Electra’s EL9 Development using HyperX

Gary Wolfe, EL9 Airframe IPT Lead

Background

Education

S.M. in Aeronautics and Astronautics
Massachusetts Institute of Technology (2017)

B.S. in Aerospace Engineering, Minor in Engineering Leadership and Development,
University of Maryland, College Park (2015)

Aurora Flight Sciences

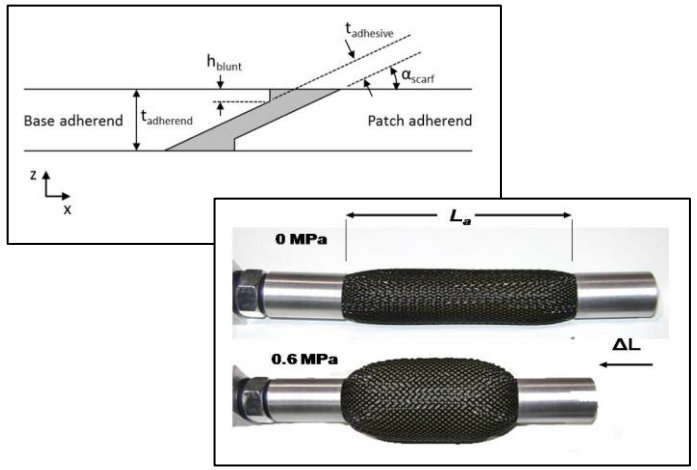
- ***Senior Structures Engineer***
- ***Stress Lead, DARPA X-65 CRANE***
- ***Business development, R&D, design/analysis of prototype/production vehicles, manufacturing, and sustainability***
- ***Programs:*** *NASA ACC, CH-53K, MQ-25, Orion, V-22, PAV, CRANE, Other*

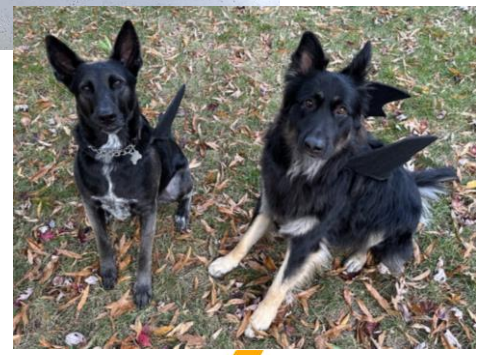
Electra.Aero

- **Principal Structures Engineer**
- **Structures & Mechanical Group Manager**
- **EL9 Airframe IPT Lead**

Hobbies

Jeep & Dogs!





Introducing the EL9

Operational flexibility of a helicopter at less than fixed-wing economics

Current design. Subject to refinement.
Type certification in progress. Anticipated by late 2028 / early 2029.

9 passengers
1 pilot + 2,700 lb payload
3,000 lbs in cargo config

1,100 nm
Max range (+ 45 min reserve)

