

글로벌 ICT 표준 컨퍼런스 2023

Global ICT Standards Conference 2023

(세션3) 미래 모빌리티: 새로운 이동 생태계

도심항공모빌리티 생태계 – 규제편

Ecosystem of Urban Air Mobility – Regulatory

김 명 집, 지식경영이사(CKO), 파블로항공
“항공과 비평” 블로거

주최



과학기술정보통신부
Ministry of Science and ICT



특허청
Korean Intellectual
Property Office

주관



국립전파연구원
National Radio Research Agency



ITP

KEA

kista

ETRI

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02 Policy & Regulations – eVTOLs, AirOps, & Vertiports

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As of November 6, 2023

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Global ICT Standards Conference 2023



도심항공모빌리티 생태계 - 규제편

Ecosystem of Urban Air Mobility - Regulatory

Presenter



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Blog: <https://blog.naver.com/myungjip>

- 2022.05~Present : Pablo Air
- 2023.03~Present : Korea Aerospace Industries Association, Research Fellow
- 2022.09~Present : Korean Agency for Technology and Standards, Aerospace (ISO TC20) Expert Member
- 2006~2021 : Korea Aerospace Research Institute
 - ✓ Korea Utility Helicopter FSD for ROK Army
 - ✓ Multi-ministerial Program Planning for National Security sUAS
 - ✓ Head of Unmanned Vehicle Advanced Research Center
 - ✓ International R&D planning btw. Korea & Denmark
 - ✓ Multi-ministerial Program Pre-planning for National Security Medium-Heavy UAS
 - ✓ Future Planning of Institute
- 1996~2006 : Daewoo Heavy Industries, Korea Aerospace Industries, Ltd.
 - ✓ KT-1 Basic Trainer FSD & FRP for ROKAF
 - ✓ T-50 Advanced Trainer FSD & LRIP for ROKAF



“새로운 시각과 인사이트,
그리고 도전”



공허 空虛 Emptiness



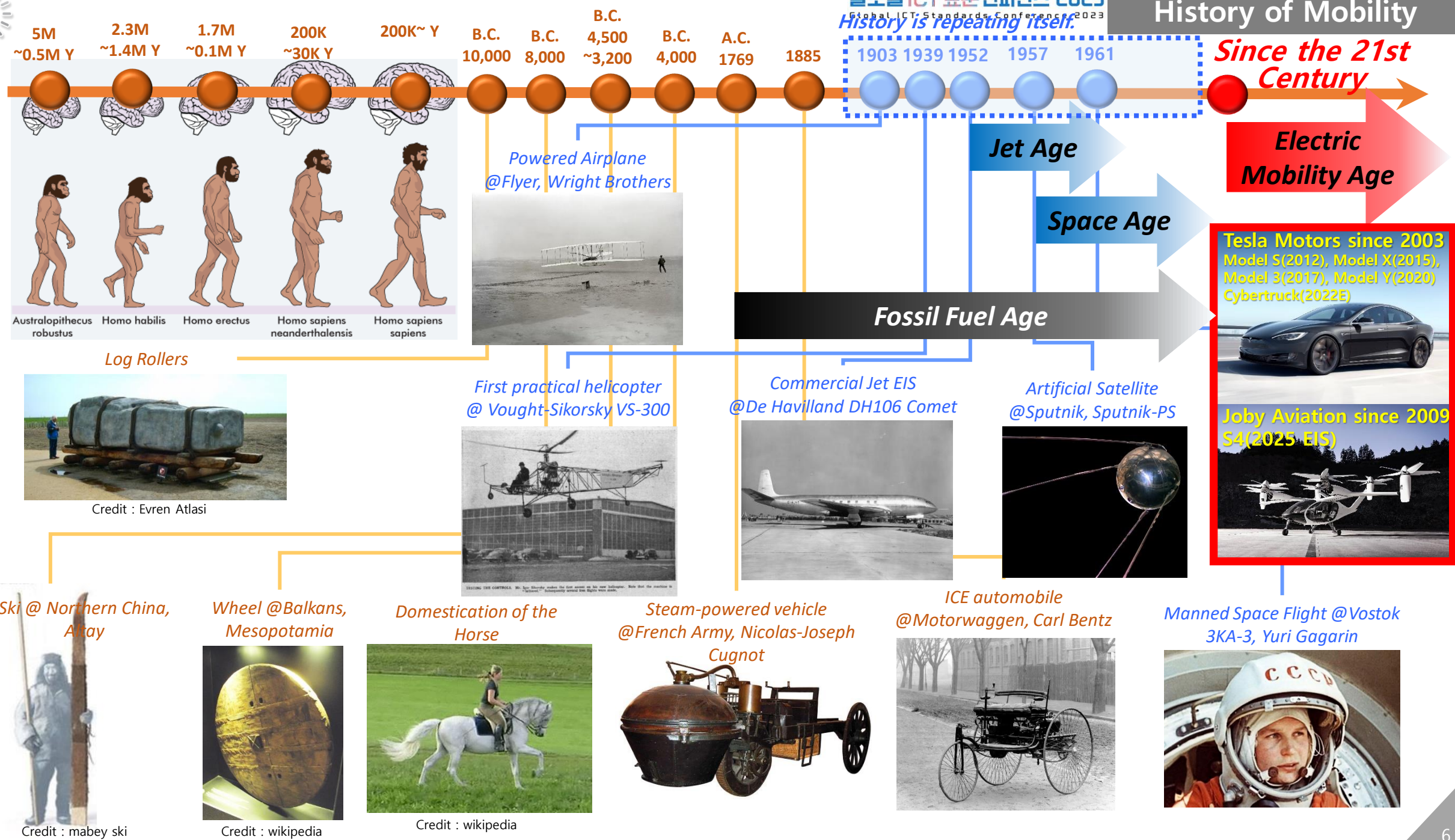
혼잡



混雜



Congestion



The Great Electric Airplane Race

Directed by Miles O'Brien, @PBS NOVA on May 26, 2021

BERTRAND PICCARD (Solar Impulse Foundation):
It's extremely difficult to get rid of the fuel, if you want to transport tons and tons of passengers.

MILES O'BRIEN: Could rapid progress in electric technology change the equation?

TERIK WEEKES (Elroy Air): Electric motors are at a certain point today, the battery systems are at a certain point today, we're within that edge of possible.

MILES O'BRIEN: New technology is driving a global race to push that edge.

SEBASTIAN THRUN (Kitty Hawk): This might sound crazy, but we believe it's the future of transportation for everybody.

MILES O'BRIEN: A new era may be closer than you think.

Are we flying the future right now?

JOSEPH OLDHAM (New Vision Aviation): We absolutely are.

MILES O'BRIEN: The Great Electric Airplane Race is cleared for takeoff, right now, on NOVA.

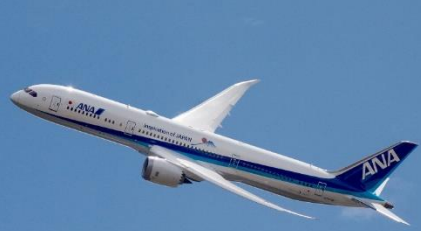
Aircraft Electrification

MEA ✓ (More Electric Aircraft)

- Pneumatic (Anti/De-icing, ECS,...)
- Hydraulic (Actuation, Brake,...)



A380 (2007 EIS)



787 (2011 EIS)



A350 (2015 EIS)



Bye Aerospace eFlyer2 (in certi)

LSA, small (14 CFR Part 23 Amdt 64, CS-LSA Amdt 1)

VELIS Electro ✓
(20.6 TC)
50min+VFR reserves



de Havilland DHC-2 Beaver (in certi)



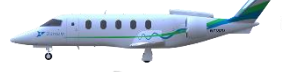
Cessna 208B Grand Caravan (in certi)

eCTOL (electric Conventional Takeoff and Landing)

BJ (Business Jet)



Eviation Aircraft Alice (9-pax)



Zunum Aero ZA10 (finance issue)

RJ (Regional Jet)



Airbus E-Fan X (suspended)



Zunum Aero 50pax (concept)



WrightElectric Wright 186pax (concept)



Hear Aerospace ES-19 (PAC 2026)

eSTOL (electric Short Takeoff and Landing)

LCA (Large Commercial Aircraft)



Boeing SUGAR Volt (concept)

EPA (Electric Propulsion Aircraft)

- AEA(All Electric Aircraft)
- HEA(Hybrid-Electric Aircraft) -Serial/Parallel
- TEA(Turbo-Electric Aircraft)

eVTOL (electric Vertical Takeoff and Landing)

For UAM (Urban Air Mobility)



Airbus CityAirbus



Joby Aviation S4



Ehang EH216-S



Lilium Jet



Volocopter Velocity

Electric Helicopter



Tier1 Engineering Electric R44

항공기 전기화는 소형에서부터 진행 중

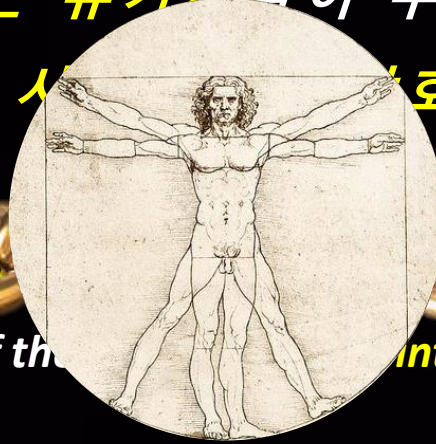


UAM Ecosystem

네이버블로그
항공과비행



“ 생태계란 **살아있는 유기체들이 무기물들과 함께**
그들의 환경에서 **하나의 시스템으로 상호 작용하는 공동체** ”

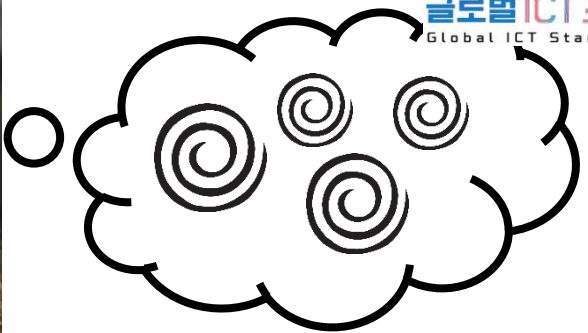


What do you want to be?



If you must select ONLY one,

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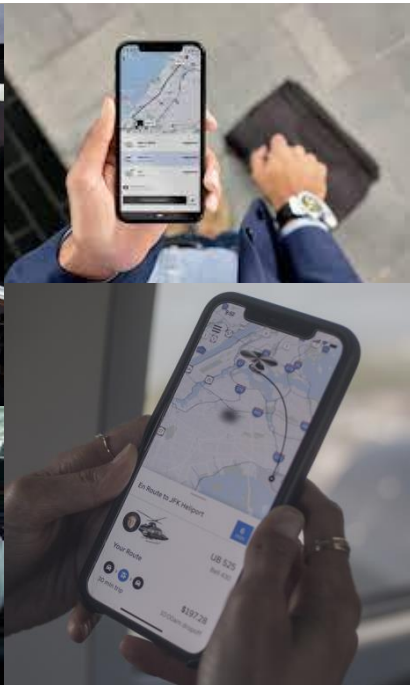
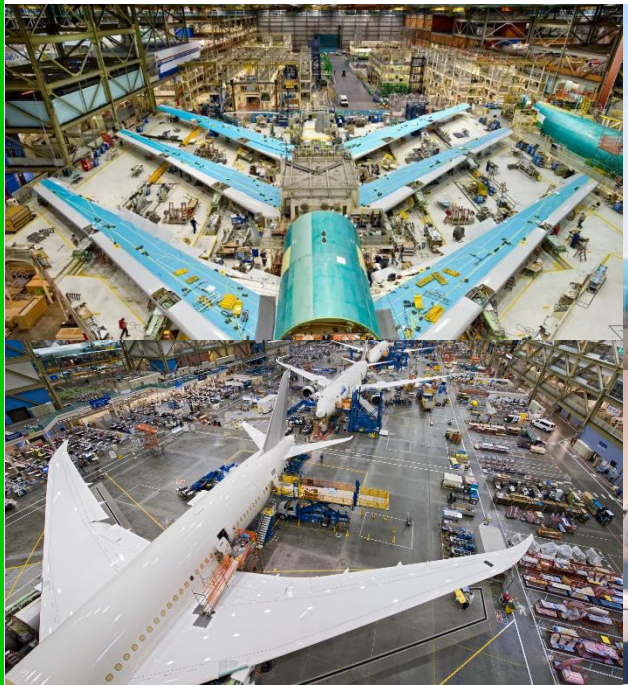
Airframers
& their supply chains

Air Operators, Airmen, MRO
& their related businesses

Aerodromes
& their related businesses

ANSPs
& their related business

Passenger Solution
(Platform)



...



