support and positive reception. Therefore, alongside all necessary preparations across strategic, legal, operational, and industrial domains, the foremost priority for the EU and EASA must remain the safety and security of individuals on board the VTOL aircraft and those on the ground. Keeping this focus in mind is crucial for the UAM/IAM framework. Even if it results in lower speeds, achieving safe outcomes will undoubtedly benefit the future of the mobility environments under consideration.

3.4. CONCLUSION

This chapter purposely provides a selective review of the EU legal framework concerning unmanned aviation and VTOLs/VCA, highlighting the role of EASA as a cornerstone of this effort. It primarily discusses the current legal mechanisms related to authorisation/certification and licensing required for the safe and regulated operation of UAS and VCA over urban areas. Furthermore, this chapter presents what EASA refers to as the "final legislative element" essential for launching air taxi services, complementing existing legislation.[340]

It is clear that the EU and EASA have developed a comprehensive and multifaceted approach to safely integrating the aforementioned aircraft into urban airspace for their intended uses. However, this system, as showcased in

339 The significance of municipalities in the materialisation of UAM/IAM will be further assessed in Chapter VI.

340 See, (https://www.easa.europa.eu/en/newsroom-and-events/news/european-commission-adopts-regulatory-package-giving-go-ahead-vtol), accessed (30-09-24).

the previous paragraphs, is highly complex. It can be argued that EU standards could delay or even eliminate many aircraft projects that cannot comply with such intricate requirements.
Most eVTOL and VCA producers are new companies and startups that do not have the same market standing as established players, such as Airbus and Boeing in aircraft manufacturing or the Lufthansa Group in air transportation. As a result, there is a significant possibility that these sophisticated, tailored standards for VCA aircraft could hinder new startups from successfully launching their products. Compliance with industry regulations often requires large teams dedicated to ensuring adherence, something that many startups simply cannot afford.
While this speculation is understandable from a market perspective, it may also suggest that EU bureaucracy could stifle innovation and favour established players who are well-equipped to navigate complex regulations and who may also engage in lobbying to influence decision-making within EU authorities.
Nevertheless, the author firmly believes that the EU authorities will continue to recognise the value of this emerging industry and support all players who are committed to bringing innovation to the skies over urban and urbanised environments in the EU.

Furthermore, the author supports the view adopted by EU authorities, which emphasises that, in addition to establishing necessary standards for safe operations, the success of UAM will depend on gaining acceptance from the European public. This demonstrates the proactive and healthy approach of the EU administration and EASA. They recognise the complex nature of UAM, which requires the approval and cooperation of various stakeholders for it to succeed. Consequently, the author concludes that UAM is not merely a legal issue, as its success hinges not only on the legal frameworks governing it but also on the collective efforts of a diverse range of stakeholders beyond just the aviation sector. In the following chapter, the focus will shift from EU standards, certification processes, and regulations to operational aspects, with an emphasis on both international and EU air law.

CHAPTER IV-OPERATIONS

4.0. INTRODUCTION

Following the thorough evaluation of aviation safety matters, with a clear orientation on the regulatory and policy aspects of the EU, this chapter aims to assess the concept of aircraft operation in these environments.

In the 41st ICAO Assembly, experts discussed the importance of lower airspace operations above urban areas and the role of cities/local authorities in the context of UAM/AAM environments, with ICAO seconding their statements.[341] The emergence of the concept of "municipal airspace" in the Assembly[342] brings up questions regarding its significance and legal implications in reference to established international legal norms. However, to address these inquiries, it is necessary to first undertake an analytical investigation of the origins of international civil aviation and the notion of "airspace sovereignty". This concept has been the subject of evaluation and legal analysis for a duration that exceeds common perception.

The purpose of this chapter is to assess certain legal and operational aspects referring to aircraft in the context of the discussed air mobility environments, especially when the element of cross-border transport is present. To achieve this, the chapter will examine the principle of airspace sovereignty and its connection with the emerging mobility environments discussed in previous sections on a global scale. The chapter will also investigate the potential legal implications of "municipal airspace," which was discussed in the 41st Assembly of ICAO within the framework of the Chicago Convention of 1944. Finally, the chapter will

341 See, Chapter II.

342 See, A41-WP/1101 EX/50 27/7/22, ASSEMBLY — 41ST SESSION, EXECUTIVE COMMITTEE, Agenda Item 23: Innovation in Aviation, LEGAL AND SOCIETAL STAKES FOR THE EMERGING AIR MOBILITY IN METROPOLITAN AREAS (Presented by the International Coordinating Council of Aerospace Industries Associations (ICCAIA) and the Airports Council International (ACI)).

evaluate certain legal requirements for the operation of eVTOLs and other aircraft in the EU within the context of the aforementioned environments.

4.1. SOVEREIGNTY IN INTERNATIONAL LAW

Before assessing a state's sovereignty over its airspace, it is essential first to explore the broader construct of sovereignty in international law. Given the extensive nature of this subject, this analysis will be presented in a concise but step-by-step approach to facilitate logical argumentation.

The term "sovereignty" etymology traces its roots to the vulgar Latin term "superanus".[343] The term, initially referring to a "chief" or "ruler", first appeared in English in the 14th century. The varied spellings of the term since its inception in English can be attributed to the influence of the English word "reign".[344] The philosophical concept of absolute sovereignty[345] in the Western world is attributed to Jean Bodin, a renowned French philosopher,[346] who provided the first "systematic discussion of the nature of the doctrine mentioned above".[347] Bodin's theory of absolute and undivided sovereignty emerged due to the particular historical context in which he lived. He wrote his influential work, *Six Livres de la République*, in 1576, four years after the heinous Saint Bartholomew's Day Massacre.[348] This massacre saw the Catholic League systematically slaughter thousands of prominent Huguenots (Calvinist

343 See, (SOVEREIGN definition and meaning | Collins English Dictionary (collinsdictionary.com)), accessed (02-02-24).

344 Ibid.

345 Bodin, *The Six Bookes of a Commonweale*, trans. Knolles, (G. Bishop, London, 1606), at 84., *"Majesty or Sovereignty is the most high, absolute, and perpetual power over the citizens and subjects in a Commonwealth"*. Hence, the term "sovereignty" here is attached to the respective monarch or sovereign of the respective state.

346 See, Maritain, *The Concept of Sovereignty*, in Stankiewicz (ed.), *In Defense of Sovereignty* (1969), at 41-43.

347 See, Merriam, *History of the Theory of Sovereignty since Rousseau* (1900), at 13; See also Pharand, *Perspectives on Sovereignty in the Current Context: A Canadian Viewpoint*, Canada–United States Law Journal, Vol. 20 (1994), at 19.

348 See, Andrew, *Jean Bodin on Sovereignty*, Republics of Letters: A Journal for the Study of Knowledge, Politics, and the Arts, Vol. 2, No. 2 (2011), at 75.

Protestants) following the marriage between Margaret of the House Valois and Henri of Navarre, a Protestant who later converted to Catholicism upon his ascension to the French throne as Henri IV in 1589.[349] According to Bodin, the term "sovereignty" indicates the supreme power that governs citizens, operating outside the bounds of ordinary laws. Bodin's perspective on this concept includes an acknowledgement that sovereignty is only subject to natural laws, [350] the laws of God and specific universal human laws. [351] Therefore, as per Bodin's writings in his work, the independent communities shaping a state had to recognise the authority of the law, while the "sovereignty" (here it refers to the above interpretation of a ruler) had to be placed above the ordinary laws to govern successfully.[352]

Bodin's theories received various levels of approval from other legal scholars. Hugo Grotius, for example, advocated for the independence of sovereign states from foreign control, while Thomas Hobbes maintained that sovereignty was absolute and could never be misused.[353] John Locke, however, expressed the concept of non-absolute sovereignty, which endorsed limitations on the power of the state and placed emphasis on the social trust between the government and the governed. It is evident that a breach of this trust would lead to a weakening of the concept of sovereignty.[354]

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349 Ibid.

350 Philosophy of Law accepts that all these three terms address in reality the same concept of divine law as that was presented by Sophocles in his tragedy "Antigone".

351 The original text in French at 131 of the *Six Livres de la République,* dictates that*, "car si nous disons que celui a puissance absolue, qui n"est point sujet aux lois, il ne se trouvera Prince au monde souverain, vu que tous les Princes de la terre sont sujets aux lois de Dieu, & de nature, & à plusieurs lois humaines communes à tous peuples."* The aforementioned can be translated as follows: "If we insist however that absolute power means exemption from all law whatsoever, there is no prince in the world who can be regarded as sovereign, since all the princess [sic] of the earth are subject to the laws of God and of nature, and even to certain human laws common to all nations."

352 See, Six Livres, 215 (original).

353 See, Abeyratne, *Convention on International Civil Aviation, A Commentary*, (Springer, 2014), at 16.

354 Ibid.

The notion of sovereignty is a dynamic concept that has evolved significantly over time. Furthermore, its interpretation is largely conditional on the context in which it is used, thus making it a “sponge concept."[355] This characterisation implies its flexible nature, allowing for various interpretations. It is essential to underline that sovereignty does not have a universally recognised definition, and as Crawford aptly noted, “sovereignty comes in all shapes and sizes."[356]As such, a comprehensive analysis of the concept of sovereignty in both philosophy and international law in general would be beyond the purpose of this doctoral dissertation. However, the author will provide a brief overview of relevant information pertaining to the subject under evaluation.

As emphasised above, the notion of sovereignty has long been a subject of discourse among legal scholars and experts. Over the course of centuries, various views have been expressed on this topic. Krasner’s work, “Problematic Sovereignty: Contested Rules and Political Possibilities”,[357] identifies at least four distinct ways in which the term has been utilised.

a. Firstly, "internal or domestic sovereignty" refers to a state’s exclusive right and competence to determine the character of its own institutions and to provide for their function. The concept of internal or domestic sovereignty also encompasses the exclusive power of a state to enact its internal laws and ensure their respect.[358]
b. Secondly, "interdependence sovereignty" refers to the power of public authorities to control transborder movements.[359]
c. Thirdly, "international legal sovereignty" refers to the mutual recognition of states.[360]

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355 See, Bartleson, *The Geneology of Sovereignty* (Cambridge University Press, 1995), at 237.

356 See, Crawford, *The Creation of Studies in International law* (2nd edition, Oxford University Press, 2007), at 47.

357 See, Krasner, *Problematic Sovereignty: Contested Rules and Political Possibilities*, (Columbia University Press, 2001), at 6-12.

358 See, supra note 353, at 17-18.

359 See, supra note 357, at 6-7.

360 Ibid.

d. Finally, "Westphalian or external sovereignty"[361] embodies the principle of excluding external actors from the domestic authority theatre.[362] The term is derived from the peace treaties signed in October 1648 in the Westphalian cities of Osnabrück and Münster. These treaties ended the 30-year religious wars between the Catholic and Protestant League in the Holy Roman Empire. The Peace of Westphalia introduced three fundamental elements that shaped the perception of state sovereignty. Firstly, it recognised the monarch's authority within their domain. Secondly, it acknowledged the judicial equality of all states, regardless of their size or status. Thirdly, it affirmed the principle that states are bound only by the laws to which they have consented.[363] The introduction of Westphalian sovereignty marked a significant shift in the perception of rulership. Rather than being viewed as leaders of specific groups, the emphasis was placed on ruling over territory.[364] Historical evidence supports this notion, as before the Westphalian period, European emperors were named after the people they ruled over. For example, the Holy Roman Emperor held the title of Imperator Romanorum and Kaiser der Römer. At the same time, the Roman Emperor seated in Constantinople was known as the Emperor and Autocrat[365] of the Romans. Following the Westphalian era, this perception underwent a partial transformation, as rulers/sovereigns were depicted as governing a realm rather than specific groups of people.

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361 See, Hobe, *Der offene Verfassungsstaat zwischen Souveränität und Interdependenz*, Veröffentlichungen des Walther-Schücking-Instituts für Internationales Recht an der Universität Kiel, Vol. 122, 1st ed. (Duncker & Humblot, 1998), at 44.

362 See, supra note 359 at 6-7.

363 See, Truxal, *Economic and Environmental Regulation of International Law: From International to Global Governance* (Routledge Research in International Commercial Law, Routledge, 2017), at 36–37.

364 Ibid.

365 Ancient Greek term that was extensively utilised during the Hellenistic and Roman times. Term identical to the Latin term "Imperator".

> Kaiser Wilhelm, for example, was titled the German Emperor (Deutscher Kaiser) and not Emperor of the Germans (Kaiser der Deutschen).

The principle of territorial sovereignty (Westphalian or external sovereignty) is a fundamental creed of the present public international law and order. Its importance is displayed inter alia in the ICJ Corfu Channel case (United Kingdom of Great Britain and Northern Ireland v. Albania)[366], in which the Court recognised that "respect for territorial sovereignty is an essential foundation of international relations"[367] between independent states. This principle stipulates that a state has exclusive jurisdiction and control over its territory and resources. It is a cornerstone of the current international legal framework and is crucial for maintaining peace and stability in the international community.

Considering the information above, it is a fact that the Westphalian perception of sovereignty has significantly shaped the contemporary concept of sovereignty. However, international law has gone beyond the confines of territoriality to recognise other elements that shape this concept. In the Island of Palmas Case (United States v. The Netherlands),[368] Arbitrator Hubert stated in reference to the assessed concept that:

> "s*overeignty in the relations between States signifies independence. Independence in regard to a portion of the globe is the right to exercise therein, to the exclusion of any other State, the functions of a State. The development of the national organisation of States during the last few centuries and, as a corollary, the development of international law, have established this principle of the exclusive competence of the State in regard to its own territory in such a way as to make it the point of departure in settling most questions that concern international relations. The special cases of the composite State, of collective sovereignty, etc., do not fall to be considered here and do not, for that matter, throw any*

366 "Corfu Channel case, Judgment of April 9th, 1949: I.C. J. Reports 1949, p. 4."

367 Ibid. at 35.

368 Perm. Ct. of Arbitration, 2 U.N. Rep. Int"l Arb. Awards 829 (1928).

> *doubt upon the principle which has just been enunciated. Under this reservation, it may be stated that territorial sovereignty always belongs to one, or in exceptional circumstances, to several States, to the exclusion of all others. The fact that the functions of a State can be performed by any State within a given zone is. On the other hand, precisely the characteristic feature of the legal situation pertaining in those parts of the globe which, like the high seas or lands without a master, cannot or do not yet form the territory of a State*".[369]

Thus, as evident from the information presented in both cases above, the concept of sovereignty is closely related to the notion of independence.[370] Article 2(4) of the United Nations Charter further underscores this connection by emphasising the need to respect the territorial integrity and political independence of all states across the globe.[371]

Another portrayal of the importance of state sovereignty and the respect for internal or domestic sovereignty between independent nations can be found in the Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America) ICJ judgement[372], which stresses the significance of state sovereignty, particularly concerning the principles of non-intervention[373] and the prohibition of force.[374] It also asserts that the concept of state

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369 See, Reports of International Arbitral Awards, Island of Palmas case (Netherlands, USA), VOLUME II pp. 829-871, at 838 (1928).

370It is worth noting that the conclusion reached by the author with regards to the statement made by the Arbitrator in the Las Palmas case was already presented by Dr. Browlie, a Professor of International Law at Oxford University, in his book "Principles of Public International Law" back in 1990, which is approximately three decades ago.

371 The Article 2(4) of the UN Charter dictates that: "All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations."

372 Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America). Merits, Judgment. I.C.J. Reports 1986, p. 14.

373 For more information about the principle of non-intervention see, JG Starke, An Introduction to international law, 7th ed., (Butterworth's, London, 1977).

374 Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America). Merits, Judgment. I.C.J. Reports 1986, p. 14, at 111.

sovereignty, as expressed in Article 2, Paragraph 1 of the United Nations Charter,[375] extends to a state's internal waters, territorial sea, and airspace above its territory.[376] Therefore, sovereignty represents a complex concept encompassing different principles that work together to shape its current form.

Thus, according to the U.N Charter, sovereignty is recognised above a state's territory. However, the origins of this notion and how airspace became a critical aspect of a state's sovereignty are questions that demand further assessment. The subsequent section of this analysis will delve into these issues in greater detail.

4.2. WHO OWNS THE SKY?

The question of why national airspace is considered a part of a state's sovereignty, while abstract in nature, holds significant importance for some particular inquiries posed in this doctoral dissertation. This question assumes greater significance when viewed in light of the unique features that the UAM/AAM environments bring to the discussion and, of course, as cited above, to the concept of "municipal airspace".

The legal principle of sovereignty of airspace has not been a sudden or brief development but rather a gradual process that has its roots in classical Roman times.[377] Its subsequent codification in Article 1 of the Chicago Convention[378] marks a crucial milestone in the current form of international law. This principle asserts that "the airspace over the territory of a State, which is subject to its aerial sovereignty, covers the horizontal extension of the territory within the

375The UN Charter is an international treaty that imposes binding obligations on all member states. Many of its provisions constitute customary international law and, therefore, are binding on all states, even non-members.

376 See, supra note 348.

377 See, Cooper, *Roman Law and the Maxim Cujus est Solum in International Air Law*, McGill Law Journal, Vol. 1 (1952), at 40.

378 Article 1 of the Chicago Convention dictates that "The contracting States recognize that every State has complete and exclusive sovereignty over the air- space above its territory. "

boundaries of a State."[379] The above is attached to numerous rights, which include *inter alia* the right to regulate air traffic to ensure aviation safety, prohibit unauthorised entry, and undertake necessary measures to protect national security.

4.2.1. SOVEREIGNTY IN INTERNATIONAL AIR LAW, EN ROUTE TO CHICAGO

i. PARIS CONVENTION 1919

While contemporary Air law began with hot air balloons, to comprehend how airspace became a constituent of a state's sovereignty, it is necessary to delve back into the early 20th century.[380] With the increased popularity of balloon flights, the need for a regulatory framework to oversee their function and operational domain arose.

As with many other aspects of international law that surfaced post-military conflicts or in response to military events, issues related to aviation as an emerging concept were considered at the First International Peace Conference held in the Hague in 1899.[381]

There is a widely accepted consensus among scholars and aviation experts that a series of events between April and November of 1908 triggered the initial codification of the principle of sovereignty over airspace. During this time, no fewer than ten German air balloons traversed the Franco-German Frontier,

379 See, Hobe, *Airspace and Sovereignty over Airspace*, in S. Hobe, N. von Ruckteschell, and D. Heffernan (eds.), *Cologne Compendium on Air Law in Europe* (Carl Heymanns, 2013), at 205.

380 According to the official website of ICAO (https://applications.icao.int/postalhistory/1910_the_paris_convention.htm) accessed (08-02-24), on 21 November 1783, Jean-François Pilâtre de Rozier flew a distance of 9 km in just 25 minutes over Paris. As a result, the Paris police issued a directive prohibiting balloon flights without prior authorisation.

381 See, (https://applications.icao.int/postalhistory/1910_the_paris_convention.htm), accessed (08-02-24).

landing in French territory. These balloons carried more than twenty-five aviators, primarily military officers.[382] In 1910, the French Government convened the Confèrence Internationale de Navigation Aèrienne, a diplomatic conference held in Paris that was attended by delegates from major European powers. The primary aim of this conference was to establish the fundamental principles that would govern international air navigation.[383]

While the delegates of the states reached an agreement to convene and deliberate on the issue of mutual interest, it is apparent that a consensus on the recognition of airspace under international law among them was not achieved. In essence, there were four distinct positions concerning the nature of airspace, namely:

- the dogma of free airspace;
- the doctrine of territorial airspace;
- the doctrine of sovereign airspace;
- and modified sovereign airspace dogma.[384]

The first position concerning the legal status of airspace pertains to the principle of freedom of navigation, which is a fundamental tenet of maritime law

382 See, Sand, de Sousa Freitas, and Pratt, *An Historical Survey of International Air Law Before the Second World War*, McGill Law Journal, Vol. 7 (1960), 24, at 30; See also, JCooper, *The International Air Navigation Conference Paris 1910*, Journal of Air Law and Commerce, Vol. 19 (1952), at 127–128; See also, Castelli, *Il dominio dell'aria*, Rivista internazionale di scienze sociali e discipline ausiliarie, Vol. 47 (1908), at 315–323. See also, Andritsos and Djakovic, *Balloons Challenging Sovereignty – An Aviation Story Older Than You May Think*, Zeitschrift für Luft- und Weltraumrecht, Vol. 72, No. 4 (2023), at 542.

383 Milde, *International Air Law and ICAO*, in M. Benko (ed.), *Essential Air and Space Law* (Sipos rev., Eleven International Publishing, 2023), at 8–10.

384 See, Truxal, *Economic and Environmental Regulation of International Law: From International to Global Governance*, Routledge Research in International Commercial Law (Routledge, 2017), at 5.

grounded in the *pleno jure gentium*[385] rule of law.[386] However, this approach became subject to criticism due to the apparent oversimplification of the argument that air law and maritime law are equal and that their regulation should be governed by equivalent principles.

The second position, which proposed the treatment of territorial airspace in the same manner as territorial waters were treated under the customary international maritime law, was once again derived from the principles of maritime law. However, this position was rejected in practice due to the onset of the First World War and the realisation of the paramount importance of airspace for a state's safety and security.[387]

The third position emphasises the treatment of airspace as being in totality within the sovereignty of a state. This position propagated the emergence of a distinct line of thinking, the "sovereignty of the air" school, which supported the idea of sovereign rights in the air.[388] According to Lee[389], this doctrine, presented in this position, grants sovereign rights to the atmosphere above the territory of a state, with the objective of safeguarding its territory against various risks relevant to air navigation.[390]

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385 The concept of "ius gentium" or "jus gentium", as it pertains to international law, traces its origins to the ancient Roman legal system, with its influence being evident in the Western legal tradition. It is not a statutory body or legal code but rather a customary law that is deemed to be held in common by all gentes or groups of peoples or nations, founded on reasoned compliance with standards of international conduct. While not constituting a binding legal instrument, this customary law provides a framework for international interactions and relations, and is an essential consideration in the conduct of international affairs.

386 See, supra note 384, at 6.

387 Ibid.

388 Ibid.

389 See, Lee, *Revisiting Freedom of Overflight in International Air Law: Minimum Multilateralism in International Air Transport*, Air and Space Law, Vol. 38, Issues 4/5 (2013), at 357.

390 See, supra note 384, at 6.

The last position presented at the conference stipulated the recognition of a state's sovereignty over its airspace while simultaneously granting rights to foreign aircraft for innocent passage within the aforementioned airspace.[391]

Despite the conference's lack of concrete political or legal outcomes, it served as a precursor for future decisions regarding air navigation principles. The conference's significance lies in its role in initiating the process of establishing a comprehensive framework for air navigation.