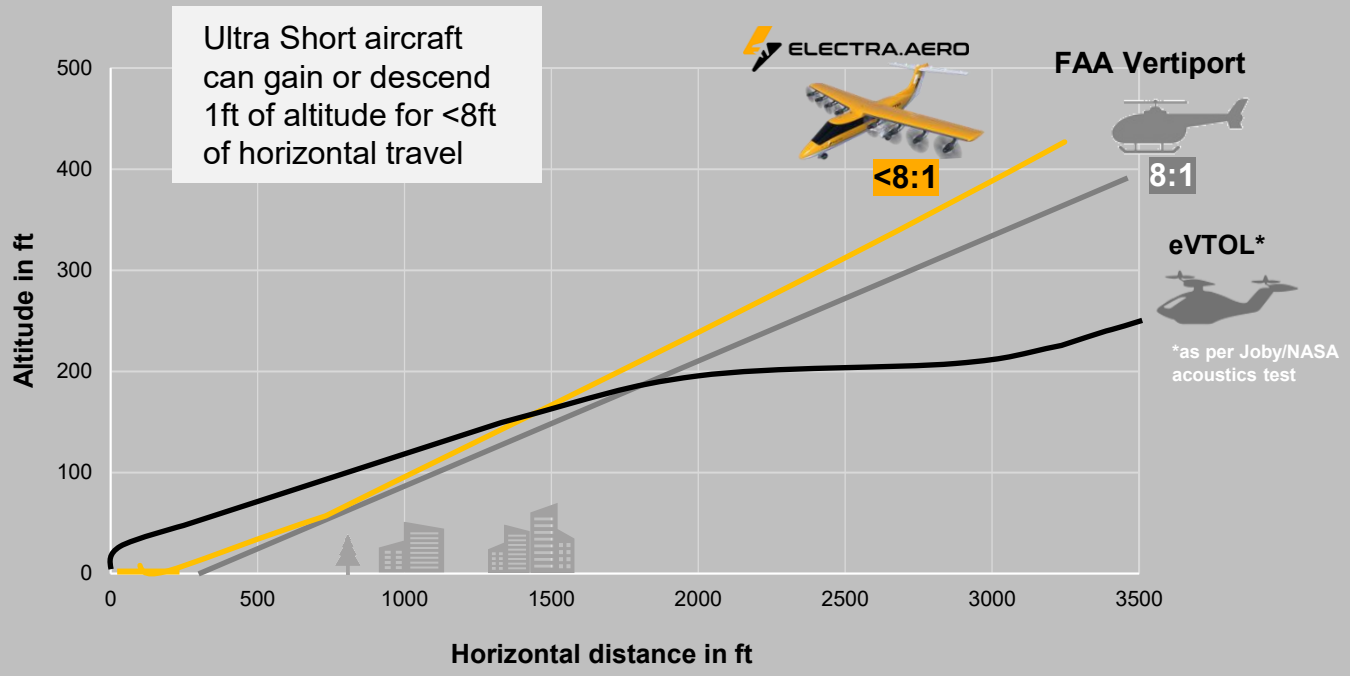
~ 150 ft
Nominal takeoff and landing roll

175 ktas
Max cruise speed

<75 dba on takeoff (300 ft)
comparable to urban background

Blown-lift provides the Ultra Short's helicopter-like operational profiles

Electra Ultra Short Aircraft Exceed FAA Design Criteria for Heliport Performance

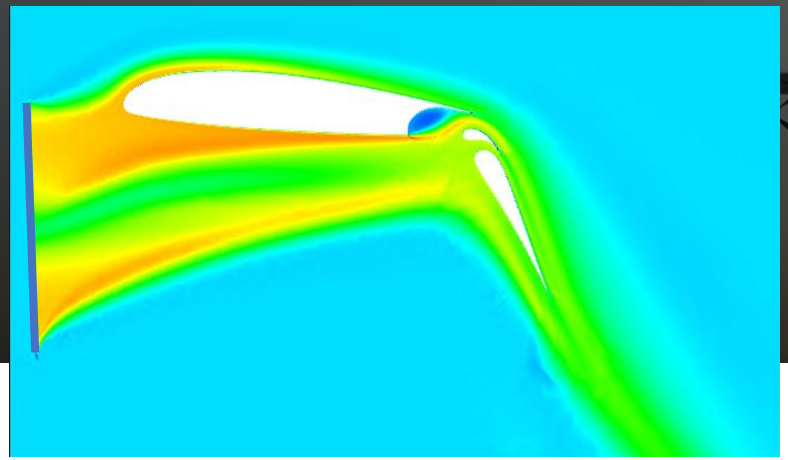


- Blown-lift increases wing lift by **>7x**
- Reduces takeoff speed **<35 kts**
- **<150 ft** ground roll
- **<300 ft** total surface length