- **Allies : 609,207** including 295,959 by U.S., 177,025 by British, 136,223 by USSR
- **Axis : 222,235** including 133,387 by Germany, 64,484 by Japan, 13,402 by Italy, 1,113 by Romania, 9,849 by others. (source: Wikipedia)



5. Faster





eVTOL MRO AirOps ATM Vertiport Pax Solution



The 2nd Key. **Policy & Regulations**

- 민간항공 규제 지배구조
- 미국과 EU의 레이싱과 부조화
- eVTOL 인증 (미 · EU)
- 항공운용(AirOps)
- 버티포트(Vertiports)
- 종합

항공산업은 법이 있어야 돈을 벌고,
돈을 벌려면 법이 먼저 있어야 하고...





19 Annexes to Convention
- SARPs



Guidance Materials
such as PANS, SUPPs, ...



- SARPs: International Standards and Recommended Practices
- PANS: Procedures for Air Navigation Services

Uniformity

~ Global Interoperability and Harmonization

Overarching Hierarchy

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Contracting States (체약국)



- **United States Code (USC)**
↳ Title 49 Transportation
- **Federal Aviation Act of 1958**



- **Basic Regulation : Regulation (EU) 2018/1139**
"Common rules in the field of civil aviation and establishing a EASA (source: [EASA](#))
- Commission Regulation (EU) ...
- Commission Implementing Regulation (EU) ...



- 항공안전법
 - 항공사업법
 - 항공보안법
 - 공항시설법
- 항공4법

DOT - FAA



45,000 federal officers as of 2021
(source: [GAO](#))
↳ 1,400 for aircraft certification services (source: [FAA](#))

- **Code of Federal Regulations (CFR)**
↳ Title 14 Aeronautics and Aviation
↳ Subchapter A. Definitions and General Requirements, B. Procedural Rules, **C. Aircraft**, D. Airmen, E. Airspace, F. Air Traffic and General Operating Rules, G. Air Carriers and Operators for Compensation or Hire: Certification and Operation, H. Schools and Other Certificated Agencies, I. Airports, J. Navigational Facilities, K. Administrative Regulation, N. War Risk Insurance
- Advisory Circulars(AC), Orders and Notices, Handbooks & Manuals, Flight Standards Information Management System (FSIMS), Information for Operators(InFOs), Safety Alerts for Operators (SAFOs), Notices to Mission (NOTAMs) ...



EASA
European Aviation Safety Agency

800 as of 2020
(source: [EASA](#))



EUROCONTROL
2,000+ officials
(source: [EUROCONTROL](#))

European Organisation for the Safety of Air Navigation

EASA acts as the European regulator of the system while EUROCONTROL is the pan-European civil-military aviation organisation playing a central coordination role.

UK CAA

CAAC

JCAB

CAAS

KOCA

시사점

❖ 국제민간항공기구(ICAO)는 UAM 국제표준 및 권고관행(SARPs) 및 지침자료(GM)이 아직 없지만, 도심항공 운용개념도 인접 국 간 국제 상용항공운송(CAT)이 가능하므로, 향후 10년 이내에 국제민간항공협약에 근거해 SARPs, PANS, GM 등의 규제 프레임워크를 수립하는 경로로 진입 중.

MOLIT - 항공정책실

- ↳ 지방항공청(서울·부산·제주)
- ↳ 항공교통본부 @대구,청주(위성)
- ↳ 항공철도사고조사위원회 @세종
- ↳ 항공안전기술원(KIAT) @인천
- ↳ 한국교통안전공단(TS) @김천

예하 행정규칙

- **항공기 기술기준(KAS)**
- Part 1, 21, 22, 23, 25, 26, 27, 29, 30, 33, 34, 35, 36, 45, VLR류 회 전익항공기 (국토부 고시)
- ...

International
Consensus Standards



Aeronautical
Design
Standards (ADS)



The 2nd Key. Policy & Regulations



누구게?

- 민간항공 규제 지배구조
- 미국과 EU의 레이싱과 부조화
- eVTOL 인증 (미 · EU)
- 항공운용 (AirOps)
- 버티포트 (Vertiports)
- 종합

고래등 싸움에 새우등은 터지고...



AAM UAM IAM



AAM & IAM ⊃ UAM	ICAO	NASA	FAA	EASA
AAM Advanced Air Mobility	None	AAM is an air transportation system that moves people and cargo btw places previously not served or underserved by aviation – local, regional, intraregional, urban – using revolutionary new aircraft that are only just now becoming possible.	The terms “advanced air mobility” and “AAM” mean a transportation system that transports people and property by air between two points in the United States using aircraft with advanced technologies, including electric aircraft or electric vertical take-off and landing aircraft , in both controlled and uncontrolled airspace. (Public Law 117-203, “Advanced Air Mobility Coordination and Leadership Act”, Oct 17, 2022)	N/A
IAM Innovative Air Mobility	None	N/A	AAM builds upon the UAM concept by incorporating use cases not specific to operations in urban environments, such as: - Commercial Inter-city (Longer Range/Thin Haul) - Cargo Delivery - Public Services - Private / Recreational Vehicles	IAM is the safe, secure and sustainable air mobility of passengers and cargo enabled by new-generation technologies integrated into a multimodal transportation system .
UAM Urban Air Mobility	None	UAM is a safe and efficient system for air passenger and cargo transportation within an urban area, inclusive of small package delivery and other urban Unmanned Aerial Systems (UAS) services, which supports a mix of onboard/ground-piloted and increasingly autonomous operations.	UAM envisions a safe and efficient aviation transportation system that will use highly automated aircraft that will operate and transport passengers or cargo at lower altitudes within urban and suburban areas. UAM will be composed of an ecosystem that considers the evolution and safety of the aircraft, the framework for operation, access to airspace, infrastructure development, and community engagement.	UAM means a subset of IAM operations conducted into, within or outside congested (urban) areas.



시사점

- ❖ 국제민간항공기구(ICAO)의 정의 부재 속에서,
- ❖ 미국과 유럽연합은 각각 AAM과 IAM 용어와 정의 채택,
- ❖ UAM 용어는 양권역이 사용

< 공통점 >

- ① 항공기의 진화와 안전성,
- ② 운용 프레임워크,
- ③ 공역 통합,
- ④ 인프라 개발,
- ⑤ 지역사회 참여

The 2nd Key. Policy & Regulations - eVTOLs

- 민간항공 규제 지배구조
- 미국과 EU의 레이싱과 부조화
- **eVTOL 인증 (미 · EU)**
- 항공운용 (AirOps)
- 버티포트 (Vertiports)
- 종합

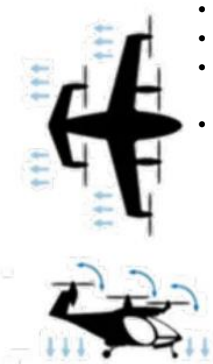
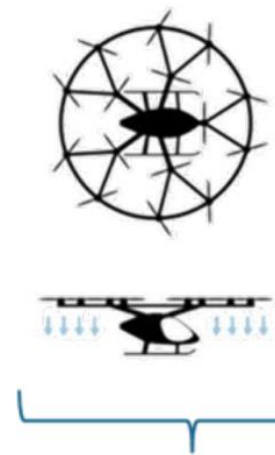
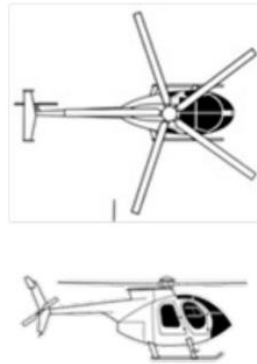


Novel & Unique
eVTOL Aircraft Type Certification

Propulsion Axis	Horizontal	Vertical		Hybrid
Definition	Conventional Aircraft		?	 Powered-lift
Configuration	Fixed Wing	Rotary Wing	 EASA European Aviation Safety Agency VTOL-Capable Aircraft (VCA)	 Multicopter  Lift+Cruise  Vectored Thrust

시사점

- ❖ 미국과 유럽은 신형 항공모빌리티 부문에서 VTOL 항공기 등급 분류/용어가 부조화.
- ❖ 국제민간항공기구(ICAO)도 국제표준 및 권고관행(SARPs)에서 아직 정의하지 않음.
- ❖ 그럼에도 불구하고,
 - ✓ 미연방항공청(FAA)은 Powered-lift,
 - ✓ 유럽연합항공안전청(EASA)은 VCA로 등급화했고,
 - ✓ 한국은 미국의 14 CFR Part 21을 추종하여, “수직추력 이착륙기(Powered-lift)”로 정의함.

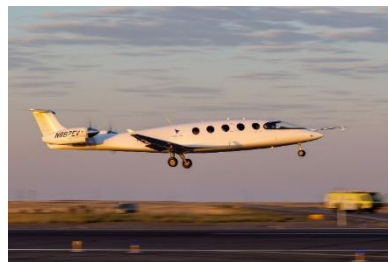


- Tilt-rotor
- Tilt-prop
- Tilt-wing
- Ducted Vectored Thrust
- ...

Wingless

Winged

Prop? Rotor? ↓





ICAO



FAA

EASA
European Aviation Safety Agency

Korea

Terms

Powered-lift

Since 10th edition of Annex 1 in 2006

Powered-lift

VTOL-Capable Aircraft (VCA)

수직추력 이착륙기

Regulation

Annex 1

14 CFR Part 21
§ 1.1 General definitionsProposed amendment to Commission
Regulation (EU) No 965/2012
Article 2 Definition항공기 기술기준(KAS) Part 21 총칙
1.3 정의Legal
Definitions

Powered-lift. 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.

Powered-lift means a heavier-than-air aircraft capable of vertical takeoff, vertical landing, and low speed flight that depends principally on engine-driven lift devices or engine thrust for lift during these flight regimes and on nonrotating airfoil(s) for lift during horizontal flight.

'VTOL-capable aircraft' means a power-driven, heavier-than-air aircraft, other than aeroplane or rotorcraft, capable of performing vertical take-off and landing by means of lift or thrust units used to provide lift during take-off and landing;



수직추력 이착륙기(Powered-lift)라 함은 공기보다 무거운 항공기로서 수직 이착륙이 가능하고 저속비행 시에는 비행시간 동안 양력을 주로 엔진구동 양력장치 또는 엔진 추력에 의존하고 수평비행시 양력을 회전하는 에어포일이 아닌(nonrotating airfoil, 회전익항공기) 장치에 의존하여 비행이 가능한 항공기를 의미한다.

The term "vertical take-off and landing" means an aircraft with lift/thrust units used to generate powered lift and control and with two or more lift/thrust units used to provide lift during vertical takeoff or landing. (Public Law 117-203, "Advanced Air Mobility Coordination and Leadership Act", Oct 17, 2022)

VERTICAL TAKEOFF AND LANDING AIRCRAFT (VTOL)- Aircraft capable of vertical climbs and/or descents and of using very short RWYs or small areas for takeoff and landings. These aircraft include, but are not limited to, helicopters. (source: FAA's Pilot/Controller Glossary, 3 Nov 2022)

요약

- ❖ VTOL 관련 정의는, ICAO 정의 부재 속에서,
- ❖ FAA는 Powered-lift로,
- ❖ EASA는 VCA로 정의하며,
- ❖ 회전익기/헬리콥터의 정의도 차별화 시작.

