

# Nuovi paradigmi di mobilità aerea: scenari di impiego e implicazioni tecnologiche e normative

Prof. Umberto Iemma

Dipartimento di Ingegneria

Università Roma Tre

Casa dell'Aviatore

17 ottobre 2022

# Summary

- Overview of new scenarios for air mobility
- National and European regulation schedule
- The technical and design challenges
- NATO Applied Vehicle Technology (AVT) group 233

# New aerial mobility



- Goods transportation and delivery
- Medical emergency services (blood, organs, life-saving drugs...)
- Human mobility (aerotaxis, flying buses)
- Environmental monitoring
- Monitoring of infrastructures
- Surveillance

From *Study on the societal acceptance of Urban Air Mobility in Europe*, EASA 2022

# New aerial mobility



UBER Elevate

Fast-Forwarding to a  
Future of On-Demand  
Urban Air Transportation

October 27, 2016



VOLOCOPTER



Amazon Prime Air seeks FCC to authorise 60-64 GHz band  
collision avoidance system bandwidth operations

- High interest from private and public operators
- Major implications on business plans and commercial system evolution

High pressure on regulation authorities

High impact on urban communities

# New aerial mobility



From [www.nasa.gov](http://www.nasa.gov)

## A revolution for urban and sub-urban communities !

- Personal Mobility
- Real estate value and development
- Urban planning
- Completely different *soundscape*

# New aerial mobility



In this context, **societal acceptance** is a concern of regulation authorities.

# New aerial mobility

## UAV Development roadmap



### Noise source level

- Quick models for noise source evaluation
- Tests in anechoic wind tunnel for validation
- Investigate the benefit of enhanced models developed elsewhere
- Noise reduction techniques



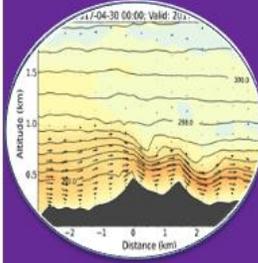
### System level

- Shielding & Acoustic Installation Effects
- Perform static test in anechoic rooms for validation purpose
- System Integration
- Noise mitigation systems
- Flight test demonstration



### Propagation effects

- Ground effects in Urban Environment
- Integrated tools for in-flight aircraft prediction including complex trajectories / Urban environment
- Validate methodology through testing



### Trajectory impact on Noise

- Investigate low-noise trajectories
- Operational constraints
- Propose methodology for defining low-noise impact trajectories

