



Overview: NASA (RVLT) Studies on eVTOL

Chris Silva

NASA Ames Research Center

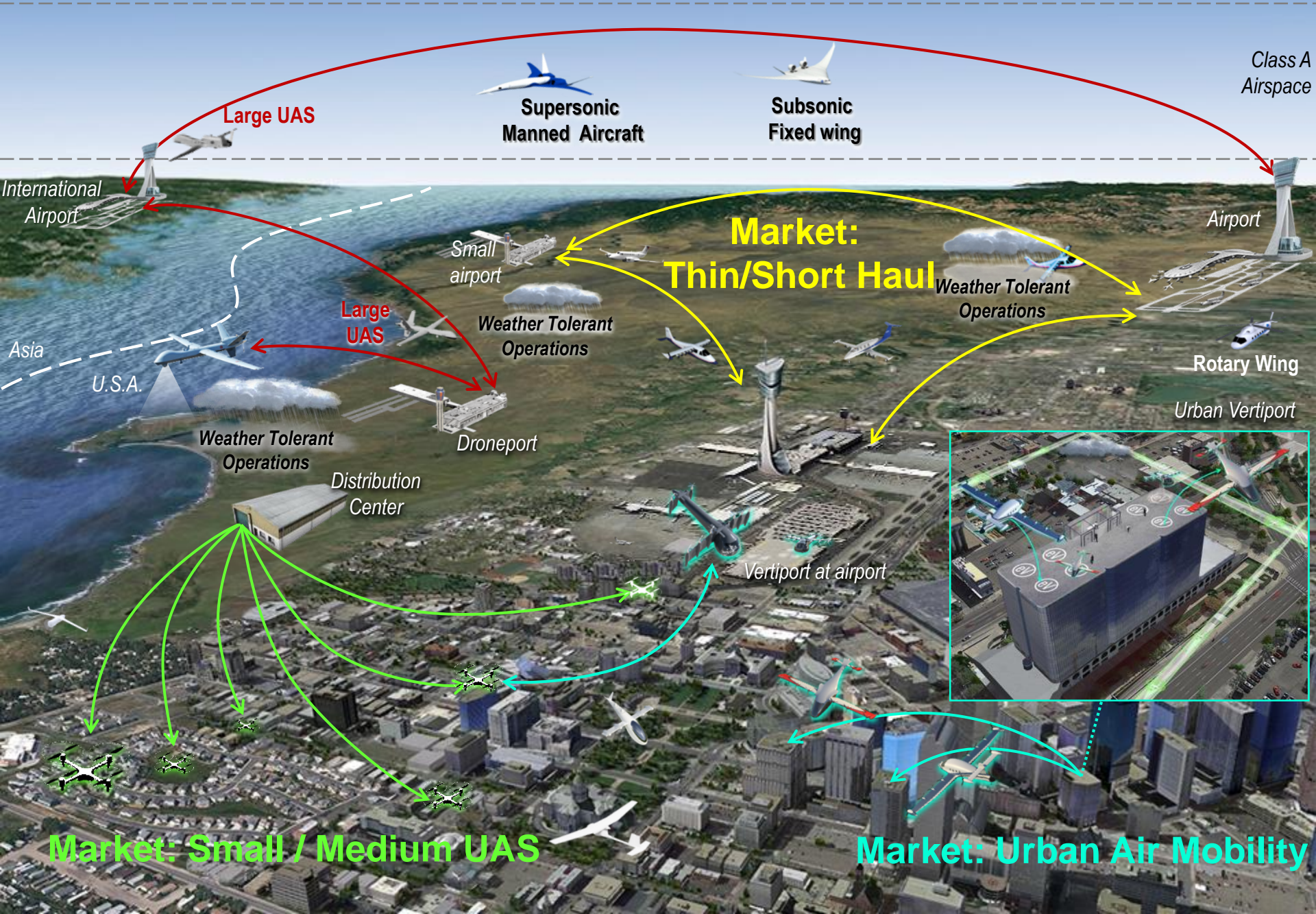
Revolutionary Vertical Lift Technology –