로터 수 ≥ 1개 vs. ≤ 2개



Rotorcraft means a heavier-than-air aircraft that depends principally for its support in flight on the lift generated by one or more rotors.

Helicopter means a rotorcraft that, for its horizontal motion, depends principally on its engine-driven rotors.



'Rotorcraft' means a power-driven, heavier-than-air aircraft that depends principally for its support in flight on the lift generated by up to two rotors;

'Helicopter' means a heavier-than-air aircraft supported in flight chiefly by the reactions of the air on up to two power-driven rotors on substantially vertical axes;

Type Certification



Starting Point

14 CFR Part 23
Part 25
Part 27
Part 29
Part 33
Part 35

- FAA AC
- **FAA accepted MoCs**
- ASTM, RTCA/DO...
- International Consensus



Special Condition
for the specific aircraft, engine, and propeller per 14 CFR §21.16, §21.17(a)

FAA's regulatory framework change **since May 2022** :
From Special Condition per §21.17(a) to

Special Class of Aircraft(Powered-lift category) per §21.17(b)

VS.



Starting Point

VTOL Special Condition
"Special Condition for small-category VTOL aircraft"
SC-VTOL-01, July 2019
Based on CS-23 Amendment 5 integrating elements of CS-27 and new elements

Special Condition:
Electric/Hybrid Propulsion System
SC E-19, April 2021



MOC (Means of Compliance)

- MOC SC-VTOL
 - Issue 2, May 2021
 - Issue 1, May 2020
- MOC-2 SC-VTOL
 - Issue 1, June 2021
 - Issue 2, June 2022
 - Issue 3, December 2022
- MOC-3 SC-VTOL
 - Issue 1, June 2022

- CS-23, 25, 27, 29...
- AMC & GM
- EUROCAE/ED
- FAA AC
- International Consensus

§21.16 Special conditions.

If the FAA finds that the airworthiness regulations of this subchapter do not contain adequate or appropriate safety standards for an aircraft, aircraft engine, or propeller because of **a novel or unusual design feature of the aircraft**, aircraft engine or propeller, he prescribes special conditions and amendments thereto for the product. **The special conditions** are issued in accordance with Part 11 of this chapter and contain such **safety standards for the aircraft, aircraft engine or propeller** as the FAA finds necessary to establish **a level of safety equivalent** to that established in the regulations.

§21.17 Designation of applicable regulations.

(a) Except as provided in §§ 25.2, 27.2, 29.2, and in parts 26, 34, and 36 of this subchapter, an applicant for a type certificate must show that the aircraft, aircraft engine, or propeller concerned meets -

(1) The applicable requirements of this subchapter that are effective on the date of application for that certificate unless -

- (i) Otherwise specified by the FAA; or
- (ii) Compliance with later effective amendments is elected or required under this section; and

(2) **Any special conditions prescribed by the FAA.**

(b) **For special classes of aircraft**, including the engines and propellers installed thereon (e.g., gliders, airships, and other nonconventional aircraft), for which **airworthiness standards have not been issued under this subchapter**, the applicable requirements will be the portions of those other airworthiness requirements contained in Parts 23, 25, 27, 29, 31, 33, and 35 found by the FAA to be appropriate for the aircraft and applicable to a specific type design, or such airworthiness criteria as the FAA may find provide **an equivalent level of safety to those parts**.

Basic Regulation, Annex I(Part 21)

21.B.75 Special conditions

(a) The Agency shall prescribe special detailed technical specifications, named **'special conditions'**, for a product if the related certification specifications do not contain adequate or appropriate safety standards for the product because:

- the product has **novel or unusual design features** relative to the design practices on which the applicable certification specifications are based;

(b) Special conditions contain such **safety standards** as the Agency finds necessary in order to establish **a level of safety equivalent** to that of the applicable certification specifications.

The 2nd Key. *Policy & Regulations - eVTOLs*

미국의 eVTOL 형식인증

Part 21.17(b) 특수분류 항공기

Powered-lift

Regulatory Applicability to eVTOL

FAA Certification Path Decision Tree

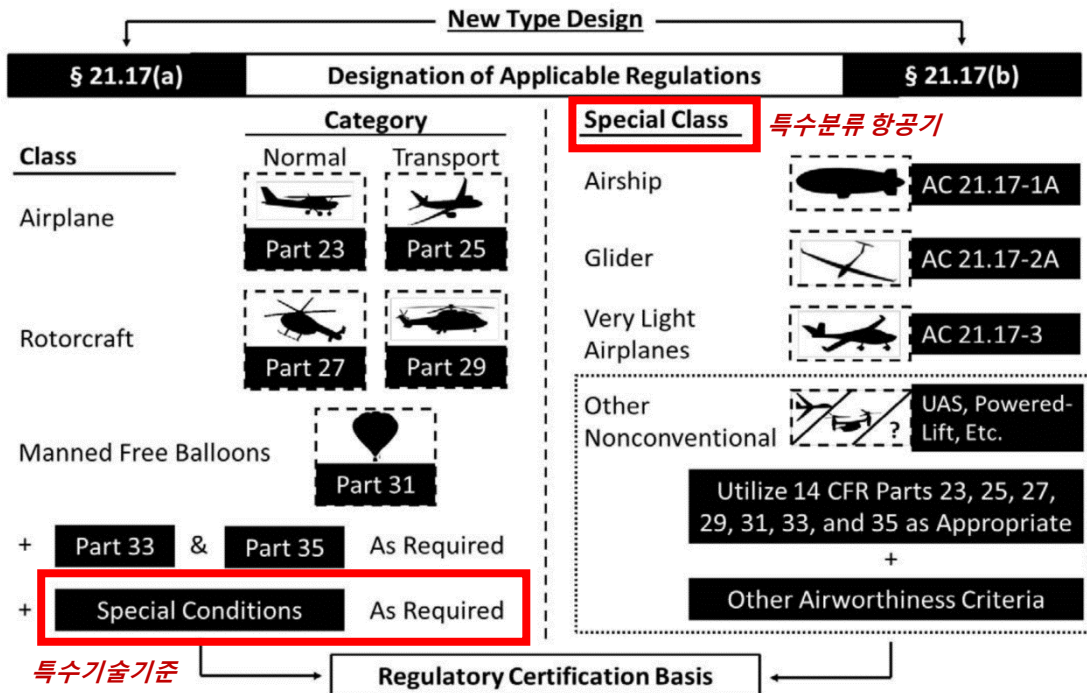


Figure 2. AAM Aircraft in the FAA Certification Process as of August 2022



Source: UAM Manufacturers (clockwise from top-left: Alakai Technologies; AirVEV; Courtesy of Joby Aviation. © Joby Aero, Inc.; Beta Technologies; Archer Aviation; and Moog, Inc.)

요약

- ❖ FAA는 1997년에 Powered-lift 항공 자격자 인증류를 신설했지만,
- ❖ 2019년에 eVTOL 인증 경로에 특수 기술기준(SC) 적용을 천명하고,
- ❖ 2022년에 특수분류의 Powered-lift로 다시 복귀



Source: U.S. DOT, "Regulatory Gaps and Lack of Consensus Hindered FAA's Progress in Certifying Advanced Air Mobility Aircraft, and Challenges Remain", 21 June 2023

FAA Powered-lift Type Certification

글로벌 ICT 표준 컨퍼런스 2023

Figure 3. Certification Basis and Existing Regulations for eVTOL Airplanes

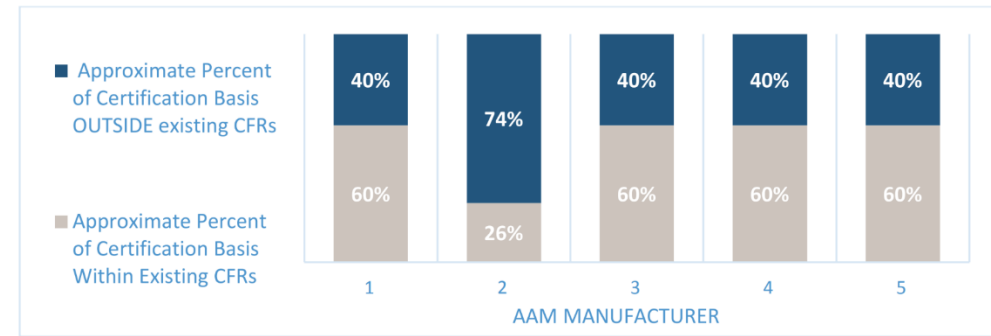
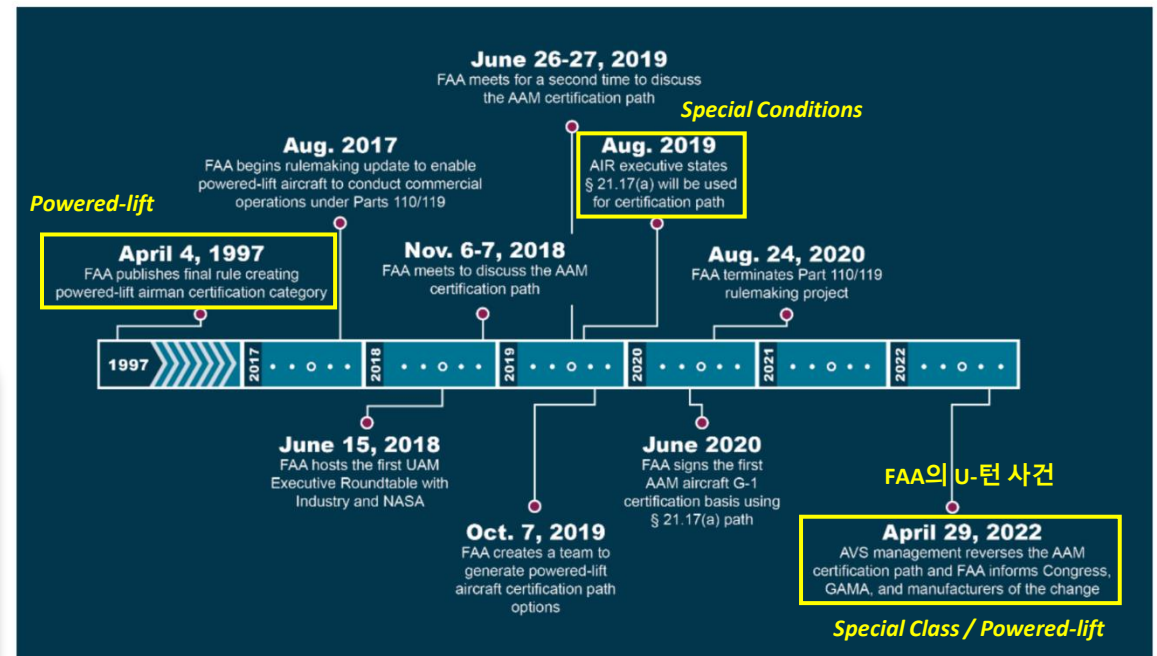


Figure 5. Timeline Source: FAA data



Legend: AIR = Aircraft Certification Service; AVS = Aviation Safety; GAMA = General Aviation Manufacturers Association; NASA = National Aeronautics and Space Administration

Source: OIG analysis of FAA and manufacturer data

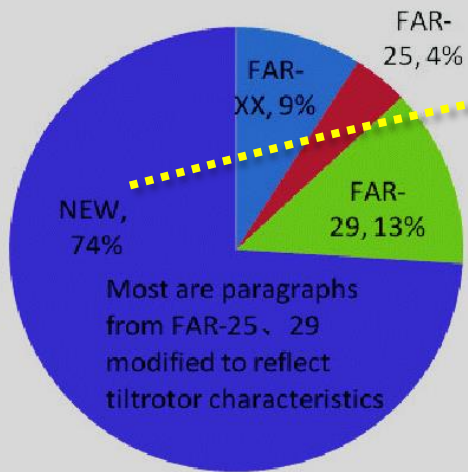


Powered-lift, Special Classes of Aircraft

Airworthiness Criteria for BA609 in 2007



AgustaWestland AW609 (proposed on 27 Sep 2007 after TC application on Aug 1996) (source: [72 FR 54968](#))