Manhattan Heliport

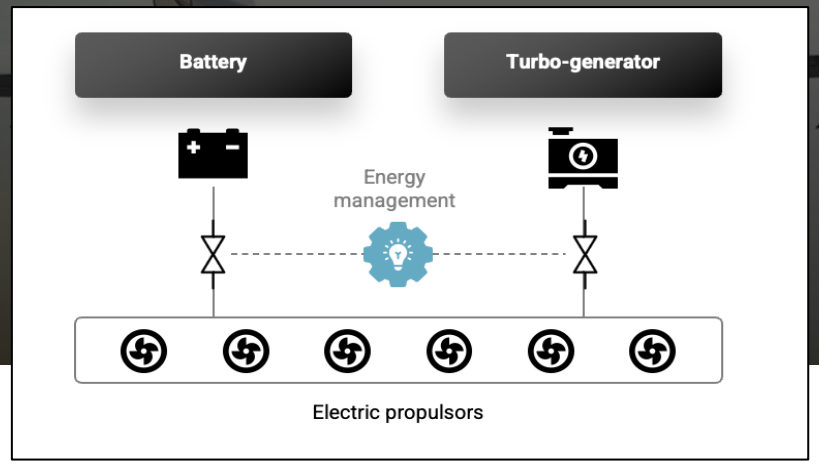
How do we do it?

Blown Lift



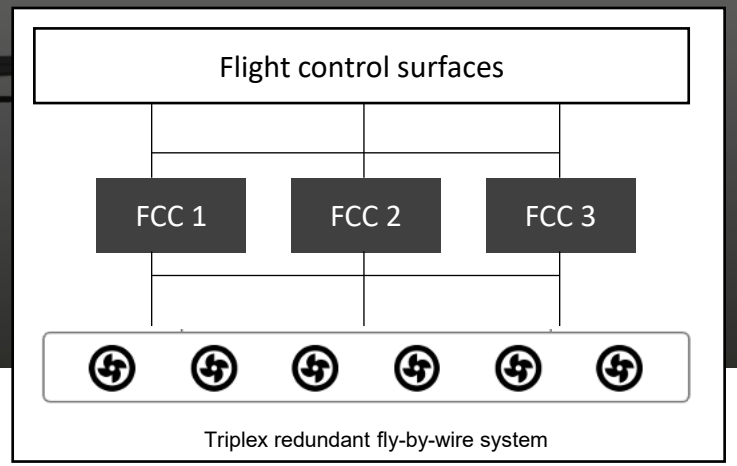
- Blown-lift increases wing lift by >7x
- Reduces takeoff speed <35kts
- 100-150 ft to accelerate to takeoff speed
- 300x100 ft total ground footprint for takeoff and landing

Hybrid-electric



- Turbogenerator and battery packs power electric motors
- Turbogenerator (TG) sized for cruise
- Battery boosts power for takeoff and landing.
- Small TG runs at most efficient operating point
- Net-zero carbon emissions today using SAF
- Zero-emissions tomorrow using eFuels or H2

Fly-by-wire



- Past STOL designs showed that taking off in a short distance is easy.
- Landing accurately is hard.
- DEP and fly-by-wire solves that problem
- Pilot augmentation supports repeatable, precision landings.