The principle of airspace sovereignty was recognised and consequently codified in international law for the first time following the conclusion of World War I. The author employs the term "codify" deliberately, as it is accepted that the concept of sovereignty over the airspace above a state's territory traces its roots back to classical Roman times. Professor J.C. Cooper, in his work "Roman Law and the Maxim Cuius est Solum in International Air Law,"[392] argues that "sovereign states have created, recognized, regulated, and protected exclusive private rights of the surface-owner in usable space above their lands since Roman times."[393] It is also noted that "states claimed, held, and in fact exercised sovereignty in the airspace above their national territories long before the age of flight, and that the recognition of an existing territorial airspace status by the Paris Convention of 1919 was well-founded in law and history."[394] Thus, the concept of airspace sovereignty over a state's territory, also present in the medieval private law maxim of *Cuius est solum, eius est usque ad coelum et ad inferos*[395], is a principle present in the legal chronicles, albeit with alternations for more than 2000 years.

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391 Ibid.

392 See, supra note 377, at 65.

393 Ibid, at 65.

394 Ibid.

395 See, Garner (ed.), *Black's Law Dictionary* (Thomson Reuters, 2014). According to Black's Law Dictionary, this maxim can be translated as: "To whomsoever the soil belongs, he owns also to the sky and to the depths. The above sentence is often misattributed to classical Roman law, but actually has medieval origins. See also, Havel and Sanchez, *The Principles and Practice of International Aviation Law* (Cambridge University Press, 2014), at 40.

The cessation of hostilities in 1919 marked the signing of the "Convention Relating to the Regulation of Aerial Navigation" by 26 sovereign states. This international legal instrument sought to regulate aircraft navigation and was a pivotal milestone in the evolution of international aviation law.[396] One of the crucial aspects of this convention was the resolution of a prolonged debate spanning over two decades regarding whether the airspace over a state's territory should be considered free like the high seas or form part of a state's exclusive and complete sovereignty, with the latter being upheld. Article 1 of the Paris Convention 1919 stipulates that: "The High Contracting Parties recognize that every Power has complete and exclusive sovereignty over the air space above its territory."[397] The article's phrasing in question is of particular interest from a legal perspective, as the terminology employed clearly reflects the intentions of both the drafters and the states involved in the agreement. The emphasis on the terms "exclusive" and "complete sovereignty" indicates that in the event of an infringement, the state whose airspace has been trespassed upon possesses the full array of legal and practical options available to it, as per the relevant provisions of international law. Additionally, the author regards the term "recognise" as paramount, given that it implies that this international legislation does not introduce a novel legal concept via this provision but acknowledges a pre-existing one.[398] The above seems to verify the data presented in the preceding paragraphs of this chapter.

The Paris Convention of 1919, a focal document of its time, regrettably failed to be universally approved. Despite this, it served as a guiding light for similar conventions over the ensuing 25 years, paving the way for the establishment of the present-day international civil aviation framework.

ii. MADRID CONVENTION 1926

396 See, supra note 384 at 11-12.

397 See the Convention Relating to the Regulation of Aerial Navigation (Paris Convention 1919).

398 See, supra note 383, at 12.

While the Paris Convention 1919, as a precursor to the Chicago Convention 1944, holds an esteemed position in the history and foundation of current international air law norms, it was not the sole effort to regulate international air navigation. In the intervening 25-year period between the two aforementioned conventions, two more attempted to regulate the same legal issues. These two initiatives (with the addition of a conference that will also be assessed below) were the Madrid Convention of 1926 and the Havana Convention of 1928.

The Madrid Convention was nothing more than the manifestation of Spain's political aspiration and rivalry with the League of Nations and the ICAN[399]. Two major events instigated it. Firstly, the withdrawal of Spain from the League of Nations, as it was not granted a permanent seat in the Council.[400] Secondly, the refusal to attend the Paris Convention for not being granted equal voting rights with France and Italy.[401] The above incidents led Spain to summon all Latin American States on October 25-30, 1926, in Madrid, to an "Ibero-American Aviation Congress", which ended up drafting and adopting the Ibero-American Air Navigation Convention (Madrid Convention 1926). Alas, to Spain's geopolitical aspirations, the Convention was not deemed a success and was only ratified by 6 states,[402] thus never coming into force.[403]

The inadequacy of the Madrid Convention 1926 is founded on its inability to suggest innovative concepts concerning air traffic or the concept of sovereignty over the airspace of a state's territory that could provide solutions to the problems of the time, thus initially replicating the exact text of the Paris

399 According to ICAO's website, ICAN (International Commission for Air Navigation) "was an international governing body established on the basis of the Convention Relating to the Regulation of Aerial Navigation and dealt exclusively with the regulation of international air navigation and, in particular, public international air law." See, (https://applications.icao.int/postalhistory/international_aviation_organizations_working_alongside_ican_part_1.htm_) accessed (16-02-24).

400 See, supra note 383, at 14.

401 Ibid.

402 The States that ratified the Madrid Convention 1926 were Argentina, Costa Rica, El Salvador, the Dominican Republic, Mexico and Spain.

403 See, supra note 383, at 14.

Convention while omitting all references to the League of Nations and the Permanent Court of International Justice (hereinafter referred to as PCIJ).[404]

iii. HAVANA CONVENTION 1928

In contrast to the Madrid Convention's repetitive concept of the Paris Convention, the Havana Convention 1928 diverged significantly from its chronological precursors.

The Havana Convention was adopted during the sixth Pan-American Conference in Havana on the 20th of January 1928 and has been named the Convention on Commercial Aviation- the Havana Convention 1928.[405] While both the Paris and Madrid Conventions aimed to regulate the technical and operational aspects of aviation, leaving the establishment of international routes and traffic rights to be assessed under bilateral or multilateral agreements, the Havana Convention presented a more liberal perception of issues pertaining to traffic rights and consequently sovereignty over a state's airspace.[406] The aforementioned would materialise via the multilateral provision between the contracting states of the "five freedoms of the air".[407] Other noteworthy aspects that set the Havana Convention apart from its forerunners is the lack of a provision that pertains to the establishment of a permanent body with a safeguarding nature in relation to civil aviation, as well as the absence of technical annexes.[408]

The Havana Convention has garnered broader acceptance than the Madrid Convention, attracting 16 state-parties. While the Convention, as mentioned

404 See, supra note 383, at 14.

405 Ibid.

406 Ibid.

407 Ibid, at 14-15.

408 Ibid.

above, is no longer applicable,[409] its liberal and innovative nature is still attractive to many "open skies " and free competition of air services sceptics.[410]

iv. THE CHICAGO CONFERENCE 1944-THE PRELUDE TO THE CONVENTION

The events that led to the Chicago Convention are widely known in the international legal community, and it is commonly accepted that the Convention's nature is primarily attributed to them. The rapid development of aviation technology, which peaked during World War II, primarily through the utilisation of military aircraft as wild cards to win battles, was a significant factor in achieving victory on behalf of the Allied Forces against the Axis.

While the fires of war were still raging on the European and Pacific fronts, the Allies began planning for peace. As air transport emerged as a vital factor in passenger transportation and logistics, particularly in a world where railways and roads were disrupted and damaged, it was essential to establish swift and effective international regulation.[411] The aforementioned situation led the President of the United States to invite the representatives of 54 nations to Chicago from the 1st of November to the 7th of December 1944 to "make arrangements for the immediate establishment of provisional world air routes and services" and to "set up an interim council to collect, record and study data concerning international aviation and to make recommendations for its

409 Article 80 of the Chicago Convention stipulates that*:* "*Each contracting State undertakes, immediately upon the coming into force of this Convention, to give notice of denunciation of the Convention relating to the Regulation of Aerial Navigation signed at Paris on October 13, 1919 or the Convention on Commercial Aviation signed at Habana on February 20, 1928, if it is a party to either. As between contracting States, this Convention supersedes the Conventions of Paris and Habana previously referred to.*"

410 See, supra note 383, at 14-15.

411 Ibid. at 16.

improvement".[412] Furthermore, the Conference aimed to "discuss the principles and methods to be followed in the adoption of a new aviation convention".[413]

Since the beginning of the Conference, the aims of the participating states were distant in reference to the economic perspectives of transport via air, leading to the presentation of two central views. The United States, on the one hand, lobbied for regulating airspace sovereignty but favoured a liberal model of air transport with minimum restrictions on their economic side as outlined in the Havana Convention.[414] On the other hand, the United Kingdom aimed to safeguard its vast colonial empire through a protectionist approach that sought absolute airspace sovereignty over the lands it possessed, similar to the U.S., but strongly favoured regulating the economic side of air transport.[415] While these fundamentally different approaches could lead to a diplomatic failure, it was due to the acts of the Canadian delegation that the distance between the two sides was bridged, leading to the agreement that the upcoming Convention would not regulate the granting of traffic rights in the international scheduled carriage by air, leaving that to bilateral or multilateral agreements (the existence of which would be enshrined in the upcoming international legal document) between state-parties to the Convention and that the airspace above a state's territory is recognised to be part of its sovereignty.[416]

Having examined how sovereignty over airspace and other pertinent issues were presented in the pre-Chicago Convention 1944 era, as well as the value of the Chicago Conference 1944 in paving the path for the homonymous Convention, this chapter aims to evaluate the sovereignty outlined in the Convention (Article 1) concerning the UAM-AAM-IAM concepts under

412 See, Proceedings of the International Civil Aviation Conference, Chicago, Illinois, Nov. 1-Dec. 7, 1944, Vol. 1, at 1.

413 Ibid.

414 See, Cheng, *The Law of International Air Transport* (Stevens & Sons, 1962), at 18–20 and 24–28; see also Mendes de Leon, *The Dynamics of Sovereignty and Jurisdiction in International Aviation Law*, in Kreijen et al. (eds.), *State, Sovereignty, and International Governance* (Oxford University Press, 2002; online ed., Oxford Academic, 22 Mar. 2012), at 484.

415 Ibid.

416 See, Chicago Convention Arts. 1-2 and 5-7.

consideration. Moreover, in the following sections of this chapter, a legal analysis will ensue vis-à-vis the correlation and legal implications of specific Articles of the Chicago Convention that have a particular interaction with the UAM-AAM-IAM concepts (Arts. 2, 5, 6, and 8).

4.2.2. International Operation of aircraft under the context of the upcoming Mobility Environments

i. Sovereignty and territory under the Chicago Convention

As emphasised above, the concept of airspace sovereignty was recognised and codified for the first time in an international legal document in the Paris Convention of 1919. The second codification and consequent recognition of the aforementioned concept as a successful international legal document still applicable to the present materialised in the Chicago Convention of 1944, particularly in Article 1.

The version of “sovereignty" presented in the Convention could be characterised as an example of "extreme" or even "ultra" sovereignty,[417] portraying the strong influence that WWII and military applications of aviation had on the drafting of the Convention.[418] Article 1 of the Chicago Convention clearly stipulates that a state "has complete and exclusive sovereignty over the airspace above its territory".[419] This provision bears significant legal implications, with the most salient and crucial being that a state has the right to apply its national rule of law in that certain and geographically limited domain

417 See, supra note 384, at 49.

418 Ibid.

419 Article 1 of the Chicago Convention 1944.

to all aircraft operating or stationed therein.[420] Nevertheless, the above statement is not independent of other fundamental principles of public international law, as these are enshrined in the U.N. Charter and the Preamble of the Chicago Convention.[421]

Another crucial element portrayed in Article 1 of the Convention is the concept of "territory". The nature of the concept of "territorial sovereignty" was discussed in the previous paragraphs of this chapter with a parallel reference to significant cases of the ICJ and the U.N. Charter. The drafters of the Chicago Convention provided a clear definition of the term "territory" in Article 2 to avoid any confusion. According to the Convention, "territory" is defined as the "land areas and territorial waters that are adjacent to a state and are under its sovereignty, suzerainty, protection, or mandate[422]. "[423]

The aforementioned definition has two elements that require further explanation, and these are no other than the legal concepts of "land areas" and "territorial waters". In reference to land areas, it is accepted that according to public international law, these include, apart from the land mass of a state, all its islands, internal waters and lakes.[424] Vis-à-vis the "territorial waters", they are also not defined under the Convention. Their definition can, however, be found in another successful later piece of international law, the United Nations Convention on the Law of the Sea (hereinafter referred to as UNCLOS).[425] According to Article 2(1) of the UNCLOS, "the sovereignty of a coastal State

420 See, supra note 384, at 49.

421 The Preamble of the Chicago Convention specifies that the expansion of international civil aviation should foster cordial relations and facilitate understanding between the nations of the world and their people. Additionally, the concept of airspace sovereignty is defined by certain international legal principles, such as refraining from using force and settling differences peacefully, as outlined in the U.N. Charter.

422 The terms “sovereignty, suzerainty, protection, and mandate" are outdated terms, reminiscent of the colonial times with no actual use in the contemporary times.

423 Article 2 of the Chicago Convention 1944.

424 See, supra note 383, at 38.

425 See, United Nations Convention on the Law of the Sea signed at Montego Bay, 10 Dec. 1982.

extends, beyond its land territory and internal waters and, in the case of an archipelagic State, its archipelagic waters, to an adjacent belt of sea, described as the territorial sea".[426] Thus, to recapitulate, it is evident from the analysis above and the legal text assessed that according to the Chicago Convention, the airspace above the territory of a state is part of its exclusive sovereignty with any right or duty this brings to the fore. That territory includes all the land areas and the territorial seas (as these are defined in the UNCLOS).

Following the analysis of the evolutionary process that has shaped the current version of "airspace sovereignty" and referencing the contemporary international instrument that regulates many crucial aspects of international civil aviation, a pertinent inquiry arises: what is the relationship between the assessed air mobility concepts and the aircraft operating therein with the Chicago Convention? The answer lies in the notion of cross-border mobility of aircraft between neighbouring states' urban areas.

ii. Access and operation to foreign airspace under the provisions of the Chicago Convention

Chapter I presents a comprehensive overview, among others, of the concepts of UAM, AAM, and IAM while providing a comparative analysis of them. There, it became evident that the aforementioned terms address mobility environments that involve the lower segment of airspace to conduct passenger and cargo transportation by different types of aircraft.

It is evident that the professionals associated with these environments do not necessarily consider the Chicago Convention from a legal standpoint, as it seems to have little interaction with them. However, in reality, these concepts

426 Article 2(3) of UNCLOS stipulates that the exercise of sovereignty over a state's territorial sea is subject to the provisions of the Convention and other rules of international law. The reference to "other rules of international law" constitutes an indirect allusion to the Chicago Convention.

can and will involve cross-border activities, such as *inter alia* the operation of eVTOLs or other aircraft (manned or unmanned) from an urban environment in country A to an urban environment in country B.[427]

Considering that an eVTOL is an aircraft, as proven in Chapter II, then its access to foreign airspace and the operation from one airspace to another is ruled by the provisions of the Chicago Convention. As analysed above, the airspace above a state's territory is part of its exclusive sovereignty. Therefore, for an aircraft from another state to operate in that airspace, there must be an air services agreement between the state from where the aircraft takes-off and the state of destination according to *inter alia* Articles 5-7 of the Chicago Contention.[428] Thus, when an eVTOL operator (manned or unmanned) plans to operate from the airspace of country A to country B, all conventional aviation rules apply to them as they would with a "non-innovative"[429] aircraft.

However, the above statement is neither novel nor difficult to comprehend; on the contrary, it is the most basic air law principle; since a machine falls under the definition of an aircraft as this is presented by ICAO[430], it is civil in nature[431], and operates in an international context, then the Chicago Convention applies. What is the purpose of this analysis, then, if it just restates the basics of air law? The purpose can be found in the rising significance of the cities and their authorities in the domain of low-altitude operations, bringing forth the concept of "municipal airspace".

While in the original text of the Chicago Convention, the national airspace is perceived as a whole, its Annexes, ICAO and independent national

427 Other types of operation pertaining for example cabotage are assessed later in this Chapter.

428 The mention of the three cited articles regarding "special authorization" or "prior permission" indirectly refers to the air services agreements. These agreements establish the conditions under which bilateral or multilateral operations between aircraft of the contracting states are "authorized or permitted".

429 Here, the term non-innovative is used to describe non-electrical and/or non-VTOL aircraft.

430 See Chapter II.

431 See Article 3 of the Chicago Convention.

air laws[432] divide the airspace into different classes to take account of the different aircraft movements there. As per Annex 11 of the Convention Chapter 2.6, [433] airspace can be classified into two types and 7 Classes: controlled and uncontrolled airspace.[434] Controlled airspace encompasses Classes A and E, while uncontrolled airspace engulfs Classes F and G.[435] The figure below shows the flight requirements and services provided for each class of airspace.

432 For example, in the German legal environment, the Federal Ministry of Transport, Building and Urban Development (Bundesministerium für Verkehr, Bau und Stadtentwicklung, BMVBS) defines the airspace classes in German airspace according to § 10 para. 2 i.c.w. Attachments 4 and 5 LuftVO.

433 See ICAO Annex 11 Chapter 2 and Appendix 4 of the Chicago Convention.

434 See, Uhl, *Classification of Airspace*, in Hobe, von Ruckteschell, and Heffernan (eds.), *Cologne Compendium on Air Law in Europe*, (Carl Heymanns, 2013), at 230.

435 The airspace classes A to E are controlled, meaning air traffic control services are provided. In the remaining two classes (F and G) air traffic control services are not provided. For more information see, ICAO Annex 2 of the Chicago Convention.

Class	Type of flight	Separation Provided	Service Provided	Speed limitation*	Radio communication requirement	Subject to an ATC clearance
A	IFR only	All aircraft	Air traffic control service	Not applicable	Continuous two-way	Yes
B	IFR	All aircraft	Air traffic control service	Not applicable	Continuous two-way	Yes
	VFR	All aircraft	Air traffic control service	Not applicable	Continuous two-way	Yes
C	IFR	IFR from IFR IFR from VFR	Air traffic control service	Not applicable	Continuous two-way	Yes
	VFR	VFR from IFR	1) Air traffic control service for separation from IFR 2) VFR/VFR traffic information service (and traffic avoidance advice on request)	250 kts IAS below 10000 ft amsl	Continuous two-way	Yes
D (1)	IFR	IFR from IFR	Air traffic control service, traffic information about VFR flights (and traffic avoidance advice on request)	250 kts IAS below 10000 ft amsl	Continuous two-way	Yes
	VFR	Nil	IFR/VFR and VFR/VFR traffic information (and traffic avoidance advice on request)	250 kts IAS below 10000 ft amsl	Continuous two-way	Yes
E (2)	IFR	IFR from IFR	Air traffic control service and, as far as practical traffic information about VFR flights	250 kts IAS below 10000 ft amsl	Continuous two-way	Yes
	VFR	Nil	Traffic information as far as practical	250 kts IAS below 10000 ft amsl	No	No
F	IFR	IFR from IFR as far as practical	Air traffic advisory service; flight information service	250 kts IAS below 10000 ft amsl	Continuous two-way	No
	VFR	Nil	Flight information service	250 kts IAS below 10000 ft amsl	No	No
G	IFR	Nil	Flight information service	250 kts IAS below 10000 ft amsl	Continuous two-way	No
	VFR	Nil	Flight information service	250 kts IAS below 10000 ft amsl	No	No

* When the height of the transition altitude is lower than 10,000 ft amsl, FL100 should be used in lieu of 10000 ft

Figure 9[436]

436 (Classification of Airspace | SKYbrary Aviation Safety), accessed (05-03-24).

The use of eVTOL aircraft is expected to shift from the current Visual Flight Rules (hereinafter referred to as VFR)[437] used in helicopter operations to a greater degree of automation in the future. These aircraft will mainly operate in non-controlled Class G airspace below 400ft, where they can take advantage of the necessary land infrastructure (such as vertiports on top of urban buildings) to provide an additional mobility option for the public.[438] Despite the fact that the use of eVTOLs will primarily take place in Class G airspace, they may also operate in Class E controlled airspace in large metropolitan areas, which will be shared with commercial airlines.[439] This additionally includes areas surrounding airports. A potential operation of an eVTOL in the near future could be in the form shown in the following graph.

437 See, ICAO Annex 2 - Rules Of The Air and EU Regulation 2012/923, SERA, Standard European Rules of the Air.

438 See, Concept for Urban Airspace Integration – Integrating UAS into the Future Aviation System, A Flexible Approach Enabling Large-Scale UAS Operations, (DLR Blueprint, 2017), at 7 and 9.

439 See, Urban Air Mobility Airspace Integration Concepts, Operational Concepts and Exploration Approaches, (The MITRE Corporation, 2019), at 13.

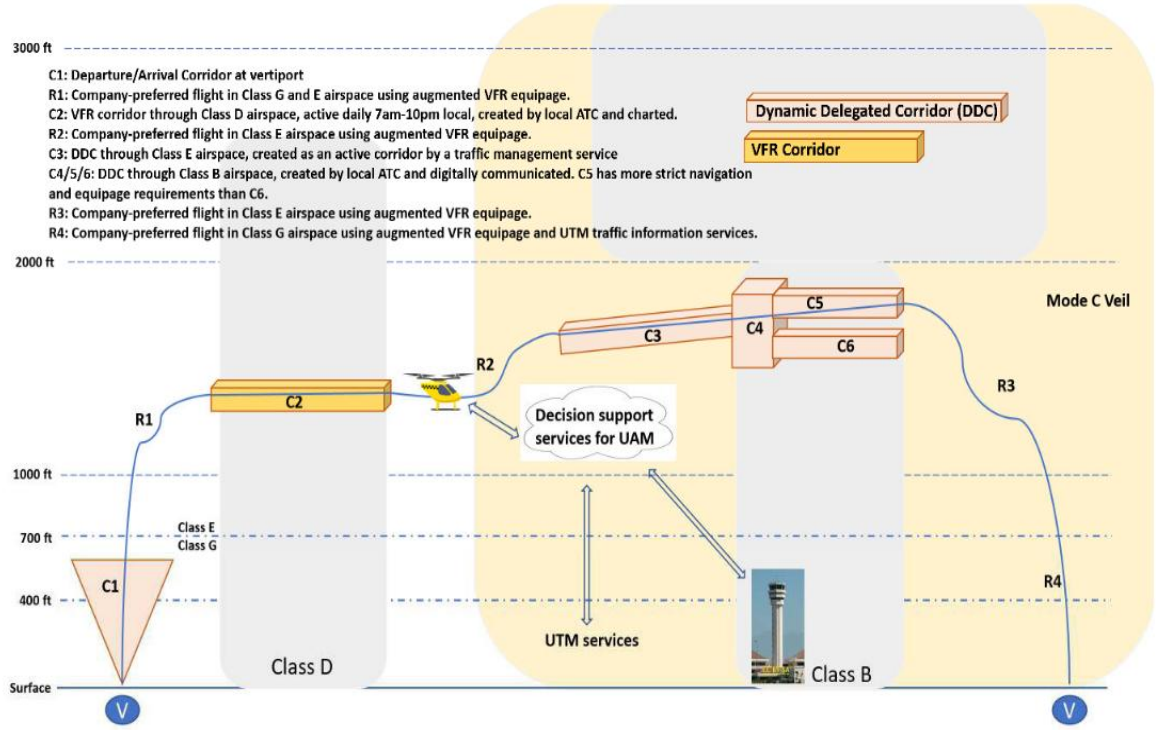

Figure 10[440]

The graph above illustrates that an eVTOL will take off from uncontrolled airspace Class G at point C1. However, it will also operate in controlled airspace, Class E, where it will share the airspace with conventional aircraft of commercial air carriers.