Certification Basis of BA609 (current AW609)

FAA draft FAR-XX "Interim Airworthiness Criteria, Powered-Lift Transport Category Aircraft", July 1988

Source: [Weirong Tan et al, "The Analysis of Airworthiness Issues Influence to the Development of Tiltrotor Aircraft", Procedia Engineering 80 \(2014\) 602-608, December 2014](#)

Part 23 amendment 64 :
Performance-based standards
effective since 30 August 2017

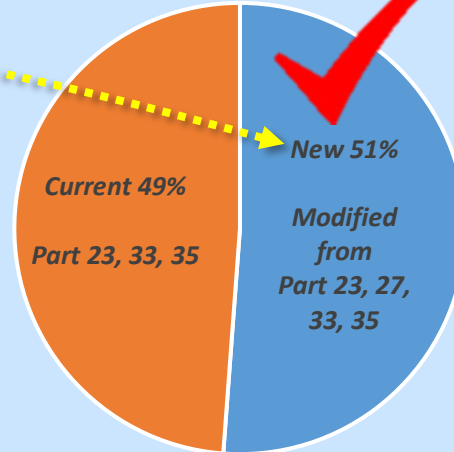
Proposed Airworthiness Criteria for JAS4-1 & MIDNIGHT in 2022



Joby Aviation JAS4-1 (proposed on 8 Nov 2022) (source: [87 FR 67399](#))



Archer Aviation Midnight (proposed on 20 Dec 2022) (source: [87 FR 77749](#))



조항 신설률

- **Part 23 45%** : 보통류 비행기 혁신 촉진을 위해 규범적 규정에서 성능기반으로 개정한 효과
- **Part 33 73%** : 내연기관(ICE)과 다른 전기엔진
- **Part 35 29%** : 추력/양력을 모두 생성, 전기엔진의 증가된 토크/회전수와 분산추진 고려

Proposed Airworthiness Criteria for JAS4-1 & MIDNIGHT

	Current	New	% of New
Part 23	36	30	45%
Part 33	11	29	73%
Part 35	15	6	29%
Total	62	65	51%



Magni350, magni650
(published on 27 Sep 2021)

The 2nd Key. *Policy & Regulations - eVTOLs*

EU의 eVTOL 형식인증

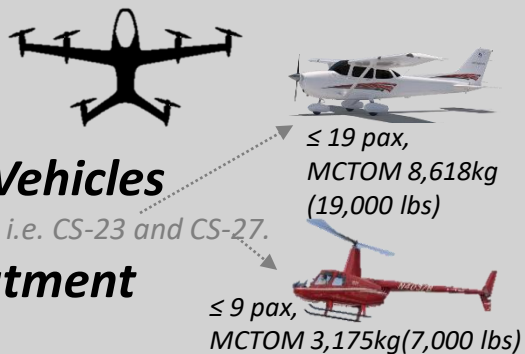
Part 21.17(a)

특수기술기준(SC)

VCA(VTOL-capable Aircraft)

Background

- EASA has reviewed **130**
- Not able to classify **New Vehicles** by the existing specifications, i.e. CS-23 and CS-27.
- Not ensure **Equal Treatment** by the existing specifications.
- CS-23** and **CS-27** has significant differences of system
- Safety Objectives & Operational aspects.**
- Use **Objective Based** certification requirements to provide the flexibility to certify innovative design & technology.
 - FAA uses the performance-based standards for Part 23 instead of the prescriptive ones from amendment 64 effective on 2017.
- Based on **CS-23 Amendment 5** harmonized with Part 23 integrating elements of **CS-27** and **new** elements.
- The **Limit** of pax seats & MCTOM are based on **CS-27** small rotorcraft limit and CS-23 aeroplane certification **level 1 to 3**.

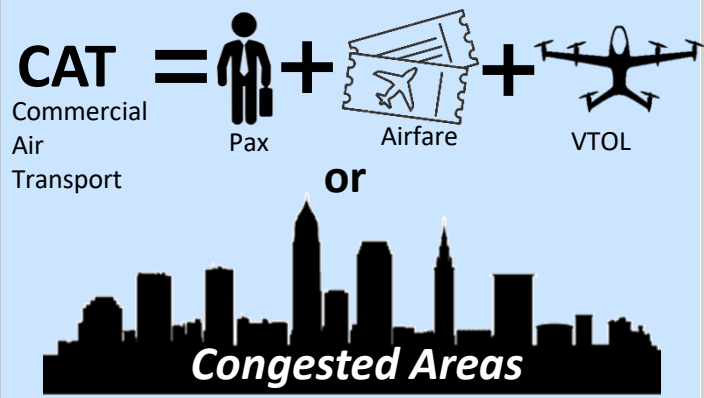


Small category



Certification category

1 **Category Enhanced**



should meet the requirement for **CSFL (Continued Safe Flight and Landing)** to the original intended destination or a suitable alternate vertiport after a failure.

2 **Category Basic**

should meet the requirement for **CEL(Controlled Emergency Landing)**, i.e. controlled glide or autorotation.

Allowable probability of catastrophic failure conditions:

- ✓ AC 23.1309-1E: Class I(SRE < 6,000 lbs) < 10⁻⁶
- ✓ SC-VTOL-01 : Category Basic(0 to 1 pax) ≤ 10⁻⁷

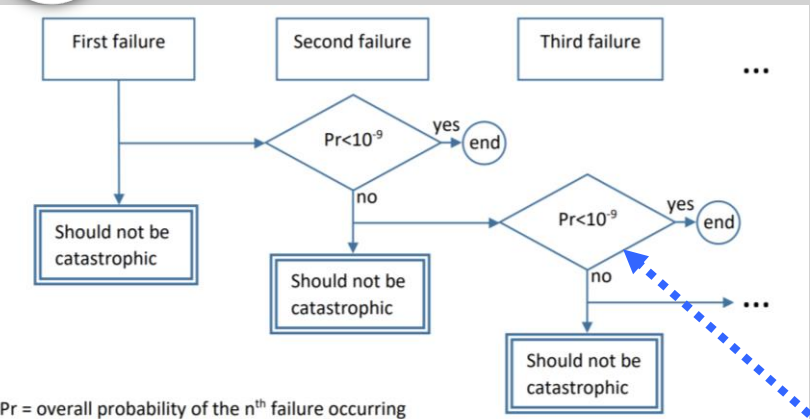
Safety

- CS-23 AMC**, including **FAA AC 23.1309-1E**, are **not appropriate** for VTOL aircraft and system safety objectives due to the level of system **complexity** by **DP** and **advanced flight control**.
 - AMC: Accepted Means of Compliance
 - DP: Distributed Propulsion
 - ConOps of **high-density** deployment
- 
- Both evaluation** confirmed the system safety objectives for **CS-25 & CS-27/29** should be maintained as a **minimum** for **CAT** operation of pax as well as for **UAM** using VTOL aircraft.
 - For Category Basic**, safety objectives are **increased by one level** compared to CS-23 due to the higher dependency on systems, i.e. DP, VTOL and the possible invalidation of other CS-23 assumptions.

Single Failure Criteria

Any catastrophic failure condition must not result from a single failure.

1 Category Enhanced



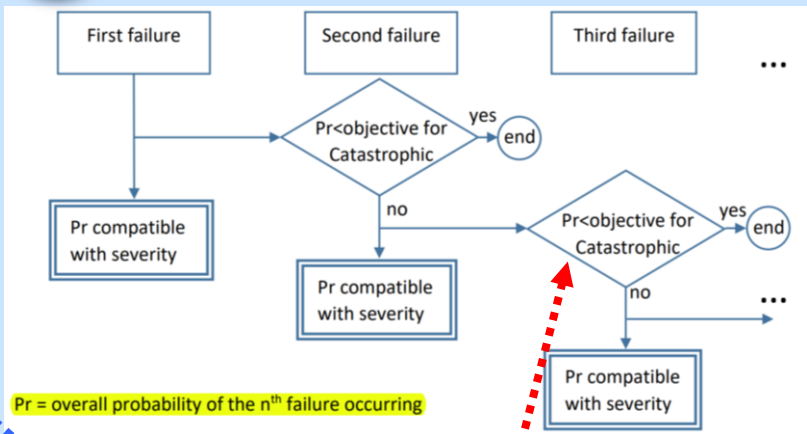
Pr = overall probability of the nth failure occurring

The first failure shall not have an immediate catastrophic effect.

It may however have a catastrophic effect by cascading events if extremely improbable.

The analysis should continue until the overall probability of the next failure is less than 1 x 10⁻⁹ per flight hour or all lift/thrust units have been assessed.

2 Category Basic



Pr = overall probability of the nth failure occurring

Table 1: Safety Objectives

Maximum Passenger Seating Configuration	Failure Condition Classifications			
	Minor	Major	Hazardous	Catastrophic
	Allowable Qualitative Probability			
	Probable	Remote	Extremely Remote	Extremely Improbable
Category	Allowable Quantitative Probability (Note C and D)			
	Development Assurance Level			
Category Enhanced	-	≤ 10 ⁻³ FDAL D (see Note B)	≤ 10 ⁻⁵ FDAL C	≤ 10 ⁻⁷ FDAL B
Category Basic	7 to 9 passengers (Basic 3)	≤ 10 ⁻³ FDAL D (see Note B)	≤ 10 ⁻⁵ FDAL C	≤ 10 ⁻⁷ FDAL B
	2 to 6 passengers (Basic 2)	≤ 10 ⁻³ FDAL D (see Note B)	≤ 10 ⁻⁵ FDAL C	≤ 10 ⁻⁸ FDAL B (see Note A)
	0 to 1 passenger (Basic 1)	≤ 10 ⁻³ FDAL D (see Note B)	≤ 10 ⁻⁵ FDAL C	≤ 10 ⁻⁶ FDAL C (see Note A)

[Quantitative safety objectives are expressed per flight hour]

All consequences of a failure should be considered including possible cascading effect taking into account the overall probability of failure.

Features of EASA SC-VTOL-01

Bird Strike Requirements

- CS-23: Level-4 aeroplane(10~19 pax)
- 2 lbs(0.907kg) bird impact to windshield
- CS-27: No requirements
- SC-VTOL-01

1 Category Enhanced

CSFL(Continued safe flight and landing)

2 Category Basic (7~9 pax)

CEL(Controlled emergency landing)

Single Bird Strike evaluation



2.2 lbs @MCP > 50 knots
(1.0 kg) (92.6 kmh)

Up to 8,000ft (2,438m)



No Penetration

Multiple Bird Strike evaluations



1 lbs Max speed @MCP in level flight
(0.45 kg)

Up to 4,000ft (1,219m)

vulnerable redundant systems and structures (wing, lift surfaces, rudder, ailerons...)

Recorder

- Must be equipped with a recorder(s);
- ETSO authorization

The 2nd Key. **Policy & Regulations - eVTOLs**

미국과 EU 사이에서
실리적인 영국의 판단은?



- 2020.01.31 UK BREXIT
- 2022.06.01 EASA SC-VTOL Adoption

High-Level Comments on the FAA approach

- The CAA has decided to not submit detailed comments on the draft criteria, as **there is a fundamentally different safety approach that FAA is proposing**, relative to that which the CAA considers appropriate, for the new class of aircraft and its intended operations.
- The CAA agrees that the Joby model JAS4-1 represents a new class of aircraft with powered lift capability, that incorporates characteristics from both conventional and rotary wing flight, but also **introduces new flight and handling characteristics**. As such the CAA agrees that the existing airworthiness standards are not adequate and new standards are needed, which may draw on existing material, but which will also incorporate new material. In this regard, **the CAA decided to adopt the SC.VTOL standards published by EASA, and which CAA helped to develop prior to the UK exit from the EU**. The CAA has continued to support the application of SC.VTOL and is an active part of the subsequent development of MoC and industry standards through the Eurocae collaborative effort. The CAA considers that the intended operational model as described by not just Joby, but all the leading designers, to provide paid for passenger flights over densely populated urban environments, **constitutes a new risk to third parties which needs to be recognised in the safety performance of the vehicle**.

