
# Designing WindRunner™, The World's Largest Aircraft

## Using HyperSizer to Design WindRunner

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# Image Disclaimers

Unless otherwise noted, all images of the WindRunner™ aircraft are computer-generated artist renderings, not photographs. No WindRunner aircraft has yet been constructed or flown.

# WindRunner Is a Dual-Use Outsized Aerial Logistics Platform

## Three Key Verticals with Primary Focus on Onshore Wind Energy

### Onshore Wind Energy


Onshore wind energy is constrained by ground logistics, hampering growth in this up to $10T market thru 2050

WindRunner can solve this transport bottleneck by enabling deployment of blades up to 105m long, as well as other oversized components

### Defense


Defense airlift capabilities are rapidly degrading, with no viable replacement planned for aging fleets

WindRunner meets existing mission requirements and can help to make new missions possible

### Commercial Cargo


Aging fleets and geopolitical constraints severely limit outsized air cargo options for commercial users

WindRunner can grow this unique market segment with little competition from historical incumbents

Key Verticals: Space, Energy and Extractives, Aviation, Project Cargo

Note: Artist renderings. All loading systems, including ramps, are Ground Support Equipment (GSE)
Source: BNEF, *"New Energy Outlook 2024"* and Radia management estimates McKinsey & Company, *"Space: The $1.8 Trillion Opportunity for Global Economic Growth,"* April 2024, RAND, *"Reducing Long-Term Costs While Preserving a Robust Strategic Airlift Fleet,"* 2013