It should be emphasised that the Chicago Convention and its Annexes provide rather general specifications regarding the minimum heights at which aircraft can operate. Chapters 4 and 5 of Annex 2 of the Chicago Convention provide some information on this matter for VFR and instrument flight rules (hereinafter referred to as IFR).[441] Nevertheless, it is important to stress that even if national airspace can be categorised/subdivided under the Annexes of the Convention, it remains part of a state's exclusive sovereignty.

After examining the concepts of "airspace" and "municipal airspace", the question arises: who has the authority to make decisions about the airspace

440 Ibid. at 12.

441 See ICAO Annex 2 - Rules Of The Air.

above cities? Despite ICAO acknowledging the significance of municipalities and cities, their recognition has not led to any changes in how or who manages the airspace above a state's territory. This is attributed to the fact that, on the one hand, the findings of the ICAO Assemblies only recognise the importance of the cities and municipalities in shaping the new environments without suggesting any alternations to the present regime of airspace management and on the other hand that even that recognition of their importance do not bring any actual legal obligation for compliance to the ICAO Member states, being a mere recommendation.[442] Thus, while innovative or advanced, aircraft operations in the discussed mobility environments will still have to comply with the existing conventional air laws, both national and international. For that matter, the access to foreign airspace of aircraft (manned or unmanned) operating in the context of these environments has to adhere to the rules of the Chicago Convention. The statements mentioned above indicate that although the concept of municipal airspace may seem promising in terms of establishing the role of cities and municipalities as central stakeholders in the future of the aforementioned environments, it remains a policy term and not a legal one. Thus, the entity that decides what happens to the airspace above its territory, including, of course, the urban environments, is the state and not the cities or municipalities, making the term "municipal airspace" null in the legal domain.[443]

While the supremacy of the state (as a central authority) over the airspace above its territory has been thoroughly examined under a theoretical spectrum, the presentation of actual use cases will bring more clarity on the nature of the discussed matter. Volocopter GmbH, a German limited company and manufacturer of 3 eVTOL aircraft of various sizes and capabilities, is planning to operate above the city of Paris during the Olympics in the Summer of 2024. This plan has faced objections from local authorities, including representatives

442 See Article 49 of the Chicago Convention.

443 Nevertheless, as per Article 18(f) of the EU's Implementing Regulation 664/2021, the importance of coordination among various stakeholders, including those at the local level, is explicitly mentioned. See, Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the U-space, Article 18(f).

of the municipality and the Council of Paris. [444] The objections are mainly centred around the visual and noise pollution that the operation of eVTOLs might cause to the citizens of Paris. [445]

However, can the municipal authorities prohibit the operation of Volocopter's eVTOLs by closing their "municipal airspace"? According to the provisions of the Chicago Convention, they cannot. If the central government of France approves it, Volocopter will be able to operate its aircraft by passing from German airspace to French airspace. The only thing that the municipal authorities can do is to express their concerns to influence the decision of the state, but they have no direct decision-making powers in reference to the airspace above Paris. If the operation of Volocopter's eVTOLs will only involve movement within the state of France and not across international borders, then international law would not be applicable as it is a matter of national jurisdiction. This renders the Chicago Convention out of scope in the aforementioned scenario. To summarise, "municipal airspace" is merely a policy term that emphasises the role of cities and municipalities in future air mobility environments. It is not a legal term and does not grant municipalities decision-making powers over the airspace above them. Even in lower airspace, when an international element is present in an aircraft operation, the power to open or close the airspace rests with the associated state, not with any provisional or regional state entity, as stipulated by the Chicago Convention.

In the upcoming section of this chapter, it is necessary to briefly analyse the concept of unmanned aircraft and unmanned aviation in the context of Article 8 of the Chicago Convention. This analysis is required to understand the operation of these aircraft in the assessed air mobility environments since the aforementioned concept has been mentioned in both this chapter and Chapter III of this dissertation.

444 See, (https://www.urbanairmobilitynews.com/air-taxis/paris-local-authorities-raise-strenuous-objections-to-launch-of-evtol-passengers-services-in-2024/), accessed (07-03-24).

445 See, (https://www.thelocal.fr/20231115/pariss-olympic-flying-taxi-plans-hit-city-council-setback), accessed (07-03-24).

iii. ARTICLE 8 OF THE CHICAGO CONVENTION AND OPERATION OF UNMANNED AIRCRAFT IN THE CONTEXT OF THE EVALUATED ENVIRONMENTS

In Chapter III of this dissertation, Article 8[446] was introduced to disentangle the misconceptions regarding the types of vehicles that will operate in the assessed air mobility environments. There, it was stated that these environments would host the operations of all aircraft that will fulfil certain requirements, either manned or unmanned.

The original text of the Chicago Convention of 1944 did not evaluate or regulate the fully operational behaviour and complexities of unmanned aircraft in their current form. This was due to the lack of maturity of the technology at that time, which made it impossible for the law to assess and/or regulate their functions effectively.[447] However, Article 8 of the Convention, titled "pilotless aircraft" (which constitutes *lex specialis*),[448] acknowledged an already emerging technology that the drafters of the Convention foresaw as crucial enough to be addressed in the first articles of the Convention. It can be understood that the term "pilotless aircraft" is rather vague and encompasses many concepts, which was precisely the drafters' intention at the time. ICAO, to address the legal implications of the operation of aircraft falling under the definition of "pilotless aircraft", promoted, among others, the term Remotely-Piloted Aircraft System

446 Article 8 of the Chicago Convention dictates: *"No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft."*

447 It should be underlined that the idea of a "pilotless aircraft" did not receive its first international legal regulation in 1944. Instead, it was established in the *Protocol relating to amendments to Articles 3,5,7,15,34,37,40,41 and 42 and to the final clauses of the Convention Relating to the Regulation of Air Navigation of October 13, 1919*, done at Paris, June 15, 1929. Specifically, the revised Article 15 stated that*: "No aircraft belonging to a contracting State, which is capable of being flown without a pilot, shall fly without a pilot over the territory of another contracting State, except by special authorization."*

448 See, Scott, *Open Skies for Unmanned Aircraft in Europe: An Outlier or a New Approach?*, Air and Space Law, Vol. 46, No. 1 (2021), at 68.

(hereinafter referred to as RPAS)[449] in the early stages of rule development of unmanned aircraft and aircraft systems.

According to ICAO's circular 328 AN/190,[450] "[A]ircraft flown without a pilot" refers to the situation where there is no pilot on board the aircraft. As a consequence, any Remotely-piloted Aircraft (hereinafter referred to as RPA)[451] is a "pilotless" aircraft,[452] consistent with the intent of the drafters of Article 8.[453] According to Chapter 2 of the circular," [a]ll UA, whether remotely-piloted, fully autonomous or a combination thereof, are subject to the provisions of Article 8.[454] Therefore, all SARPSs of the Annexes of the Chicago Convention are applicable to them as well. Thus, all unmanned aircraft must adhere to the same rules as manned aircraft, in addition to potential specific rules for them in the domains of operation, safety, etc. To avoid misinterpretations, the ICAO Circular has outlined all of the Articles and principles of the Chicago Convention that are applicable to unmanned aircraft ("pilotless aircraft" in the context of Article 8 of the Convention). Specifically, Articles 12 on the Rules of the Air, 15 on Airport and similar charges, 29 on Documents Carried in Aircraft, 31 on Certificates of airworthiness, 32 on Licenses of personnel, and 33 on Recognition of certificates and licenses are cited by ICAO as applicable to the air vehicle (UA) and to the entire system (remote pilot station, remote pilot, C2, etc.).[455]

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449 According to ICAO Cir. 328 AN/190, at x, an RPAS is: *"A set of configurable elements consisting of a remotely-piloted aircraft, its associated remote pilot station(s), the required command and control links and any other system elements as may be required, at any point during flight operation."*

450 See, Unmanned Aircraft Systems, ICAO, *Cir. 328 AN/190*, (2011).

451 According to ICAO Cir.328 AN/190, at x, an RPA is*: "An aircraft where the flying pilot is not on board the aircraft. It should be noted that an RPA constitutes a sub-category of unmanned aircraft."*

452 An RPA is a subset of unmanned aircraft. See ICAO, *Cir. 328 AN/190*, (2011), at 7.

453 Ibid., at 11.

454 Ibid., at 3.

455 Ibid., at 14.

The question at hand is how the upcoming air mobility environments are related to the legal explanation that unmanned aircraft, which are considered "pilotless aircraft" under Article 8 of the Convention (thus falling under ICAO's definition of "aircraft"), must comply and operate according to the provisions of the Chicago Convention. The answer to this question is provided in the first lines of this section. The upcoming air mobility environments will contain the operations of all aircraft that will be able to serve their purposes. These aircraft could be manned or unmanned, electric or not. Thus, the operation of unmanned aircraft in air mobility environments containing trans-border operations will be regulated by the Chicago Convention, starting with Article 8. In the present and near future, the operation of, e.g., eVTOLs is envisaged to be only with a pilot on-board the aircraft.[456] Nevertheless, this does not mean that smaller UAS will not operate for cargo delivery purposes, surveillance, telecommunications and mapping. The operation of the aforementioned aircraft when an element of international transport is included will be regulated by the provisions of the Chicago Convention.

For the purposes of legal argumentation, even if Article 8 does not cover all unmanned aircraft, the provisions of the Chicago Convention can still be applied to their operations when an international segment is involved. This can be done through the application of Article 5 of the Convention if the flight is non-scheduled.[457] However, this article may not provide relief from the prior permission requirement for cabotage, as described in Article 7 of the Convention.[458] Alternatively, if the operation is classified as a scheduled air

456 In later stages, eVTOLs are envisioned to be unmanned for passenger transportation services, with the pilot operating remotely. In the distant future, they may even be automated., according to industry.

457 See, supra note 448, at 69. See also, ICAO, Doc. 9626, Manual on the Regulation of International Air Service (2016), Ch. 4.6, where is stated that: "A non-scheduled air service is a commercial air transport service performed as other than a scheduled air service. A charter flight is a non-scheduled operation using a chartered aircraft. Though the terms non-scheduled and charter (i.e. a contractual arrangement between an air carrier and an entity hiring or leasing its aircraft) have come to be used interchangeably, it should be noted that not all commercial non-scheduled operations are charter flights".

458 See, supra note 448, at 69.

service, then the provisions of Article 6 apply.[459] According to Article 6, special permission or other authorization is required from the relevant state, which indirectly refers to air services agreements that are traditionally used for these purposes.[460]

Following the discussion of the international operation of aircraft under the provisions of the Chicago Convention, the following section will outline the legal requirements for eVTOL and UAS operations in the EU.

4.3. EUROPEAN LEGISLATION ON ACCESS AND USE OF THE UNION AIRSPACE

4.3.1. EU REGULATIONS 261/2004 AND 1008/2008, LEGAL CHALLENGES FOR AIRCRAFT OPERATION IN THE CONTEXT OF THE ASSESSED ENVIRONMENTS

The previous sections discussed the legal concept of airspace sovereignty, its historical evolution, and, consequently, the connection of certain articles of the Chicago Convention with aspects of aircraft operation in the upcoming environments of advanced or innovative mobility. In this section, an analysis will take place regarding the access and use of EU airspace in the context of the evaluated mobility environments and the aircraft operating therein.

459 Ibid. at 70. See also, ICAO, Doc. 9626 (2016), Ch. 5.3, where is stated that: "[A] scheduled air service is typically an air service open to use by the general public and operated according to a published timetable or with such a regular frequency that it constitutes an easily recognizable systematic series of flights".

460 Ibid. ASAs are not the only relevant mechanism, for more information on the topic see also, Fiallos Pazmiño, *The International Civil Operations of Unmanned Aircraft Systems Under Air Law* (Kluwer Law International, 2020).

In the EU, due to Regulation 1008/2008[461] and to the Single European Sky initiative (henceforth referred to as SES),[462] bilateral Air Services Agreements are not required between the EU member states to perform air services operations. The EU legal ecosystem boasts a comprehensive and detailed set of laws that regulate the operation of aircraft in the Union.

Regulation (EC) No 261/2004 (hereinafter referred to as the Regulation)[463] is one of the most litigated sources of EU secondary law, having been referred to the Court of Justice of the European Union (henceforth referred to as ECJ) over 70 times.[464] This regulation is primarily known as the main legal tool for passengers to receive compensation in cases of flight delays, denied boarding, and cancellations within the EU. Therefore, the analysis of this regulation would be more appropriate in the next chapter of this dissertation, which focuses on liability issues, rather than in this chapter, which is concerned with aircraft operations. Nevertheless, since one of the main uses of the eVTOL aircraft in the context of the new air mobility environments will be passenger transportation, then it becomes obvious that the scope of this regulation is very much relevant to the operational aspects of the said aircraft and not only concerning the domains of liability.

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461 Between 1987 and 1997, the EU formulated three packages to establish a unified air transport policy, known as "liberalisation" packages. These packages were later implemented in the EU member states. EU Regulation 1008/2008 replaced these packages, removing the barriers to new entries in the market entry and behaviour domains, something that the bilateral Air Services Agreements (ASAs) between the member states used to do in the past. As a result, the bilateral ASAs between them were rendered pointless.

462 The Single European Sky (SES) initiative was launched in 2004 to reduce the fragmentation of European airspace and to improve the performance of Air Traffic Management (ATM) in terms of safety, capacity, cost- efficiency and the environment.

463 Regulation (EC) No 261/2004 of the European Parliament and of the Council of 11 February 2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights, and repealing Regulation (EEC) No 295/91 (Text with EEA relevance) - Commission Statement, *Official Journal L 046, 17/02/2004 P. 0001 – 0008.*

464 See, supra note 147, at 308. See also, Scott, *Passenger Air Taxi Services: An Assessment of the Current European Union Rules on Consumer Protection for Passengers*, Journal of Intelligent & Robotic Systems (Springer, 2024), at 5.

In order for the Regulation to be applicable in cases of flight delays, denied boarding, and cancellations, certain conditions set in its text must be met. As previously mentioned, the Regulation focuses on air transport, [465,] which most commonly refers to the movement of people from point A to point B by aircraft.[466] However, not all aircraft fall under the scope of the Regulation. Article 3(4) of the Regulation clarifies that the Regulation only applies to passengers transported by motorised fixed-wing aircraft.[467] It has been repeatedly stated that in the context of AAM/IAM and their urban applications, conventional and newer types of aircraft will operate in a homeostatic mobility environment. In Chapter I, it has been discussed that the VTOLs and their electric variants fall under the definition of aircraft, as the term is defined in the Annexes of the Chicago Convention and lately adopted in the EU Regulation 2018/1139. While there is no definition of the term VTOL or eVTOL in a piece of EU legislation yet, the term VCA initially presented in EASA's Prototype Technical Design Specifications for Vertiports and Opinion 03/2023[468] came to cover that gap by stating that VTOLs and eVTOLs are aircraft in the sense of the Annexes of the Convention and EU legislation, despite their manned or

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465 Regulation (EC) No 261/2004 of the European Parliament and of the Council of 11 February 2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights, and repealing Regulation (EEC) No 295/91 (Text with EEA relevance) - Commission Statement, *Official Journal L 046, 17/02/2004 P. 0001 – 0008.*

466 In his article titled *"Passenger Air Taxi Services: An Assessment of the Current European Union Rules on Consumer Protection for Passengers,"* Scott argues that air transport can also include operations between point A to point A, such as "aerial works." Aerial works refer to "aircraft operation in which an aircraft is used for specialised services such as agriculture, construction, photography, surveying, observation, patrol, search and rescue, aerial advertisement, etc." This definition is taken from the COMMISSION IMPLEMENTING REGULATION (EU) No 923/2012, of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation and amending Implementing Regulation (EU) No 1035/2011 and Regulations (EC) No 1265/2007, (EC) No 1794/2006, (EC) No 730/2006, (EC) No 1033/2006 and (EU) No 255/2010. The perspective presented above seems to hold merit since, as previously stated in this dissertation, specialised services like patrol, search and rescue, and surveying will be essential components of the upcoming air mobility environments.

467 Article 3(4) of Regulation 261/2004 dictates that: "This Regulation shall only apply to passengers transported by motorised fixed-wing aircraft."

468 See Chapter III. The term "VCA" was finally introduced in the 2024 Package and Commission Implementing Regulation (EU) 2024/1111.

unmanned nature and design. However, not all VTOL and eVTOL designs fall under the category of motorised fixed-wing aircraft, thus making the application of the Regulation debatable due to Article 3(4). Undoubtedly, this is another proof of the weaknesses of the Regulation since it has many gaps or unnecessarily strict scopes like the aforementioned, forcing affected parties to seek interpretation of the letter of the law in front of the ECJ.

One of the eVTOL designs mentioned more than once in this dissertation is the Velocity by Volocopter,[469] which is a multi-copter aircraft without fixed wings. Automatically, this differentiation in its design renders it out of the scope of the Regulation, despite the fact that its operational aspects, as well as function and purpose in the context of the air mobility environments, is going to be that of the fixed wings eVTOLs, such as for example the Lilium Jet[470], which falls under the scope of the Regulation. This situation creates confusion for the passengers, as their rights depend on the design of the operating eVTOL and raises doubts for the operators/manufacturers, as the law creates unnecessary prohibitions that hinder competition.

Another operational aspect of the VTOLs and eVTOLs that is influenced by the provisions of the Regulation is, without doubt, enshrined in Articles 2 and 3 of the Regulation and is no other than the concept of their operating entity's legal identity. The aircraft operating in the context of the assessed environments for the foreseeable future will not be operated in the manner that physical persons drive their auto vehicles. Instead, they will be owned by legal entities that will perform mobility services. However, for the regulation to be applicable, those legal entities cannot be generic limited companies but "air carriers" in the context of EU law for the Regulation to be applicable. According to Article 2 of the Regulation, ""air carrier" means an air transport undertaking with a valid operating licence".[471] As per Case C-74/16,[472] the ECJ, considering pre-existing

469 See, (https://www.volocopter.com/en/solutions/volocity), accessed (09-03-24).

470 See, (https://lilium.com/jet), accessed (09-03-24).

471 Art. 2 of the Regulation 261/2004.

472 Case C-74/16, Congregación de Escuelas Pías Provincia Betania v. Ayuntamiento de Getafe. The concept of undertaking has also been defined in the Regulation 1008/2008 as: "any natural

EU competition case law, defined the concept of "undertaking" as "any entity engaged in an economic activity, regardless of its legal status and the way in which it is financed".[473] The requirements of a valid operating license for an air transport undertaking in the EU are portrayed in Regulation (EC) No 1008/2008.[474] In particular, Article 4 of the aforementioned Regulation states that for an undertaking to be granted a valid operation license by the competent authority of an EU member state then it should:

a) Have its principal place of business[475] located in that Member State;
b) Hold a valid AOC[476] issued by a national authority of the same Member State whose competent licensing authority is responsible for granting, refusing, revoking or suspending the operating licence of the Community air carrier; [477]
c) Have one or more aircraft at its disposal through ownership or a dry lease agreement;
d) Have as main occupation the operation of air services in isolation or combined with any other commercial operation of aircraft or the repair and maintenance of aircraft;

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or legal person, whether profit-making or not, or any official body whether having its own legal personality or not". It is evident that the economic nature of the undertakings in both sources is particularly stressed.

473 Case C-74/16, Congregación de Escuelas Pías Provincia Betania v. Ayuntamiento de Getafe.

474 REGULATION (EC) No 1008/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 24 September 2008 on common rules for the operation of air services in the Community.

475 Regulation 1008/2008 Article 2(26) defines principal place of business as "the head office or registered office of a Community air carrier in the Member State within which the principal financial functions and operational control, including continued airworthiness management, of the Community air carrier are exercised."

476 According to the same Regulation, Article 2(8), an air operator certificate (AOC) is "a certificate delivered to an undertaking confirming that the operator has the professional ability and organisation to ensure the safety of operations specified in the certificate, as provided in the relevant provisions of Community or national law, as applicable."

477 As stated in the Chapter III of this dissertation on Aviation Safety, unmanned passenger eVTOLs (when available) will fall under the certified operation category according to EASA's categorisation. For the time being EASA is still developing the relevant safety rules for the certified category.

e) Have a company structure that allows the competent licensing authority to implement the provisions of this chapter;
f) Be more than 50 % owned by Member States and/or nationals of Member states, which will have in parallel effective control[478] of the undertaking, whether directly or indirectly through one or more intermediate undertakings, except as provided for in an agreement with a third country to which the Community is a party;
g) Meet the financial conditions specified in Article 5[479] of the Regulation above;
h) Comply with the insurance requirements specified in Article 11[480] and in Regulation (EC) No 785/2004[481] and;
i) Comply with the provisions on good repute as specified in Article 7.[482]

But how do the above provisions of Regulations 261/2004 and 1008/2008 influence the operations of eVTOLs and other relevant aircraft in the context of the described mobility environments? First of all, it is rather debatable whether companies like Lilium, Volocopter, etc., will fall under the definition of "air carrier" as presented in the Regulation. If the aforementioned companies or others of the same category plan to operate the aircraft that they also

478 In the same Regulation, Article 2(9) defines effective control as "a relationship constituted by rights, contracts or any other means which, either separately or jointly and having regard to the considerations of fact or law involved, confer the possibility of directly or indirectly exercising a decisive influence on an undertaking, in particular by: (a) the right to use all or part of the assets of an undertaking; (b) rights or contracts which confer a decisive influence on the composition, voting or decisions of the bodies of an undertaking or otherwise confer a decisive influence on the running of the business of the undertaking."

479 Article 5 of the Regulation 1008/2008 portrays the financial conditions under a valid operation license is issued.

480 Article 11 stresses the importance of air carrier insurance, providing in parallel a link to Regulation (EC) No 785/2004.

481 Regulation (EC) No 785/2004, assesses the insurance requirements for air carriers and aircraft operators, by establishing minimum insurance requirements for air carriers and aircraft operators in respect of passengers, baggage, cargo and third parties. More information about the domain of insurance in the EU for the operating aircraft in the context of the forthcoming air mobility environments will be provided in Chapter 5 of this doctoral thesis.

482 Art. 4 of the Regulation 1008/2008.

manufacture, they have to fulfil all the prerequisites of Article 4 of Regulation 1008/2008 as cited above.

The transformation of the said companies and others relevant to "air carriers" via granting a valid operating license under the provisions of the above Regulations is additionally hindered by other legal issues. One of the most crucial issues stemming from Article 4(f) of Regulation 1008/2008 is the issue of ownership and control. Companies located in the EU, like the pioneering Lilium and Volocopter (both having the legal form of a German limited company, Gesellschaft mit beschränkter Haftung), especially in the early phases of development of their product, received massive financial investments from, among others, non-EU funds and individual investors. This is problematic as it might influence their levels of ownership and control, which might not reach the desirable 50% and above. This provision, although rather unfair for a developing industry, portrays, on the one hand, the strictness of EU law in reference to its aviation industry and, on the other hand, the potential necessity of newer pieces of legislation that will be able to adequately address novel concepts. Judging from the aforesaid fact that the Regulation is the most litigated piece of EU legislation, it is highly probable that in the interim period before the emergence of an EU law addressing the unique nature of operation of VTOLs and their electric variants, a plethora of interpretative decisions will be released by the ECJ to address potential legal issues emerging from the strict wording of the Regulation.