- The FAA makes a number of statements about the unique flight & handling characteristics of the powered lift category, as well as expressing that there are concerns in respect to how these aircraft will perform following loss of power or thrust. It also states that these aircraft have highly integrated lift/thrust systems which provide flight directional control. These are all factors with which the CAA agrees. That said, **it is not clear why the FAA has chosen to not apply Class 4 (from Pt-23) as the safety target**. The rationale is not discussed, and the decision appears to be linked to structural considerations, rather than the wider systems safety & functional hazards issues. **The CAA considers that for powered lift vehicles undertaking commercial passenger operations over densely populated urban areas, Class 4 would be an appropriate certification category. This aligns broadly with category Enhanced under SC.VTOL.**
- The FAA states that the JAS4-1 will be used in Pt-135 operations. It is understood that this would be the basis for commercial (hire and reward) operation, and that in the USA Pt-135 permits a lower level of safety than for commercial air transport. These factors may be relevant to the FAA determination to not make Class 4 applicable. However, **Pt-135 does not exist in the UK and as such CAA considers that the intended type of operation would fall under Commercial Air Transport (Pt-121 equivalent). This aligns with category Enhanced under SC.VTOL.**
- **JS4.2000 definitions of Continued Safe Flight & Landing (CSF&L), and Controlled Emergency Landing (CEL).** The definitions proposed by the FAA are different from those in SC.VTOL. **It is unclear if the FAA definition for CSF&L would take into account the limited options for a safe alternate landing site in an urban operational situation.** This concern is specifically recognised within the definition of CSF&L in SC.VTOL. **The FAA definition for CEL implies limited control by the flight crew of the aircraft, other than directing it toward a landing site.** Recognising there will be a need to transition the aircraft from wing-borne to thrust borne to achieve a touchdown, **further details are needed from FAA to understand what level of "touchdown impact severity" might be considered acceptable.** The CAA supports the CEL definition and guidance on compliance contained in SC VTOL.2000 and MOC VTOL.2000.

- **JS4.2320(b) Bird Strike.** The CAA agrees that this category of aircraft and its intended operations will place it at increased risk from bird strike, so the inclusion of modified criteria based on the output of the RBSWG is supported. However, following a review of the ref ARAC report, **it is unclear what safety benefit FAA expects from the inclusion of bird deterrence technology.** The ref report recognises that the evidence base is limited, and that there is variability btw bird species as regards light frequencies and their effectiveness in scaring birds. Additionally, **the FAA has not included a criteria for the evaluation of the effects of a multiple bird strike as described in MOC to SC.VTOL.2250(f).** While it is noted that **the ref ARAC RBSWG report did not recommend multiple bird strike evaluation criteria for classic rotorcraft, the intended operational environment and low noise signature of these new aircraft, means that the historic data for rotorcraft bird strikes may not be directly applicable.**
- While the criteria described in the draft G-1 IP are performance based, there remains **uncertainty as to how an applicant satisfactorily demonstrates compliance to the FAA.** To this end, it will **not be possible for the CAA to indicate its detailed position in regard to the proposed airworthiness criteria for the Joby JAS4-1,** without a detailed review of the means of compliance yet to be assessed and dispositioned by the FAA Administrator under the issue paper process. The CAA looks forward to working with both the applicant and the FAA.

• The Advisory and Rulemaking Committee (ARAC)
Rotorcraft Bird Strike Working Group(RBSWG)

시사점

- UK CAA는 EASA SC-VTOL을 감항기준으로 채택
- UK CAA는 FAA의 Powered-lift 형식인증에 우려 표출
 - Part 23 Class 4 (pax 10~19) 불채택 → UK는 SC-VTOL 채택
 - 안전도: Part 135 < Part 121 → UK는 CAT(Part 121) 채택
 - CSFL/CEL 정의 : FAA < EASA → FAA 정의 모호성 지적
 - FAA 조류충돌 요구도에 "다중조류충돌" 부재 지적
- TC 신청자의 적합성 입증을 어떻게 할지 불확실!!!

The 2nd Key. *Policy & Regulations - AirOps*

- 미국의 선진항공모빌리티(AAM) 정책 개발
- 민간항공 규제 지배구조
- 미국의 민간항공 법제도
- 미국과 EU의 레이싱과 부조화
- eVTOL 인증 (미 · EU · 중)
- **항공운용(AirOps)**
- 버티포트(Vertiports)
- 종합

High-tempo Low-altitude

Air Operations over Congested Areas



The 2nd Key. **Policy & Regulations - AirOps**

EU의 VCA AirOps 제정안

Concepts

Proposed Amendment to Commission Regulation(EU) 965/2012



Definitions

ICAO, FAA,
& EASA →



- **'Rotorcraft'** means a power-driven, heavier-than-air aircraft that depends principally for its support in flight on the lift generated by up to two rotors;
- **'Helicopter'** means a heavier-than-air aircraft supported in flight chiefly by the reactions of the air on one or more up to two power-driven rotors on substantially vertical axes;
- **'VTOL-capable aircraft(VCA)'** means a power-driven, heavier-than-air aircraft, other than aeroplane or rotorcraft, capable of performing vertical take-offs and landings by means of lift or thrust units used to provide lift during the take-off and landing;
- **'VEMS'** is a VCA employed in emergency medical services.



Part-IAM

Proposed amendments to Commission Regulation (EU) No 965/2012

- Cover Regulation, Articles 1 to 10
- Annex I Definitions
- Annex II Part-ARO
- Annex III Part-ORO
- Annex IV Part-CAT
- Annex V Part-SPA
- Annex VI Part-NCC
- Annex VII Part-NCO
- Annex VIII Part-SPO

- Cover Regulation, Articles 1 to 10 (amended)
- Annex I Definitions (amended)
- Annex II Part-ARO (amended)
- Annex III Part-ORO (amended)
- Annex IV Part-CAT
- Annex V Part-SPA (amended)
- Annex VI Part-NCC
- Annex VII Part-NCO
- Annex VIII Part-SPO

Annex IX Part-IAM

The new Annex IX covers:

- UAM ⇒ Urban Air Mobility (urban = congested areas)
- NAM ⇒ Non-urban Air Mobility

Current Regulation (EU) 965/2012

ARO: Authority Requirements for AIR OPS
ORO: Organisation Requirements for AIR OPS
CAT: Commercial Air Transport



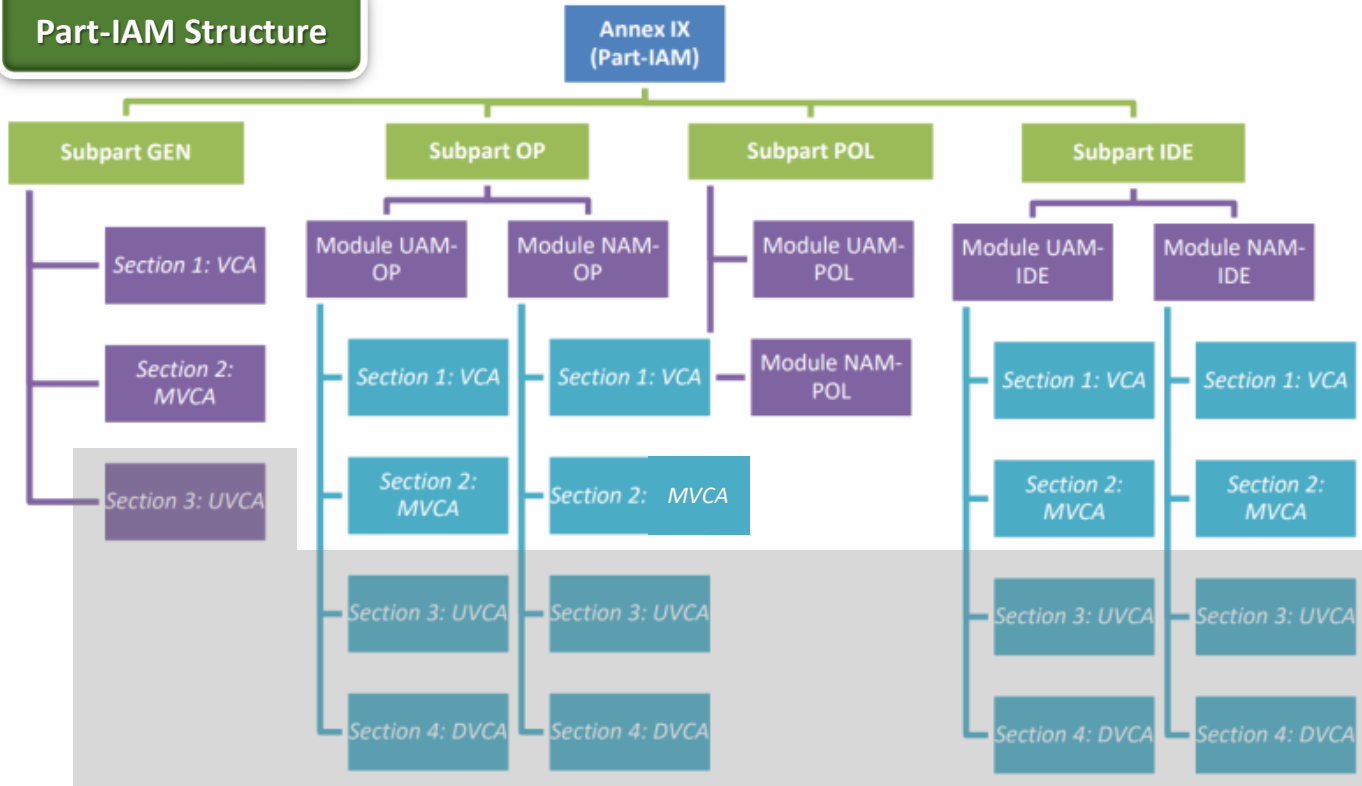
Proposed amendments

SPA: Special Approvals
NCC: Non-Commercial AIR OPS with Complex motor-powered aircraft
NCO: Non-Commercial AIR OPS with Other-than complex motor-powered aircraft
SPO: Specialised Operations

시사점

- EASA는 혁신항공모빌리티(IAM) 용어 제창
- 회전익기/헬리콥터 정의 개정
- VTOL-가능 항공기(VCA) 용어 제창
- Part-IAM 신설 : VCA 운용(운항)
 - ① 일반사항(GEN)
 - ② 운용절차(OP)
 - ③ 성능 및 운용 한계(POL)
 - ④ 계기, 데이터 및 장비(IDE) 규정 제안

Part-IAM Structure



3

Sections

Section 1. VCA	VTOL-Capable Aircraft (VCA) 수직이착륙-가능 항공기
Section 2. MVCA	VCA in Manned Configuration 유인 형상의 수직이착륙-가능 항공기
Section 3. UVCA (Reserved)	VCA in Unmanned configuration that carry passengers 승객을 운송하는 무인 형상의 수직이착륙-가능 항공기
Section 4. DVCA (Reserved)	VCA in Unmanned configuration that carry cargo 화물을 운송하는 무인 형상의 수직이착륙-가능 항공기



1

Subparts

- GEN** : General 일반사항
- OP** : Operating Procedures, 운용절차
- POL** : Performance and Operating Limitation 성능 및 운용 한계
- IDE** : Instruments, Data and Equipment 계기, 데이터 및 장비

2

Modules

Operations in congested(urban) area

Module-UAM

* UAM: Urban Air Mobility

Operations in Non-congested area

Module-NAM

* NAM: Non-congested Air Mobility



요약

- 혁신항공모빌리티(IAM) 전용 Part-IAM 신설
- 서브파트는 GEN, OP, POL, IDE로 구성
- 모듈은 운용지역 혼잡도에 따라 Module-UAM, Module-NAM 구별
- 섹션은 ① VCA 공통, ② 유인 MVCA, ③ 무인 여객 UVCA, ④ 무인 화물 DVCA 구별
- UVCA/DVCA는 예비(추후 제정)