# The Potential for Large Scale Onshore Wind Turbines is Immense

## Today's Onshore Wind

## Future Onshore Wind Turbines

Power available to convert to electricity

Rotor swept area increases with the square of blade length

$$P = \rho A v^3 / 2$$

Air density varies with elevation and temperature

Average wind velocity increases with height above ground

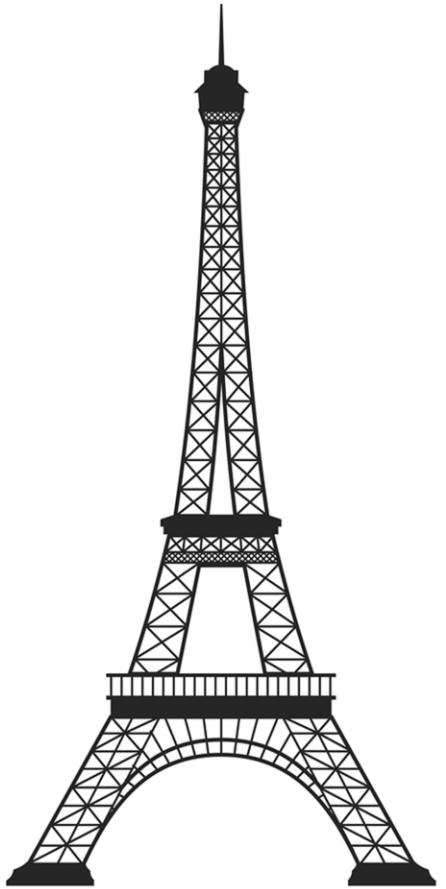
Artist Rendering

# The Future of Renewables is Big

## The Largest Onshore Turbines Ever Built

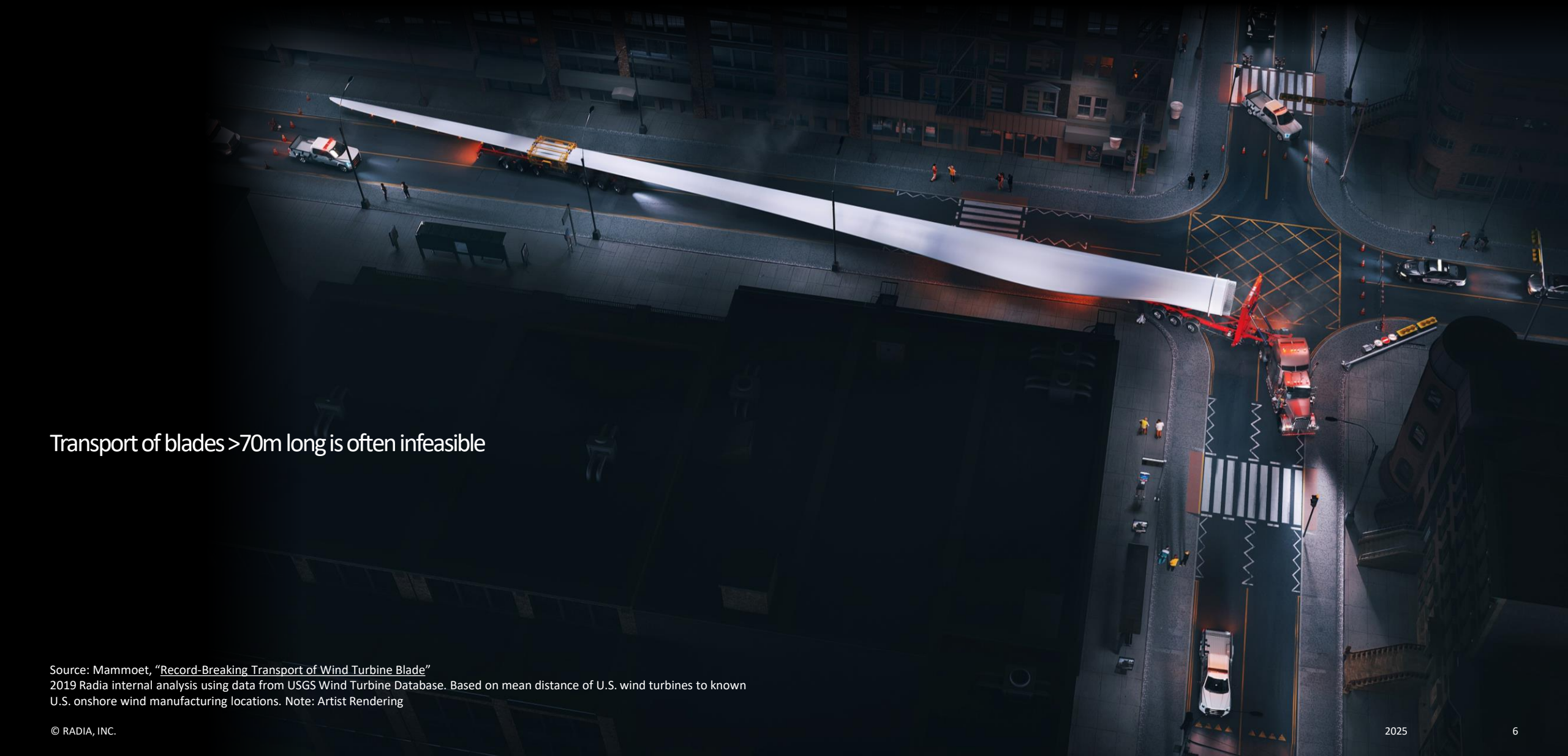
**Saturn V**
(111m)

**Radia-Enabled Turbine**
(250m)



**Eiffel Tower**
(330m)

# Onshore Wind Is Limited by Terrestrial Transportation Constraints



Transport of blades >70m long is often infeasible

Source: Mammoet, "Record-Breaking Transport of Wind Turbine Blade"
2019 Radia internal analysis using data from USGS Wind Turbine Database. Based on mean distance of U.S. wind turbines to known U.S. onshore wind manufacturing locations. Note: Artist Rendering

# Bridge Height and Tunnel Width Pose Insurmountable Transportation Challenges for Onshore Wind


Length is not the only consideration – Tunnels, overpasses and other obstacles impose height and width limits for road and rail

Note: Artist Rendering
Source: https://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter3/3_verticalclearance.cfm
https://www.bnsf.com/ship-with-bnsf/industrial-products/machinery-and-oversized/