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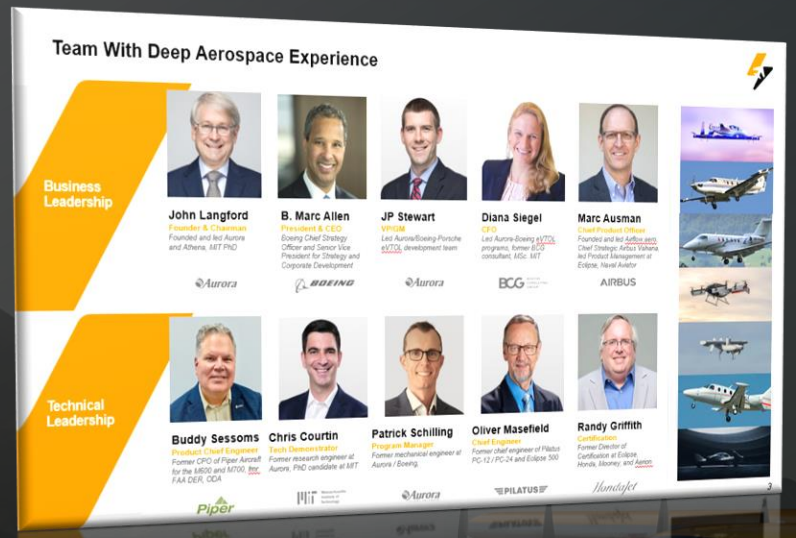
Airframe Challenges



Team Size

Small team of extremely talented engineers - roughly 80 employees

System Integration

The EL9 combines blown lift technology with distributed electric propulsion using four independent battery packs and a small turbine-powered generator that drives eight electric motors distributed along the wing to provide high lift at low airspeeds

Schedule

First test flights are planned for 2027, with certification and service entry anticipated in 2029 under FAA Part 23 regulations.

HyperX at Electra – Why?

HyperX is an industry trusted tool that provides documented analysis methods per classical and industry standards, while also supporting customizable plug-ins to meet specific company requirements.

When trying to move this fast with a small team, you need the right resources to answer all the many questions.

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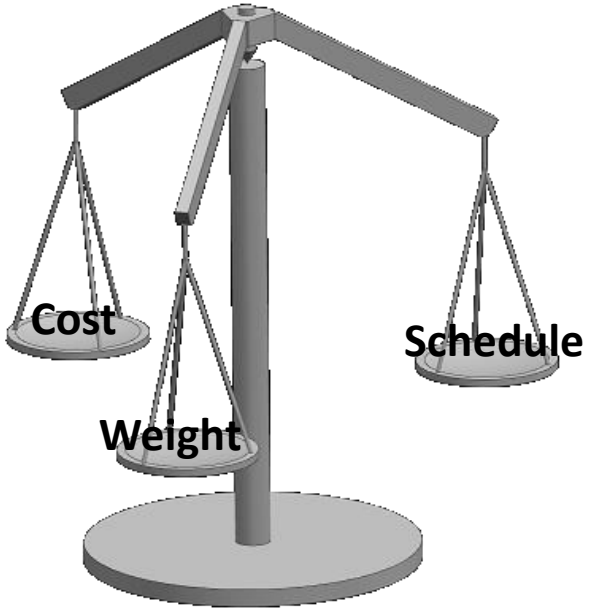
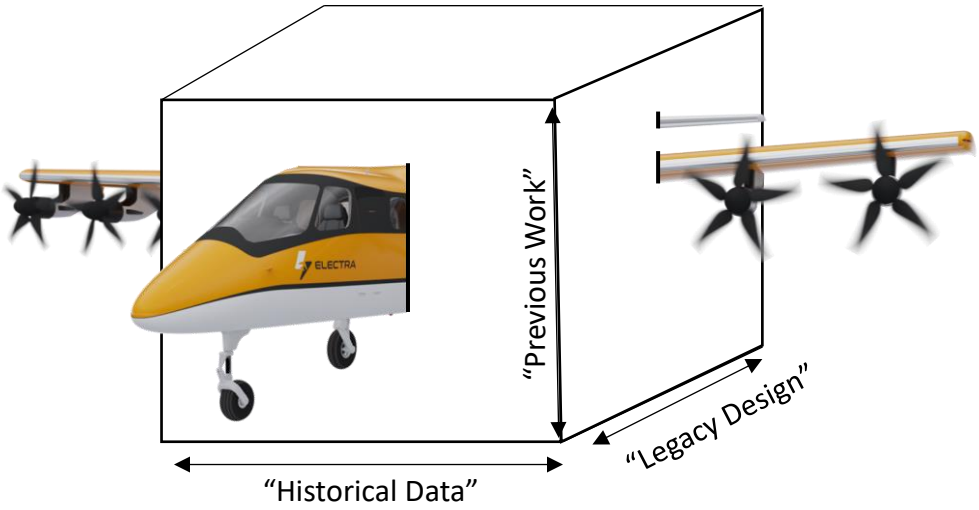
HyperX at Electra – How?