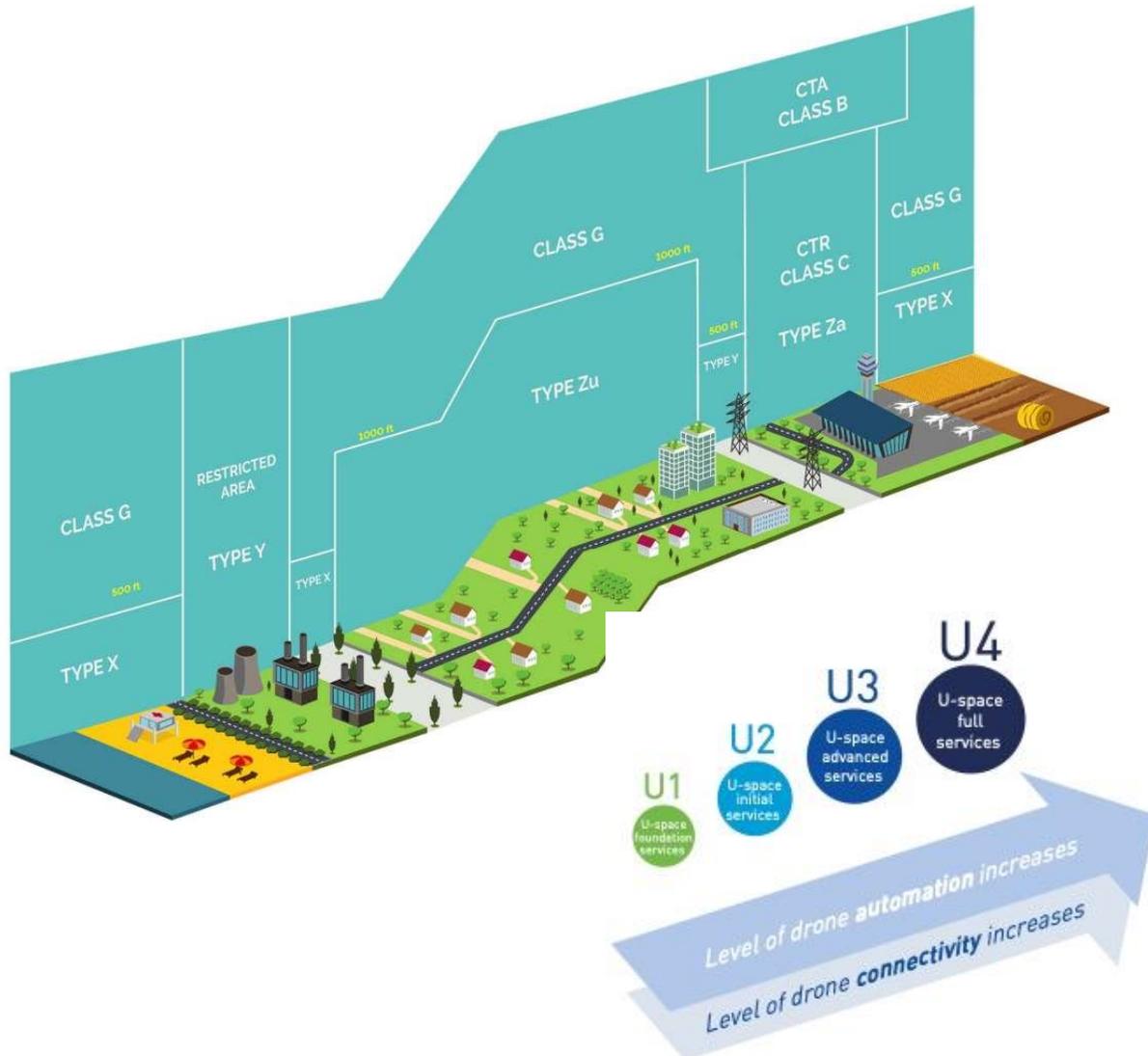


### Public acceptance

- Psychoacoustic surveys
- Public acceptance including non-acoustic factors
- Define strategies for low impact on citizens
- Regulation

In this context, **societal acceptance** is a concern of regulation authorities.

# The U-space concept



U-space is a set of services to **guarantee the safe integration of traditional air traffic with that of UAS.**

UTM zones:

- **X** - No conflict resolution service is offered
- **Y** - Pre-flight (“strategic”) conflict resolution is offered only
- **Z** - Pre-flight (“strategic”) conflict resolution and in-flight (“tactical”) conflict resolution are offered

