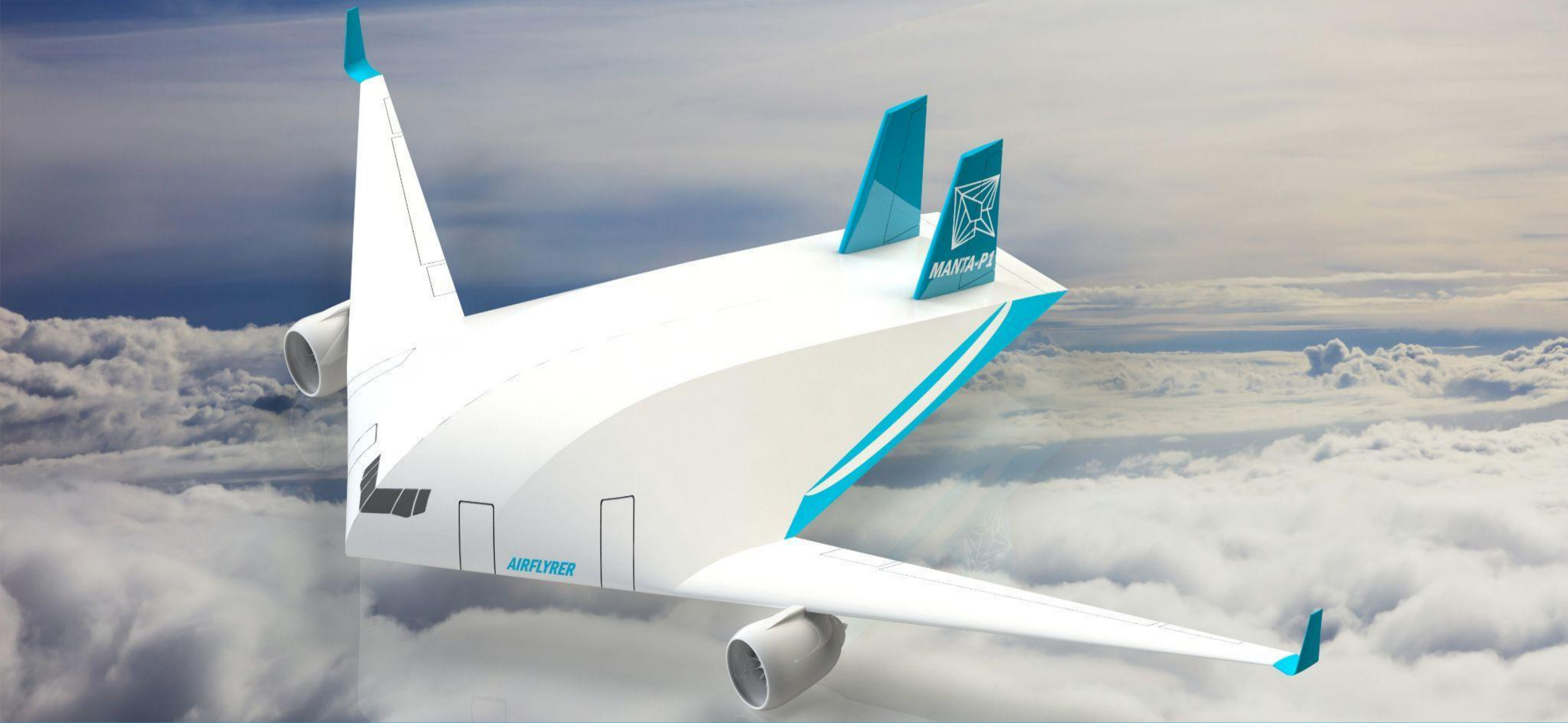

FINAL PRESENTATION

AIRFLYRER

Ong Han Yang Chia Wei Fong Daniel Hendri Dikshit Abhijnan
Ong Kai Le Peranut Foo Yong Li Tham Jay Shen

1. INTRODUCTION
2. MARKET ANALYSIS
3. AIRCRAFT DESIGN
4. BUSINESS DEVELOPMENT

Introduction

Mission

To significantly reduce carbon emissions of short-to-medium range flights while maintaining cost-effectiveness of airlines

Objective

To design a commercial transport aircraft capable of carrying 156 pax over 6,300 km with 10% carbon-fuel savings per pax

