INTERNATIONAL REGULATORY APPROACHES TO ELECTRIC AIR VEHICLES

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GORDON WOOLLEY OBE FRAeS
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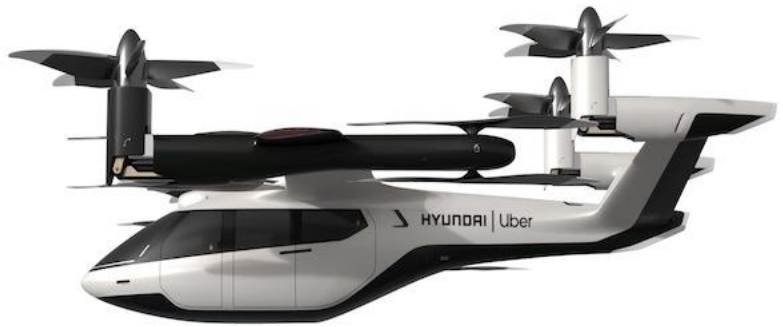
INTERNATIONAL REGULATORY APPROACHES TO ELECTRIC AIR VEHICLES

- **TECHNOLOGIES and CAPABILITIES**
- **CHALLENGES TO REGULATORS**
- **REGULATORY APPROACHES**
  - **WESTERN WORLD**
  - **CHINA**



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ENABLING TECHNOLOGIES

ELECTRIC DRIVE =

DISTRIBUTED, ARTICULATED, VECTORED, QUIET, GREEN PROPULSION

NOVEL CONFIGURATIONS

NOVEL CAPABILITIES - VTOL STOL

EXPANDED AREAS OF OPERATION

AUTOMATED CONTROL

- **PILOT ASSISTANCE**
- **REMOTE CONTROL**
- **AUTONOMOUS FLIGHT**

CHALLENGES

NEW SECTOR OF AEROSPACE
OUTSIDE ESTABLISHED STANDARDS, PROCEDURES, ETC
AIRSPACE FROM GROUND LEVEL UP
TRAJECTORY MANAGEMENT >> AUTONOMOUS FLIGHT
ENDURANCE, MALFUNCTIONS
SECURITY, NUISANCE, PRIVACY
'TEMPO'
NON-AEROSPACE COMPANIES and TECHNOLOGIES
RAPIDLY CHANGING MARKETS, CONCEPTS, USES
GLOBAL INDUSTRY, UNIQUE LOCAL ISSUES

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REGULATORY 'FOUNDATIONAL' DOCUMENTS

UK CIVIL AVIATION AUTHORITY (CAA) CAP 722

- **UK RESEARCH and INNOVATION (UKRI) FUTURE FLIGHT VISION AND ROADMAP AUGUST 2021,**

EU AVIATION SAFETY AGENCY (EASA) IMPLEMENTING REGULATION 2019/947, OF 24 MAY 2019,AND MORE RECENT WORKING PAPERS AND OPINION PIECES

US FEDERAL AVIATION ADMINISTRATION (FAA) CONCEPTS OF OPERATIONS (CONOPS) FOR URBAN AIR MOBILITY (UAM) AND UNMANNED AIRCRAFT SYSTEMS TRAFFIC MANAGEMENT – (UTM)

E HANG (CHINA) WHITE PAPER

TWO PRONGED APPROACH - 1

BRING INTO THE REGULATORY REGIMES THE SMALL PILOTLESS DRONES FOR SURVEY, RECREATION ETC

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TWO PRONGED APPROACH - 2

START TO PUT TOGETHER FRAMEWORKS WITHIN WHICH LARGER PASSENGER AND FREIGHT CARRYING AIR VEHICLES CAN BE DEVELOPED AND PERMITTED TO OPERATE, AT INCREASINGLY LEVELS OF AUTOMATION, INTEGRATED INTO TRADITIONAL AIRSPACE USE, AT INCREASED TEMPO.