# WindRunner: Optimized for Volume

## Exceptionally Large Payload Bay and Semi-Prepared Field Capable


Note: Artist Rendering



### Key Highlights

**Dimensions**

108m length
80m wingspan
24m height

**Payload, Up to**

105m long
8.5m wide
73 metric tons

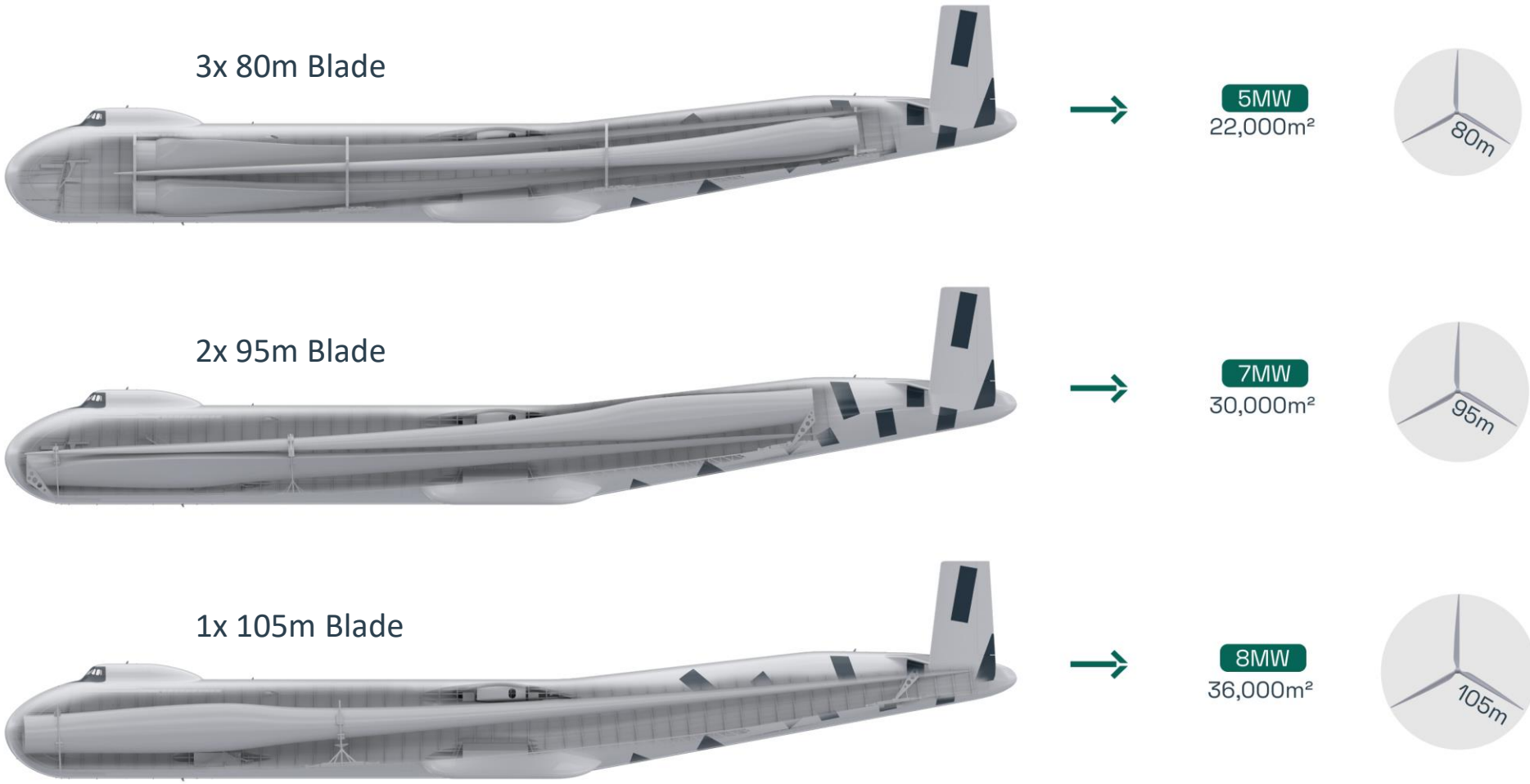
**Runway**

Unpaved
1,800m long

**Target Fleet Size**

150 Aircraft