Sub-Project Technical Lead: Optimization Process for Conceptual Design

Market: Large UAS & HALE

HALE UAS

Upper E
Airspace



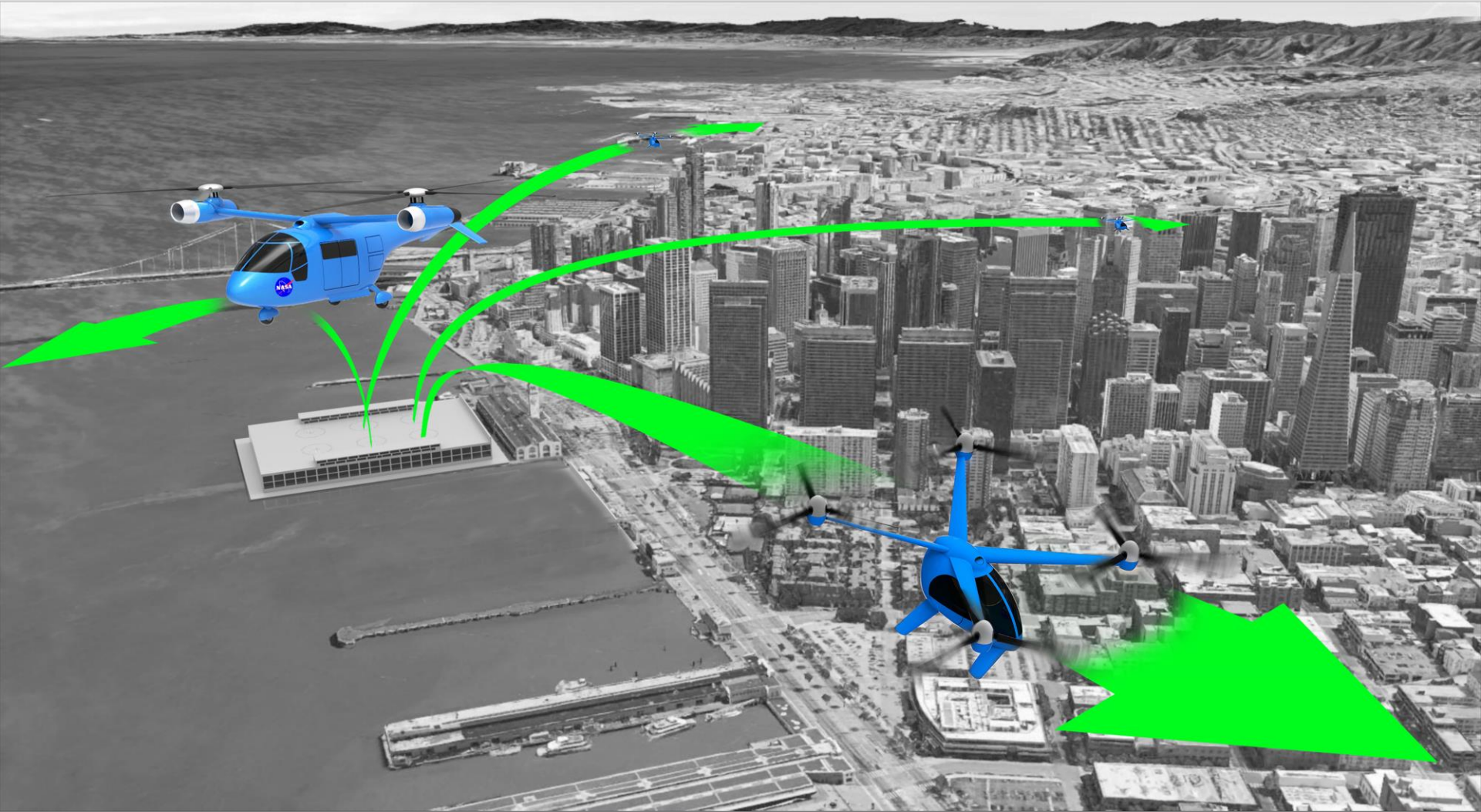
Supersonic
Manned Aircraft

Subsonic
Fixed wing

Market:
Thin/Short Haul

Market: Small / Medium UAS

Market: Urban Air Mobility



Emerging Aircraft Markets – Integrated Challenges

NASA Aeronautics pivoting to address complex challenges



Flight Physics

Decision Making

Flight Rules/Interaction

Emerging Market Opportunities

s/mUAS

Urban Air Mobility

Thin/Short Haul

Large UAS/HALE

Electrified Aircraft Propulsion & Integration
flight-critical, flight-weight power/energy

Noise
vehicle & fleet

Weather/Environment-Tolerant
vehicle robustness (wind/rain/ice...)