What are the legal implications, though, if a non-EU air carrier[483] plans to operate in the internal EU market? For instance, if an aircraft like the EHang eVTOL[484], which is manufactured by a company based in Guangzhou, China, aims to operate in the EU internal market, it must first gain access to the airspace via an air services agreement, per the provisions of the Chicago Convention

483 An EU air carrier is called "community air carrier" and is defined in Regulation 261/2004 as: "an air carrier with a valid operating licence granted by a Member State in accordance with the provisions of Council Regulation (EEC) No 2407/92 of 23 July 1992 on licensing of air carriers (1)".

484 See, (EHang | UAM - Passenger Autonomous Aerial Vehicle (AAV)), accessed (11-03-24).

1944.[485] However, when a non-EU air carrier operates within the internal market, say for an A to B transportation within the same member state, then it is a cabotage flight that falls under the 9th Freedom of the Air category, which is known as "stand-alone" cabotage and it is rarely given in the context of an air services agreement.[486] On the other hand, if a non-community air carrier plans to operate within the EU not for transportation but for leisure purposes, with the point of take-off and destination being the same (A to A transportation), then a new type of cabotage emerges which exceeds the 9th freedom of the air.[487] This is known as the tenth freedom of the air, which is not a right ever given again in the context of air services agreements, as per Scott in his article "Open Skies for Unmanned Aircraft in Europe: An Outlier or a New Approach".[488]

The legal synergy issues between aircraft operations in the air mobility environments under evaluation and the aforementioned EU laws do not end with the already assessed points. As per Article 3(1)(a) and (b) of the Regulation, the place of departure and arrival has to be an "airport".[489] In the Regulation, the definition of the term "airport" is absent. Thus, the only way to evaluate the meaning of the term from the EU legal perspective is to check other EU sources, e.g., Regulations. Despite the fact that the definitions present in the aforementioned Regulation, including that of "airport" exist "for the purposes of this Regulation"[490], it is essential to assess the European legal environment as a whole and not as a fractured body of separate laws in order to better understand its aim and principles. According to Article 2(7) of Regulation 1008/2008, an

485 See, Scott, *Passenger Air Taxi Services: An Assessment of the Current European Union Rules on Consumer Protection for Passengers*, Journal of Intelligent & Robotic Systems (Springer, 2024), at 7.

486 See, (Freedoms of the Air (icao.int)), accessed (11-03-24).

487 See, supra note 485 at 7.

488 See supra note 448, at 78.

489 See, Article 3 of the Regulation 1008/2008.

490 See, Article 2 of the Regulation 1008/2008.

"airport" is "any area in a Member State especially adapted for "air services".[491] As has been repeatedly stated in the previous sections of this dissertation, in the context of UAM/AAM/IAM, the eVTOL aircraft will perform passenger, cargo and/or mail transportation for remuneration and/or hire, which constitute air services. The legal challenges in this case start in reference to the area where the eVTOL will take off and land. In Chapters 2 and 3 of this thesis, the concept of "vertiports" has been defined and assessed. The legal issue is whether or not "vertiports" fall under the above definition of "airport". It could be argued that since the definition of "airport" is rather open and any area adapted for air services could be considered one, then the definition of "vertiport", as presented in Chapter 2, could fit in that rather broad context.[492] The only prerequisite is that the "landing, take-off and movement of eVTOL-capable aircraft"[493] is performed for "carriage of passengers, cargo and/or email for remuneration and/or hire."[494]

The compatibility challenges of eVTOL/VTOL aircraft operation vis-à-vis the assessed EU Regulation do not halt with the aforementioned analysis. The penultimate point that will be discussed vis-a-vis aircraft operations and the Regulation refers to the people utilising the services of these aircraft in the context of the upcoming air mobility environments. For the Regulation to apply, these people have to be "passengers". Again, to the discomfort of many professionals, the Regulation does not directly define the aforementioned term. Instead, a person is defined as such when they are in possession of a "ticket". However, the issue concerning the "ticket" has to do with the method by which companies that will operate eVTOLs plan to issue their "tickets". Companies like Lilium and Volocopter[495] are developing electronic applications that will be the sole way to book a ticket for their services. Considering the on-demand and

491 In Regulation 1008/2008, Article 2(4) defines the term "air services" as "a flight or a series of flights carrying passengers, cargo and/or mail for remuneration and/or hire".

492 See, supra note 485, at 8.

493 See definition of "vertiports" Chapter I of this dissertation.

494 See Article 2(4) of Regulation 1008/2008.

495 See, (Volocopter is Developing an App!), accessed (12-03-24).

at-scale nature of their services, then the booking of tickets will not be a procedure scheduled in advance as it happens most of the time in conventional aviation, but there will be a much shorter time gap between the booking, the issuing of the e-ticket and the flight with the eVTOL. Whether the above situation influences the validity of the document titled "ticket" is rather doubtful since the statements of the associated companies seem to address and adhere to the definition of "ticket". Nevertheless, since that type of air mobility is about to be tested for the first time at a large scale (issuing of aircraft tickets the same way as bus or metro tickets are issued), the compatibility between the Regulation and the issue mentioned above will be likely to be tested there too.[496]

Finally, a last point that could create inconsistencies between the application of the Regulation and the operation of eVTOLs in the context of the forthcoming air mobility environments is that according to Article 3(3) of the provisions of the Regulation, "shall not apply to passengers travelling free of charge or at a reduced fare not available directly or indirectly to the public."[497] The legal concern regarding the aforementioned emerges similarly to the previous paragraph regarding the methods by which the associated companies plan to issue their tickets. The web applications that will serve as the ticket booking points for users of the eVTOL services are envisioned to resemble already existing web applications offering ground mobility services like Bolt, Uber, Wolt and others. These companies almost catholically offer some discounts or free uses of their services to newly registered or loyal customers, a behaviour that can potentially make these flights fall outside of the scope of the Regulation and, as a consequence, their passengers unfit to benefit from its provisions.[498]

Academic research has shown that assessing a problem, whether it is new or pre-existing, is the easiest part of the process. However, when it comes to proposing solutions to address emerging problems, the challenge becomes much

496 See, supra note 485 at 8.

497 See Article 3(3) of Regulation 261/2004.

498 See supra note 485, at 9. Scott accurately assessed first the evaluated issue providing valuable insight about the inconsistencies between the applicability of the Regulation and the proposed operational aspects of eVTOLs.

more complex. In the initial sections of this dissertation, it was stated that one of the main goals was to present realistic solutions to the legal issues being examined.

To address the compatibility issues analysed above between the Regulation and the proposed operation of the eVTOLs in the context of the evaluated air mobility environments, three distinct paths could be adopted. The manufacturers of eVTOL aircraft could either lease or sell their aircraft to air carriers with a valid AOC. In this way, these air carriers would perform air mobility services, issue tickets, and take off and land from specific areas (pre-existing airports) with the necessary equipment to charge electric aircraft. This arrangement would remove any legal uncertainties as existing air carriers have the necessary knowledge and experience to operate aircraft with their skilled pilots. Lilium's collaboration with Lufthansa Group could possibly pave the way for this scenario. [499] However, this approach faces several challenges. Firstly, companies like Lilium, Volocopter, and EHang want to be both manufacturers and aircraft operators. Secondly, having eVTOLs operate from traditional airports defeats the purpose of having multiple vertiports spread across the current megacities, thus not significantly impacting the mobility of a large number of people. Lastly, the absence of qualified pilots poses a challenge as there is already a shortage of pilots for conventional aircraft, let alone eVTOLs.

The second course of action that could be taken is one that is already planned in the long term, which involves amending EU laws to better address the unique nature of eVTOL operations. EASA has already made significant efforts in this regard, and it is certain that in the next decade, many EU laws will be properly amended. In the meantime, as previously mentioned, the ECJ will be called upon to interpret any potential inconsistencies between the proposed operation of eVTOLs and existing EU legislation.

The third option for eVTOL manufacturers is to fully comply with all EU regulations. This is already happening, as evidenced by the industry's focus on

499 See, (Lufthansa Group and Lilium sign Memorandum of Understanding for strategic partnership - Lilium), accessed (12-03-24).

certifying the relevant aircraft in accordance with EASA's certification specifications.

The industry developments and actions by the associated stakeholders indicate that eVTOL manufacturers/operators use a hybrid method combining options two and three. This approach aims to comply with the existing EU regulations governing their upcoming operations while simultaneously lobbying the EU administration for updates of these regulations to better cover and interact with the operation of their eVTOL aircraft.

The final section of this chapter will evaluate U-space and its interactions with eVTOL and other aircraft within the context of the studied air mobility environments.

4.3.2. Regulation 664/2021, U-space and its interaction with the eVTOL operations

In the EU, significant steps have been taken for the appropriate integration of eVTOL and other aircraft relevant to the air mobility environments under evaluation such as UAS, which Deutsches Zentrum für Luft- und Raumfahrt (hereinafter referred to as DLR) calls "all aircraft in all airspaces."[500] However, despite the promising developments in technology, its current limitations make the integration of aircraft associated with the new air mobility environments a complex and demanding issue. In its 2017 Blueprint titled "Concept for Urban Airspace Integration,"[501] DLR highlighted the need for a future airspace management system that allows joint operations of manned and unmanned aircraft. Such a system should consider various factors, including the terrain and ground obstacles, static no-fly zones (including critical infrastructure), and static restricted zones.[502] Additionally, it should consider dynamically arising restricted and prohibited zones such as those used for rescue

500 See, supra note 438, at 7 and 9.

501 Ibid. at 10.

502 Ibid.

and security forces missions.[503] The system should be able to handle traffic users with different capabilities, performances, and priorities while also considering the current and future demand for airspace usage for strategic airspace and traffic management.[504]

Since 2017, significant efforts have been made in the legal domain to properly manage the airspace above cities where both eVTOL (manned and unmanned) and UAS will operate. As a result, in April 2021, the EU Commission released its inaugural regulation on rules and procedures for the safe operation of UAS in U-space airspace.[505] The main objective of the regulation is to facilitate the safe integration of UAS into the modern air traffic system and the provision of U-space activities. To achieve this goal, a regulatory framework has been established, which includes defining technical and operational requirements and providing Acceptable Means of Compliance (hereinafter referred to as AMC) and Guidance Material (henceforth referred to as GM) to guide initial operations in U-space airspaces.[506]

As already hinted above, the aforementioned regulation was not an abrupt development but rather a gradual one that was necessitated by the changes in the aviation industry, particularly the increasing use of UAS for cargo and passenger transportation. The aforementioned increase in UAS operations highlighted the fact that the current air traffic management (hereinafter referred to as ATM) system was not designed to manage their operations. Additionally, the existing ATM system, which is already quite complex both technically and legally, is reaching its maximum capacity. Lastly, the current legal framework for operating unmanned aircraft is not fully developed. Therefore, it was

503 Ibid.

504 Ibid.

505 See, Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the U-space, C/2021/2671, OJ L 139, 23.4.2021, p. 161–183.

506 See, Sievers, Geister, Schwoch, Peinecke, Schuchardt, Volkert, and Lieb, *DLR Blueprint – Initial ConOps of U-Space Flight Rules (UFR)*, DLR Institute of Flight Guidance, Version 1.0 (2024), at 7.

imperative to create an appropriate management system to regulate their operations.[507]

The term "U-space" refers to the UAS traffic management system in the European Union. It is a set of services and procedures that are specifically designed to introduce UAS operations in the airspace. The ultimate goal of U-space is to achieve automated UAS management and integration, which will allow multiple operations of the associated aircraft at once while integrating with the contemporary ATM system.[508] The U-space regulation applies to specific zones[509] designated as "U-space airspace". According to Article 2 of Regulation 664/2021, "U-space airspace"[510] is defined as a designated geographical zone by Member States where UAS operations are only permitted with the assistance of U-space services[511].[512] These services in the respective airspaces will be provided by U-space Service Providers (hereinafter referred to as USSP),[513] while each member state will be able to assign a single Common Information Provider[514] (henceforth referred to as CISP).[515] The following graph depicts a

507 See, supra note 105, at 97.

508 See, supra note 506, at 12.

509 See, Commission Implementing Regulation (EU) 2021/665 of 22 April 2021 amending Implementing Regulation (EU) 2017/373 as regards requirements for providers of air traffic management/air navigation services and other air traffic management network functions in the U-space airspace designated in controlled airspace, C/2021/2672, OJ L 139, 23.4.2021, p. 184–186. Regulations 664/2021 and 665/2021 assess the designation of a Geographic Zone to a U-space airspace.

510 It is important to state that according to ICAO, U-space airspaces are characterised as "Restricted Areas".

511 According to Article 2 of Regulation 664/2021, U-space service is "a service relying on digital services and automation of functions designed to support safe, secure and efficient access to U-space airspace for a large number of UAS."

512 See, Article 2 of Regulation 664/2021.

513 See, Article 7 of Regulation 664/2021 for the requirements of the U-space service providers.

514 See, Article 5 of Regulation 664/2021 for the requirements of the Common Information Services providers.

515 See, supra note 506, at 7.

number of U-space services categorised into 3 distinct categories, per the analysis of Eurocontrol in the CORUS-XUAM project.[516]

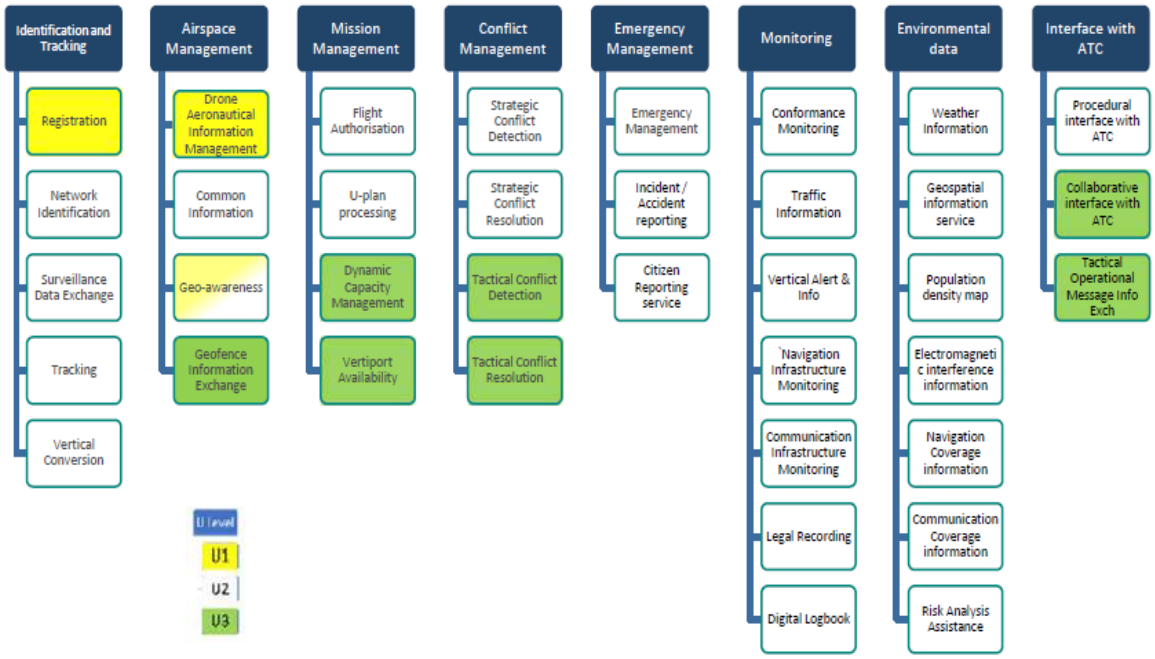

Figure 11[517]

The U-Space regulation lays out a comprehensive set of requirements to ensure unmanned aircraft's safe and secure operation in designated airspaces. In the EU, UAS operations are planned to occur in uncontrolled airspace at low altitudes below 500 feet above ground level.[518] However, this area will also be used by eVTOLs (manned and unmanned in the future) for their respective operations. This could create certain issues because there is currently no holistic and technologically feasible way to operate both manned aircraft (under VFR and IFR) and unmanned areas in the same airspace. Until a feasible way to manage the traffic in both manned and unmanned aircraft that share the same airspace is discovered, manned aircraft operating in U-space airspaces in

516 See, SESAR Joint Undertaking, "U-space ConOps and architecture (Edition 4)," at 47(2023).

517 Ibid.

518 See, supra note 506, at 7.

uncontrolled airspace are required to make themselves visible to the USSP.[519] In U-space airspaces that will be situated in controlled airspace, ATC will be responsible for the dynamic airspace configuration, thus segregating the airspace and delegating its respective segments to uncrewed (UAS or unmanned eVTOLs) or crewed[520] aircraft separately.[521] It is worth noting that the Regulation mentioned above includes a provision regarding the establishment of cross-border U-space airspaces under Article 3(7). This provision suggests that the operation of unmanned aircraft for activities such as passenger and cargo transportation, as well as delivery, across borders is likely to become more common in the coming years.[522]

In reference to the UAM environments, the presence of U-space airspaces in both controlled and uncontrolled airspace below 500ft is the first step towards ensuring safe operations between manned and unmanned aircraft, including eVTOLs and UAS. This aims to create an integrated ATM system in the EU that can effectively monitor and manage the safe and secure operations of all involved aircraft in all airspaces. The U-space regulation signifies a bold move by EU authorities to introduce a new holistic ATM system that can provide the necessary safety for the successful implementation of all aircraft operating in air mobility environments over inhabited areas.

4.4. CONCLUSION

This chapter provides an overview of certain matters of international civil aviation, with a particular focus on manned and unmanned aircraft in the context of the assessed air mobility environments. The discussion begins with an analysis of the fundamental principle of "airspace sovereignty" as presented in Article 1 of the Chicago Convention. The evaluation of this principle was

519 Ibid., at 12.

520 The terms crewed and uncrewed are used interchangeably with manned and unmanned in this doctoral dissertation.

521 See Article 4 of the Regulation 664/2021.

522 See Article 3 (7) of the Regulation 664/2021.

prompted due to the emergence of the term "municipal airspace", which was introduced by stakeholders during the 41st ICAO Assembly. The analysis concludes that the term does not have any legal implications on who is responsible for decision-making above urban settlements, as the central state is the ultimate authority in these matters.

The chapter then examines the operation of unmanned aircraft in cross-border transportation in relation to Articles 8, 5, 6, and 7 of the Chicago Convention. The analysis shows that the provisions of the Convention apply to unmanned aircraft operations, as the term "pilotless aircraft" in Article 8 applies to most, if not all, unmanned aircraft operating today.

The discussion continues with an analysis of the legal implications of applying EU regulations to the operation of eVTOLs (both manned and unmanned) and other aircraft (e.g., UAS) in the mobility environments under evaluation. This analysis identifies certain disharmonies that have arisen due to the application of Regulation 261/2004 in the operation of these aircraft and suggests possible solutions.

The chapter concludes with an overview of the unmanned air traffic management regime introduced in the EU via Regulation 664/2021, known as the U-space Regulation and its relation with the UAM environments. The U-space Regulation aims to facilitate more complex and longer-distance operations, particularly in low-level and densely operated airspaces and when remote pilots are out of sight.[523] The EU administration seeks to integrate the U-space system into the present ATM environment to enable the co-existence of multiple aircraft of different philosophies in the European skies in the context of the upcoming air mobility environments. In essence, U-Space will provide the necessary digital infrastructure and traffic management to ensure that unmanned aircraft can safely operate and cooperate with other UAM aircraft in the airspace above urban areas. Therefore, U-Space will comprise a foundational subsystem within the broader UAM ecosystem.

523 See, (New EU rules on dedicated airspace for drones enter into force - European Commission (europa.eu)), accessed (19-03-24).

CHAPTER V-LIABILITY

5.0. INTRODUCTION

Following the thorough analysis of the legal aspects regarding aircraft operations in the air mobility environments under evaluation, the next vital matter to evaluate is the potential legal implications stemming from operational issues that may cause damage to individuals on board the aircraft or on the ground.

The chapter will commence with an evolutionary analysis pertaining to the international legal regime in reference to contractual liability, and in particular from the Convention for the Unification of certain rules relating to international carriage by Air of 1929 (commonly known as the Warsaw Convention 1929) to the Convention for the Unification of Certain Rules for International Carriage by Air (commonly known as the Montreal Convention 1999). The latter document will be assessed in reference to its applicability to the operation of aircraft in the assessed air mobility environments, with an emphasis on the EU. Furthermore, second-party liability matters in reference to the evaluated in the Operations Chapter, EU Regulation 261/2004, will be brought into the spotlight.

A separate assessment of damages on the ground (third-party liability) will be performed after the second-party liability analysis. The Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface (commonly known as the Rome Convention 1952) will be assessed, focusing on significant issues caused by its potential application.

5.1. FROM WARSAW TO MONTREAL, A 70-YEAR PROCESS

The roots of the first private international law regarding carrier liability can be traced back to the First International Conference of Air Law, which took place

in Paris in 1925. [524] During the conference, the Comité International Technique d'"Experts Juridique Aériens (CITEJA) was established to assess the conditions necessary for the creation of a relevant private international air law. Its other objective was to produce draft proposals of the aforementioned law for national governments to consider.[525] The efforts for an international private air law regime governing air carrier liability bore fruit in 1929, when delegates from 33 nations gathered in the city of Warsaw, Poland, to adopt the Convention for the Unification of certain rules relating to international carriage by Air (hereinafter referred to as the Warsaw Convention).[526] The Warsaw Convention was a crucial legal instrument introduced to address the growth of the commercial aviation industry during its time. It created a unified international legal framework that standardised the format and legal significance of carriage documents,[527] as well as liability and its limitations[528] and court jurisdiction.[529]

The issue of particular importance, especially in reference to the reasons that led 70 years later to the subsequent creation of the Convention for the Unification of Certain Rules for International Carriage by Air (hereinafter referred to as the Montreal Convention), is the structure of the Warsaw Convention's liability regime. For the first time since the inaugural scheduled passenger airline service,[530] a comprehensive set of rules governing the liability of air carriers for various aspects such as death and injury of passengers,[531] destruction, loss or damage to baggage and cargo,[532] and delays in the carriage

524 See, Dempsey, *Liability of the Carrier*, in Hobe, von Ruckteschell, and Heffernan (eds.), *Cologne Compendium on Air Law in Europe*, (Carl Heymanns, 2013), at 968.