# WindRunner Is Designed to Transport Blades up to 105m in Length… and Multiple Smaller Blades at Once




Note: Artist Renderings

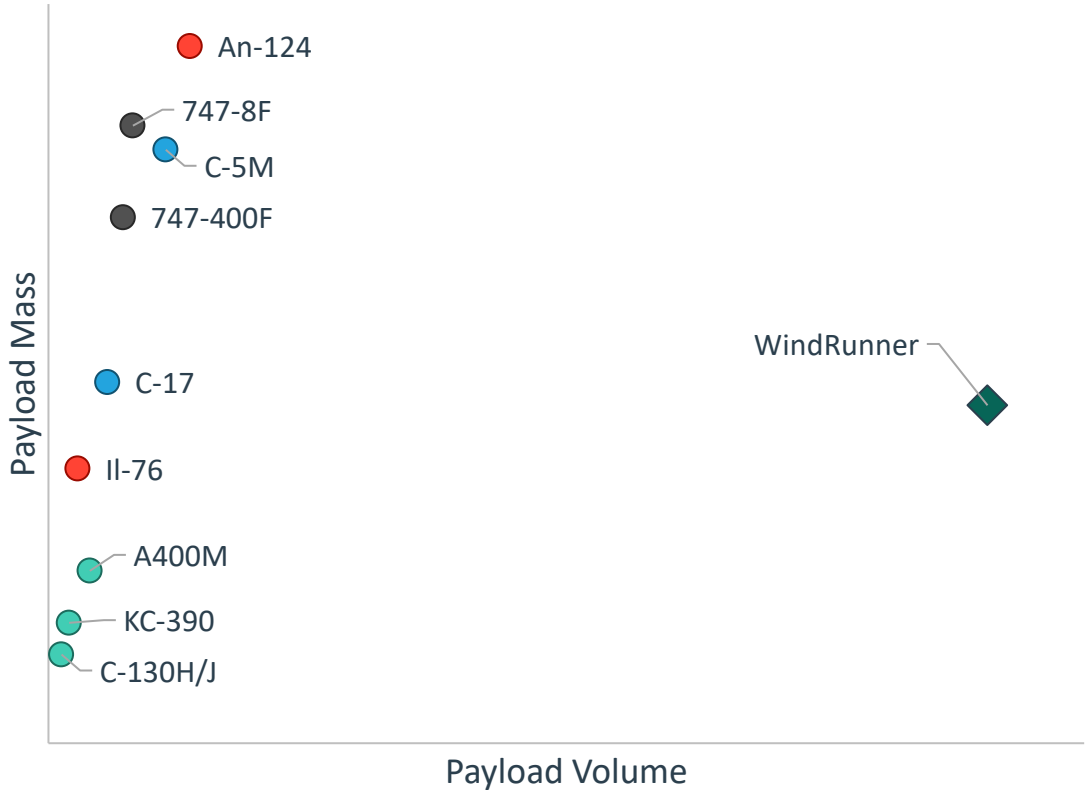
# The Future of Renewables is Big

## The Largest Aircraft Ever Built

# A New Class of Airlift for Giga Logistics

## WindRunner Covers Current Airlift Gaps and Generates a New Class of Cargo Capacity