Risk to Occupant

Assumptions

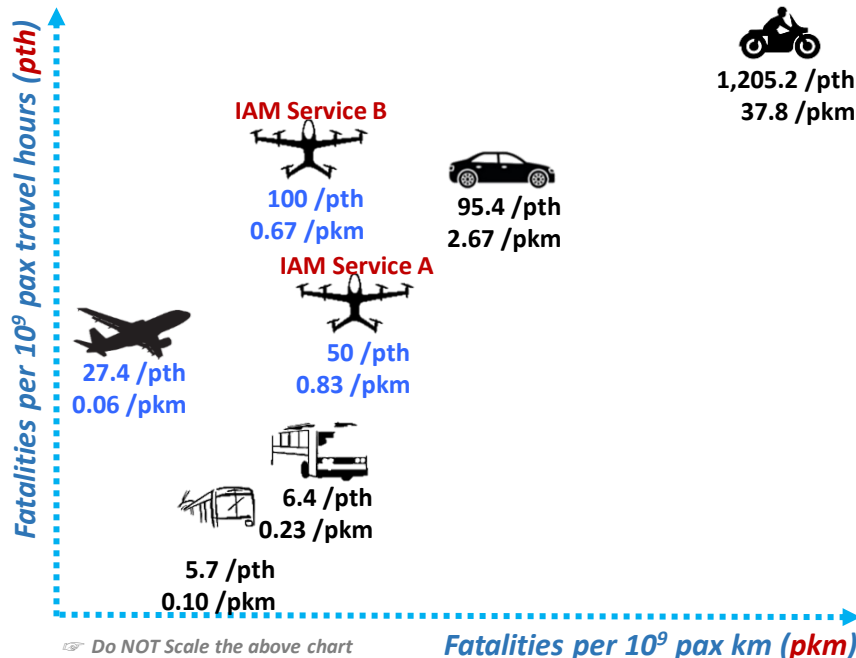
• VCA 자체 고장 확률만 고려

A design safety objective of 1×10^{-9} per FH for each individual catastrophic failure condition in accordance with SC-VTOL-01 Category Enhanced

Average fatality rates for different modes of transport in the EU



1,205.2 /pth
37.8 /pkm



Ground Safety Risk

Assumptions

MTOW: 1,000 kg

Table 6: Number of design-related fatal accidents per year per city

IAM Service A
ConOps



Σ Fatal Accidents per Year per City
0.02

Population Density Assumptions



City population density	Average population density (number of people per km ²)
Low	1 000
Medium	5 000
High	20 000

예) 서울시 일일평균 생활인구 밀도
10,523천명 / 605.23 km² = 17,400 명/km²

Damage Area Definition

IAM Service A : 2,450 m² (741 평)

Total Number of Affected People

Average Ground Fatalities per year per city per fleet

0.2



Low-density population city

1



Medium-density population city

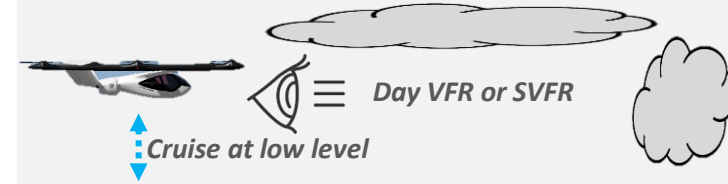
5



High-density population city

Air Safety Risk

Assumptions



Intracity Operation:

Heavy-traffic,
High-complexity

Intercity Operation:

Low-traffic density,
Reduced complexity

Safety Strategy & Objective



Safety Level

=



VFR Operations
under AOC(CAT)

Operational Environments(OPE)

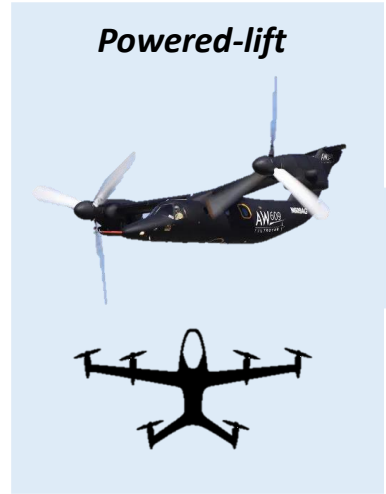
Airspace	Without U-Space	With U-Space
Uncontrolled Airspace	OPE#1	OPE#2
Controlled Airspace	OPE#3	OPE#4

The 2nd Key. *Policy & Regulations - AirOps*

FAA 항공운송사업자 정의 개정 NPRM,
그리고 특별연방항공규정 (SFAR) NPRM

SUMMARY:

The FAA proposes to amend the regulatory definitions of certain air carrier and commercial operations. This proposed rule would add **powered-lift** to these definitions to ensure the appropriate sets of rules apply to air carriers' and certain commercial operators' operations of aircraft that FAA regulations define as powered-lift. The FAA also proposes to **update certain basic requirements that apply to air carrier oversight**, such as the contents of operations specifications and the qualifications applicable to certain management personnel. In addition, this proposed rule would **apply the rules for commercial air tours to powered-lift**. **This proposed rule is an important step in the FAA's integration of new entrant aircraft in the National Airspace System (NAS).**



요약 FAA는 "Powered-lift"를 국가공역체계(NAS)에 통합하기 위한 규제정비의 첫 단추로 Powered-lift를 일련의 운용규칙 정의에 추가하는 개정안 (단, 현행 Part 135는 Powered-lift를 포함한 "항공기(Aircraft)" 용어를 사용하므로 개정 불필요)

Sources: UK CAA / UKRI / ATRIN's [Future Flight Aircraft Capabilities](#) (15 Dec 2022)

글로벌 ICT 표준 컨퍼런스 2023
Global ICT Standards Conference 2023

Terminology for Aircraft Classification

Propulsion Axis	Horizontal	Vertical	Hybrid
Definition	Conventional Aircraft		Powered-lift
Configuration	Fixed Wing	Rotary Wing	VTOL-Capable Aircraft (VCA) Multicopter Lift+Cruise Vectored Thrust

시사점

- 미국과 유럽은 신종 항공모빌리티 부문에서 VTOL 항공기 등급 분류/용어가 부조화.
- 국제민간항공기구(ICAO)도 국제표준 및 권고안행(SARPs)에서 아직 정의하지 않음.
- 그럼에도 불구하고, 미연방항공청(FAA)은 Powered-lift, 유럽연합항공안전청(EASA)은 VCA로 등급화했고, 한국은 미국의 14 CFR Part 21을 추종하여, "수직추력 이착륙기(Powered-lift)"로 정의함.

Wingless **Winged**

• Tilt-rotor
• Tilt-prop
• Tilt-wing
• Ducted Vectored Thrust
• ...

Prop? Rotor? ↓

Subchapter F. Air Traffic and General Operating Rules

Part 91 General operating and flight rules
범용 운용 및 비행 규칙

Subchapter G. Air carriers and operators for compensation or hire: certification and operations

Part 110 General requirements
일반 요구도

Part 119 Certification: Air carriers and commercial operators
인증: 항공운송사업자 및 상용운용자

Part 121 Operating requirements: domestic, flag, and supplemental operations
운용요구도: 국내, 국적 및 부가운용

Part 125 Certification and operations: aircraft having a seating capacity of 20 or more passengers or a maximum payload capacity of 6,000 pounds or more; and rules governing persons on board such aircraft
인증 및 운용: 20명 이상 승객의 좌석 용량을 가진 항공기 또는 최대 탑재 용량이 6,000파운드 이상인 항공기; 그리고 그런 항공기에 탑승한 사람을 규율하는 규칙

Part 136 Commercial air tours and national parks air tour management
상용항공투어 및 국립공원 항공투어 관리



Evolution of UAM OPS



Six Indexes

Source : FAA, "Urban Air Mobility (UAM) Concept of Operations v2.0", 26 April 2023

FAA UAM ConOps V2.0

글로벌 ICT 표준 컨퍼런스 2023
Global ICT Standards Conference 2023

UAM-Driven Regulatory Changes

Existing regulations may need to evolve to address the needs for UAM OPS' structure and performance.

3

UAM COPS

COPs implement the updated regulations to establish the expectations and interactions.

4

2

UAM Structure (Airspace & Procedural)

The level of complexity of infrastructure and services that support the UAM environment.

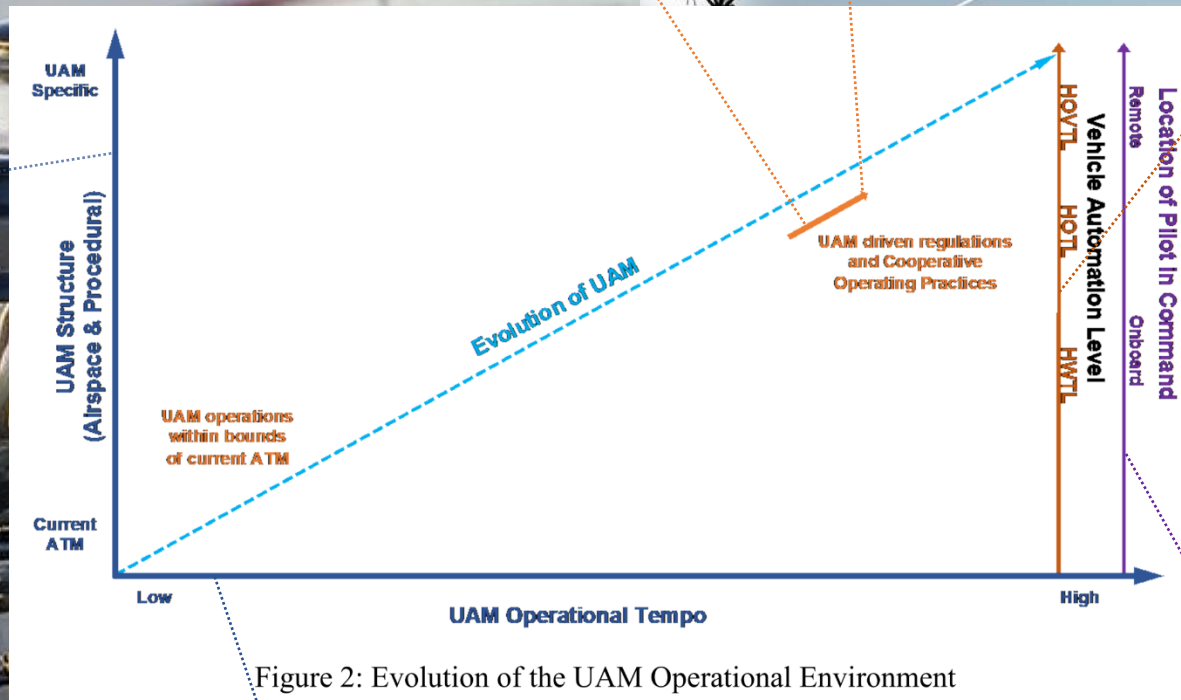


Figure 2: Evolution of the UAM Operational Environment

5

Aircraft Automation Level

The level of "PIC" engagement with the UAM ACFT enabling systems. The following categories describe the evolution of ACFT automation:

- **Human-Within-the-Loop (HWTl)**
 - Human is always in direct control of the automation (i.e., systems)
- **Human-on-the-Loop (HOTL)**
 - Human has supervisory control of the automation (i.e., systems)
 - Human actively monitors the systems and can take full control when required or desired
- **Human-Over-the-Loop (HOVTL)**
 - Human is informed, or engaged, by the automation (i.e., systems) to take action
 - Human passively monitors the systems and is informed by automation if, and what, action is required
 - Human is engaged by the automation either for exceptions that are not reconcilable or as part of rule set escalation

6

Location of the PIC

The physical location of the PIC. UAM OPS may evolve from a PIC onboard the UAM ACFT to RPICs/remote operators via the advent of additional ACFT automation technologies.