Progressive entry into service.  
 Connettivity and automation are key words

# Drones typologies (aero-design viewpoint)



multicopters



Fixed wing



Hybrid

# Drones typologies (aero-design viewpoint)

- Drugs delivery

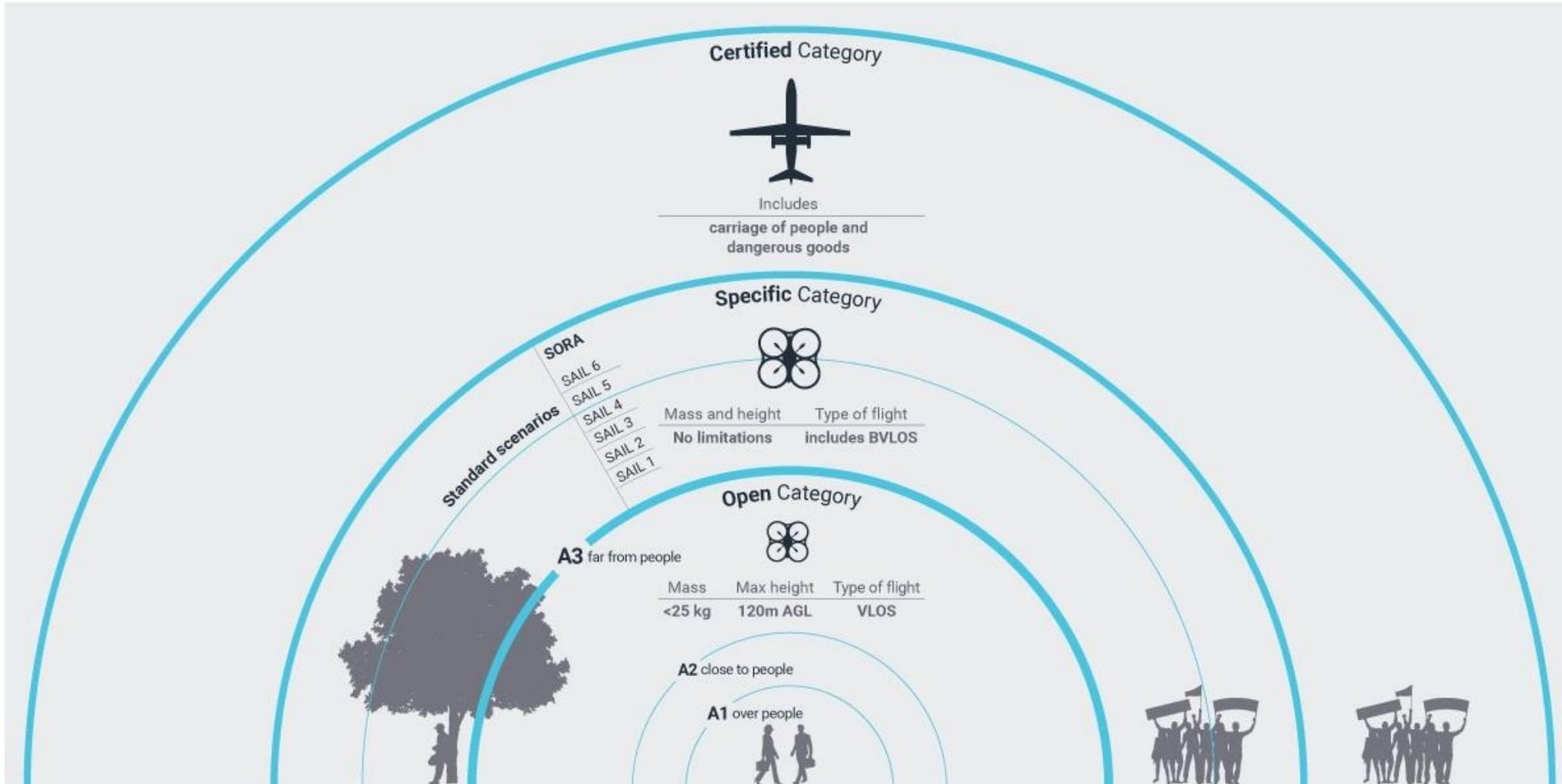


- Organs delivery

- Air Ambulance



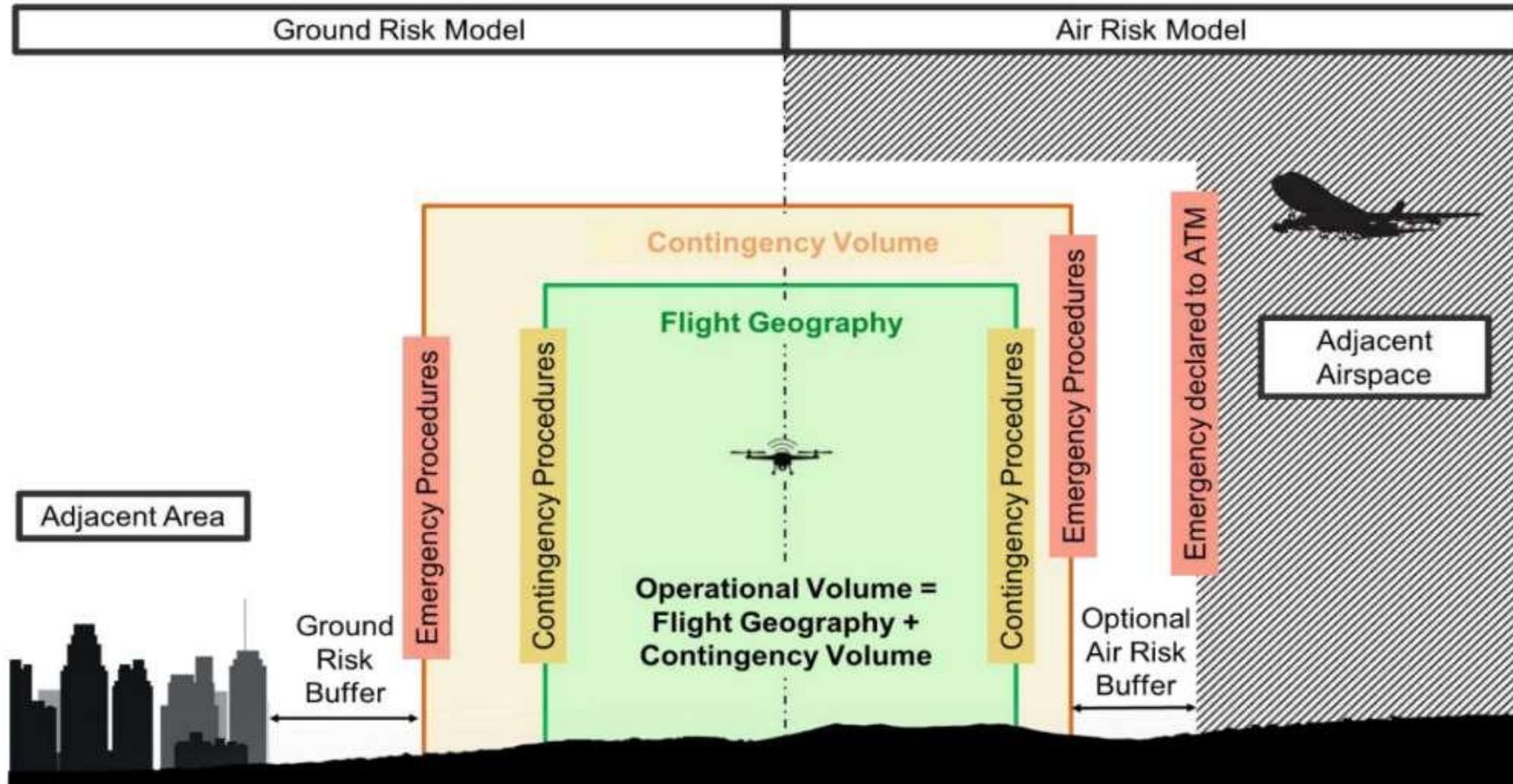
# Operations categories



# Operations categories (open limited)

UAS	Operation		Drone Operator/pilot		
Max weight	Subcategory	Operational restrictions	Drone Operator registration	Remote pilot competence	Remote pilot minimum age
< 250 g	A1 (can also fly in subcategory A3)	<ul style="list-style-type: none"> <li>- No flying expected over uninvolved people (if it happens, should be minimised)</li> <li>- no flying over assemblies of people</li> </ul>	No, unless camera / sensor on board <b>and</b> a drone is not a toy	- no training needed	No minimum age
< 500 g			Yes	<ul style="list-style-type: none"> <li>- read user manual</li> <li>- complete the training and pass the exam defined by your national competent authority</li> </ul>	16*
< 2 kg	A2 (can also fly in subcategory A3)	<ul style="list-style-type: none"> <li>- no flying over uninvolved people</li> <li>- keep horizontal distance of 50 m from uninvolved people</li> </ul>	Yes	<ul style="list-style-type: none"> <li>- read user manual</li> <li>- complete the training and pass the exam defined by your national competent authority</li> </ul>	16*
< 25 kg	A3	<ul style="list-style-type: none"> <li>- do not fly near or over people</li> <li>- fly at least 15m from residential, commercial or industrial area</li> </ul>	Yes	<ul style="list-style-type: none"> <li>- read user manual</li> <li>- complete the training and pass the exam defined by your national competent authority</li> </ul>	16*

# SORA (Specific Operations Risk Assessment)



# SAIL (Specific Assurance and Integrity Level)

The SAIL represents the level of confidence that the UAS operation will remain under control.