### WindRunner offers a new class of Airlift

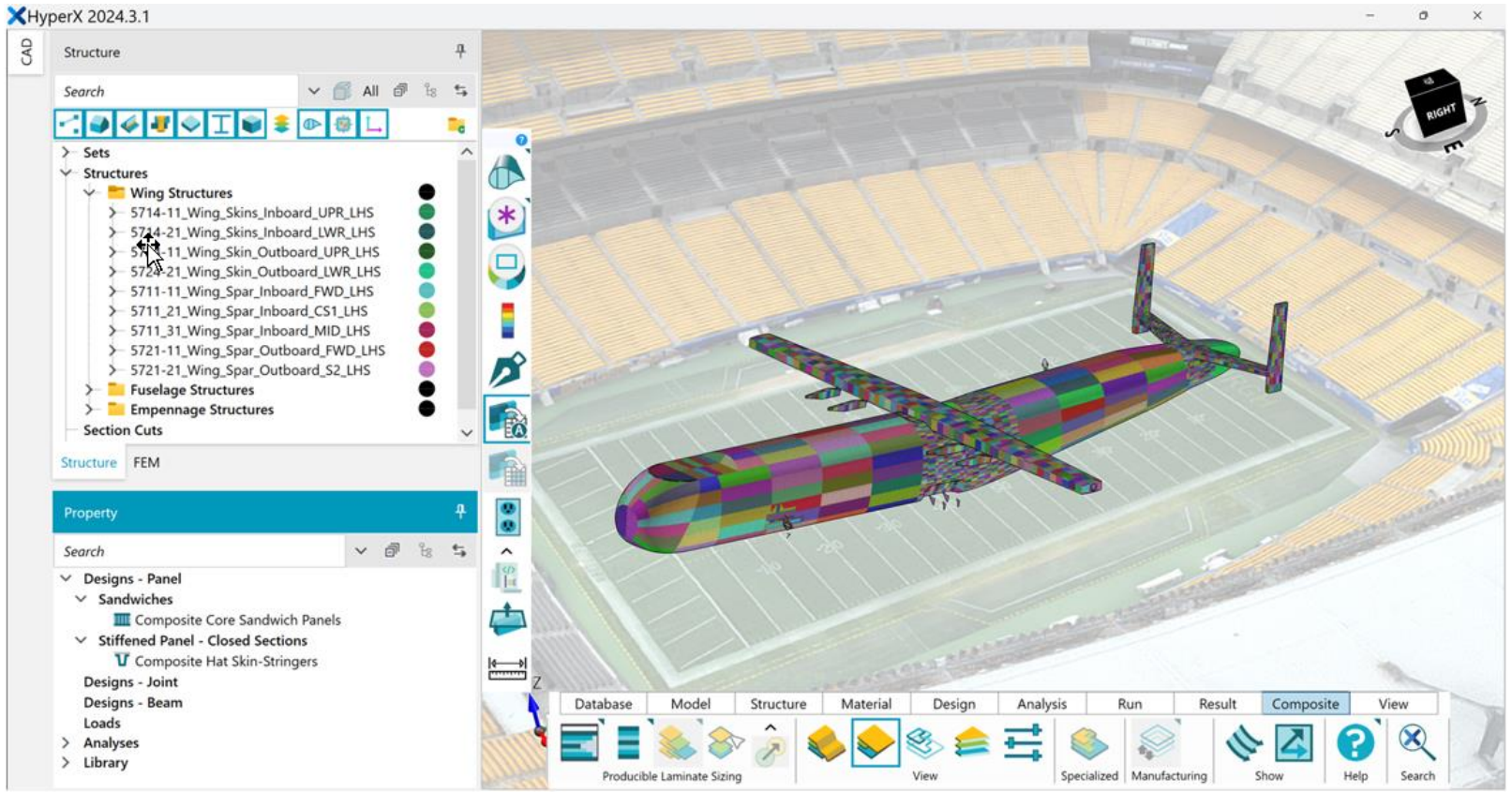



### Visual Comparison

# GFEM Approach

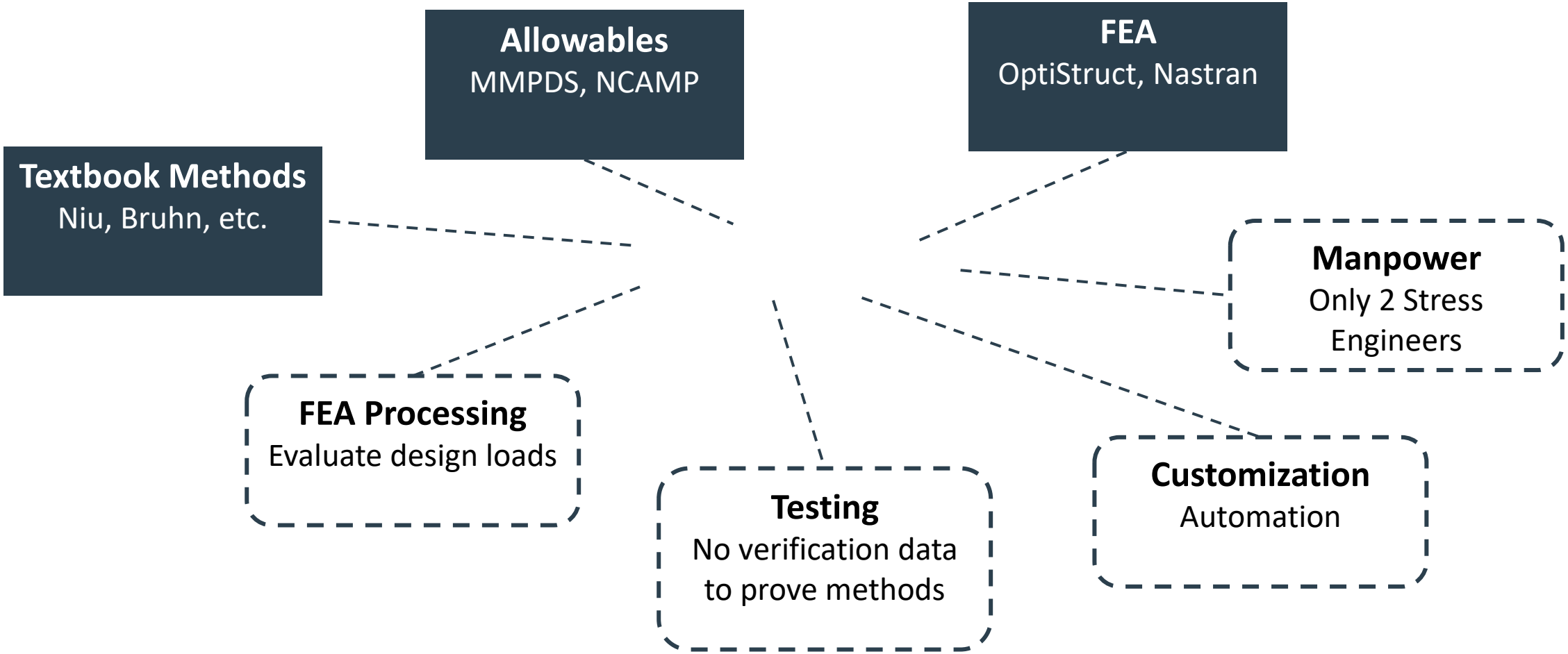
## WindRunner's unique requirements resulted in an aircraft incompatible with parametric design

Within the first year of design, Radia stood up a finite element approach to estimate structural weight