525 Ibid.

526 Ibid.

527 See, Articles 3 and 4 of the Warsaw Convention 1929.

528 See Articles 17-30 of the Warsaw Convention 1929.

529 See, supra note 172, at 298–302.

530 See, (The world's first commercial airline | Space), accessed (25-03-24).

531 See Article 17 of the Warsaw Convention.

532 See, Article 18 of the Warsaw Convention.

of passengers, baggage, and cargo was established[533]. The liability system that the aforementioned Convention built was based on the fault of the carrier (intention or negligence). The novel element of this system, however, was that it assumed the carrier was at fault by reversing the burden of proof. This goes against the traditional legal principle that the claimant is responsible for proving their case *(actori incubit probatio).* [534] Thus, as per the Warsaw Convention, a passenger or claimant does not need to prove the fault of the carrier. The carrier is presumed to be at fault and can only be exempted from liability if they can prove that they and their agents have taken all necessary measures to prevent the damage or if it was impossible for them to take such measures.[535]

This version of a fault-based regime of the Warsaw Convention was really a ground-breaking element for its time, aiming to better protect the passengers. Nevertheless, since the first few decades after the ratification of the Warsaw Convention, the presented limits of liability have been a matter of dispute. The Convention stipulates a fixed maximum monetary compensation, which goes against the fundamental legal principle that compensation should be equivalent to restitution (*status quo ante*) or an equivalent monetary compensation.[536] The aforementioned doctrine was put into effect to support the growth and development of the commercial aviation industry during its early stages. This was done as higher liability limits could potentially hinder its progress and prevent it from evolving in its current state. [537] As the industry developed steadily but progressively on a large scale, the need to amend the Warsaw Convention became more and more necessary and evident. This led to the following initiatives from 1955 to 1999:

a. The Hague Protocol of 1955, which amended the Warsaw Convention to accommodate the evolving demands of the aviation industry at that time.

533 See, Article 19 of the Warsaw Convention.

534 See, supra note 172, at 299.

535 See, Article 20 of the Warsaw Convention. See also, supra note 499, at 969.

536 See, supra note 172, at 300.

537 See supra note 147, at 187.

The Protocol came into effect on August 1, 1963, and received 137 ratifications.[538] Its purpose was to address the new conditions that arose in the commercial aviation industry after World War II and its subsequent growth. It is noteworthy that most of the countries that had ratified the original text of the Convention have also ratified the Hague Protocol.[539]

b. The Guadalajara Convention for the Unification of Certain Rules Relating to International Carriage by Air Performed by a Person Other than the Contracting Carrier of 1961. This piece of international law constitutes a supplementary Convention as it assesses an entirely different subject matter in reference to the original Convention. Its theme pertained to the distinction between the "contracting carrier" and the "operating carrier". It has 86 state parties.[540]

c. The Guatemala City Protocol of 1971, which was also intended to be an amendment to the original Convention, did not come into force whatsoever.[541]

d. Four separate amending Protocols concluded at Montreal on 25 September 1975, in particular:

- Montreal Additional Protocol No.1 (MAP 1), which converted the liability limits presented in the Warsaw Convention from Francs into Special Drawing Rights (hereinafter referred to as SDRs) of the International Monetary Fund (IMF). It has 51 state parties. [542]
- Montreal Additional Protocol No.2 (MAP 2), which altered the liability limits portrayed in the initial Convention as amended by the Hague Protocol into SDRs of the IMF. It has 52 state parties. [543]

538 See, (WC-HP_EN.pdf (icao.int)), accessed (26-03-24).

539 See, supra note 147, at 188. According to ICAO's official website, WC-HP_EN.pdf (icao.int)), 152 state parties have ratified the Warsaw Convention 1929 and 137 the Hague Protocol 1955.

540 See, (Microsoft Word - Guadalajara_EN.doc (icao.int)), accessed (26-03-24).

541 See, (Guatemala City Protocol (mcgill.ca)), accessed (26-03-24).

542 Article 22 of the Protocol. See, (AP1_EN.pdf (icao.int)), accessed (26-03-24).

543 See, (AP2_EN.pdf (icao.int)), accessed (26-03-24).

- Montreal Additional Protocol No.3 (MAP 3), which amended the liability limits of the Guatemala City Protocol of 1971 into SDRs. It received 22 ratifications but never came into force.[544]
- Montreal Additional Protocol No. 4 (MAP 4), which altered the limits of the initial Convention as amended by the Hague Protocol into SDRs and introduced special provisions for the international carriage of cargo. It has 61 state parties.[545]

The decision to change the currency presented in the original text of the Warsaw Convention from Francs to SDRs was influenced by political factors, particularly the U.S. government's choice to halt the conversion of the U.S. dollar to gold.[546] This caused a global fluctuation in gold prices, including the value of the golden Francs. This highlighted the need for a more stable currency to be used when calculating the amounts for liability under the Convention.[547] This established the necessity for the aforementioned protocols.

e. The Montreal Intercarrier Agreement of 1966, which constitutes an agreement between the International Air Transport Association (hereinafter referred to as IATA) carriers operating from, via or into the U.S. and the U.S. Civil Aeronautics Board (CAB).[548] This agreement augmented the liability limits of the Warsaw Convention in cases of passenger injury and death, consequently establishing a regime of absolute liability.[549]
f. In 1995, the International Air Transport Association (IATA) introduced the IATA Inter-Carrier Agreement. This agreement functioned as an umbrella accord, allowing the airlines to implement it according to their

544 See, (ADDITIONAL PROTOCOL NO (icao.int)), accessed (26-03-24).

545 See, (MP4_EN.pdf (icao.int)), accessed (26-03-24).

546 See, supra note 147, at 189.

547 Ibid.

548 Ibid.

549 Ibid.

existing conditions of carriage and respective legal regimes.[550] One year later, the Agreement on Measures to Implement the IATA Inter-Carrier Agreement was introduced. IATA's position was that these agreements function as temporary measures to waive the restrictive liability regime outlined in the Warsaw Convention.[551]

By 1995, it became evident that the above constellation of legal initiatives (unofficially known as the Warsaw System) was inadequate in addressing the new reality vis-à-vis the commercial aviation industry. The increasing standards of living, coupled with the lack of specific liability limits for national carriage by air in numerous countries, particularly in the U.S., resulted in court decisions awarding higher compensations for passenger injury and death than what was provided for in the Warsaw System.[552] This pressured the Convention's member states to deviate from its provisions and low liability limits, highlighting the need for a new Convention that would not be a part of the Warsaw System but would effectively replace the Warsaw Convention and its multiple amending Protocols.[553] The graph cited below illustrates the Warsaw System and its relation or, better yet, absence of relation to the Convention for the Unification of Certain Rules for International Carriage by Air (hereinafter referred to as the Montreal Convention).

550 Ibid.

551 See, supra note 147, at 189.

552 See, Clarke, *Liability of the Carrier*, in Hobe, von Ruckteschell, and Heffernan (eds.), *Cologne Compendium on Air Law in Europe*, (Carl Heymanns, 2013), at 977.

553 See, supra note 524, at 974.

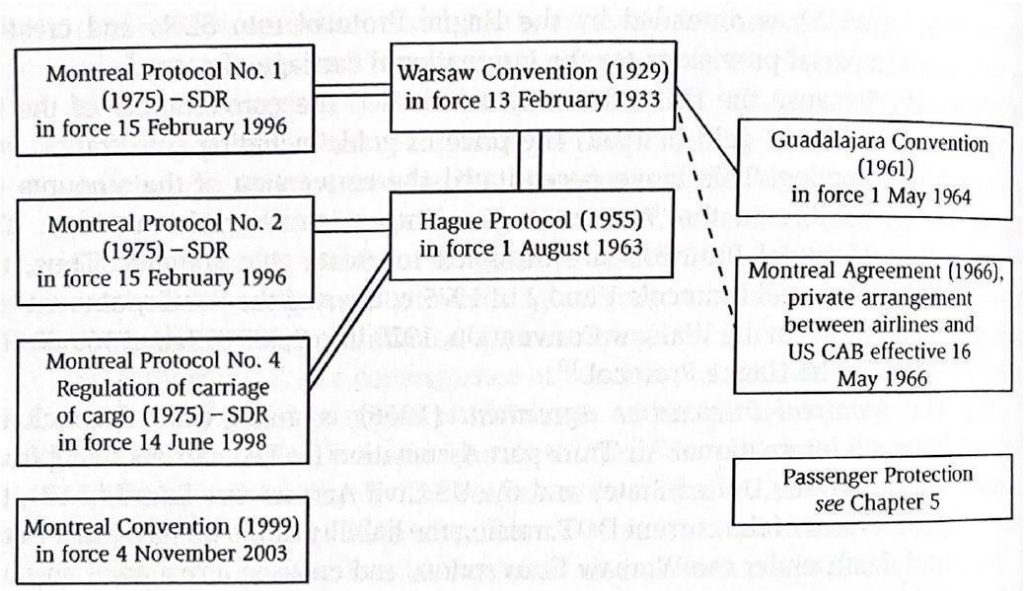

Figure 12[554]

The circumstances outlined above prompted ICAO to take charge and develop a legal instrument that eventually came to be called the Montreal Convention 1999. The following section will examine the legal character of the said Convention, as well as its compatibility with the air mobility ecosystems being scrutinised in this dissertation within the context of the EU.

5.2. THE LEGAL PRINCIPLES OF THE MONTREAL CONVENTION AND THEIR IMPLICATIONS ON THE MOBILITY SYSTEMS UNDER EVALUATION

5.2.1. SCOPE OF APPLICATION

On May 28th, 1999, representatives from 122 countries and 11 organisations met in Montreal for a Diplomatic Conference. Their goal was to adopt the Montreal Convention, which entered into force on November 4th,

554 See, supra note 147, at 190.

2003.[555] Currently, the Convention has been ratified by 139 parties, including the European Union and its member states.[556]

The Montreal Convention, as is evident by its full title, addresses the unification of certain rules in the domain of international carriage by air, thus sharing the same focus as its predecessor, the Warsaw Convention. The question that arises at this point is whether or not the provisions of the Montreal Convention will be applicable to the operation of aircraft in the context of IAM/AAM and their urban applications.

According to Article 1 of the Montreal Convention, the Convention applies to "all international carriage of persons baggage or cargo performed by aircraft for reward."[557] Therefore, three conditions must be met for the provisions of the Convention to be applicable: the transportation must be international, it must involve the carriage of passengers, baggage, or cargo, and there must be a fee for these services. The concept of "international carriage" is further explained in Article 1 (2) of the Convention to avoid any potential misconceptions.[558]

Regarding the operation of aircraft, whether they are manned or unmanned, eVTOL or not, in the lower airspace over urban areas, it is evident that as long as the conditions outlined in Article 1 are met, the provisions of the Montreal Convention will apply. However, when it comes to the concept of the international nature of carriage by aircraft, there is a unique phenomenon that is apparent in the EU's operation domain. According to Regulation (EC)

555 Ibid., at 191.

556 See, (CONVENTION FOR THE UNIFICATION OF CERTAIN RULES (icao.int), accessed (28-03-24).

557 Article 1 (1) of the Montreal Convention.

558 According to Article 1 (2) of the Montreal Convention: "[…] the expression international carriage means any carriage in which, according to the agreement between the parties, the place of departure and the place of destination, whether or not there be a break in the carriage or a transhipment, are situated either within the territories of two States Parties, or within the territory of a single State Party if there is an agreed stopping place within the territory of another State, even if that State is not a State Party. Carriage between two points within the territory of a single State Party without an agreed stopping place within the territory of another State is not international carriage for the purposes of this Convention."

889/2002,[559] which amended EU Regulation 2027/1997,[560] the entire text of the Montreal Convention is incorporated into the Union's legal environment. Article 1(2) of the aforementioned Regulation broadens the scope of application of the Convention,[561] making it applicable to both international and national carriage of EU member-states.[562] Based on the above information, it is important to note that, as proven in the previous sections, eVTOLs, whether manned or unmanned, fall under the category of aircraft as defined by both ICAO and the EU.[563] Since these aircraft will be used for both national and international carriage of passengers, baggage, and cargo, the provisions of the Montreal Convention will apply to them in the context of air mobility environments.[564]

One issue of particular interest, not only in relation to Article 1 but to the entire Convention, is the infrequency with which the term "airport" appears.[565] In particular, Article 1, which determines the extent of the Convention's application, refers to transportation between the "place of departure" and the "place of destination".[566] Several EU laws mandate that aircraft should operate between airports or to and from airports for their provisions to be applicable. Such a requirement, however, does not exist in the Montreal Convention.

559 See, Regulation (EC) No 889/2002 of the European Parliament and of the Council of 13 May 2002 amending Council Regulation (EC) No 2027/97 on air carrier liability in the event of accidents, *OJ L 140, 30.5.2002, p. 2–5.*

560 Council Regulation (EC) No 2027/97 of 9 October 1997 on air carrier liability in the event of accidents, *OJ L 285, 17.10.1997, p. 1–3.*

561 Article 1 (2) of Regulation 889/2002 states that: "This Regulation implements the relevant provisions of the Montreal Convention in respect of the carriage of passengers and their baggage by air and lays down certain supplementary provisions. It also extends the application of these provisions to carriage by air within a single Member State."

562 Mendes de Leon, in his book *"Introduction to Air Law"* (Wolters Kluwer, 2022), at 193, states that apart from the EU, Israel and India have applied or plan to apply the Montreal Convention's provisions to non-international carriage of persons, baggage and cargo.

563 See Chapter I of this dissertation.

564 This perspective seems to be shared by other professionals within the domain of contractual liability in aviation. In particular, Ravich underlines that "[…] as a textual matter, particularly Article 1 of the Montreal Convention is likely elastic enough to include new methods and modes of passenger and cargo transportation in international commerce, be it rooftop-to-rooftop travel via uncrewed passenger drones or multimodal operations by freight forwarders. For more information, see, Ravich, *Article 1 – Scope and Application*, in Leloudas, Dempsey, and Chassot (eds.), *The Montreal Convention: A Commentary* (Edward Elgar Publishing, 2023), at 22.

565 The Montreal Convention mentions the term "airport" thrice - twice in Article 12 and once in Article 18.

566 See, Article 1 (2) of the Montreal Convention.

Therefore, any discussions regarding whether "vertiports" are classified as airports or aerodromes in the context of Annex 14 of the Chicago Convention, for the provisions of the Montreal Convention to apply, are irrelevant. Nevertheless, it is worth noting that while it is not a prerequisite for the aforementioned Convention to apply, normally, the carriage of persons, baggage and cargo as described in Article 1 usually occurs between and to or from airports.

After establishing that the operation of the aircraft in the evaluated air mobility environments falls within the purview of the Montreal Convention, it is important to analyse further potential issues that could arise due to the application of the said Convention's provisions to the aforementioned aircraft operation in the future.

5.2.2. ARTICLE 5 AND ITS SYNERGY WITH THE UPCOMING MODELS OF AIR MOBILITY

One crucial aspect that should be addressed in this analysis is the issuance of documentation for the cargo UAS operation and its compliance with Article 5 of the Montreal Convention.[567] In contrast to passenger transportation, where the ticket is the only required document, the carriage of cargo requires various additional documents in addition to the obligatory issuance of the Air Waybill as specified in Article 4 of the Montreal Convention.[568] These

567 As per Article 5 of the Montreal Convention, the air waybill or cargo receipt must contain the following information:
"(a) The places of departure and destination.
(b) If the places of departure and destination are within the territory of a single State Party, but one or more agreed stopping places are within the territory of another State, at least one such stopping place must be indicated.
(c) The weight of the consignment."

568 Article 4 of the Montreal Convention dictates that:
"1. In respect of the carriage of cargo, an air waybill shall be delivered.
2. Any other means which preserves a record of the carriage to be performed may be substituted for the delivery of an air waybill. If such other means are used, the carrier shall, if so requested by the consignor, deliver to the consignor a cargo receipt permitting identification of the consignment and access to the information contained in the record preserved by such other means."

documents include but are not limited to customs, declarations of dangerous goods, and invoices.[569] As the demand for faster and more secure air cargo transportation increases, digitalisation becomes essential. However, the wording of Article 5 of the Montreal Convention omits any reference to electronic data or whether the places of departure/destination, the agreed stopping places, and the indication of the weight of the consignment are to be included in the electronic document(s) used in practice instead of the Air Waybill.[570] Instead, it refers only to the Air Waybill in paper form or the cargo receipt, but not to "other means"[571].[572] Regarding the delivery of cargo by uncrewed aircraft in the context of the mobility environments under evaluation, certain issues need to be considered in terms of feasibility and practicality. In the proposed environments, cargo delivery with UAS will likely involve an order through an electronic application without additional paper documentation. For instance, one party can order goods via an electronic application and select delivery via UAS, and the other party can deliver the goods by issuing relevant documents via the same application.[573] However, the issuance of a paper-form Air WayBill is both difficult and without purpose in this procedure, something that creates issues. While the issuance of electronic documents is allowed under the provisions of the Montreal Convention, [574] the paper-form Air WayBill or Cargo Receipt is still a requirement. A way to circumvent this obligation stemming from the provisions regarding the Air WayBill or cargo receipt is via the electronic Air WayBill as introduced by the International Air Transport Association (hereinafter referred to as IATA).[575] The e-Air WayBill, when presented with

569 See, Leloudas and Soffin, *Article 5 – Contents of Air Waybill or Cargo Receipt*, in Leloudas, Dempsey, and Chassot (eds.), *The Montreal Convention: A Commentary* (Edward Elgar Publishing, 2023), at 60.
570 Ibid. at 61.
571 The term "other means" is referring to Article 4 (2) of the Montreal Convention.
572 See, supra note 569, at 61.
573 This proposed application of UAS delivery, with its door-to-door nature, establishes specific legal relationships between physical and public persons and the company that operates the UAS.
574 See Article 4 of the Montreal Convention.
575 See, IATA "RESOLUTION 672, Form of Multilateral E-Air Waybill Agreement", (https://www.iata.org/contentassets/783ac75f30d74e32a8eaef26af5696b6/csc-672-en-28dec2019.pdf), accessed (04-04-24).

the terms and conditions of the relevant electronic application, can provide a solution to a new problem using old legal tools.[576]

As analysed above, the Montreal Convention does not require operations between airports or to and from airports for its provisions to apply. Instead, as already evident by Article 1, Article 5 also refers to places of departure and destination.[577] However, in practice, the standard Air WayBill has been traditionally associated with the presence of an airport, as it includes a section on its format to enter the relevant information.[578] It is clear that this can be seen as a remnant of the past. This is because, during the drafting and initial years of the Convention, the cargo was handed over to the air carrier at its airport receiving office, and the air carrier's responsibility and contract of carriage commenced and ended at an airport.[579] The times have, however, changed, and with that have come technological advancements and the expansion of the air carriers' obligations. Their contracts now include carriage by road from the place of origin to the final destination, even if that is not an airport.[580] Similarly, the door-to-door carriage, as it was described in the previous paragraph, has challenged the traditional interpretations of the place of departure and destination mentioned in Article 5 and its attachment to the concept of an airport.[581] Thus, it is evident that the provisions of Articles 4-7 of the Montreal Convention and the practical link of cargo carriage by air with the concept of an airport might pose a problem to the mobility environments and their associated aircraft that are set to operate from and to vertiports.

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576 See, Deschuttere and Thijssen, *Civil Liability Issues in International Transport*, in Scott (ed.), *The Law of Unmanned Aircraft Systems*, 2nd ed. (Wolters Kluwer, 2022), at 210–11.

577 EU Regulation 889/2002 adopts the provisions of the Montreal Convention and also refers to places of departure and destination. However, EU Regulation 1008/2008, on common rules for the operation of air services in the Community, specifically mentions "airports", which causes confusion as to whether the "vertiports" or warehouses used for cargo UAS operations can be considered airports. It is likely that the EU will address this issue in its upcoming regulatory works and encompass all the relevant operations envisaged in the assessed air mobility environments.

578 See, supra note 569, at 66.

579 See, supra note 569, at 66.

580 Ibid.

581 Ibid.

The Montreal Convention's application to the assessed concept seems to have another practical issue. Unlike airports, vertiports are expected to be located in urban areas or high buildings and occupy less space than airports. However, in airports, all necessary paperwork and document checks for cargo or passenger transportation are done on-site. The question remains whether vertiports, which are designed to be small and flexible to meet their mobility goals, will have the necessary facilities and personnel to perform such checks as conventional airports. Again, while this query cannot be answered, it is evident that it creates a certain level of discrepancy between a pre-existing and successful international legal instrument like the Montreal Convention and aircraft operations in the context of the air mobility environments under analysis.

5.2.3. LIABILITY OF THE CARRIER IN THE CONTEXT OF THE UPCOMING AIR MOBILITY ENVIRONMENTS

Chapter III of the Montreal Convention lays down a detailed set of regulations that dictate the liability of the air carrier and the extent of compensation for damages. [582] As underlined in the previous sections, the Montreal Convention establishes a system of presumed liability of the carrier, which is limited to specific caps, as presented in Articles 22-25 of the Convention.[583]

This comprehensive and successful liability system, as proven above, can apply to the operation of eVTOL aircraft and UAS in the context of the air mobility environments under evaluation. However, it is uncertain whether the liability regime of the Convention is designed to handle the nature of these operations. By "nature of operations," one of the main synergy issues between them and the Convention is the number of passengers per eVTOL operation in the domain of the evaluated environments. Passenger transportation via manned

582 See, Montreal Convention Articles 17- 37.

583 In 2019, the liability limits in the Montreal Convention Articles 21 and 22 were revised by ICAO. See, (https://www.icao.int/secretariat/legal/Pages/2019_Revised_Limits_of_Liability_Under_the_Montreal_Convention_1999.aspx), accessed (26-04-24).

or unmanned eVTOL, at least according to the available aircraft designs, is equipped to transport a very limited number of people in contrast to conventional carriage by manned aircraft.[584] This raises certain concerns about the economic feasibility for future service operators and about the willingness of their insurers to cover such operations.[585] The aforementioned considerations may indeed impact the size and, ultimately, the materialisation of such services.

One possible solution to the strict liability regime issue in the air mobility systems under analysis could be to implement a regime similar to the Warsaw Convention and its satellites. However, this measure is unlikely to be adopted as it may seem like a compromise to the safety and security standards currently enforced in the EU, which could lead to reduced public acceptance. The acceptance of the public, which is considered the 6th stakeholder for the realisation of the new era of mobility, is equally important as financial considerations for the successful implementation of the assessed air mobility projects in the lower airspace segment.[586]

The aforementioned issues magnify when the provisions of the Montreal Convention apply not only to international but also national or domestic carriage, as in the EU, creating a plexus of legal challenges for the operators that are difficult to overcome. In the EU, however, the provisions of the Montreal Convention via Regulation 889/2002 are not the only ones applicable in cases of passenger delay, as Regulation 261/2004 is equally applicable. The following section will assess the implications of applying Regulation 261/2004 in the concept of the discussed operations.

584 Promising designs such as the Lilium Jet and Volocity, which have received DOA in the EU, have a passenger range from 1 to 6 passengers on board, in addition to the pilot.
585 See, supra note 576, at 209.
586 See, supra note 327, at 316–317.

5.3. REGULATION 261/2004 AND ITS IMPLICATIONS ON THE MOBILITY SYSTEMS UNDER EVALUATION

5.3.1. FLIGHT DELAY

As previously discussed, the Montreal Convention serves as the legal instrument that addresses cases of death and injury to passengers and damage to baggage (Article 17), damage to cargo (Article 18), delay (Article 19) and matters regarding the compensation of the air carrier in cases of the above (Articles 21-30) in international but also in domestic carriage (EU case).