Depends on

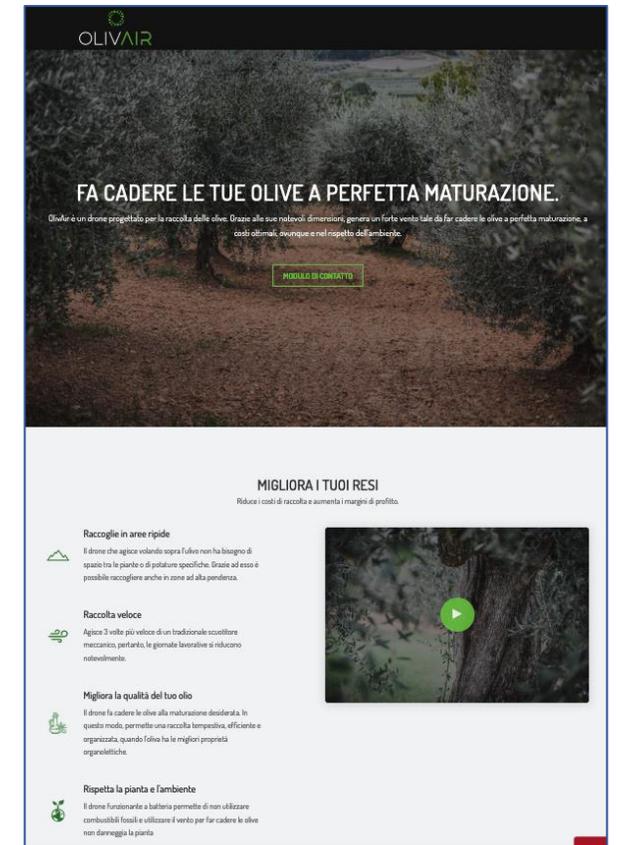
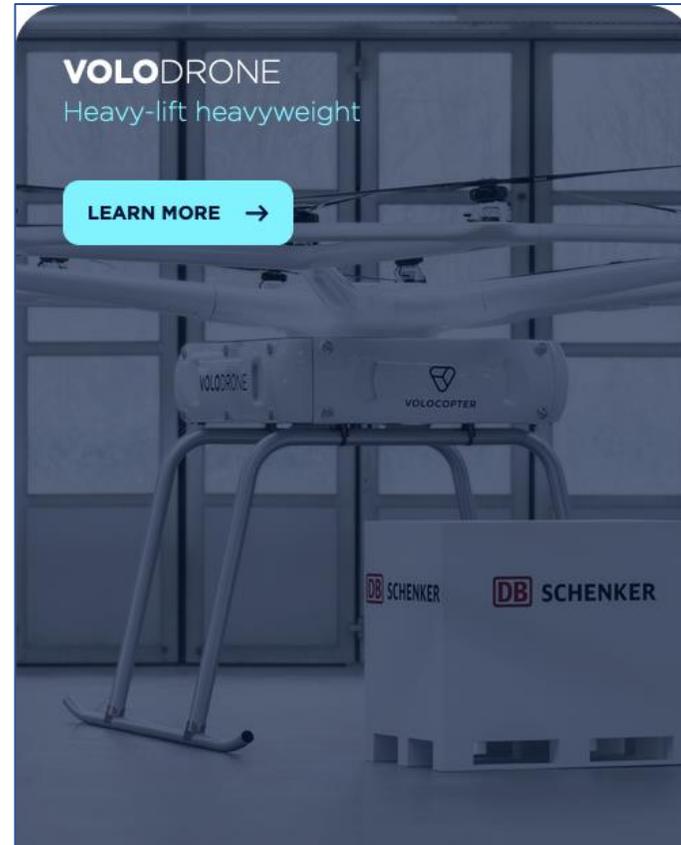
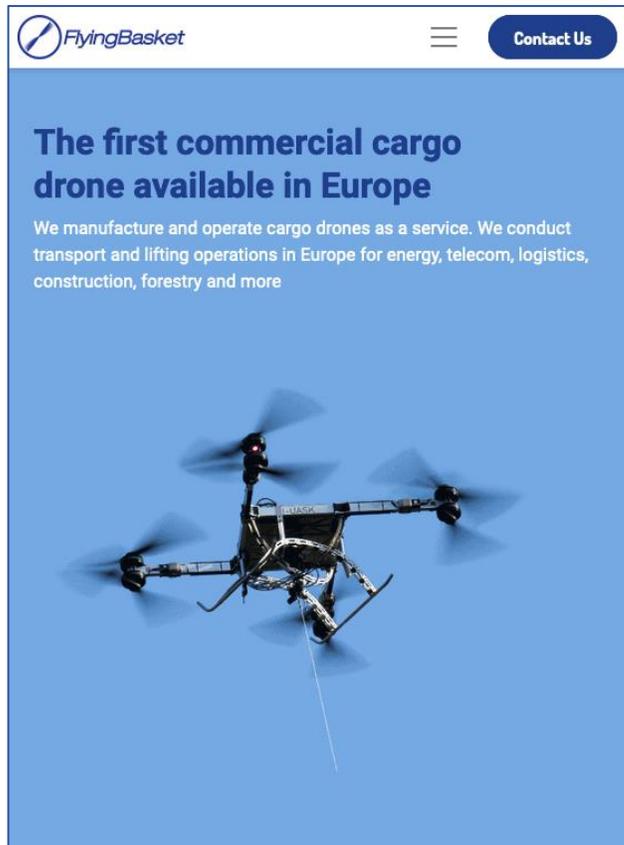
- GRC Ground Risk Class
- ARE Aerialim Risk Class