1. INTRODUCTION

2. **MARKET ANALYSIS**
3. AIRCRAFT DESIGN
4. BUSINESS DEVELOPMENT

Market Analysis

New Aircraft Demand

Growth in APAC

Growing middle-class

Expected annual growth of 5.3%

Eco-friendly policies

Paris Agreement

Cost pressures from environmental policies

Fleet Renewal

Widespread grounding of aircraft

Delayed maintenance impacts airworthiness

Narrow-Body Jet Demand

Flexibility of Low-Capacity Planes

Flexible fleet size management

Fewer passengers to recoup operational costs

Jet Fuel Price Volatility

Uncertainty from OPEC actions and economic shocks

Expected higher average fuel prices

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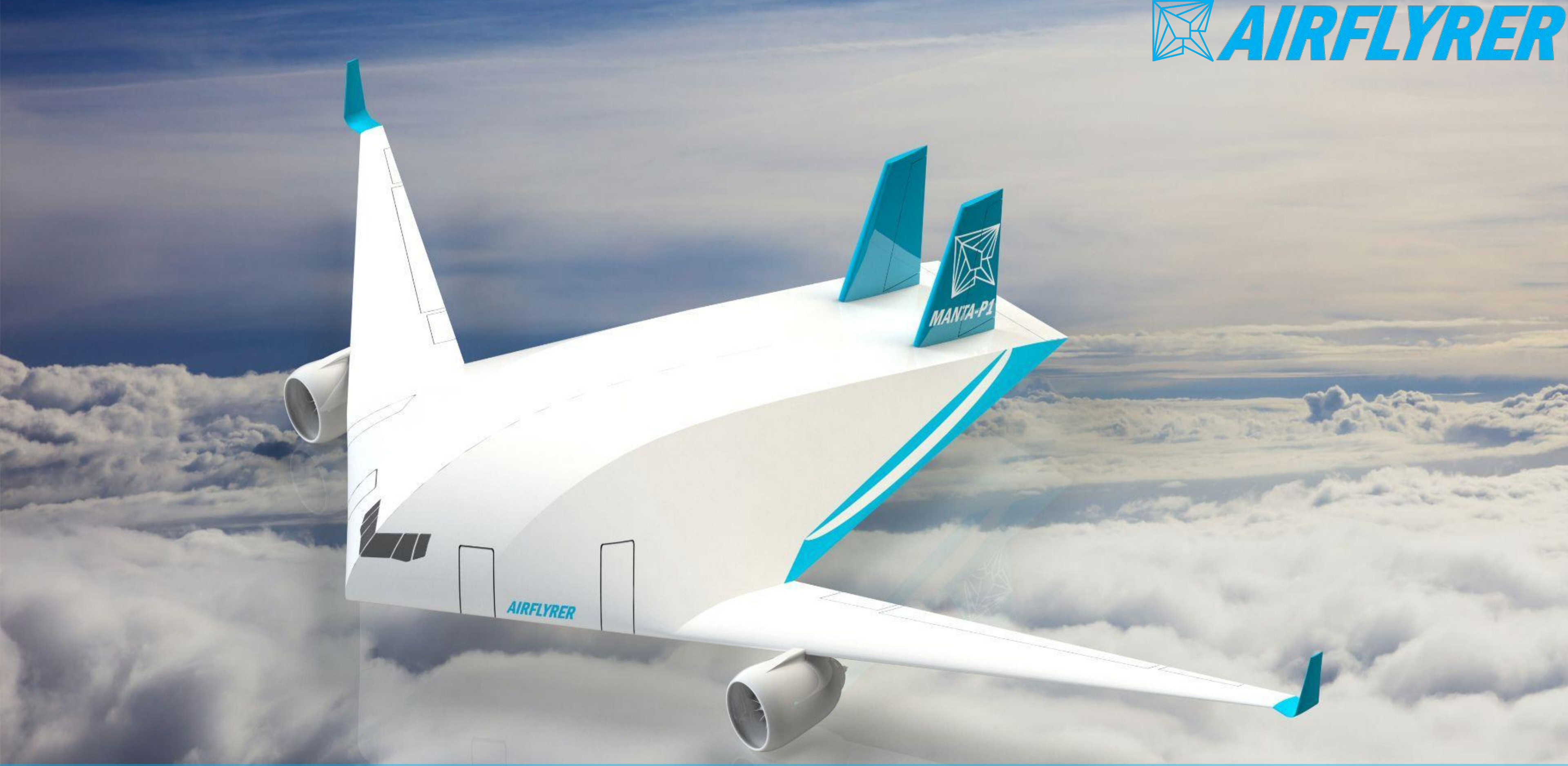