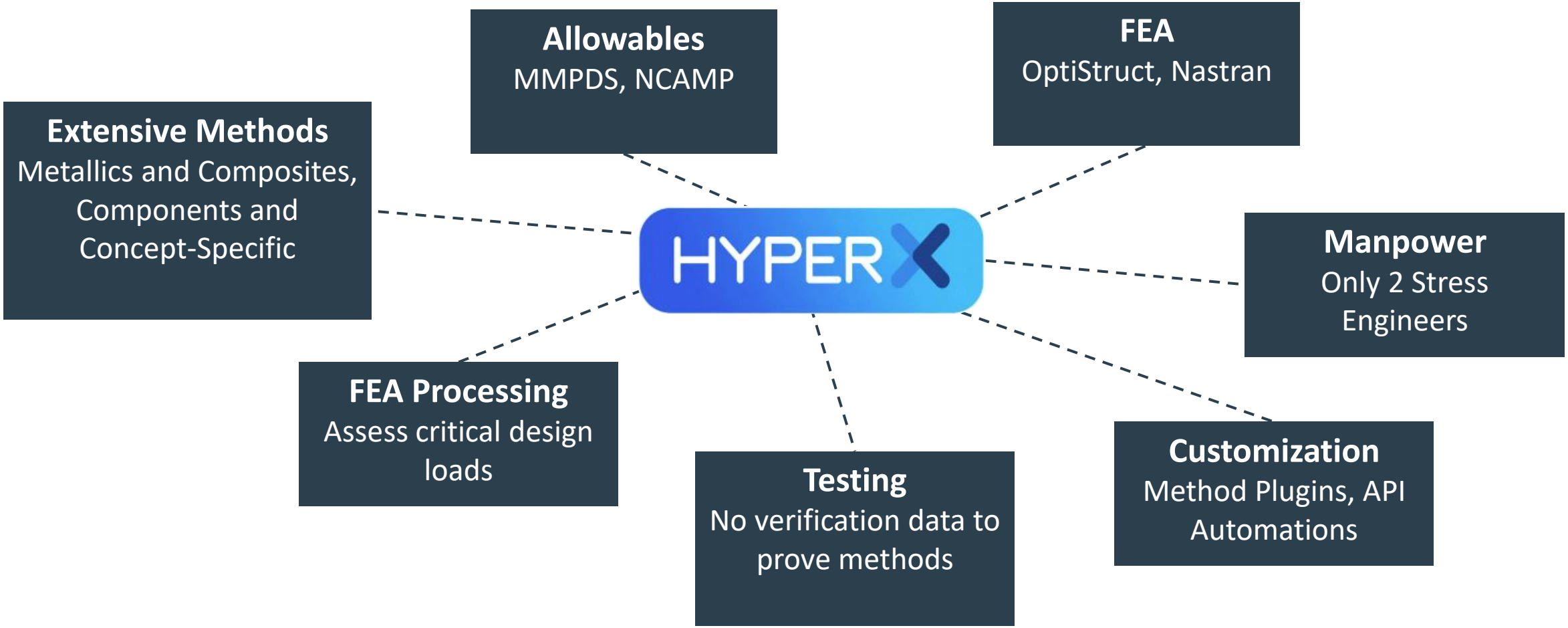
# New Company, No Toolchain

## Radia had some of the building blocks, but not an integrated solution



# Collier Has It All!

## Software provides a customizable infrastructure with tested