SAIL Determination				
	Residual ARC			
Final GRC	a	b	c	d
≤2	I	II	IV	VI
3	II	II	IV	VI
4	III	III	IV	VI
5	IV	IV	IV	VI
6	V	V	V	VI
7	VI	VI	VI	VI
>7	Category C operation			

# Technical and design challenges (some of the...)

- Gravimetric and volumetric energy storage density for electric propulsion;
- Noise emissions (intensity and directivity!!)
- Automation and connectivity
  - UAS-to-UAS, UAS-to-GRD, UAS-to-A/C
  - Large swarms
- Aeronautical-standards-certified design and manufacturing for robustness and reliability of heavy duty drones (also in presence of uncertainties)
- ...

# Technical and design challenges (some of the...)



Heavy multicopters for civil applications

# Technical and design challenges (some of the...)



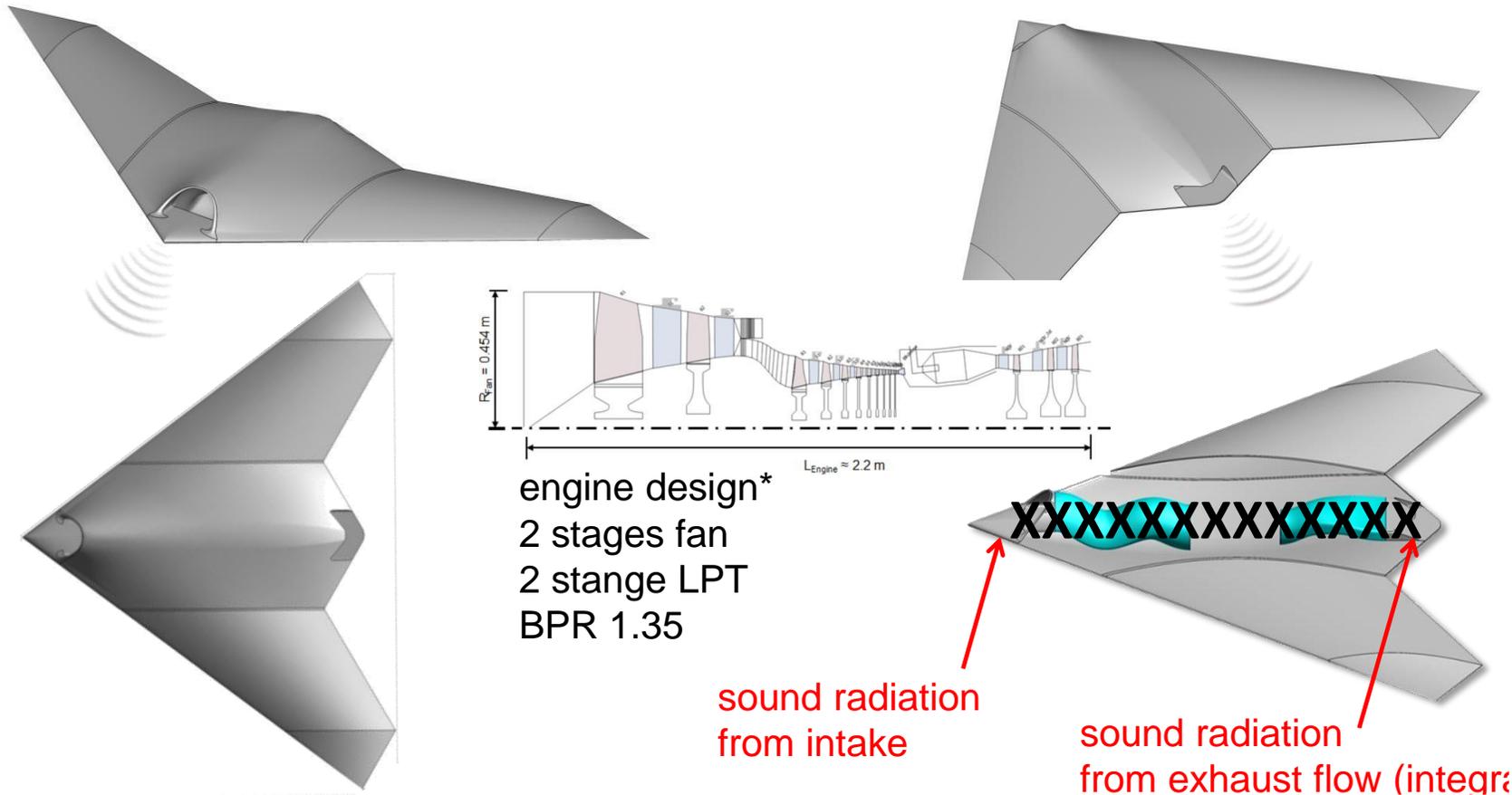
Volocity operation in Rome ready by 2024