질문

- FAA는 왜 수평축을 시간으로 삼지 않고 운용템포로 정했을까?

1

Operational Tempo

Representation of the density, frequency, and complexity of UAM OPS. Tempo evolves from a small number of low-complexity OPS to a high-density, high frequency of complex OPS.

The 2nd Key. Policy & Regulations - Vertiports

- 민간항공 규제 지배구조
- 미국과 EU의 레이싱과 부조화
- eVTOL 인증 (미 · EU)
- 항공운용 (AirOps)
- **버티포트 (Vertiports)**
- 종합

도심항공과 승객의 접점



The 2nd Key. Policy & Regulations - Vertiports

수직이착륙장 형과 아우,
헬기장과 버티포트





Civil Aviation Authority

HELICOPTER CHART - ICAO

ARP 512812N 0001046W

AD ELEV 18FT

LONDON HELIPORT EGLW

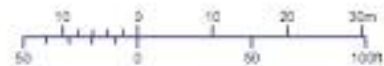
AERO INFO DATE 10 APR 14

GUND (Geoid Undulation) = The height of the Geoid (MSL) above the Reference Ellipsoid (WGS 84) at the stated position.	
BEARINGS ARE MAGNETIC ELEVATIONS AND HEIGHTS ARE IN FEET	
ELEVATIONS IN FEET AMSL	18

RUNWAY/TAXIWAY/APRON PHYSICAL CHARACTERISTICS			
APRON / RWY / TWY	SURFACE	BEARING STRENGTH	ELEVATION
RWY 02/20	Concrete	-	-
Main Apron	Tarmac	-	-
Main Taxiway	Tarmac	-	-

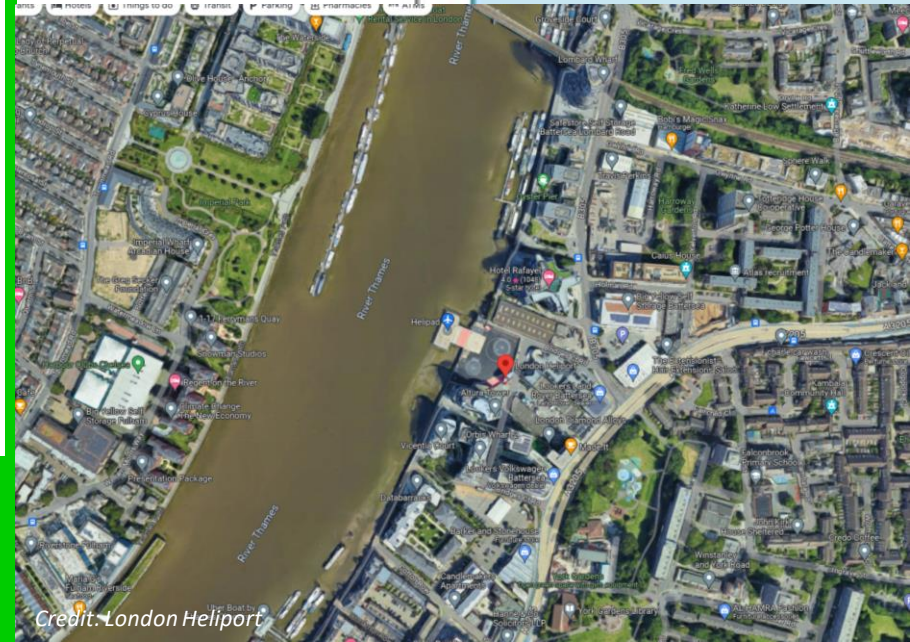
VAR 1.1°W - 2014
N
Annual Rate
of Change 0.14°E

TLOF (Centre)	Elevation
H1 = To be surveyed	+
H2 = To be surveyed	+
H3 = To be surveyed	+
H4 = To be surveyed	+
(GUND 150)	



COM		
APCH/TWR	122.900	BATTERSEA TOWER
LIGHTING		
FATO	Yellow perimeter 4 stage intensity.	
Aiming Point	Soft sodium floodlighting.	
TLOF	Soft sodium floodlighting.	

NOTES/POSITIONS/FATO/STANDS/MARKINGS/BUILDINGS AMENDED



Credit: London Heliport

Heliports

요약

Vertiports

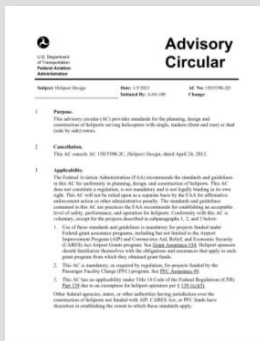
- ❖ 버티포트에 관한 ICAO SARP 부재속에서,
- ❖ FAA는 헬기장 권고회람(AC)을 기반으로,
- ❖ EASA는 ICAO Annex 14 기반의 헬기장 인증규격(CS)을 기반으로 초안 제시

Not yet

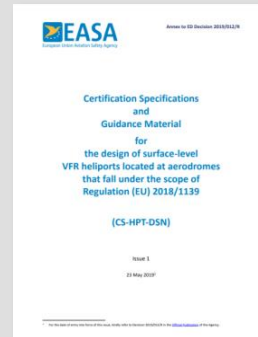
ICAO SARP is relatively less reflected

ICAO SARP is very well reflected

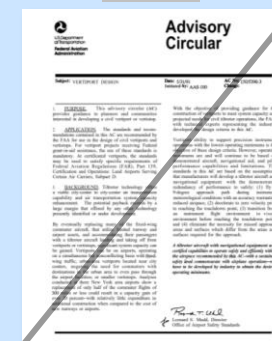
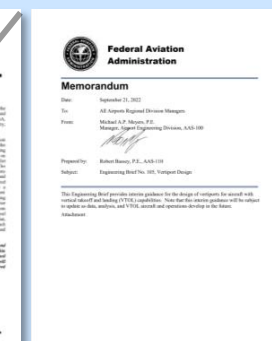
FAA

AC 150/5390-3
CancelledEB 105
Vertiport DesignPTS-VPT-DSN
Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category

AC 150/5390-1: 1964.11.03
AC 150/5390-1A: 1970.01.15
AC 150/5390-1B: 1977.08.22
AC 150/5390-1B Change: 1986.07.28
AC 150/5390-2: 1988.01.04
AC 150/5390-2A: 1994.01.20
AC 150/5390-2B: 2004.09.30
AC 150/5390-2C: 2012.04.24
AC 150/5390-2D: 2023.01.05~present

CS-HPT-DSN, Issue 1
Certification Specifications and Guidance Material for the design of surface-level VFR heliports located at aerodromes that fall under the scope of Regulation (EU) 2018/1139

CS-HPT-DSN Issue 1: 2019.05.23

AC 150/5390-3:
1991.05.31~2010.07.28EB 105: 2022.09.21
ICAO SARP is relatively less reflected

PTS-VPT-DSN: 2022.03.24

ICAO SARP is very well reflected



The 2nd Key. **Policy & Regulations**

- 민간항공 규제 지배구조
- 미국과 EU의 레이싱과 부조화
- eVTOL 인증 (미 · EU)
- 항공운용 (AirOps)
- 버티포트 (Vertiports)
- **종합**

도심항공모빌리티 규제 개발에는
긴 시간과 시행착오 수반되고,
항공사고도 뒤따르고...
클리프행어처럼 신중해야!!!



Certification



- **Powered-lift, Special Classes of Aircraft per § 21.17(b)**
- 1988.07 : "Interim Airworthiness Criteria, Powered-lift Transport Category Aircraft" published by FAA
- 1996.08 : Bell's BA609 TC application
- 1997.04.04 : Powered-lift pilot certificate
- 2012.02 : AgustaWestland's AW609 TC application

- 2018.11.02 : Joby's JAS4-1 TC application
- 2020.12 : Joby's JAS4-1 IP G-1 Certification Basis agreement
- 2022.03.30 : Archer's MIDNIGHT TC application
- 2022.05.09 : **FAA statement regarding Powered-lift Special Classes of Aircraft**
- 2022.11.08 : Joby's JAS4-1 Special Class Airworthiness Criteria proposed by FAA
- 2022.12.20 : Archer's MIDNIGHT Special Class Airworthiness Criteria proposed by FAA

- **Special Conditions for Small-category VTOL Aircraft**
- 2019.07.02 **SC-VTOL-01 Issue 1**
- 2020.05.25 **MOC SC-VTOL Issue 1**
- 2021.04.07 SC E-19 "Electric/Hybrid Propulsion System" Issue 1
- 2021.05.12 MOC SC-VTOL Issue 2
- 2021.06.23 MOC-2 SC-VTOL Issue 1
- 2022.06.29 MOC-2 SC-VTOL Issue 2
- 2022.12.22 MOC-2 SC-VTOL Issue 3
- 2022.06.29 MOC-3 SC-VTOL Issue 1 proposed

< Work in progress >

- **Three MOC SC-VTOL will be combined into one MOC SC-VTOL.**
- **RMT.0230(D) : Certification Specification of VTOL Aircraft (CS-VTOL) - planned**

Operations



- 2022.11.21 : NPRM "Update to Air Carrier Definitions"
- * NPRM : Notice of Proposed Rulemaking
- Adding **Powered-lift** to definitions of; **Part 91, Part 101, Part 119, Part 121, Part 125, Part 136**
- 2023.06.14 : NPRM "Integration of Powered-Lift: Pilot Certification and Operations; Miscellaneous Amendments Related to Rotorcraft and Airplanes)"
- Adding **Part 194 "SFAR No. 120 – Powered-lift: Pilot Certification and Training; Operations Requirements"** for 10 years under new Subchapter L "Other Special Federal Aviation Regulations"

< Work in progress >

- **Final rulemaking of the NPRMs above**

- 2022.06.30 : **NPA 2022-06**

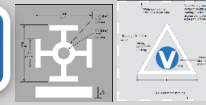
- * NPA: Notice of Proposed Amendment
- Commission Regulation (EU) No 965/2012 "Technical requirements and administrative procedures related to **air operations**..." proposing to add **VCA(VTOL-capable Aircraft)**-related provisions and a new **Part-IAM**
- Commission Regulation (EU) No 1178/2011 "Technical requirements and administrative procedures related to **civil aviation aircrew**..." proposing to add **VCA Type Rating** and the amendment of **Part-FCL**
- Commission Regulation (EU) No 923/2012, "The **common rules of the air** and operational provisions regarding services and procedures in air navigation..." proposing the amendment of **SERA(Standardised Rules of the Air)**
- 2023.08.30 : **Opinion No 03/2023**
- Proposing to the European Commission(EC) as an EASA opinion

< Work in progress >

- 2023.04 : **EC's adoption as an Implementing Delegated Act**
- **RMT.0230(C) : UAS operations in the 'certified' category and Urban Air Mobility - ongoing**

UAM Regulatory Framework Development of FAA & EASA

Vertiport



- 1991.05.31 : **AC 150/5390-3 "Vertiport Design" - Cancelled on 28 July 2010**
- 2021.05.24 : High-Density Automated Vertiport ConOps published by Nuair funded by NASA
- 2022.02.25 : EB 105 "Vertiport Design" Draft
- 2022.09.21 : **EB 105 "Vertiport Design" Interim Guidance**

< Work in progress >

- 2023.09 : **end of research effort**
- 2024.09 : **AC "Vertiport Design"**

- 2022.03.24 : **PTS-VPT-DSN "Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category"**

< Work in progress >

- **RMT.0230(G) – "Certification Specifications for vertiports design (CS-VPT-DSN)" - planned**

* **RMT.0230** "Introduction of a regulatory framework for the operation of unmanned aircraft systems and for urban air mobility in the European Union aviation system"

* RMT: Rulemaking Task

Airspace Integration



- 2018.05.18 : ConOps v1.0 of UTM
- 2020.03.02 : ConOps v2.0 of UTM
- 2020.06.26 : **UAM ConOps v1.0**
- 2020.12.02 : UAM Vision ConOps UML 4 version 1.0 published by NASA
- 2023.04.26 : **UAM ConOps v2.0**
- 2023.07.18 : **AAM Implementation Plan v1.0**