methods and easy integration



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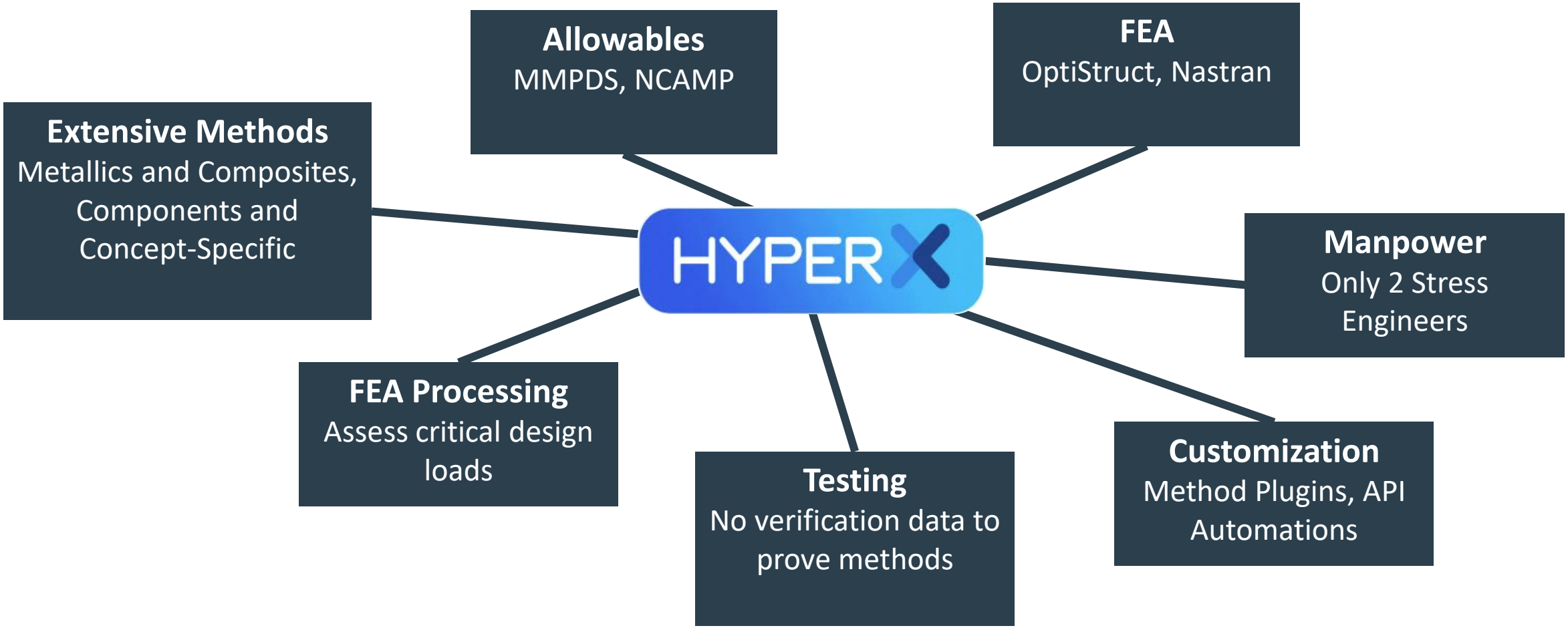
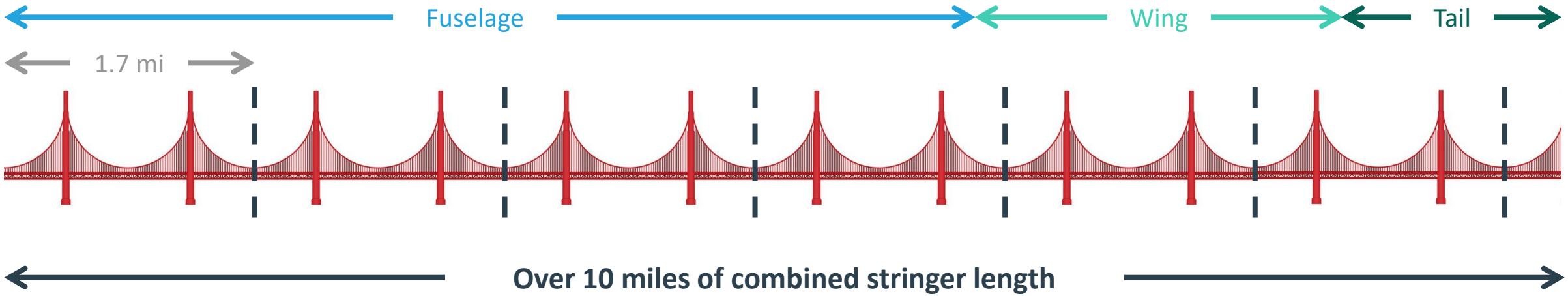


# Miles of Stringers

7 miles of stringers … in the fuselage!