Historical data and legacy design practices are valid… to a point.



Evaluate impact on ***cost*** vs ***schedule*** vs ***weight***

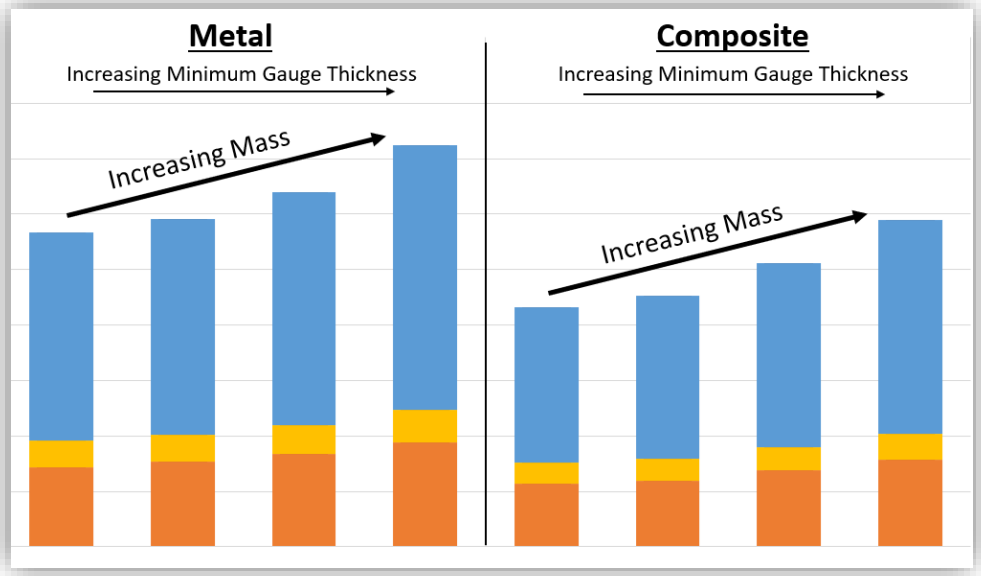
Pressure test ***criticality*** and ***impact*** of requirements