- 2019.10.25 SESAR JU's U-space ConOps (ed. 03.00.02)

* SESAR JU: Single European Sky ATM Research Joint Undertaking

- 2021.04.22 : **Implementing Regulation (EU) 2021/664 "A Regulatory framework for the U-space"**
- 2021.09.24 : SESAR JU's AURA(ATM U-space InterfAce) Solution2 Initial Concept Description
- 2022.12.16 : **Acceptable MoC and GM to Regulation (EU) 2021/664**

< Work in progress >

- **RMT.0230(B) – "U-space and airspace integration" - partially completed**

FAA vs. EASA

- 미국의 선진항공모빌리티(AAM) : VTOL 인증 접근법 혼선을 겪은 후 1980년대 동력-리프트(Powered-lift) 프레임워크 계승
- 유럽연합의 혁신항공모빌리티(IAM) : 체계적인 규칙제정작업을 통해 초기 규제 프레임워크를 미국보다 신속히 수립 중



Artificial Intelligence

- 2020.02.07 EASA Artificial Intelligence Roadmap - A human-centric approach to AI in aviation version 1.0

- 2021.12.20 EASA Concept Paper: First usable guidance for Level 1 machine learning applications Issue 01

- 2023.02.24 EASA Concept Paper: First usable guidance for Level 1&2 machine learning applications, Proposed Issue 02

- 2023.05.10 EASA Artificial Intelligence Roadmap - A human-centric approach to AI in aviation version 2.0

**Powered-lift,
Special Classes of Aircraft**
per §21.17(b)

FAA’s Safety Objective
10⁻⁷ to 10⁻⁸
for catastrophic failure condition

Update to Air Carrier Definitions
Into 14 CFR Part 91, 101, 119, 121, 125, 136

**Integration of Powered-Lift: Pilot
Certification and Operation**
*to add Part 194 “SFAR No. 120 – Powered-lift: Pilot
Certification and Training; Operations Requirements”*

EB 105 “Vertiport Design” *as
an interim guidance*

AC “Vertiport Design”
being prepared till 2024

ATM
+
FAA UAM ConOps v2.0
+
FAA UTM ConOps v2.0
*pursuing the open architecture to
the third parties with digitalization*

한국의 첫 단추는?

- eVTOL의 등가적 안전목표는 수송류(transport cat)와 보통류(normal cat) 중 무엇인가?
- VTOL 감항표준/인증규격 수립 전략은 무엇인가? 영국처럼 EASA 인증규격을 채택할 것인가, 기존처럼 FAA를 추종할 것인가? 설마, 조합?
- 한국의 도심 저고도 운용환경은 미국과 유럽 도시 중 어디에 더 가까운가?
- eVTOL 조종사 초기 수급에는 EASA 브리징 솔루션 전략이 FAA보다 유리한가?
* EASA Bridging solution : CPL(A) or CPL(H) → Add VCA type-rating through type-rating training according to OSD(Operational Suitability Data)
* FAA: Aircraft category rating ~ Powered-lift” & Type rating to specific powered-lift
- 버티포트는 높은 안전장벽의 ICAO를 추종한 EASA인가, 권고회람 역사를 갖는 FAA인가?
- 버티포트 설계기준 적용은 권고인가 의무인가?
- 기존 공역에 UAM 통합을 위한 초기 전략은 무엇이고, 중장기 전략은 무엇인가?
- 국제민간항공기구(ICAO)의 통일성(uniformity)에는 어떻게 참여하고 대비할 것인가?



Choose? Or Combine?

**Small-category VTOL,
Special Conditions**
per SC-VTOL and its MoC sets

CS-VTOL
*being planned by
RMT.0230(D)*

EASA’s Safety Objective
10⁻⁹
for catastrophic failure condition

NPA 2022-06, Opinion 03/2023
*amending AirOps(Part-IAM), Civil Aviation Aircrew(VCA
Type Rating, Part-FCL), and Common Rules of the Air(SERA)*

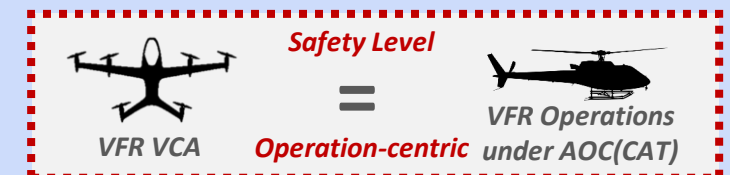
‘Certified’ category UAS operation & UAM
ongoing by RMT.0230(C)

**PTS-VPT-DSN “Prototype Technical Specifications for the Design of VFR
Vertiports for Operation with Manned VTOL-Capable Aircraft Certified
in the Enhanced Category”**

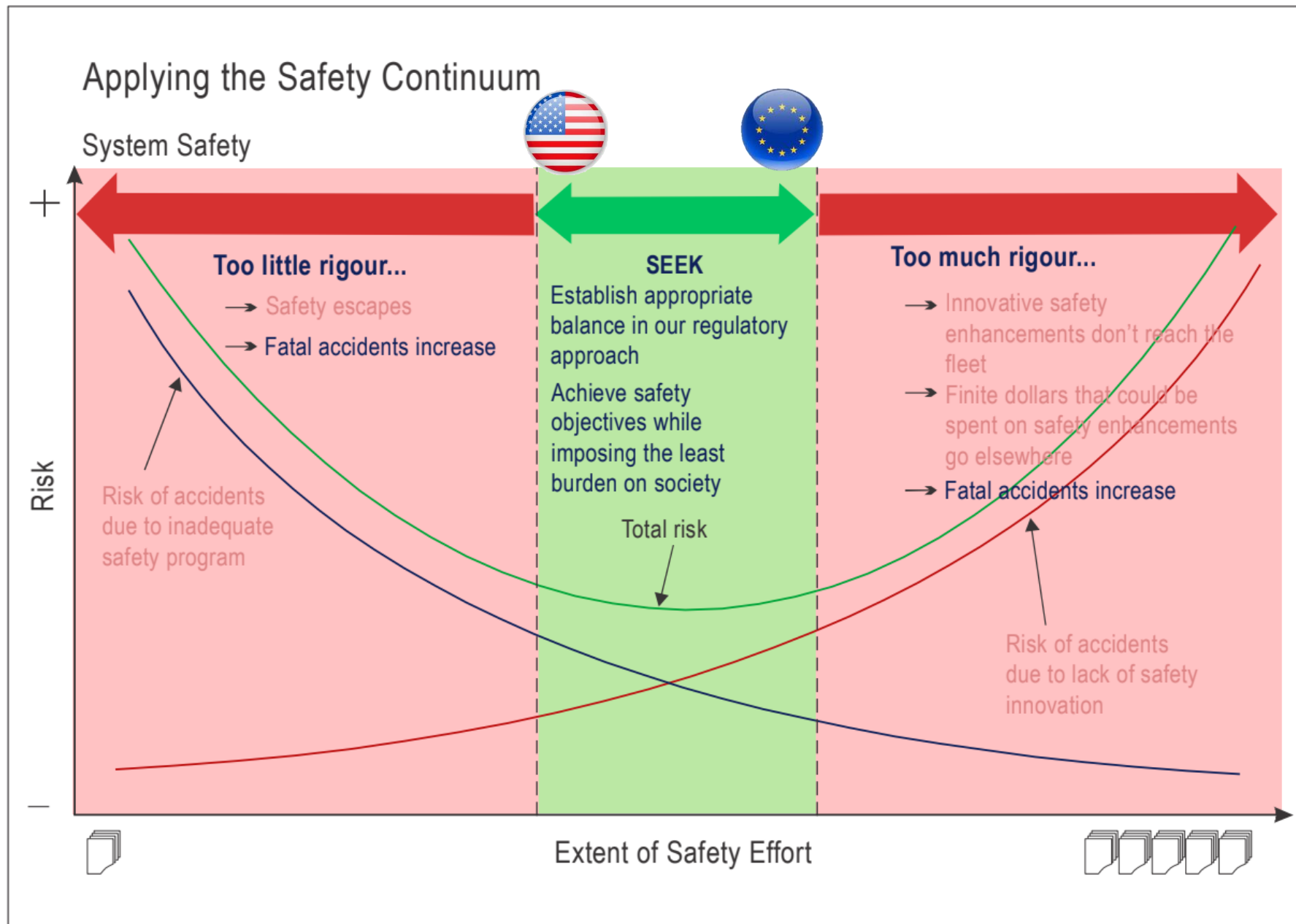
based ICAO Annex 14 Vol I Aerodromes, Vol II Heliports, Doc 9261 Heliport Manual, etc.

CS-VPT-DSN
planned by RMT.0230(G)

ATM
**+ IR (EU) 2021/664 “A Regulatory Framework
for the U-space”**
+ NPA 2022-06’s Impact Assessment



U-space and Airspace Integration
partially completed by RMT.0230(B)

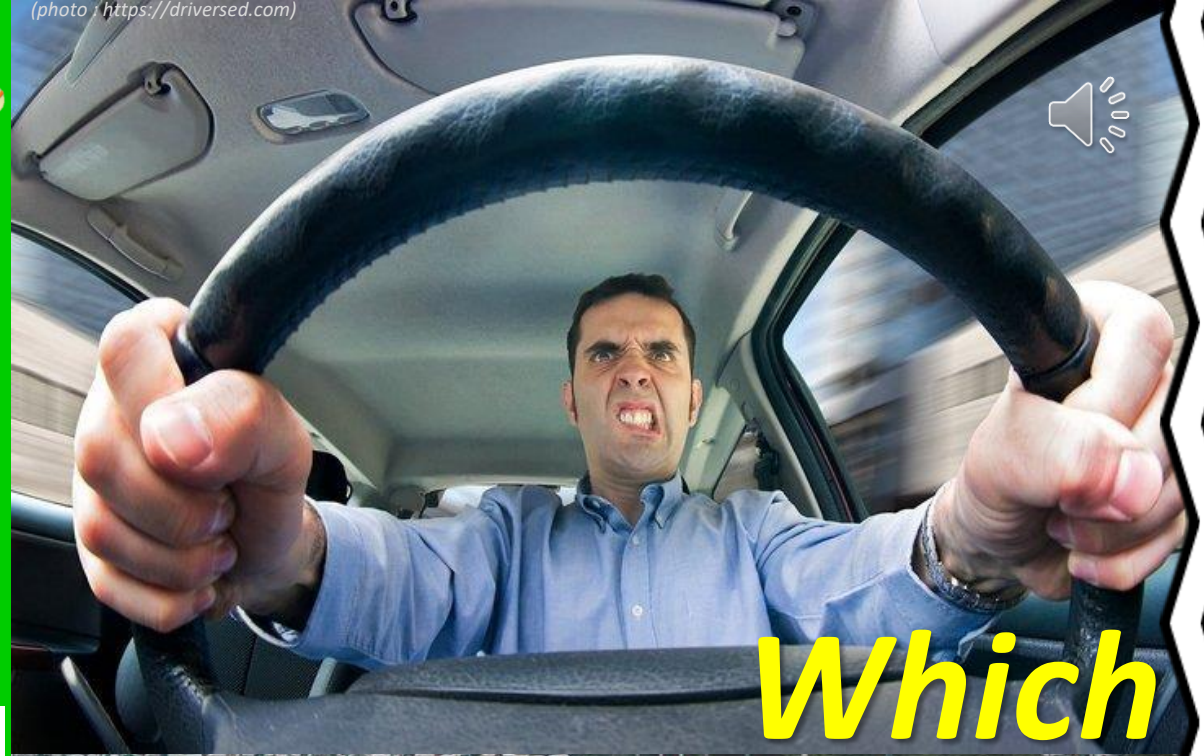


ICAO [Doc 9760 Airworthiness Manual, 4th Edition, 2020](#)

Figure V-7-C-4. Example of applying the safety continuum



SCC: Social Cost of Carbon



Which World?



Many thanks.



감사합니다.

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myungjjip@gmail.com