Assured Autonomous Systems & Human Integration
autonomous awareness & contingency management
UAS mission management (one operator/many vehicles)

Integrated ATM System
Efficient, high density operations with access to diverse platforms
in airspace with integrated air/ground/cloud technologies

Integrated Aviation System Challenges

NASA Revolutionary Vertical Lift Technology (RVLT) Investment Strategy



FY18+ RVLT technology emphasis

<FY17 RVLT technology emphasis

Very Small <100lbs	Small <55lbs	Very Light <1500lbs	Light <6000lbs	Medium <12,000lbs	Med-heavy <25,000lbs	Heavy <50,000lbs	Ultra-Heavy <100,000lbs
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Technology applicability scales up and down in many areas



- NASA RVLT project technology emphasis will include smaller vertical lift vehicles, particularly emphasizing technology for UAS and UAM

Research Areas for Air Taxi Aircraft Development

PROPULSION EFFICIENCY

- high power, light battery
- light, efficient, high speed electric motors
- power electronics and thermal management
- light, efficient diesel engine
- light, efficient small turboshaft engine
- efficient drives

PERFORMANCE

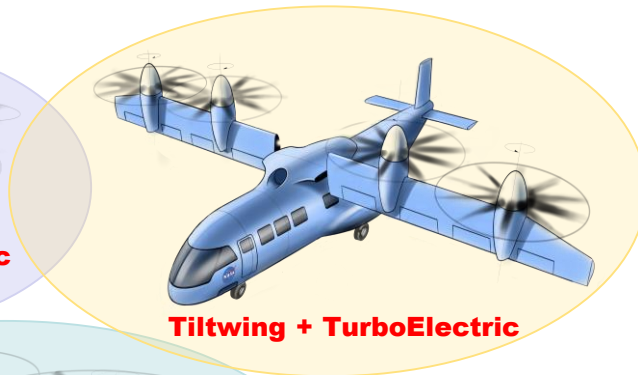
- aircraft optimization
- rotor shape optimization
- hub and support drag minimization
- airframe drag minimization

ROTOR-ROTOR INTERACTIONS

- performance, vibration, handling qualities
- aircraft arrangement
- vibration and load alleviation

SAFETY and AIRWORTHINESS

- FMECA (failure mode, effects, and criticality analysis)
- component reliability
- crashworthiness
- propulsion system failures

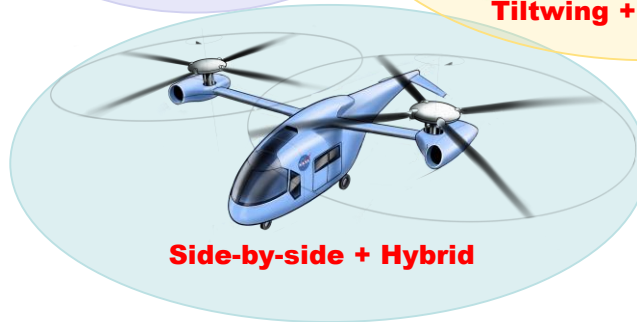


ROTOR-WING INTERACTIONS

- conversion/transition
- interactional aerodynamics
- flow control

OPERATIONAL EFFECTIVENESS

- disturbance rejection (control bandwidth, control design)
- all-weather capability
- cost (purchase, maintenance, DOC)



AIRCRAFT DESIGN

- weight, vibration, handling qualities
- active control

NOISE AND ANNOYANCE

- low tip speed
- rotor shape optimization
- aircraft arrangement
- active noise control
- metrics and requirements

STRUCTURE AND AEROELASTICITY

- structurally efficient wing and rotor support
- rotor/airframe stability
- crashworthiness
- durability and damage tolerance

Ref: Johnson, W., Silva, C., and Solis, E., "Concept Vehicles for VTOL Air Taxi Operations,"

AHS International Technical Meeting on Aeromechanics Design for Transformative Vertical Flight, 16 Jan 2018