MANTA-P1

156
Passengers

6,300 km
Range

830 km/h
Cruise Speed

Aerodynamics

Dikshit Abhijnan

Propulsion

Daniel Hendri

Structural Design

Ong Kai Le

Stability and Controls

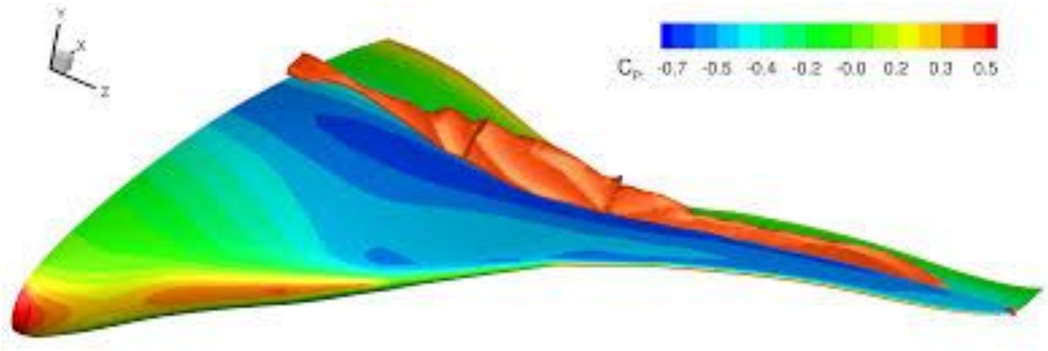
Tham Jay Shen

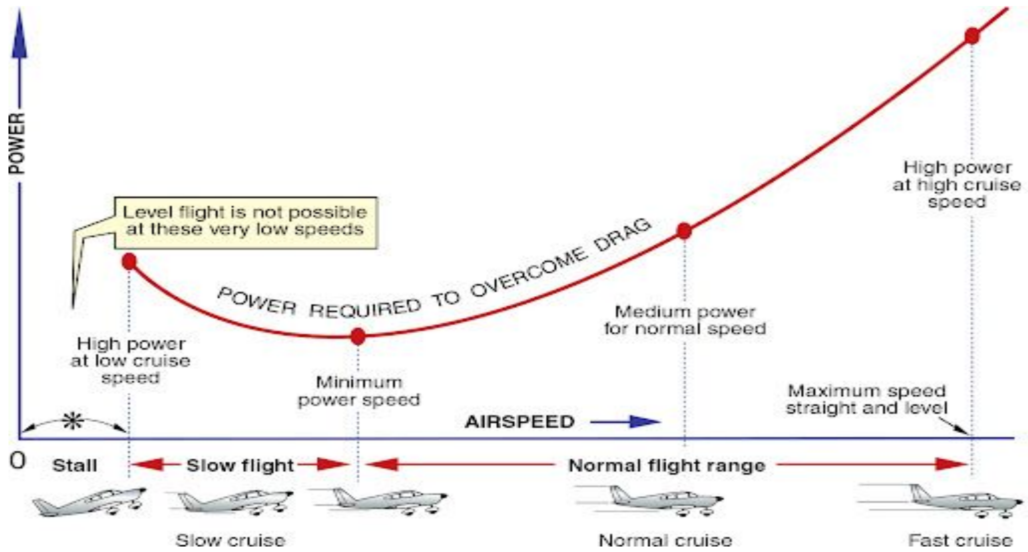
Systems

Peranut Foo Yong Li

Avionics

Ong Han Yang





AIRFLYRER

Aerodynamics

Dikshit Abhijnan

VP, Engineering

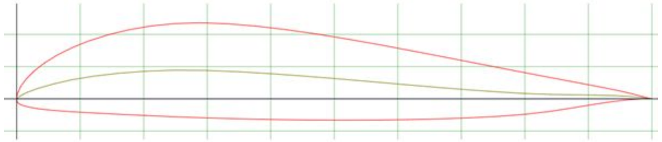
Aerodynamics Engineer

Airfoil Selection

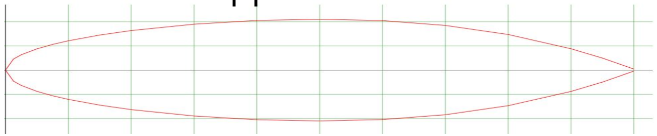
Main Considerations

1. Low pitching moments so that aircraft can be easily stabilized
2. Good cruise performance of the aircraft
3. Centrebody airfoil has high thickness to accommodate the passenger cabin

Centrebody Airfoil



Eppler 344



Symmetrical NACA 16 Series

Trade-off between low drag and greater space

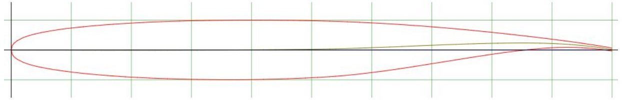
NACA 64 Series

Eppler 344

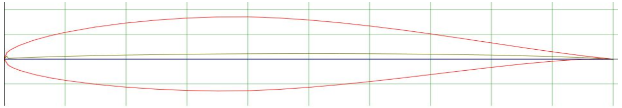
Final Airfoil

- Better Pitch Stability
- Design Lift Coefficients of Airfoil and Aircraft Match
- Dimensions adjusted to provide enough space
- High sweep angle to mitigate shockwaves