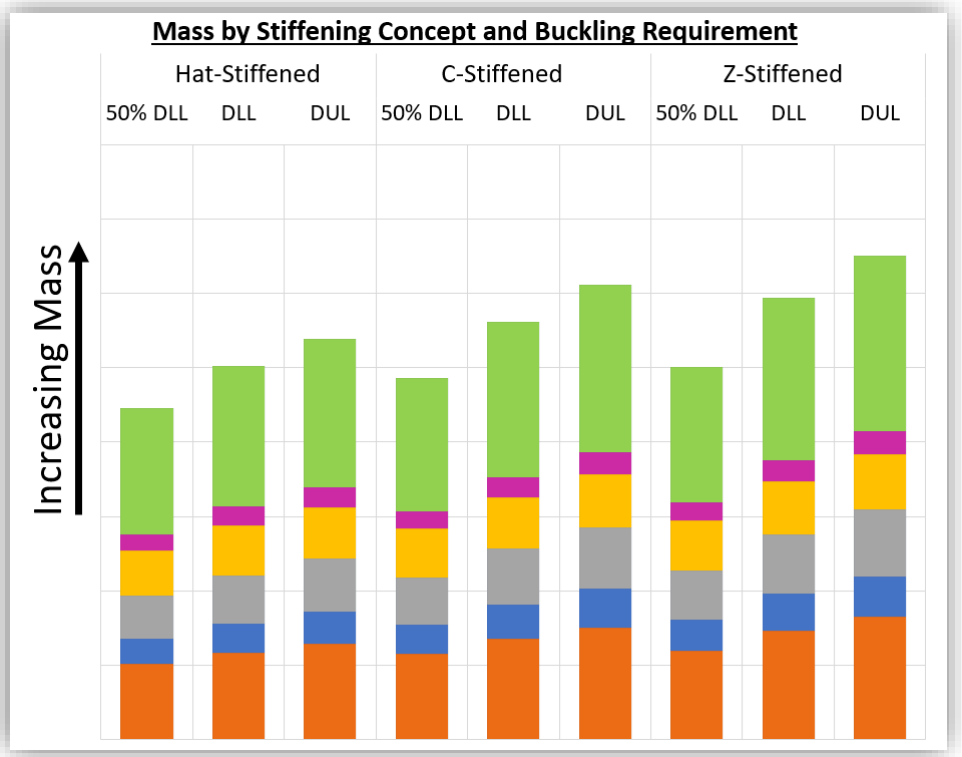


Optimize a novel ***design*** outside historical precedence

EL9 is a clean-sheet development program starting from first principals – outside historical precedent– enabling optimized design decisions for a novel aircraft architecture.

HyperX at Electra – Structural Trade Studies





Optimal Structural Layout

Material Trades

Stiffening Concepts

Analysis Requirements

Producibility Assessment

Electra's using HyperX to evaluate structural layout and design/analysis requirements to rapidly mature beyond parametric estimates and feed airframe design guides and analysis plans.

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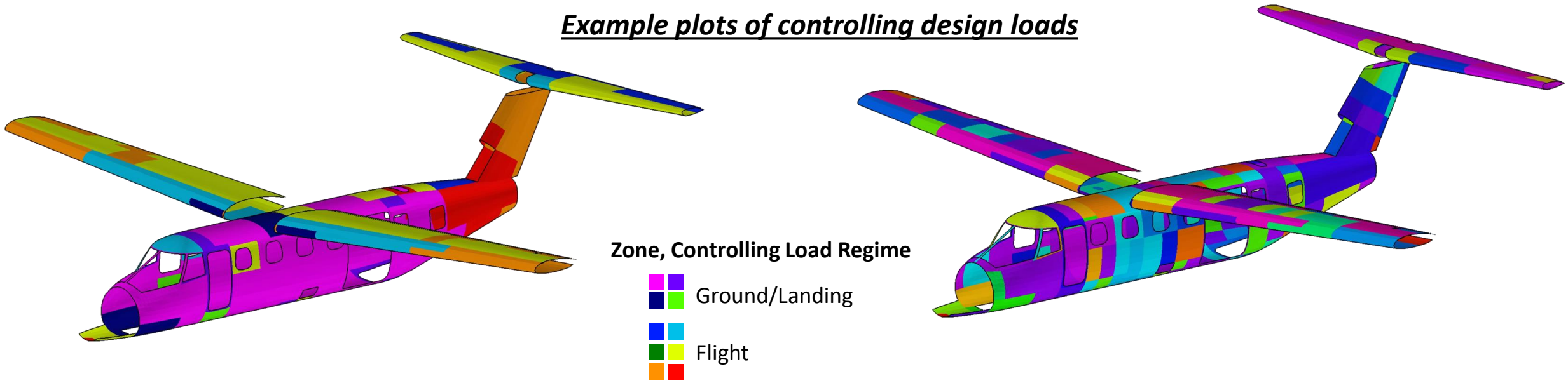
HyperX at Electra – Opportunities & Risks

Electra uses HyperX's extensive plotting capabilities to interrogate the model for opportunities and risks. The ability to view data such as critical load case, failure method, part thicknesses, etc., on the full airframe enables the engineering team to identify critical weight and cost opportunities.