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DRONES: RISK-BASED REGULATION

CATEGORIES ASSIGNED BASED ON MASS AND RISK TO PEOPLE, PROPERTY, OTHER AIRCRAFT

REGISTRATION, LICENSING, TRAINING and QUALIFICATION, VEHICLE ID,

VISUAL LINE OF SIGHT (VLOS), PROXIMITY, HEIGHT, NO-FLY ZONES,

EG

A1 - DRONES WEIGHING LESS THAN 250G (0.55 LB) CAN BE FLOWN OVER PEOPLE

A2 - DRONES WEIGHING MORE THAN 250G BUT LESS THAN 2KG (4.4 LBS) MUST BE FLOWN AT LEAST 50M (164FT) AWAY FROM PEOPLE

A3 - DRONES WEIGHING MORE THAN 2KG MUST BE FLOWN WELL AWAY FROM PEOPLE

MORE STRINGENT RESTRICTIONS BEING INTRODUCED

NEXT STAGE: KEY ISSUES FOR REGULATION

- AIRSPACE USE AND TRAFFIC MANAGEMENT
- AUTOMATION
- PUBLIC CONCERNS - PRIVACY AND SECURITY

CHALLENGES FOR AN EAV CONTROL AND COORDINATION ARCHITECTURE

- SAFE and RESILIENT
- ENSURE THE OPTIMUM USE OF THE LIMITED AVAILABLE AIRSPACE AND ROUTE OPTIONS
- BE FLEXIBLE AND RESPONSIVE
  - CHANGES IN TRAFFIC DEMAND
  - PRIORITY PATTERNS,
  - WEATHER RESTRICTIONS,
  - SUDDEN EVENTS AND INCIDENTS, ACCIDENTS, ABORTED FLIGHTS, AND SO ON.
- SCALABLE to HIGH TEMPO

THE ‘U SPACE’

SEGREGATED FROM CONVENTION AIR TRAFFIC

GROUND LEVEL TO 400 FT AGL

CERTIFIED SERVICE PROVIDERS

- AT LEAST FOUR MANDATORY U-SPACE SERVICES:
  - GEO-AWARENESS,
  - TRAFFIC INFORMATION,
  - FLIGHT AUTHORISATION AND
  - NETWORK IDENTIFICATION.

CO-ORDINATION WITH ATC AND MANNED AIRCRAFT

INCLUDED IN THE EU ‘SUSTAINABLE AND SMART MOBILITY STRATEGY’

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THE ROUTE TO AUTONOMOUS FLIGHT 1

WHAT DOES IT HAVE TO ACHIEVE?

- PRE-PROGRAMMED FLIGHT PATH
- PERFORMANCE PARAMETERS and CHARACTERISTICS
- OPERATING SITE DEPARTURE/APPROACH PATHS
- RESPECT RESTRICTED ETC AREAS
- HAZARD and COLLISION AVOIDANCE
- PRIORITY ADJUSTMENT
- EMERGENCY LANDING/DIVERSION/REROUTING

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THE ROUTE TO AUTONOMOUS FLIGHT 2
'CRAWL, WALK, RUN'

1. HUMAN-WITHIN-THE-LOOP (HWTL)

- Human is always in **direct control** of the automation (systems) PIC or REMOTE CONTROL

2. HUMAN-ON-THE-LOOP (HOTL)

- Human has **supervisory control** of the automation (systems)
- Human **actively monitors** the systems and can take full control when required or desired

3 HUMAN-OVER-THE-LOOP (HOVTL)

- Human **is informed, or engaged, by the automation** (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

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THE ROUTE TO AUTONOMOUS FLIGHT 3

AUTOMATION IS A CONTINUUM

DIFFERENT LEVELS OF CONTROL AT DIFFERENT STAGES OF FLIGHT?

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E HANG (CHINA) WHITE PAPER EXTRACTS

"SMART" UAM VEHICLES TO US MEAN THAT THEY ARE

- PILOTED AUTONOMOUSLY,
- CLUSTER MANAGEMENT TECHNIQUES CENTRALIZED AT A GROUND-BASED COMMAND-AND-CONTROL CENTER WOULD ALLOW UAM OPERATORS TO CONTROL A MULTITUDE OF VEHICLES SIMULTANEOUSLY IN AN ORDERLY AND SAFE MANNER.
- ALL FLIGHT ROUTES COULD BE PRE-REGISTERED AND PRE-DETERMINED SO THAT UAM VEHICLES CAN TRAVEL ONLY BETWEEN CERTIFIED "BASE POINTS ".

PUBLIC CONCERNS

PRIVACY

- IMAGING and INTERFACES

NUISANCE

- NOISE
- 'PRESENSE' – ANNOYANCE, DISCOMFORT,
- POLLUTION

IDENTIFICATION

SAFETY

SECURITY and RESILIENCE

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SUMMARY

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