

Towards Routine Airspace Use by UAVs

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1 Impact of UAVs on civil aviation

Unmanned aircraft systems (UAS) are enjoying widespread success in military applications due to their persistence, efficiency, flexibility of mission and information collection abilities

They comprise a flying vehicle without a co-located pilot but operated under the authority of a human from a remote control station

The vehicles are endowed with a variable level of autonomy according to the application and the phase or circumstances of the mission

They are operated in effectively segregated airspace with co-ordinated mission plans to ensure separation from other air traffic

UAS also have significant benefits for civil applications but there are some challenges to overcome

So very little impact to date

2 The airspace integration problem

Regulations for manned flight have matured over the past 100 years

Implicit assumption that pilot is on-board

No agreed interpretation on standards and regulations for unmanned systems

100 year maturation timescale for UAS not acceptable

Regulatory authorities have provided guidance

- Transparency
- Equivalence
- No less safe than manned aviation

Catch 22 situation

- Regulators require example system to certify
- Industry require standards to specify requirements

3 Challenges

Accommodating the remote pilot

- Communications to support command and control of the platform
- Communications to enable interaction with Air Traffic Control
- On-board systems to replace the pilot's responsibility to see and avoid other air traffic
- On-board systems to monitor and manage aircraft health condition
- An integrated human-machine partnership to enable remote high level management of the mission
- On-board decision systems that act appropriately in normal and emergency situations