However, in reference to delay, the provisions of the Montreal Convention via Regulation 889/2002 are not the only ones applicable in the EU. Regulation 261/2004 applies in cases of flight delay,[587] denied boarding[588] and cancellation[589], creating an overlap between the 2 aforementioned EU regulations in the delay domain. This legal overlap created multiple compatibility issues between the two frameworks, which led to landmark decisions such as the *IATA/ELFAA*[590] and the *Nelson and Others*[591] cases. In the aforementioned cases, the main findings of the CJEU were the following:

- The scope of Regulation 261/2004 is different from the scope of the Montreal Convention, as it addresses a different type of damage.[592]

587 See Article 6 of Regulation 261/2004.
588 See Article 4 of Regulation 261/2004.
589 See Article 5 of Regulation 261/2004.
590 Case C-344/04, International Air Transport Association and European Low Fares Airline Association v. Department of Transport (2006).
591 Joined Cases C-581/10 and C-629/10, Nelson and Others v. Lufthansa and TUI Travel and Others v. Civil Aviation Authority (2012).
592 See, Joined Cases C-581/10 and C-629/10, Nelson and Others v. Lufthansa and TUI Travel and Others v. Civil Aviation Authority (2012), par. 51-55:
"First of all, a loss of time is not damage arising as a result of a delay, but is an inconvenience, like other inconveniences inherent in cases of denied boarding, flight cancellation and long delay and encountered in them, such as lack of comfort or the fact of being temporarily denied means of communication normally available. Next, a loss of time is suffered identically by all passengers whose flights are delayed, and consequently, it is possible to redress that loss by means of a standardised measure without having to carry out any assessment of the individual situation of each passenger concerned. Consequently, such a measure may be applied immediately. Lastly, there is not necessarily a causal link between, on the one hand, the actual

- Regulation 261/2004 provides standardised and immediate compensation with respect to “loss of time” or “inconvenience”, which does not differ between passengers.[593]
- Passengers may claim additional compensation under the Montreal Convention for damages caused by delay (Article 19) in addition to compensation under Regulation 261/2004.[594]

The aforementioned approach taken by the CJEU, which allows for both the Montreal Convention and Regulation 261/2004 to coexist without one precluding the other, has caused confusion in the legal community regarding the exclusivity of the Montreal Convention in cases of delay. This legal paradox will likely spread in the case of the assessed aircraft operations in the lower segment of the airspace within the context of the air mobility ecosystems under evaluation, creating further confusion beyond the domain of conventional aviation.

However, applying Regulation 261/2004 in the evaluated environments raises legal concerns not only regarding the exclusive framework in the domain of flight delay. The provisions of the Regulation may create more compatibility

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delay and, on the other, the loss of time considered relevant for the purpose of giving rise to a right to compensation under Regulation No 261/2004 or calculating the amount of that compensation. The specific obligation to pay compensation, imposed by Regulation No 261/2004, does not arise from each actual delay but only from a delay which entails a loss of time equal to or in excess of three hours in relation to the time of arrival originally scheduled. In addition, whereas the extent of the delay is normally a factor increasing the likelihood of greater damage, the fixed compensation awarded under that regulation remains unchanged in that regard, since the duration of the actual delay in excess of three hours is not taken into account in calculating the amount of compensation payable under Article 7 of Regulation No 261/2004. In those circumstances, the loss of time inherent in a flight delay, which constitutes an inconvenience within the meaning of Regulation No 261/2004 and cannot be categorised as” damage occasioned by delay” within the meaning of Article 19 of the Montreal Convention, cannot come within the scope of Article 29 of that convention.”

593 See, supra note 185, at 192.

594 See, Case C-344/04, International Air Transport Association and European Low Fares Airline Association v. Department of Transport (2006), par. 47:

“The standardised and immediate assistance and care measures do not themselves prevent the passengers concerned, should the same delay also cause them damage conferring entitlement to compensation, from being able to bring in addition actions to redress that damage under the conditions laid down by the Montreal Convention.”

issues within its scope of application with the proposed operation of manned and unmanned aircraft in the context of the assessed air mobility ecosystems.

As cited above, Regulation 261/2004 applies to cases of flight delay, denied boarding and flight cancellation. However, its provisions when addressing the discussed environments may be rather problematic. Resuming the analysis regarding flight delay issues, applying the said Regulation's provisions to the discussed operations faces more issues. These stem from the fact that the Regulation was drafted to address conventional aviation rather than the upcoming models of air mobility in lower airspace. Hence, the threshold for delay of 2 hours for care[595] or 3 hours and above (long delay) for compensation[596], as portrayed in Article 6 (1) (a) to (c),[597] for a flight that will probably have a much shorter duration or could be supplemented by other means of mobility or transportation such as trains, subways etc. seems to be unfair and disproportionate for the operator. Additionally, it will likely encourage some passengers to refrain from seeking other suitable transportation or mobility

595 Article 9 (1) of Regulation 261/2004 dictates that: "Where reference is made to this Article, passengers shall be offered free of charge: (a) meals and refreshments in a reasonable relation to the waiting time; (b) hotel accommodation in cases — where a stay of one or more nights becomes necessary, or — where a stay additional to that intended by the passenger becomes necessary; (c) transport between the airport and place of accommodation (hotel or other)".

596 Regarding to compensation, Article 7 (1) of Regulation 261-2004 dictates that: "Where reference is made to this Article, passengers shall receive compensation amounting to: (a) EUR 250 for all flights of 1 500 kilometres or less; (b) EUR 400 for all intra-Community flights of more than 1 500 kilometres, and for all other flights between 1 500 and 3 500 kilometres; (c) EUR 600 for all flights not falling under (a) or (b). In determining the distance, the basis shall be the last destination at which the denial of boarding or cancellation will delay the passenger's arrival after the scheduled time. Furthermore, "Case C-402/07 "sturgeon Case" ruled that passengers experiencing a flight delay of 3 or more hours can also claim compensation according to the aforementioned Article, *"as passengers whose flights are cancelled".*

597 In reference to the flight delay, Article 6 (1) of Regulation 261/2004 dictates that: "When an operating air carrier reasonably expects a flight to be delayed beyond its scheduled time of departure: (a) for two hours or more in the case of flights of 1 500 kilometres or less; or (b) for three hours or more in the case of all intra-Community flights of more than 1 500 kilometres and of all other flights between 1 500 and 3 500 kilometres; or (c) for four hours or more in the case of all flights not falling under (a) or (b), passengers shall be offered by the operating air carrier: (i) the assistance specified in Article 9(1)(a) and 9(2); and (ii) when the reasonably expected time of departure is at least the day after the time of departure previously announced, the assistance specified in Article 9(1)(b) and 9(1)(c); and (iii) when the delay is at least five hours, the assistance specified in Article 8(1)(a)."

alternatives in case of a flight delay, as they will be entitled to the provisions of Article 9 (1) and Article 7 of the Regulation, thus exploiting the law for profit.[598]

Regarding Article 7, there is an apparent inconsistency between the provisions of the Article and the operation specifications and cost of the proposed services of promising eVTOL concepts, such as Volocopter's Volocity. The aforementioned eVTOL is designed to fly independently for circa 36 kilometres with a single charge, and Volocopter aims to charge approximately 3 to 4 € per km per passenger. Thus, the expected maximum cost per passenger rises to 144 € for a single charge of the eVTOL (36 km), while the compensation for a flight delay of above 3 hours is calculated to be at least 250 € per passenger according to Article 7 (1) for all flights below 1500 km. It can be easily understood that when the expected price is around 144 € and the compensation for a delay of 3 hours and above is at least 250 €, there is a massive window of opportunity for willing passengers to exploit.

While the right to compensation portrayed in Regulation 261/2004 in case of long delay is problematic, as proven above, the right to care for flight delays of 2 hours or more creates equal issues. The said issues commence with the method by which delay is calculated and by whom. According to FP Passenger Service GmbH v. Austrian Airlines AG case[599], *"for the purposes of determining the extent of the delay suffered by passengers on a flight on arrival, it is necessary to calculate the time between the scheduled time of arrival and the actual arrival time, that is to say, the moment when at least one of the doors of the aircraft is opened, it being understood that, at that moment, the passengers are permitted to leave it."*[600]

In conventional aviation, the responsibility of closing and opening the aircraft doors before and after the flight falls on the cabin crew. However, in the upcoming mobility services operated by eVTOLs, whether manned or unmanned in lower airspace, as underlined above, there will not be any

598 This issue was first raised by Scott in his Article: "Passenger Air Taxi Services: An Assessment of the Current European Union Rules on Consumer Protection for Passengers", Journal of Intelligent & Robotic Systems, Springer, at 11-12 (2024).
599 C-654/19, FP Passenger Service GmbH v. Austrian Airlines AG.
600 C-654/19, FP Passenger Service GmbH v. Austrian Airlines AG.

personnel assigned to these duties except for the pilot in the manned version of the aircraft. This creates another compatibility issue between the operational concept of these services and the provisions of Regulation 261/2004. To address this issue, a possible mitigation method could be for the personnel of the vertiport to perform these duties. However, the personnel of the vertiport are not in an employer-employee relationship with the air carrier, which means that the carrier does not have complete control over this matter, which could lead to further inconsistencies.[601]

While the discussed issues might seem trivial, and a possible solution would be for the ECJ to interpret Regulation 261/2004 in a way that better addresses the characteristics of the evaluated air mobility environments, more litigation over an already over-litigated piece of legislation does not seem like the optimal measure. In the next sections, more problematic aspects in reference to cancellation and denied boarding, as presented in the Regulation above, will be assessed.

5.3.2. DENIED BOARDING

The concept of denied boarding, as defined by Regulation 261/2004, pertains to situations such as overbooking, issues with passenger documentation, as well as concerns around passenger weight and personal items. While it may not initially appear to be a significant problem for passengers in the context of the aircraft operations in the assessed environments, nevertheless, there are some considerations that require further clarification.

Overbooking is a practice followed by airlines where they book more passengers on a flight than the actual number of seats available. [602] The rationale behind this is that some passengers may not show up at the time of the flight, due to various reasons. Thus, the airlines, with a certain level of certainty,

601 See, supra note 485, at 11.

602 See, (https://www.iata.org/contentassets/2e46aace261040b9a47fb7b9da18efc9/overbooking.pdf), accessed (01-05-24).

overbook a flight considering the number of expected no-shows, thus maximising the capacity available to customers.[603] However, in some instances, a bigger number of passengers appear at the check-in than the number of seats in the aircraft. In such cases, airlines may ask for volunteers to give up their seats in exchange for specific benefits, as outlined in Article 4 of Regulation 261/2004.[604] If there are not enough volunteers, the airline may be forced to deny boarding to some passengers against their will.[605]

Whether the concept of overbooking and the consequent denied boarding will be an issue for the passengers utilising the air services under evaluation is not yet clear. Scott, in his article "Passenger Air Taxi Services: An Assessment of the Current European Union Rules on Consumer Protection for Passengers", identifies six points creating uncertainty about the potential interaction between the assessed aircraft operations and the concept of denied boarding.[606]

- The small number of passenger seats in upcoming eVTOL projects is attached to significantly smaller numbers of no-show passengers for flights.
- The business and operational model for passenger eVTOL projects in the assessed environments is still unclear. It is uncertain whether busy areas will be served by multiple aircraft, similar to ground taxis, or if the service will be limited, similar to conventional aviation.
- As mentioned earlier, the passenger ticket creates certain legal considerations. With regard to the situation of denied boarding, it is unclear whether the ticket refers to a particular numbered flight or to a specific time slot. If the latter is the case, it would be difficult to

603 See, (https://www.iata.org/contentassets/2e46aace261040b9a47fb7b9da18efc9/overbooking.pdf), accessed (01-05-24).

604 According to Article 4 (1) of Regulation 261/2004, "When an operating air carrier reasonably expects to deny boarding on a flight, it shall first call for volunteers to surrender their reservations in exchange for benefits under conditions to be agreed between the passenger concerned and the operating air carrier. Volunteers shall be assisted in accordance with Article 8, such assistance being additional to the benefits mentioned in this paragraph."

605 See, Article 4 (2) of Regulation 261/2004.

606 See, supra note 485, at 9.

determine whether the passenger was genuinely denied boarding an aircraft or not.

- As the business model of offering affordable flights in urban areas on short notice and on a large scale is still untested, it is difficult to predict how passengers will behave as consumers. Specifically, it is unclear whether they will be as punctual as passengers in conventional aviation or less punctual, like passengers of ground taxi services where multiple vehicles operate simultaneously. This behaviour will have an impact on potential boarding denial to aircraft.
- It is still uncertain who will be responsible for denying boarding to passengers. In the initial stages of the evaluated concept, only the on-board pilot will be present as aircraft personnel, but such a responsibility should not fall on the pilot for obvious reasons. While it is possible that vertiport personnel could perform this task, it is not yet determined.
- As eVTOL aircraft operation is part of a wider, interoperable mobility concept, alongside other modes of transport such as underground trains and electric buses, it's unclear whether this integrated and unified perception of mobility will result in passengers being late for their eVTOL flights, which could lead to denied boarding.[607]

As indicated in the first paragraph of this section, denied boarding is not solely attributed to overbooking. In addition, passengers may be denied boarding if they do not possess the necessary travel documents, such as ID or a passport. In previous sections, the proposed model of air mobility was discussed, which is likely to employ electronic applications for ticket booking. However, for international travel, the storage of passengers' personal data in electronic applications can pose legal concerns with regard to data protection. [608] One plausible resolution is to delegate this responsibility to the vertiport personnel. However, solely relying on personnel for every operational and administrative task could impede the entire concept's efficiency and success.

607 See, supra note 485, at 9.
608 Ibid., at 9-10.

The last consideration regarding the denied boarding as it is presented in Article 4 of Regulation 261/2004 and the aircraft operations in the environments under analysis, is a rather peculiar one and is associated with passenger weight. The weight of an aircraft is an important factor for a flight for safety and energy consumption issues. In recent years, there have been incidents in which passengers have been denied boarding an aircraft due to their weight.[609] The same incidents could happen in the context of the aircraft operations in the assessed environments, primarily due to the maximum take-off mass (MTOM) of the aircraft. For instance, Volocopter's Volocity eVTOL has an Operating Weight Empty (OWE) of 700 kg and an MTOM of 900 kg, indicating that its maximum payload capacity is 200 kg.[610] This payload capacity takes into account the combined weight of the passenger and pilot, along with any baggage or cargo. If the payload capacity exceeds 200 kg, passengers may be denied boarding.

Upon analysing this section, it becomes evident that while denied boarding does not create any interpretation problems for aircraft operations in the evaluated mobility environments, its implementation as a part of the provisions of Regulation 261/2004 can result in significant legal and practical issues.[611]

5.3.3. CANCELLATION

Similar to the definition of "denied boarding", Regulation 261/2004 provides a definition of the term "cancellation". According to Article 2(l) of the Regulation[612], cancellation refers to the non-operation of a previously planned flight on which at least one seat was reserved.

609 See, (https://www.fodors.com/news/news/can-you-be-kicked-off-a-plane-if-the-flight-is-too-heavy), accessed (12-05-24).
610 See, (https://assets.ctfassets.net/vnrac6vfvrab/73kYdf0o0kR7Y8XqAz9rEl/40bcf5c38552f6d1fcca71f7fe9736f3/20220607_VoloCity_Specs.pdf), accessed (12-05-24).
611 See, supra note 485, at 10.
612 Article 2 (l), Regulation 261/2004.

However, the main issue with the operations discussed is linked to the phrase "previously planned" in the definition mentioned above. The business model of aircraft operations in the assessed environments is different from conventional aviation since booking occurs on short notice (a couple of minutes) or on the spot instead of well in advance. This model creates compatibility issues with Article 5 of Regulation 261/2004, making its application unsuitable for the operations under evaluation.

It is evident that the pre-existing legal framework above, surrounding second-party liability in Europe, gives rise to certain legal complexities that exist in both the sphere of interpretation and application of provisions/suitability. These legal issues can have far-reaching implications for businesses involved in the assessed mobility environments and passengers/consumers alike. In this regard, EASA and the ECJ are poised to play a pivotal role in shaping a new legal environment that is appropriate for aircraft operations in the context of the mobility environments under analysis. EASA, as the competent EU authority tasked with *inter alia* rulemaking powers,[613] and ECJ, with its power to provide authoritative interpretation,[614] will be instrumental in shaping a relevant legal environment that is appropriate for the operation of aircraft in the context of the assessed operations.

Following the analysis of central EU laws regarding second-party liability, this dissertation will resume with an assessment of the existing legislation referring to damages on the ground or third-party liability in the EU.

5.4. THE QUESTION OF THIRD-PARTY LIABILITY. THE APPLICATION OF THE ROME CONVENTION IN THE ASSESSED MOBILITY ENVIRONMENTS

613 One of EASA's main tasks is drafting aviation safety legislation and providing technical advice to the European Commission and to the Member States. For more information see, (https://www.easa.europa.eu/en/the-agency/faqs/agency), accessed (13-05-24).

614 See, (https://max-eup2012.mpipriv.de/index.php/Interpretation_of_EU_Law), accessed (13-05-24).

5.4.1. THE ROME CONVENTION 1952

The operation of aircraft in EU airspace is governed by comprehensive regulations designed to ensure safe and secure operations for both passengers and people on the ground. However, the addition of more aircraft in various segments of the airspace increases the risk of collision, thereby elevating the danger for individuals on the ground. The issue of third-party liability becomes even more prevalent when, apart from the operation of conventional aircraft in the higher airspace, an additional segment in the lower airspace is added, which aims to incorporate both manned and unmanned variants that will operate a few meters over the heads of citizens of urban environments. To mitigate such risks, a third-party liability regime is considered crucial.

In the EU, in contrast to Regulation 889/2002, there is no unified regime addressing the liability to third parties. The only international agreement that addresses the aforementioned matter is the Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, signed in Rome on 7 October 1952 (hereinafter referred to as Rome Convention 1952). The application of the convention above, however, presents certain obstacles that will be better explained below.

5.4.2. SCOPE OF APPLICATION

Article 1 of the Rome Convention stipulates that, individuals on the ground who suffer damage "by an aircraft in flight or by any person or thing falling therefrom"[615] are entitled to compensation. [616]

615 See Article 1 of the Rome Convention 1952.

616 Article 1 of the Rome Convention dictates that: "1. Any person who suffers damage on the surface shall, upon proof only that the damage was caused by an aircraft in flight or by any person or thing falling therefrom, be entitled to compensation as provided by this Convention. Nevertheless, there shall be no right to compensation if the damage is not a direct consequence of the incident giving rise thereto, or if the damage results from the mere fact of passage of the aircraft through the airspace in conformity with existing air traffic regulations. 2. For the purpose of this Convention, an aircraft is considered to be in flight from the moment when power

Notably, the language of the convention refrains from employing the terms manned or unmanned/crewed to characterise the "aircraft in flight." Whether the drafters of the Convention deliberately omitted these terms or presciently anticipated the significance of unmanned operations akin to those in the Chicago Convention remains uncertain. However, from a legal perspective, this reference to aircraft[617] in general appears to encompass unmanned aircraft as well, which, in conjunction with their manned counterparts, are envisioned to operate within the purview of the air mobility environments under scrutiny.

Nevertheless, the application scope of the aforementioned Convention is narrowed by the stipulations of Article 23, which necessitates an element of internationality for its applicability. Specifically, the Convention is applicable to "damage, as enshrined in Article 1, caused within the territory of a Contracting State by an aircraft registered in another Contracting State."[618] Therefore, from a legal standpoint, the Rome Convention seems to be a viable potential framework to regulate the paramount issue of damage on the surface, at least when the international operation of manned and unmanned eVTOLs and other aircraft associated with the environments under analysis is involved. Nonetheless, various reasons to the contrary will be portrayed below, disproving this assumption.

5.4.3. Unsuitability of the Rome Convention 1952

While from a strict applicability perspective, the Rome Convention could pose as the equivalent of the Montreal Convention 1999 in the EU for international operations, offering a common liability regime for damages caused on the surface, in reality, the application of this regime is encumbered by various challenges, rendering it problematic.

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is applied for the purpose of actual take-off until the moment when the landing run ends. In the case of an aircraft lighter than air, the expression "in flight" relates to the period from the moment when it becomes detached from the surface until it becomes again attached thereto."

617 The classification of eVTOL, either manned or unmanned as aircraft, has been proven multiple times in this dissertation.

618 See Article 23 of the Rome Convention 1952.

The primary concern pertains to the limited international acceptance of the Rome Convention. To date, the Convention has been ratified by only 51 states, of which a mere 10 are EU members.[619] Consequently, the framework's efficacy in regulating issues related to damages on the ground is significantly compromised both within the EU and on an international scale.

A further critical concern refers to the liability limits enshrined in the Convention. Article 11 (2) of the Rome Convention stipulates that "The liability in respect of loss of life or personal injury shall not exceed 500 000 francs per person killed or injured".[620] While this sum may have held significance in the 1950s, its contemporary equivalent of approximately 25,000€ renders it notably low and unjust, particularly when considering the unlimited liability that the passengers who may perish in the same incident on board the aircraft under the provisions of the Montreal Convention 1999 would benefit from.[621]

The final consideration presented to demonstrate the inadequacy of the Rome Convention concerns the inclination of states, both within the EU and at a global level, to enforce their domestic tort laws in instances of damage caused by aircraft to third parties on the ground. This predisposition is primarily influenced by the incapacity of any international framework to effectively address the matter, prompting states to resort to their own legal tools in addressing the aforementioned issue.

Recent attempts to regulate the liability issue under scrutiny, namely the Convention on Compensation for Damage to Third Parties Resulting from Acts of Unlawful Interference Involving Aircraft (hereinafter referred to as Unlawful Interference Convention 2009) and the Convention on Compensation for Damage Caused by Aircraft to Third Parties (hereinafter referred to as the

619 See, (https://www.icao.int/secretariat/legal/List%20of%20Parties/Rome1952_EN.pdf), accessed (09-06-2024). In the EU, out of the 27 member-states, only Belgium, Denmark, France, Greece, Italy, Luxembourg, the Netherlands, Portugal, Spain, and Sweden have ratified the Rome Convention 1952.

620 See, Article 11 (2) of the Rome Convention 1952.

621 The authors" calculations account for an average inflation rate of 2% over 22 years. Other authors" previous calculations attribute it to 36.988€. See, supra note 185, at 203.

General Risks Convention 2009) have proven to be yet more ineffective and have not entered into force.

In summary, the Rome Convention has been deemed inadequate as a piece of international legislation primarily but not solely due to the reasons cited above. In addition, it was not specifically tailored to address the operation of unmanned aircraft, including eVTOLs and other aircraft intended to operate at the low segments of airspace in the upcoming air mobility environments. Consequently, applying the aforementioned Convention has been proven to be a doubtful option to address the damage caused by aircraft to third parties on the ground.

5.5. CONCLUSION

In this chapter aspects of second- and third-party liability regarding the operation of UAM aircraft has been assessed. The position of the author is that the operational model of eVTOLs in the context of the mobility environments under scrutiny will require specific legal attention. While there are legal frameworks that could regulate the operation of aircraft associated with the assessed air mobility environments, they were designed for different operations, leading to varying levels of applicability issues.