Example plots of controlling design loads



There are few things more easily understood across the Program team than your aircraft color-coded for critical design features!

Challenges & Solutions

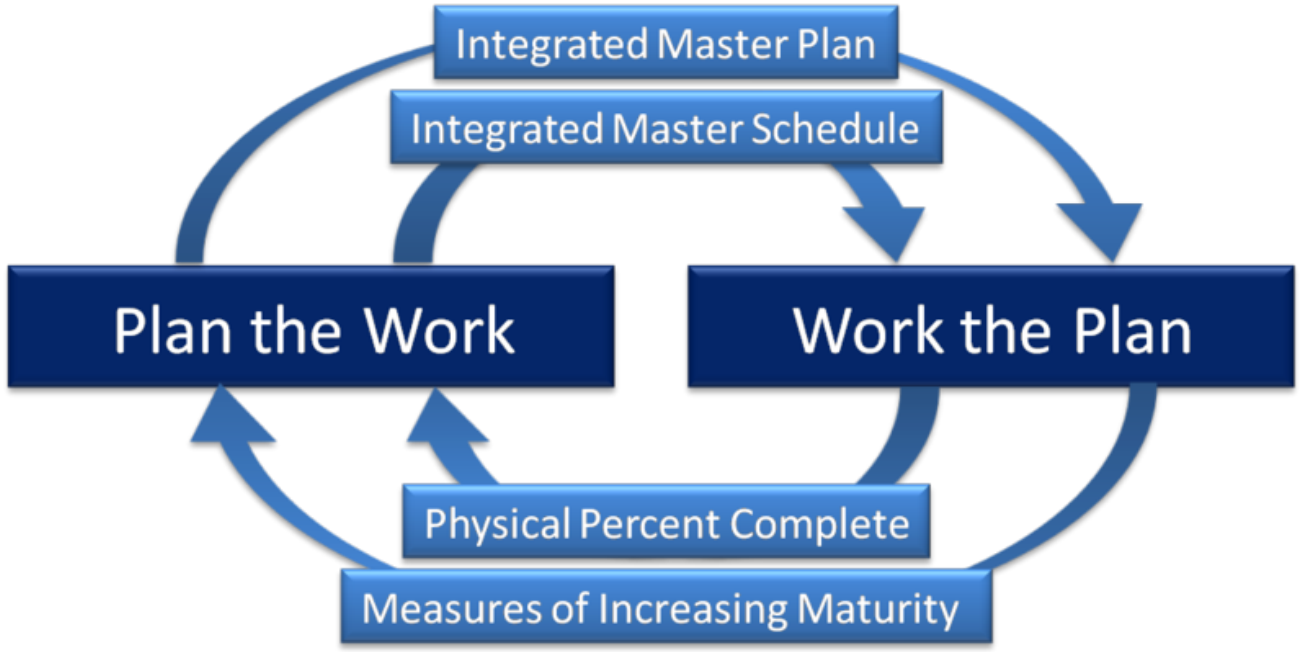
As with any tool, users must recognize challenges and master design principles to avoid the classic "Garbage In, Garbage Out"

New programs ***typically*** allocate time for analysis tool development – essential to address the unique demands of novel configurations.

With a small team running a large aircraft assembly, it's easy to fall into an undesirable "optimal" design.

Challenges & Solutions

- Decide at the beginning
- Understand the limitations
- Allocate time to develop custom plug-ins
- Know how to transition between program phases
- Develop plan for interacting with those outside of stress



https://herdingcats.typepad.com/my_weblog/2009/09/plan-the-work-work-the-plan.html

Plan around incorporating and optimizing **FOR** HyperX to fully leverage its structural analysis capabilities.

“With great power comes great responsibility”

- Uncle Ben (Spiderman)

Electra’s small team is using HyperX to optimize the EL9 airframe with inputs across the Program team through rapid trade studies on hundreds of load cases.

Thank you!

www.electra.aero