Affordably implementing the above systems within stringent SWAP budgets

Interpreting the regulations in the context of remote operation

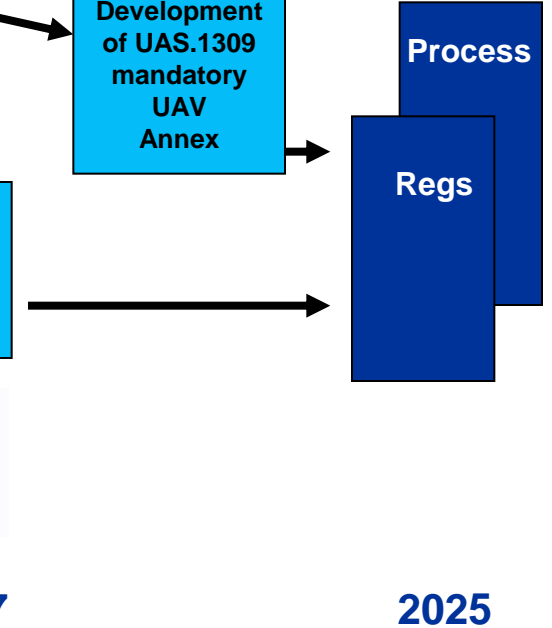
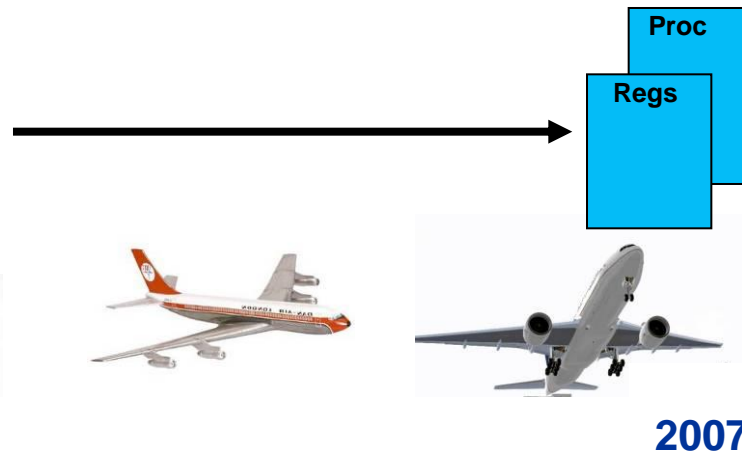
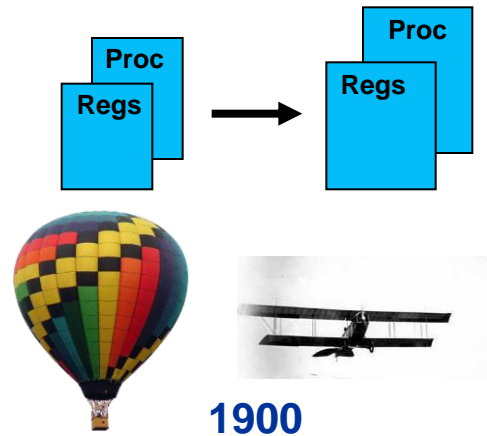
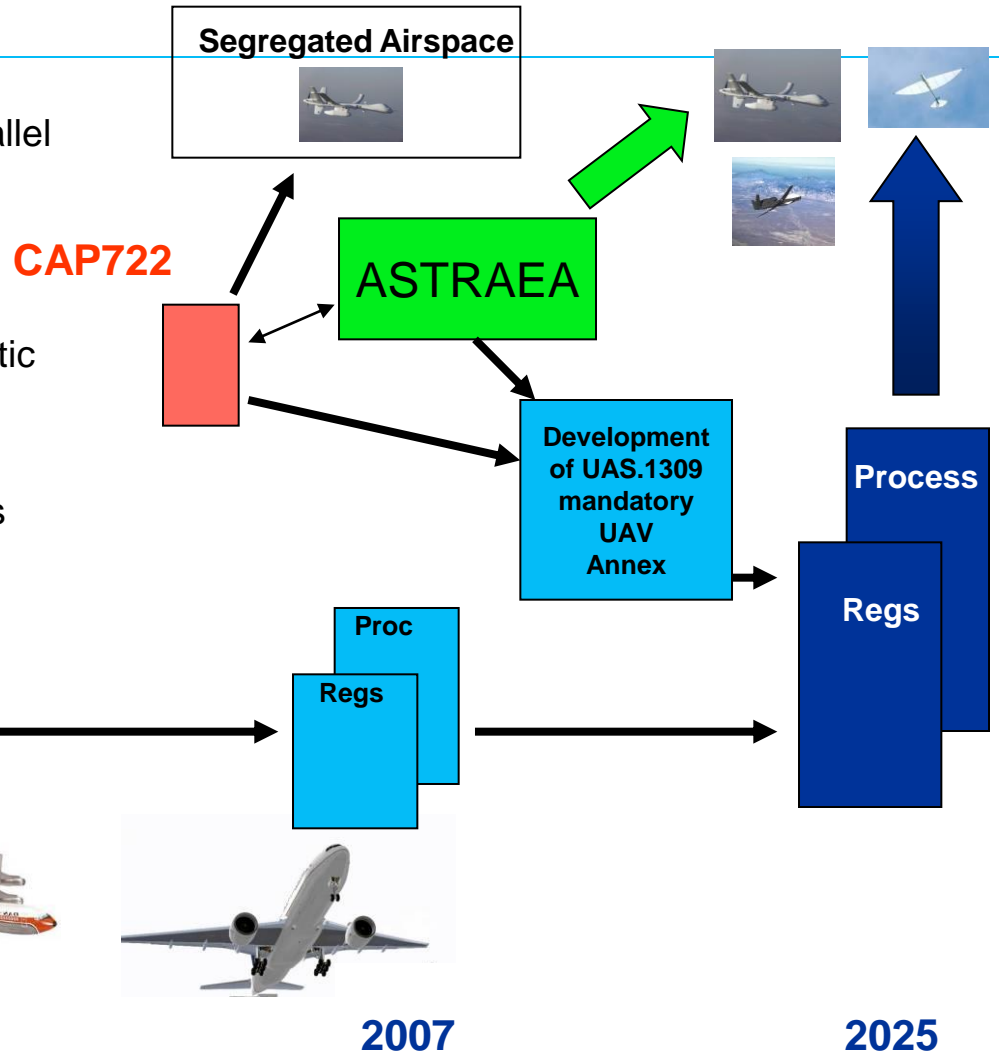
4 ASTRAEA Approach