When it comes to second-party liability, the Montreal Convention and, as an extension, the EU Regulation 889/2002 seem to offer the most comprehensive framework for addressing aircraft operations in air mobility systems. However, as discussed above, there are some inconsistencies with these legal instruments. Conversely, the implementation of Regulation 261/2004 appears to introduce more problems than it resolves, making its application more of a concern. This is likely to lead to an increase in litigation related to this heavily contested EU Regulation. Consequently, a new EU regulation that will amend Regulation 261/2004 in a way that will properly address the operational model in UAM environments seems to be the most appropriate measure, according to the author.

The presentation of the aforementioned predicaments by the author aims to initiate a discussion within the academic and EU policy-making communities concerning the pre-emptive legal assessment of these issues. This discussion is essential for ensuring the safe, secure, and compliant launch of UAM environments and their associated aircraft.
If the launching of these environments proceeds without a proper regulatory assessment of the liability considerations first, it could jeopardise both the commercial viability of proposed UAM services and lead to potential litigation stemming from these inconsistencies. Finally, while Chapter III of this thesis highlights the complex and comprehensive framework for the authorisation and standardisation of eVTOL/VCA and UAS, EU authorities appear to be taking a passive "wait-and-see" approach regarding liability, delaying action until these environments are operational at a large scale.

In the realm of third-party liability, the Rome Convention of 1952 is considered an insufficient legal framework for regulating damage caused by aircraft to third parties on the ground. Within the EU, the member states appear to be continuing to apply their national laws to trans-border operations of aircraft within their respective national segments, at least for the time being. Consequently, the emergence of an international legal framework to address third-party liability issues seems less likely, and the continuance of the legal status quo appears to be the optimal scenario to avoid disruptions.

Following this concise and apt review of liability frameworks pertaining to the operation of aircraft within the context of IAM and its urban applications, this doctoral dissertation will proceed to its penultimate chapter. Specifically, the evaluation of two case studies within the realm of smart cities, the Hanseatic city of Hamburg and the green island of Astypalaia.

CHAPTER VI-CASE STUDY

6.0. INTRODUCTION

Having concluded the discussion on the assessed legal topics in the previous chapters, this chapter aims to introduce practical aspects of UAM environments in the context of a smart city through two case studies. These case studies highlight promising elements in the journey towards transforming their status into what was defined in Chapter II. as a smart city. The success of a legal concept with various practical and operational implications, particularly when it impacts citizens' daily lives, depends significantly on the correct application of its constitutional elements. This ensures that potential haste does not hinder its intended message and desired outcomes.

This chapter will present the actions taken by two-plus-one EU cities/regions with distinctly different mindsets regarding mobility in order to achieve the status of a smart city. The analysis will start with the city-state of Hamburg, providing details of projects related to the city's transformation to a "smart" level and a commercial project aimed at this goal. This will be followed by an exploration of the city's approach to UAM. The case study assessment will conclude with an overview of the existing challenges that the city of Hamburg faces in order to harness the innovative elements of UAM in its current state.

The second case study that will be presented in this chapter is the green island of Astypalaia. At the time of conceptualising this thesis, Astypalaia exemplified a model of innovative thinking within a country where facilitating mobility across its extensive and remote island network is deemed essential for the well-being of numerous citizens. In addition to the island of Astypalaia, the example of the city of Trikala will be briefly outlined to serve as a comparison point in reference to the innovative perspective of urban mobility (with and without the air element) in the same country.

The chapter will conclude with general remarks about the value of initiatives aimed at transforming cities to better accommodate the mobility needs of their citizens. It will also highlight errors and dangers that may lead to short- and long-term setbacks, ultimately dooming the entire concept of the mobility environments under evaluation to failure.

6.1. The Free and Hanseatic City of Hamburg

The city of Hamburg was selected as a case study because of its unique status as the largest harbour in Germany, processing up to 140 million tons of goods annually. Additionally, it is the second-largest city in Germany, with its metropolitan region home to 5.3 million people. The metropolitan area of Hamburg is one of the 16 federal states in Germany and has always been characterised as an open-to-new-ideas city, striving to compete with other significant global city-states like Singapore and Monaco.[622]

6.1.1. Hamburg and UAM

Hamburg's efforts to transform into a "smarter" city began as a theoretical discussion between the public and private sectors in 2011.[623] However, tangible actions were implemented a decade ago, in 2014, when the then-lord mayor launched a relevant initiative.[624] This initiative aligned with the perception of the German Federal Administration that the smart transition constitutes the digitalisation of administration.[625] The mayor's initiative followed the approval of an official framework for transportation planning by the City Senate in 2013.

622 See, Späth and Knieling, *Smart City Experimentation in Urban Mobility—Exploring the Politics of Futuring in Hamburg*, in Lösch, Grunwald, Meister, and Schulz-Schaeffer (eds.), *Socio-Technical Futures Shaping the Present*, Technikzukünfte, Wissenschaft und Gesellschaft / Futures of Technology, Science and Society (Springer VS, 2019), at 167–168.
623 Ibid. at 169.
624 Ibid.
625 See Chapter I, at 36.

This framework, titled "The Mobility Program for 2014-2020," aimed to set the course for transportation planning during that period.[626] The initial link between the concept of a smart city, as envisioned by the Hamburg city administration, and UAM emerged in 2017 with the launch of the "Windrove" project. This initiative aimed to develop a drone network that would promote the commercial use of drones within the Hamburg metropolitan area.[627]

The primary goal of this initiative was the gradual implementation of UAM principles throughout the metropolitan region. In its initial stages, the focus was largely on Unmanned Aerial Vehicles (UAVs) capable of autonomous operation. This emphasis can be interpreted due to the significant advantages that UAVs can offer to public authorities and the Port of Hamburg, which is a major asset for the entire region.[628] Windrove became the leading project for UAV economic development in Hamburg. It focused on promoting events related to UAM environments and UAV operations. The project encouraged cooperation and networking between the local private sector and the public sector. Importantly, it recognised that public acceptance was crucial for the success of UAM, aiming to increase visibility and awareness among the general public.[629] The result of this active collaboration between the public sector and industry players led to public institutions joining as project partners alongside industry stakeholders.[630]

The next milestone for Hamburg's engagement with UAM was joining the UAM Initiative Cities Community (UIC2) of the European Union's Smart Cities Marketplace as one of the first cities to do so back in 2018.[631] Over the past six years, this initiative has made significant strides in defining the concept

626 See, supra note 622 at 170.

627 See, (https://www.hamburg-aviation.de/en/focus-areas/urban-air-mobility/windrove/), accessed (04-12-24). See also, (https://www.eurocontrol.int/sites/default/files/2021-06/u-space-lessons-learner-3-hamburg.pdf?), accessed (04-12-24).

628 See, (https://www.eurocontrol.int/article/revolutionising-mobility-cities-through-uavs-airspace-design-challenge), accessed (04-12-24).

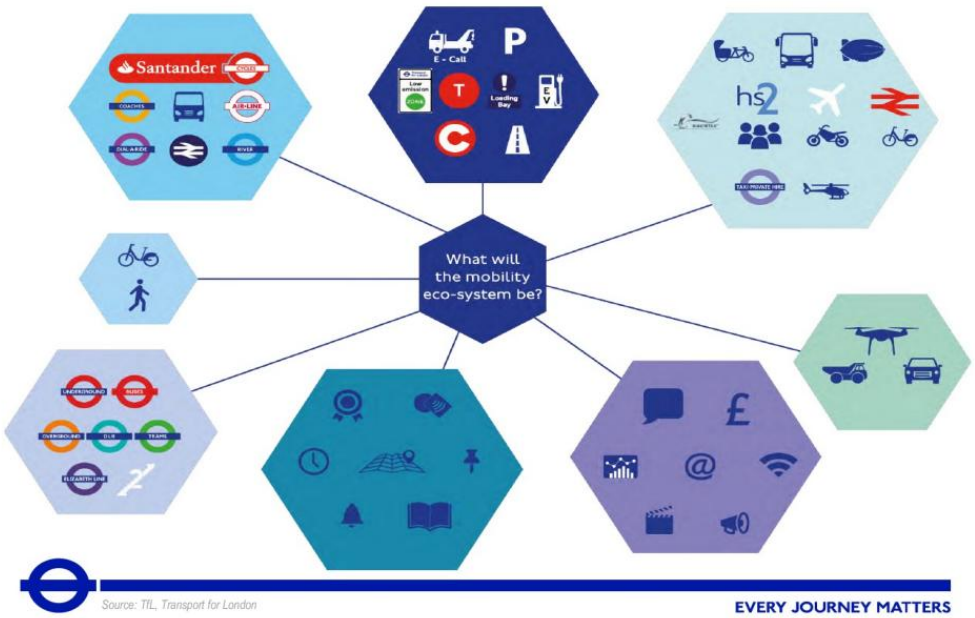
629 Ibid.

630 Ibid.

631 The Urban Air Mobility Initiative Cities Community (UIC2) was established in October 2017 within the EU's Smart Cities Marketplace. Its mission is to promote a sustainable and secure transition of urban mobility to the vertical dimension. For more information, see (https://civitas.eu/urban-air-mobility), accessed (04-12-24).

of UAM. It has involved cities in the discussion, identified and assessed practical challenges related to very low-altitude airborne traffic over populated areas, and worked towards integrating this traffic sustainably with surface mobility systems.[632] The member cities of the initiative view urban air traffic as only one part of the overall impact of urban transportation. To ensure the above, the smart city of the future must foster a harmonious coexistence among various modes of mobility while ensuring proper integration. This approach should adhere to essential safety and security principles. The figure below illustrates a proposed model of an urban air mobility ecosystem within the framework of a smart city.[633]

Figure 13[634]



A key aspect of the initiative is its comprehensive approach to integrating UAM into future urban mobility systems within the framework of smart cities. At the same time, it serves as a city-centric platform that ensures a holistic approach to urban mobility. The initiative actively engages with citizens and co-creates solutions alongside public and private stakeholders, including the

632 This constitutes a working definition of UIC2 regarding UAM. See, (https://civitas.eu/sites/default/files/UIC2_Overview_February-2022.pdf), accessed (04-12-24).
633 See, (https://civitas.eu/sites/default/files/UIC2_Overview_February-2022.pdf), accessed (04-12-24).
634 Ibid.

public.[635] The efforts of the initiative as a whole and its member cities individually culminated in the release of the Amsterdam Manifesto (officially titled the "Manifesto on the Multilevel Governance of the Urban Sky") in 2020.[636] The Manifesto consists of five fundamental pillars that request the following:

a. Cities and regions should have a decisive role in permitting the operation of UAM services that serve the public interest, such as future public transportation, postal deliveries, and emergency services, while aligning with the needs and preferences of their citizens;
b. Cities and regions should have the authority to determine the extent to which UAM and U-Space operations can take place within their territories;
c. Cities and regions should be responsible for designating where UAM and U-Space flight operations are allowed within their areas, including considerations such as geo-fencing, day and night restrictions, and measures to reduce noise and visual impact;
d. Cities and regions should have the power to decide the locations for the construction of take-off and landing sites;
e. The prosecution of violations related to public use of urban airspace should remain a responsibility at the local/regional level.[637]

Although the Manifesto and the initiative cannot be credited as the only forces behind the European Union's recognition of the role and importance of cities in Commission Implementing Regulation (EU) 2021/664, enacted on April 22, 2021, they played a significant role in the aforementioned realisation. This is clearly reflected in Article 18f of the Regulation.[638] In this Article, the

635 See, (https://civitas.eu/sites/default/files/UIC2_Overview_February-2022.pdf), accessed (04-12-24).
636 See, (https://civitas.eu/sites/default/files/UIC2%20Manifesto%20-%20Multilevel%20Governance%20of%20the%20Urban%20Sky_wtih%20supporting%20cities_15Sep2022.pdf), accessed (04-12-24).
637 Ibid.
638 Article 18f of EU Regulation 2021/664 dictates that, among other things, the designated competent authorities shall: "establish a mechanism to coordinate with other authorities and entities, including at local level, the designation of U-space airspace, the establishment of

EU issued a binding legal declaration stating that member states should consult cities and local authorities regarding activities in their respective airspace. As a result, it is evident that Hamburg, being one of the first cities to join this initiative and one of the most active cities with dynamic collaborations among various stakeholders, serves as a stronghold for innovation within the upcoming EU mobility ecosystem.

In 2019, Hamburg continued its exploration of UAM with the “Medifly” project. As suggested by its name, this project served as a proof-of-concept for the delivery of medical supplies using UAVs. The objectives were not only to ensure timely delivery but also to demonstrate the social benefits of utilising UAVs. This included reducing the workload for medical staff, decreasing emissions, avoiding traffic congestion, and providing faster service to patients in need.[639]

However, this project (as every project till that point involving the operation of unmanned vehicles) faced particular challenges due to the dense and complex airspace in Hamburg. With two airports located within the city’s boundaries, operating UAVs became particularly difficult, as almost the entire airspace of the city is part of a controlled zone (CTR), making their operation restricted in some instances.[640]

The aforementioned practical difficulty and the fact that the city of Hamburg, as well as the operator of the port and its port authority[641], have been highly interested in the extensive operation of UAVs for inspection, transport or surveillance purposes, pushed the administration of Hamburg to enter the UDVeo Project in 2020. The UDVeo project, which stands for "Urbaner Drohnenverkehr effizient organisiert,"[642] was an interdisciplinary research

airspace restrictions for UAS within that U-space airspace and the determination of the U-space services to be provided in the U-space airspace”.

639 See, (https://medifly.hamburg/en/project/), accessed (04-12-24).

640 See, (https://www.eurocontrol.int/article/revolutionising-mobility-cities-through-uavs-airspace-design-challenge), accessed (04-12-24).

641The Port of Hamburg operates in a regulatory environment controlled by HPA (Hamburg Port Authority), enabling experimentation with various regulatory approaches related to UAM.

642 See, (https://bmdv.bund.de/SharedDocs/DE/Artikel/DG/UAV-Projekte/udveo.html), accessed (04-12-24).

initiative led by Helmut Schmidt University in Hamburg, Germany. Funded by the German Federal Ministry of Transport and Digital Infrastructure, the project aimed to develop practical concepts and solutions for integrating UAS into urban airspace.[643]

Project UDVeo was developed prior to the implementation of EASA's U-space Framework, which came into effect in April 2021.[644] The project ran from February 1, 2020, to December 31, 2022.[645] The objective of UDVeo was to conduct research and prototypically develop an official control centre for the safe and efficient coordination of drone traffic.

The prototype was tailored to facilitate all essential processes related to drone coordination, including operator and drone registration, flight clearance, and both strategic and tactical conflict management. Additionally, the integration of drone traffic with manned aviation, particularly helicopters, was also considered.[646]

The last project that will be assessed in this dissertation pertaining to UAM in the city of Hamburg is project FALKE, an acronym for "Fähigkeit des Abfangens von in gesperrte Lufträume eindringenden Kleinfluggeräten durch zivile Einsatzmittel", which can be translated as the "Ability to intercept small aircraft entering restricted airspace by civilian means".[647]

The objective of the FALKE counter-UAS initiative is to develop and demonstrate a comprehensive technical and organisational framework for the defence against unauthorised UAS operations at Hamburg Airport. This project aims to establish automated and standardised protocols that encompass all areas of authority and responsibility, ranging from the detection of a UAS to the subsequent automated deployment of an interceptor UAS. The ultimate goal is

643 See, (https://www.hsu-hh.de/forschung/en/interdepartmental/advanced-aerial-mobility-uas-and-more/udveo), accessed (04-12-24).
644 Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the U-space.
645 See, (https://www.hsu-hh.de/forschung/en/interdepartmental/advanced-aerial-mobility-uas-and-more/udveo), accessed (04-12-24).
646 See, (https://www.wps.de/en/wps/research/organising-urban-drone-traffic-efficiently-udveo), accessed (04-12-24).
647 See, (https://bmdv.bund.de/SharedDocs/DE/Artikel/DG/UAV-Projekte/falke.html), accessed (04-12-24).

to create a model that can be replicated at other airports.[648] The primary areas of focus within the FALKE project include:

a. The development of a coordinated action plan that addresses the diverse responsibilities within the airport environment, inclusive of reporting chains and procedural guidelines.
b. The definition, implementation, and standardisation of data interfaces and communication protocols to facilitate the integration of subsystems across the various organisations present at the airport.
c. The automation of interception procedures and the safe removal of unauthorised UAS.
d. The characterisation and verification of effective systems designed for UAS interception.[649]

The projects previously mentioned represent an initial, albeit significant, step in Hamburg's broader engagement with the concept of UAM and its transformation into a more advanced urban mobility environment. These initiatives mark the beginning of the city's journey toward evolving its mobility framework and integrating vertical transportation solutions into its overall mobility interface. Nonetheless, these efforts do not constitute the entirety of the city's engagement with UAM. Hamburg continues to observe, fund, and actively participate in various projects aimed at addressing operational and regulatory challenges, drawing on expertise from multiple sectors. A notable recent example is the Vertiport project, which has received funding from the City of Hamburg to develop a modular design for eVTOL take-off and landing

648 See, (https://bmdv.bund.de/SharedDocs/DE/Artikel/DG/UAV-Projekte/falke.html), accessed (04-12-24). See also, (https://www.frequentis.com/en/pr/falke-research-project-managing-drone-incursions-airport-environment), accessed (04-12-24).

649 See, (https://bmdv.bund.de/SharedDocs/DE/Artikel/DG/UAV-Projekte/falke.html), accessed (04-12-24).

infrastructure, catering to both passenger and freight services associated with Advanced Air Mobility[650].[651]

6.1.2. Traffic Management in Urban Airspace: Practical Applications and Challenges for Hamburg

The objectives of the aforementioned projects align closely with the goals of the U-Space framework, as they can be viewed as initiatives aimed at facilitating its implementation. The overarching aim is to manage and integrate UAS into the airspace in a manner that is safe, efficient, and sustainable. With respect to their practical implications, all projects have achieved similar operational outcomes.

Designing an inclusive urban airspace environment that can accommodate UAVs, eVTOL aircraft, and traditional aircraft presents a significant challenge despite the EU's U-Space Framework outlining essential considerations. In scenarios involving UAVs and other aircraft operations within controlled zones, as evidenced by the case of Hamburg, the U-Space Framework appears to function as a promising regulatory instrument. However, the principal challenge arises when considering UAV operations in densely populated areas, such as urban environments, or during automated operations.[652]

It is apparent that, as observed in the case of Hamburg, the U-Space Framework and the relevant projects analysed above, while addressing fundamental issues related to the establishment of safe and secure urban airspace, still fall short in providing a detailed technical framework necessary for the transition of the U-Space system from a conceptual model to an

650It is apparent that the term AAM is utilised interchangeably with the term UAM in this context. Although the regulatory framework distinguishes between these terms based on their specific characteristics, in practical applications, they are employed similarly as they pertain to the same or nearly identical operational concept.

651 See, (https://vertiport-hamburg.de/), accessed (04-12-24).

652 See, (https://www.eurocontrol.int/article/revolutionising-mobility-cities-through-uavs-airspace-design-challenge), accessed (04-12-24)

operational reality. This assertion is supported by the fact that the development of the infrastructure prerequisites of the U-Space regulation constitutes a complex and, up until now, unapplied endeavour in the EU.[653]

In response to the operational and applicability challenges associated with the U-space environment and the integration of electric aircraft within urban airspace, Hamburg has initiated projects like *inter alia*, the U-Space sandbox[654] and project BLU-Space (Blueprint U-Space)[655], which have the precise aim of implementing "a safe and automated traffic management system for UAS under actual conditions and in urban, controlled airspace."[656] A proposed depiction of Hamburg's urban airspace (containing the airport, urban areas and the port) is presented below.

653 In a proposed U-space environment, it is essential for all pertinent information required by the UAV remote pilot to be collected by relevant stakeholders. Official entities, including law enforcement agencies, fire departments, and air traffic control centres, must structure data in a manner that facilitates immediate transmission to the remote pilot via a digital interface. These agencies would also be responsible for ensuring the availability of necessary technology, either by adapting existing equipment or by developing new solutions as required.
Moreover, U-space Service Providers are tasked with establishing a novel system that can receive information in real-time and present it to the UAV remote pilot through an intuitive application. To enable the prior reservation of airspace, these providers must implement a coordination platform.
The new U-space systems play a crucial role in generating and disseminating information, which necessitates comprehensive testing to validate their reliability and practicality. This process is particularly crucial when integrating diverse stakeholders from both the private and public sectors. The effectiveness of the entire management system is contingent upon the stable functioning of all interconnected systems. The absence of critical information could jeopardise the system's/environment's security and lead to incidents that may undermine the successful execution of large-scale aircraft mobility in urban airspace.
For more information see, Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the U-space, C/2021/2671, OJ L 139, 23.4.2021, p. 161–183.
654 See, (https://www.hafen-hamburg.de/en/press/news/successful-trial-of-germanys-first-traffic-system-for-drones-u-space/), accessed (04-12-24).
655 See, (https://www.blu-space.de/en/), accessed (04-12-24).
656 See, (https://www.blu-space.de/en/), accessed (04-12-24).