# Technical and design challenges (some of the...)



Dronus Nest<sup>®</sup>  
concept for  
surveillance

# The NATO AVT 251/318 panel



Design (251) and  
aeroacoustic  
assessment (318) of  
an attack drone.

# A commitment for educators

Next generation of engineers must be prepared and trained for this challenge.

## 2022 Students' Projects

### Masters in Aeronautical Engineering – Roma Tre

<b>Air Bombero</b>	Wildfire detection of large wild areas
<b>DM Rush</b>	Medical delivery (drugs, organs)
<b>Moltres</b>	Agridrone for olives harvesting
<b>WildFireUAV</b>	Wildfire suppression STOL UAV
<b>Poseidon</b>	Ocean temperature monitoring
<b>Fair-Prandtl</b>	Unconventional medium range AC

Almost all students' projects focused on drones for civil services

# A commitment for educators

New program in Roma Tre University to cope with this challenge...



**CONTATTI**  
Segreteria Didattica Ing. Aeronautica:  
Tel. 06 57337410  
didattica.aeronautica@uniroma3.it  
<https://ingegneria.uniroma3.it/>  
@ingegneriaR3

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**INGEGNERIA DELLE  
TECNOLOGIE  
AERONAUTICHE E  
DEL TRASPORTO  
AEREO**

**OBIETTIVI FORMATIVI**  
L'Università Roma Tre propone un percorso innovativo orientato all'ingegneria aeronautica, con l'inclusione di competenze trasversali dettate dalla moderna evoluzione della tecnologia e delle applicazioni.  
Questo corso di laurea triennale coniuga le conoscenze tipiche di una robusta preparazione di base nei settori dell'ingegneria aeronautica e industriale (sono presenti corsi riguardanti strutture aeronautiche, aerodinamica, propulsione convenzionale ed elettrica, meccanica del volo, materiali aeronautici convenzionali e innovativi), con l'acquisizione di competenze nell'ambito dei trasporti, delle infrastrutture e della logistica di interesse nel settore aeronautico, e della gestione di sistemi complessi con l'uso di tecniche di intelligenza artificiale, machine learning, ottimizzazione multi-obiettivo, big-data e data-analytics.  
L'assetto formativo che si propone agli allievi ingegneri è ispirato dagli attualissimi temi di interesse che riguardano l'ecosostenibilità dell'aviazione e lo sviluppo di nuovi servizi di trasporto aereo in aree urbane e suburbane, mediante l'utilizzo di velivoli di nuova concezione, anche a guida autonoma.

**INTERNAZIONALIZZAZIONE**

- Preparazione nella lingua inglese a livello B2
- Ampia disponibilità di sedi per soggiorni ERASMUS

Thank you for your attention

[umberto.iemma@uniroma3.it](mailto:umberto.iemma@uniroma3.it)