Whole system approach considering in parallel

- Technology requirements
- Regulatory requirements
- System of systems integration

Visualisation and experimentation in synthetic environments with validation of certain key technologies in flight tests

Collaboration with other international bodies

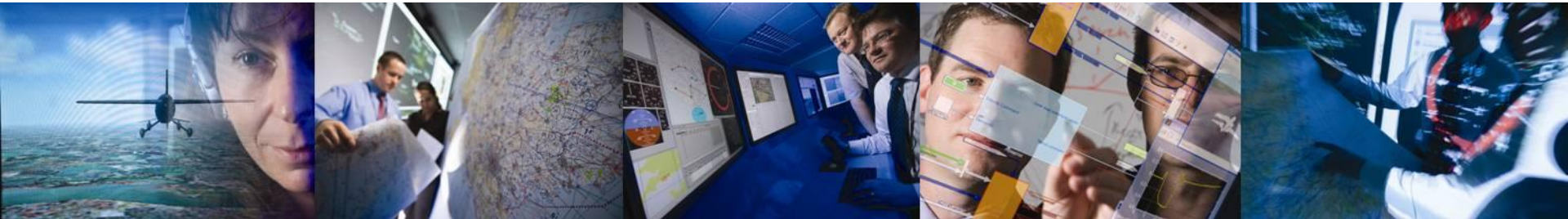


4 Future plans – ASTRAEA Phase 2

Continuous spiral development process to bring to TRL7 the following technologies

- Sense & avoid
- Secure command & control and data communication
- Autonomous decision-making
- Prognostics and health management
- Ground control stations

These will be subjected to a virtual certification exercise with the CAA in a series of surrogate and UAV flights with the aim of rapid exploitation into UAS



5 UAV Management of Agricultural Practice



A potential UAV service for managing agricultural practice and environmental monitoring

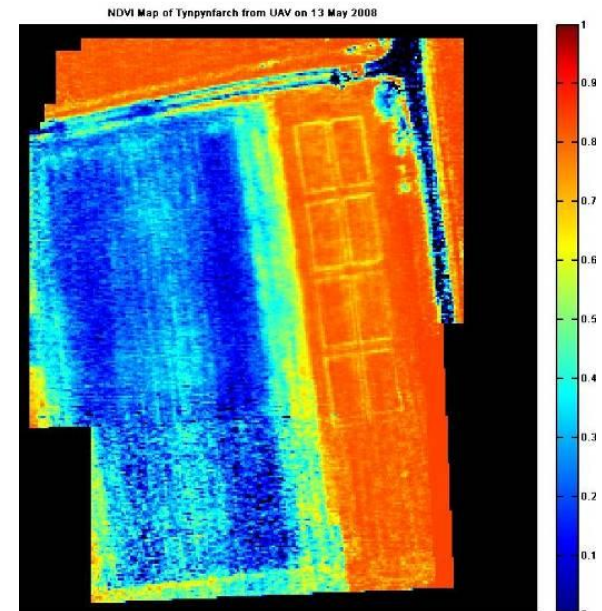
Phase 1 (Apr 07 – Mar 08)

- Market and technical assessment of economic and technical validity
- Simple proof of concept demonstration using Normalised Difference Vegetation Index (NDVI)
- Collaboration with Aberystwyth University, Institute of Biological, Environmental and Rural Sciences

5 Managing Agricultural Practice

Phase 2

- Demonstration of an integrated hyperspectral and lidar system in flight trials
- Establish viability of products



6 Conclusions

The impact of UAVs on civil aviation has been limited to date due to the immaturity of regulations and the absence of certified systems such as sense and avoid

The ASTRAEA programme is set to proceed to its second phase to prove the technologies required for routine airspace access by UAVs and to assist the maturation of regulations

Early experiments with smaller UAVs are establishing their economic, environmental and societal benefit for applications in

- Protection of resources
- Protection of environment
- Protection of citizens
- Protection of infrastructure



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