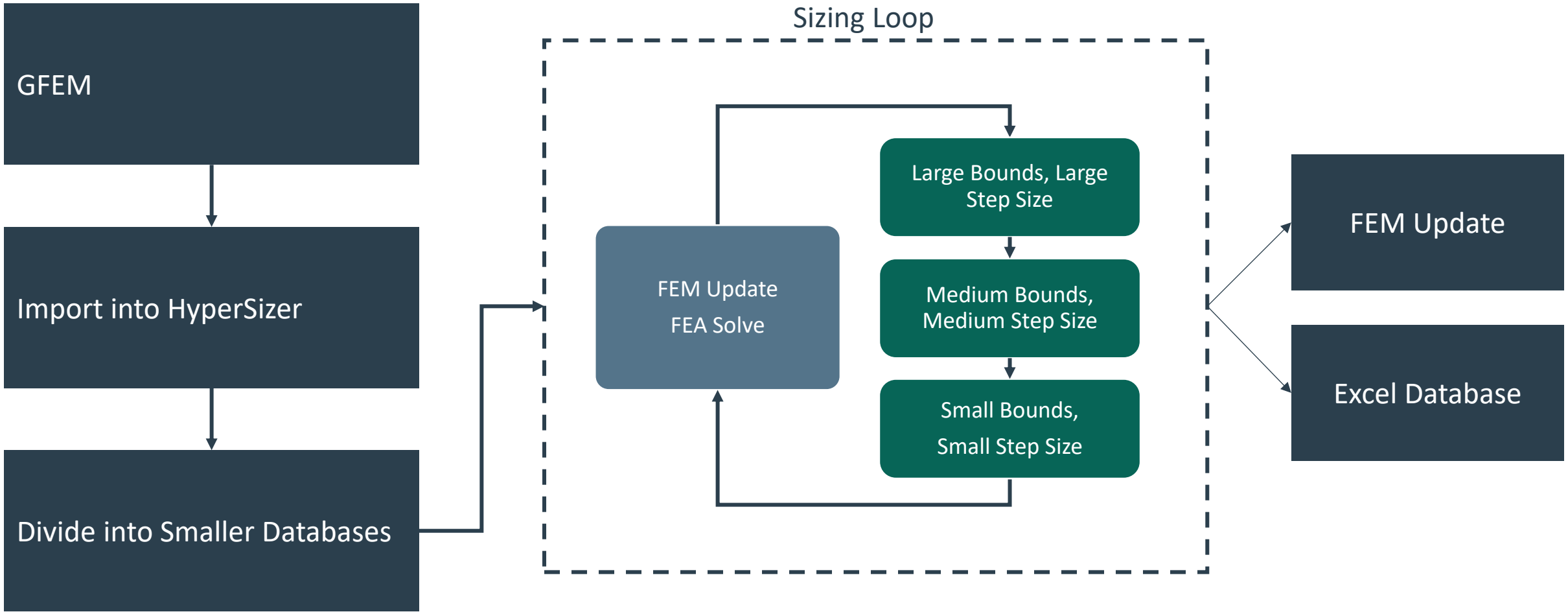

**Over 10 miles of combined stringer length**

Large OEM Stress Analysts

Radia's Original Stress Analysts

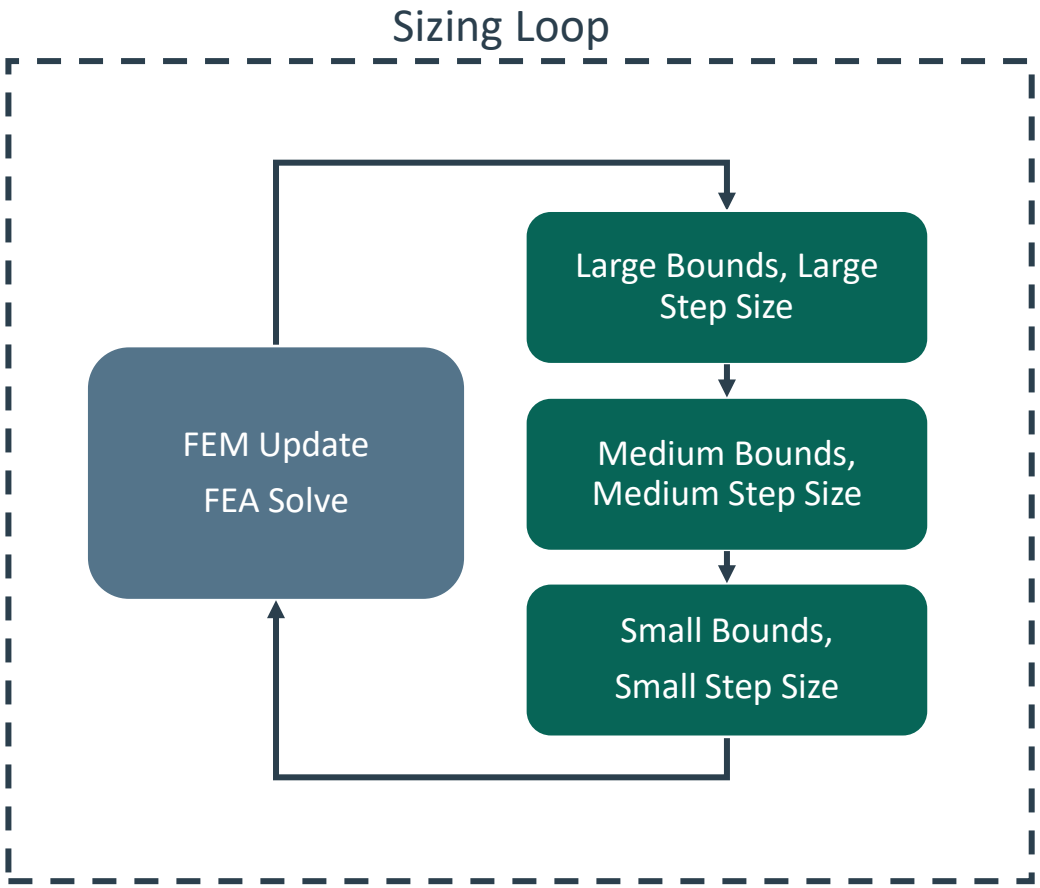
# Customized Sizing Routine

## Leveraging the Collier API offloaded manual work with efficient automation



# Speed!

## Leveraging variable step size and parallelization enables quick sizing iterations




150,000 elements

30,000 components

400 load cases

Millions of candidates per component

- Using customized toolset capabilities

**Full GFEM sizing iteration in 7 hours[1]!**

[1] Utilizing 32-core computer for parallelization

# WR Is Unique, Collier Provided Value

**Key Features**

- Extensive Methods and Failure Analyses
- FEA Processing and Exporting
- Verified Methods
- Automation/Customization

**Enabled**

- Small team
- Convergent mass properties
- Fast sizing iterations
- Complex trade study permutations