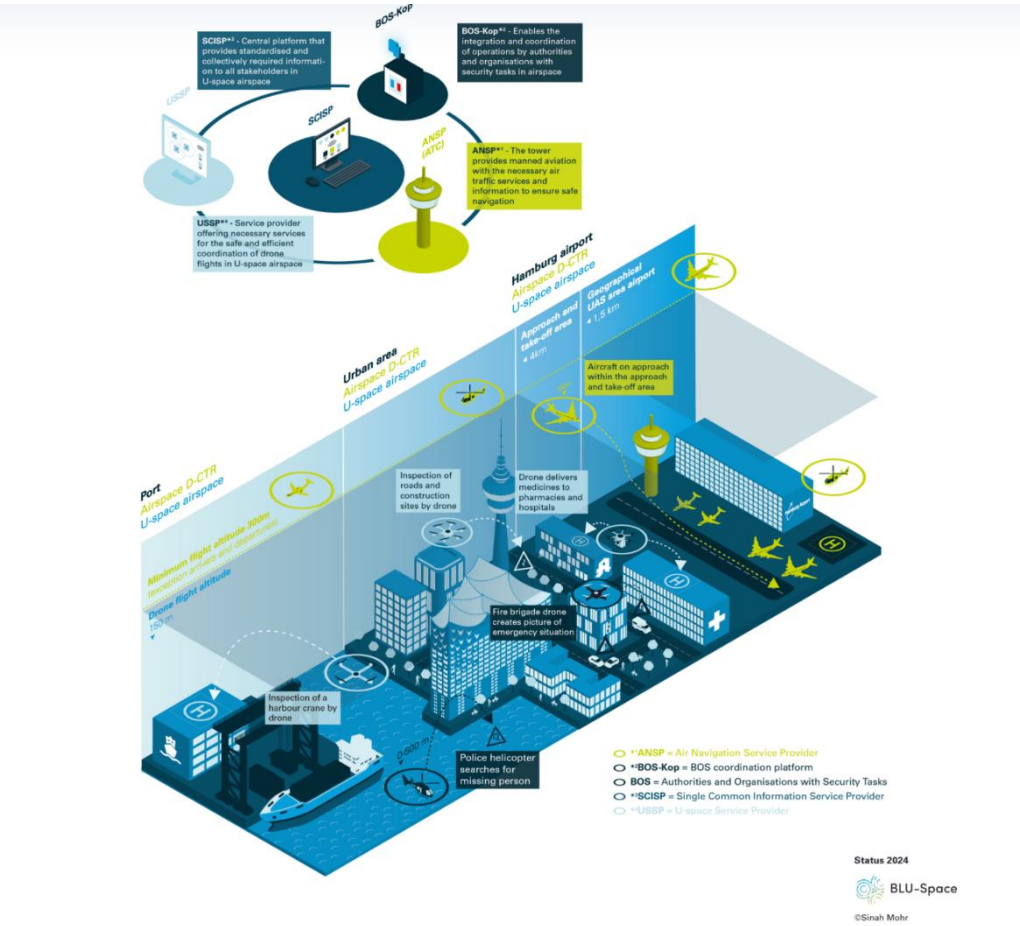


Figure 14[657]

Although the technical aspects of implementing U-Space and managing the operations of both electric and conventional aircraft in urban airspace represent a significant advancement towards the realisation of UAM, the city of Hamburg appears to be addressing the whole spectrum of requirements necessary for the effective implementation of UAM, as discussed in Chapter III of this dissertation. A key component to achieving acceptance among its citizens involves collaborative efforts by elected officials and private entities to establish a U-Space living lab over the next two years.[658] This initiative includes all relevant private and public stakeholders who are either impacted by or have an interest in the project.[659]

657 See, (https://www.blu-space.de/en/), accessed (04-12-24).

658 See, (https://dronetalks.online/hamburg-aviation-and-european-cities-are-building-frameworks-for-uam-integration-and-drone-adoption/), accessed (04-12-24).

659 See, (https://www.eurocontrol.int/article/revolutionising-mobility-cities-through-uavs-airspace-design-challenge), accessed (04-12-24).

The living lab will facilitate essential repetitive development and legislative learning to address the gaps created by existing EU regulations. This approach is not only instrumental in supporting the UAV value chain but also serves as a critical opportunity to engage society in the transition towards digital and urban mobility transformation. By bringing together legal practitioners, lawmakers, technology developers, and the broader community, the living lab aims to promote the next era of urban mobility.[660]

The aforementioned initiatives undertaken by the city of Hamburg, in collaboration with other public and various private stakeholders, position it as a pioneering force in the UAM transformation on a pan-European scale. As discussed above, the city faces two significant challenges: the operational implementation of the U-Space, with the parallel introduction of both electric and conventional aircraft within urban airspace, and securing public acceptance of UAM among its citizens. While these issues have yet to be fully addressed, the ongoing efforts and initiatives appear to be progressing in a positive direction towards the practical realisation of UAM.

In the next chapter, a completely different concept will be evaluated in reference to mobility philosophy, that of the Island of Astypalaia in Greece.

6.2. The Smart and Sustainable Island of Astypalaia

Astypalaia, also referred to as Astypalea, is a Greek island located within the Dodecanese prefecture. According to data from the 2021 census conducted by the Hellenic Republic, the island boasts a population of approximately 1,376 residents.[661] Despite its relatively small size in comparison to the prefecture's capital, Rhodes, Astypalaia has embarked on a transformative initiative in the years following the first wave of the COVID-19 pandemic. This initiative aims

660 See, (https://www.eurocontrol.int/article/revolutionising-mobility-cities-through-uavs-airspace-design-challenge), accessed (04-12-24).

661 See, (https://www.statistics.gr/2021-census-pop-hous), accessed (04-12-24).

to position the island as the first smart, green island in the Mediterranean, with a focus on achieving energy autonomy.[662]

The transformation initiative commenced on November 4, 2020, with the signing of a Memorandum of Understanding between the Hellenic Government and the Volkswagen Group. This collaboration aimed to establish an innovative transport system on the island of Astypalaia. This proposed system aimed to replace traditional modes of land transportation, both public transport (such as buses) and private vehicles (including automobiles and motorcycles), with electric vehicles.[663] A significant portion of the island's electricity requirements will be met through renewable energy sources, particularly solar power. Ultimately, the goal was for Astypalaia to serve as a model for climate-neutral mobility.[664] In pursuit of the previously stated objective, the Hellenic Government, in partnership with the Volkswagen Group, has initiated the Smart and Sustainable Island Program. This program encompasses several key initiatives, including:

a. The transfer of electric vehicles to municipal and public services to replace conventional vehicles;
b. The provision of grants aimed at facilitating the replacement of all vehicle types—such as bicycles, scooters, cars, and vans—with electric alternatives, alongside the installation of private charging stations;
c. The establishment of an on-demand shuttle service for urban transportation utilising vans, which will be accessible through a mobile application or telephone;
d. The introduction of an exclusive vehicle-sharing service for electric cars, scooters, and bicycles, available for use by residents and visitors for as long as required, with users paying only for the duration of their usage;

662 See, (https://www.greeknewsagenda.gr/the-smart-green-island-of-astypalea/), accessed (04-12-24).
663 See, (https://www.astypalea-sustainable-island.gr/en/about-the-project/2_about-the-project), accessed (04-12-24).
664 See, (https://www.astypalea-sustainable-island.gr/en/about-the-project/2_about-the-project), accessed (04-12-24).

e. The construction and implementation of a hybrid power system to facilitate renewable energy generation, significantly reducing the reliance on existing diesel generators for electricity production;
f. The enhancement and digitalisation of the island's electrical grid, alongside the development of a publicly accessible charging network.[665]

As this doctoral dissertation is being drafted, preliminary results indicate a successful outcome for the project. According to the most recent data, 25% of the island's population regularly utilises the ASTYBUS[666] ridesharing service. Between 2022 and 2023, this service completed over 200,000 customer kilometres. Additionally, the progress toward electrification of ground mobility is noteworthy, as nearly all new vehicle registrations on Astypalaia are now for fully electric cars.[667] With regard to the energy supply for electric ground vehicles, the local energy ecosystem is set to undergo significant expansion by 2026. It is projected that, during the final phase of this development, approximately 80 % of the total energy demand will be met. The initiative will commence with the construction of a 3-megawatt solar park, scheduled for completion in 2024.[668] While the project presented above seems promising, aiming to transform an energy-isolated island in the Aegean Archipelago into a case study of clean energy, low carbon emissions, and electric mobility, it seems to lack a particular element: the concept of air mobility above urban settlements at scale.

Back in 2021, the concept of this dissertation was developed, with Astypalaia selected as a noteworthy case alongside a pioneering city such as Hamburg, representing unique standards for Southern European and Mediterranean contexts. The public authorities' declarations that the island will transform into smart and green led the author to anticipate that, in conjunction

665 See, (https://e-astypalea.gov.gr/index_en.html), accessed (04-12-24).
666 Astybus is the application that allows visitors and residents of Astypalaia to ride on board electric shuttle vehicles. For more information, see (https://www.astypalea-sustainable-island.gr/en/astygo/), accessed, (04-12-24).
667 See, (https://www.volkswagen-group.com/en/press-releases/electric-island-astypalea-transformation-of-mobility-fully-underway-17312), accessed, (04-12-24).
668 See, (https://www.volkswagen-group.com/en/press-releases/electric-island-astypalea-transformation-of-mobility-fully-underway-17312), accessed, (04-12-24).

with ground electromobility, Astypalaia would engage in initiatives similar to the HARMONY project, akin to those undertaken by the Greek city of Trikala, to effectively address the community's needs for rapid and secure holistic mobility, utilising its third dimension at scale.[669]

Regrettably, the conception of Astypalaia's smart and green identity is notably one-dimensional, primarily emphasising electric ground mobility, digital assistance, and the provision of clean energy by solar means. The incorporation of UAM elements into Astypalaia's model of smart and green identity could significantly enhance the quality of life for residents, particularly in areas such as medical assistance and education, which are currently limited on the island. At present, aerial transport options are predominantly reserved for extreme emergencies, with maritime transport being the primary means of travel to the nearest sizeable urban environment of Rhodes. Nevertheless, as it stands, the concept of a smart and green island, regarding the specific case of Astypalaia, remains confined solely to ground mobility considerations.

6.3. CONCLUSION

The objective of the case study presented in this dissertation is to provide practical examples of the independent and collaborative initiatives undertaken by cities and regions in partnership with central state authorities to implement UAM. It is essential to comprehend that cities differ significantly in various aspects, including available resources such as funding, skilled personnel, a supportive ecosystem comprising both private and public sectors, and public acceptance of innovative projects and experiments that involve the integration of a third dimension into urban mobility. The aforementioned has as an immediate result that these factors substantially impact the aspirations of cities and regions to transition into their smart counterparts.

669 The HARMONY project commenced on July 1, 2019, and concluded on February 28, 2023. Its primary objective was to develop a new generation of harmonised spatial and multimodal transport planning tools. These tools were intended to empower metropolitan authorities in facilitating the transition to a low-carbon, new mobility paradigm in a sustainable manner. For more information about the Harmony project, see, (https://cordis.europa.eu/project/id/815269), accessed (04-12-24).

It is the author's perspective that the aforementioned observation applies to *inter alia* the two examples discussed, namely the city of Hamburg and the island of Astypalaia. Furthermore, while Astypalaia consists of various urban settlements, its total area of 97 square kilometres is significantly smaller than Hamburg's 755 square kilometres, rendering it more than seven times less extensive. As a result, the developmental trajectories of these two regions towards becoming their smart iterations diverge considerably.

Hamburg benefits from a comprehensive ecosystem comprising a relevant and extensive private sector, including industry, and holds the position of the third-largest seaport in the EU. Additionally, as one of the 16 federal states (Bundesländer) within the Federal Republic of Germany, Hamburg possesses considerable flexibility in terms of partnerships, funding, and the allocation of resources. This positions the city to explore innovative opportunities for revolutionising its mobility sector by effectively integrating U-space and UAM elements on a large scale.

On the contrary, the situation for Astypalaia- a small island in the Aegean Archipelago with tourism as its primary source of economic growth- differs remarkably. Since it lacks the support of a vast private ecosystem and separate state funding mechanisms, the adoption of electrokinesis solely for ground vehicles emerges as a more viable strategy for Astypalaia in its pursuit of a smart transformation.

In conclusion, while the EU acknowledges the significance of cities in the integration and application of UAM within their urban airspaces, as delineated in Regulation (EU) 2021/664, Article 18f, the realisation of such initiatives fundamentally relies on the specific capacities of each city or region and of course financial standing of the member state. These entities must devise a model of urban air mobility that aligns with their unique needs and characteristics. The complexities associated with UAM/IAM and U-space, along with their relevant aircraft and infrastructure on the ground, undeniably impose greater demands than those associated with the operation of solely electric ground vehicles. As a result, the transition of cities within the EU towards their smart versions will not occur at a uniform pace, nor will it adhere to the same objectives.

CONCLUSIONS

The present study was conducted as a direct response to the intriguing research question, "Is the upcoming model of advanced urban mobility simply another aircraft network?" The characterisation of the above question as intriguing is due to the fact that it functions as a rhetorical device, hinting from the beginning what this new mobility model is not while simultaneously outlining essential elements of its nature, such as its air component and its nexus to urban environments.

The unconventional approach of this dissertation follows the Socratic method of argumentation, which posits that comprehending a topic or concept begins with a proper definition. Due to this unique method of assessing the topic under scrutiny, the main question of this dissertation was addressed in Chapter I, as rhetorical questions can be easily debunked; their purpose is to open the discussion for the actual inquiries intended by the author. Thus, the primary research question of this thesis serves as a foundation for the dialectical progression toward the actual questions the author sought to explore regarding the topic in question.

These questions orbit around the position of UAM in relation to other terms used in public discussion, the role of ICAO in UAM standardisation efforts worldwide, the realm of UAS and eVTOL authorisation within the European Union, and other questions concerning the applicability of existing legal instruments to this new air mobility environment, along with potential conflicts arising from this application.

This constellation of derivative questions serves to clarify and connect the fragmented information found in various sources, including academic writings, policy and regulatory documents, and materials from fields such as sociology, aviation operations, and urban planning viewed through a legal lens. To effectively address these queries regarding UAM, this thesis adopted a transparent macro-to-micro approach, moving from theoretical to practical aspects. This approach took the form of a passage from the theoretical topics pertaining to the definitions relative to UAM, the relevant works of ICAO, to

aviation safety aspects (standardisation, authorisation), followed by an assessment of the UAM operations. The above naturally led to the exploration of the concept of liability, assessing how existing legal frameworks interact with the risks posed by UAM operations. Finally, the employment of a case study aimed to evaluate how the aforementioned regulatory and legal principles discussed earlier function in practice.

Chapter I of this research made clear that UAM is not another aircraft network. On the contrary, it is a far more complex concept, a holistic mobility environment that boasts an air component (third dimension), but its realisation and implications extend further than a topic that falls strictly in the aviation domain and jurisdiction. Is UAM the only term to describe these environments? The answer is no. The author adopted EASA's classification of UAM as a sub-term of IAM, which is a part of IAS, and not the term AAM. Still, since these are purely theoretical concepts at the moment, the practical implications of their accurate distinction from each other do not seem to be visible or intended. Chapter I debunked another common misconception that UAM equals eVTOLs. UAM is not eVTOLs and eVTOLs are not UAM. eVTOLs might be the aircraft that constitute a fundamental element of the UAM environments; however, they are one of the many that will operate in UAM environments. The same can be said about the UAS. But what is the nexus between the air mobility environments and aircraft above, with the concept of the smart city? In this dissertation, it was posited that the materialisation of UAM in the EU cities will be a contributing factor leading to what the industry and EU administration perceive as a smart city, transforming the perception of urban mobility on the continent, which will lead to a transition from transportation to mobility for the public.

The investigation into the nature of UAM naturally led to the evaluation of the initiatives undertaken by the international organisation responsible for civil aviation and its member states. Although some essential discussions were held regarding the position of ICAO on international civil aviation, including its structure and competencies, Chapter II examined ICAO's perspectives through the lens of the most recent three Assemblies and the viewpoints of its member states, as well as current initiatives related to UAM/AAM.

The results of this evaluation led to the conclusion that UAM is too complex to be managed solely by entities exclusively focused on aviation. Furthermore, despite the good intentions expressed by ICAO through the AAM SG to formulate international standards and guidelines pertaining to UAM/AAM, the substantial progress already achieved by the EU and the U.S. may render these initiatives ineffective. Both the above examples have already established relatively sophisticated regulations and standards concerning the air mobility environments under scrutiny. Nonetheless, it constitutes the opinion of the author that the SG holds great value in the establishment of minimum standards to ensure minimum safety requirements for UAM/AAM operations worldwide remains critical for the appropriate and secure implementation and acceptance of UAM/AAM globally and should be endorsed and supported appropriately by the ICAO member states. For the SG to effectively fulfil its objective of establishing the desired standards for future SARPs, the author proposes that industry stakeholders must be actively engaged beyond mere token participation, ensuring that their input is genuinely considered. Furthermore, the SG should explicitly communicate the multifaceted nature of UAM and encourage collaboration also from non-aviation stakeholders to contribute to the development of future SARPs. However, it appears that, given its focus on aviation, an organisation such as ICAO may find such engagement to be a challenge.

Chapter III shifts the focus from the realm of international aviation safety to the EU, with a legal analysis of the standardisation and authorisation framework pertaining to two main aircraft components within the UAM environments: the eVTOL/VCA and the UAS. This analysis, while detailing various technical aspects within the EU regulatory structure, concludes with three significant points. Firstly, the EU possesses one of the most sophisticated and comprehensive regulatory systems regarding standardisation and authorisation, if not the foremost, ensuring the safe and secure operation of UAS and eVTOLs in its urban airspace. Secondly, the complexity of this regulatory framework may hinder numerous emerging players, such as eVTOL manufacturers, from entering the market, primarily due to their inability to

navigate this intricate EU compliance environment. In the discussion about the rapid materialisation of UAM and the importance of preventing fatal accidents that could damage public perception of UAM, the author aligns with the European Union's stance, prioritising safety and security over the ambition for market success in the assessed mobility environments. Lastly, for that reason. safety and security transcend merely legal or regulatory boundaries, with public acceptance serving as a crucial factor influencing the success of UAM. In the context of the EU standardisation and the authorisation of UAS and eVTOLs/ VCA, the author’s proposals focus on expediting the regulatory assessment of operations classified under the "certified" risk category as designated by EASA. This is aimed at fulfilling one of the final prerequisites necessary for the deployment of UAS and unmanned eVTOL operations over populated areas, as well as for the transportation of passengers or dangerous goods.

Upon the completion of the etymological evaluation of the crucial terms involved, and following the discourse on aviation safety within both international and the EU domains, Chapters IV and V present an analysis of aircraft operations within the UAM environments. This analysis is augmented by a comprehensive assessment of legal considerations pertaining to liability, with a specific focus on the existing liability laws applicable within the EU, which, due to their scope, may potentially be applied to eVTOL and UAS operations in the foreseeable future. The analysis concerning the operational domain of UAS and eVTOL within UAM environments is guided by multiple objectives.

Firstly, utilising a term referenced in Chapter II, to evaluate the legal significance of the term “municipal airspace” and its connection to UAM as cited during the last ICAO Assembly under the Chicago Convention of 1944. Secondly, to assess the applicability of the provisions of the Chicago Convention to unmanned aircraft that will operate in UAM environments. Lastly, to analyse the implications of existing EU legal instruments concerning access to EU airspace for aircraft conducting UAM operations. While designating the term “municipal airspace” as inconsistent with the Chicago Convention and therefore not a legal term, despite its usage during the 41st ICAO Assembly, was a necessary yet unsurprising element of this analysis, the applicability of the

Chicago Convention to the UAS in UAM environments reaffirms their aviation core and consequently their classification as aircraft, akin to conventional aircraft. Unfortunately for the eVTOL operators, classifying a flying vehicle as an aircraft not only comes with benefits from the expansive legal support of international and supranational aviation regimes but also with certain drawbacks. The envisioned operation of eVTOL and UAS in UAM environments potentially conflicts with EU Regulations pertaining to access to airspace for conventional aircraft. The penultimate section of Chapter IV focuses on the significant inconsistencies and legal irregularities that may arise from this application. A major inconsistency, among others, pertains to Regulations 1008/2008 and 261/2004, which are applicable to air carriers. However, leading EU eVTOL operators/manufacturers such as Volocopter and Lilium have not yet acquired a valid AOC. Without an AOC, these companies are not categorised as air carriers and consequently cannot operate their aircraft independently. A viable alternative would be to lease their aircraft to an AOC holder, such as Lufthansa AG; however, this approach would contradict their research and development efforts and declarations of a desire to control the entire operational cycle of their aircraft (including ticket booking, take-off, landing, charging, etc.). Consequently, for the eVTOL operators to operate their aircraft, they would have to comply with the comprehensive set of regulations tailored for conventional aviation established for and by the existing market players. This situation could lead to compliance challenges and, ultimately, viability issues. This appears to be true for Lilium, which, as of early 2025, has filed for insolvency due to a multitude of challenges.[670]The final part of Chapter IV focuses on the critical concept of U-Space and its correlation with UAM, portraying the holistic nature of UAM as a comprehensive system in the EU urban skies capable of accommodating both manned and unmanned aircraft.

As this dissertation approaches its conclusion, Chapter V evaluates the second and third liability regimes under international and EU law. Following the established pattern from previous chapters, an evolutionary evaluation was conducted to highlight the differences between the so-called Warsaw world and

[670] See, (https://www.aerospacetestinginternational.com/news/lilium-declares-bankruptcy-for-the-second-time.html), accessed (01-03-25).

the regime currently applicable in most ICAO member states and the EU, namely the Montreal Convention 1999. The emphasis on legal inconsistencies in the same principle as discussed in the preceding chapter is maintained, alongside a focus on potential measures to mitigate the negative implications arising from the application of existing legal instruments on liability to UAM operations. The approach taken varies regarding the respective legal instruments. While the Rome Convention of 1952 is entirely inadequate to address the issue of international third-party liability, the Montreal Convention (and consequently Regulation (EC) No 889/2002) appears to be better equipped to handle the novel operations under scrutiny; however, it is not without its own problematic aspects. Regarding Regulation 261/2004, the concerns about its unsuitability, as stated in Chapter IV, are reiterated in Chapter V. The author, in addressing the inconsistencies that may arise from the application of existing legal frameworks to the operation of UAM aircraft, asserts, with reference to both Chapters IV and V, that if the large-scale operation of eVTOL/VCA within UAM environments does not align with new regulations designed to amend the problematic aspects of the aforementioned legal instruments, particularly Regulation 261/2004, then the ECJ will be compelled to undertake significant interpretative work through judicial rulings to address the identified issues. This endeavour may lead to legal ambiguity and a phase of regulatory instability as the courts strive to harmonise existing laws with evolving realities.

The final chapter examines the practical perspective of UAM assimilation in the EU, utilising the examples of Hamburg and Astypalaia. The results of this evaluation see UAM as a checkpoint towards the transformation of EU cities into their “smart” versions, which each city will reach at its own pace, according to its financial capabilities, existing relevant industry, public acceptance, and political willingness. The same applies to what is perceived as “smart”. For Hamburg, its smart version is undoubtedly connected with UAM. Astypalaia, on the other hand, lacking all the aforementioned capabilities, views its smart version as adding the element of ground electromobility to its transportation system. This leads to the realisation that UAM as a democratisation attempt of urban aviation, will not be a uniform mobility

revolution but a revolution for those capable of sustaining and accommodating the operation of its constituent aircraft and infrastructure.

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Curriculum Vitae

Konstantinos Ioanni Andritsos graduated in 2017 from the European University of Cyprus with a Bachelor of Laws. In 2019, after completing his mandatory 18-month legal internship in various positions in Greece, he successfully passed the Bar Association exams and took his oath at the first instance court of Giannitsa, Pella, registering with the local Bar Association.

In 2020, Konstantinos obtained an LL.M (Adv.) in Air and Space Law from Leiden University, where he further developed his skills in public international law, focusing on innovative aviation matters, particularly concerning unmanned aircraft systems.

In 2021, following the initial wave of the COVID-19 pandemic, he pursued his aspiration of obtaining a doctorate in aviation after being invited by Prof. Stephan Hobe to the Institute for Air Law, Space Law, and Cyber Law. During the writing of his doctoral dissertation, Konstantinos worked as a *Wissenschaftlicher Mitarbeiter* at the Institute, where he was responsible for aviation legal matters.

Konstantinos has a strong research and academic interest in public international air law, EU aviation law, innovative technologies in aviation, and the operations of UAS in EU airspace at scale. He is the author of several scientific contributions, academic articles, and a book chapter.

Since 2024, Konstantinos has served as the sole legal counsel for Eurowings Europe Limited, a member of the Lufthansa Group, where he is responsible for various matters, including compliance, contracts, human rights, and governance.