Outer Wing Airfoil



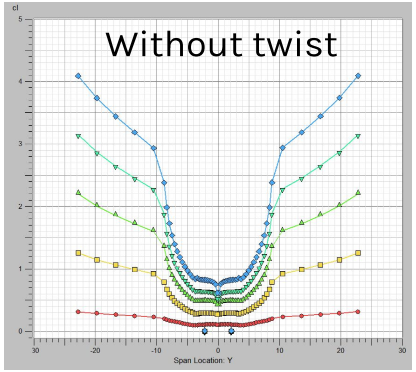
Supercritical Airfoils

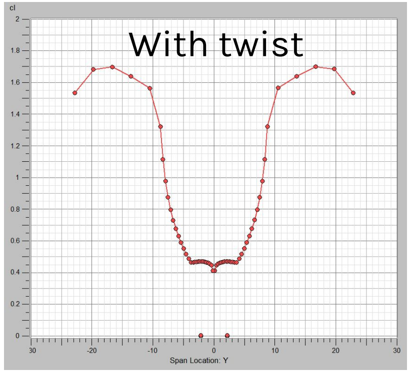


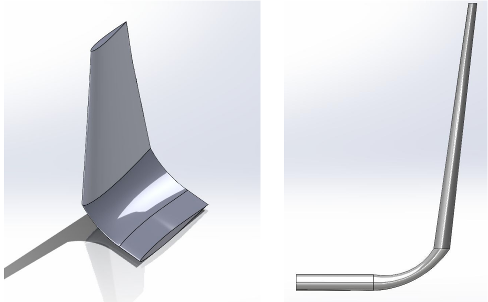
NACA 64 Series

Trade-off between design lift coefficient and shockwave mitigation

Aerodynamic Design





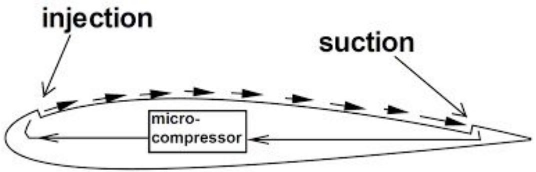


Sharklet winglet design with angular transition

Tip stall problem in BWB aircraft

Unable to mitigate with twist

Use of vortex generators on tip of the aircraft to delay tip stall

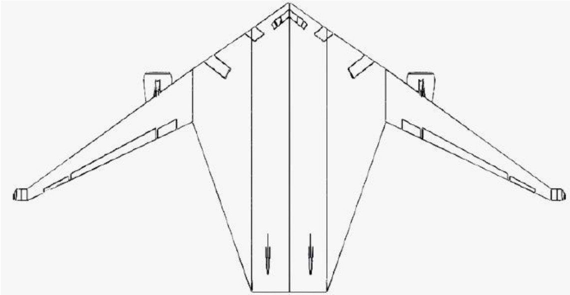


Alternative Stall Prevention Device

Co-flow jet airfoil

Jet of bleed air flowing across airfoil surface of aircraft to re-energize the boundary layer

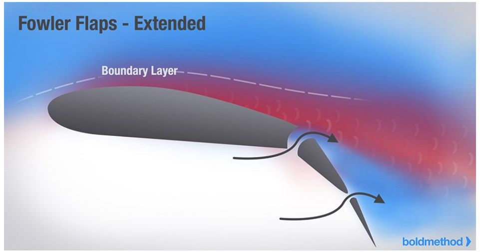
Aerodynamic Design



Wing Sweep kept between 30-40 degrees

Reduce effective Mach Number

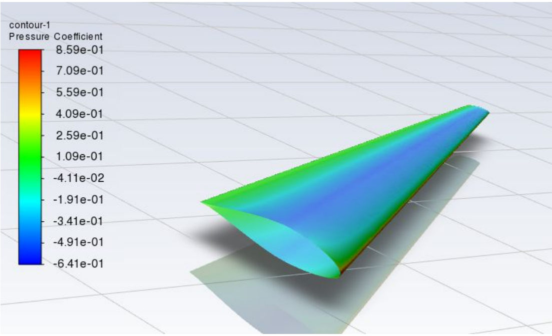
Improve Aerodynamic Efficiency

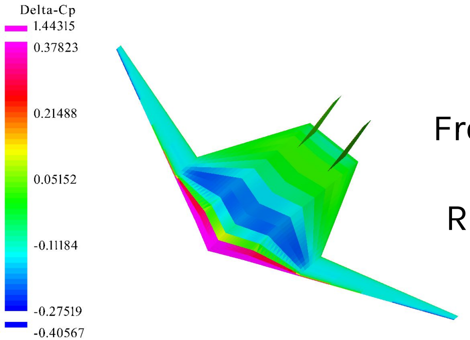


Increasing maximum coefficient of lift

Highly effective Fowler Flaps

Increase coefficient of lift to lower stall speed, improve landing and takeoff performance



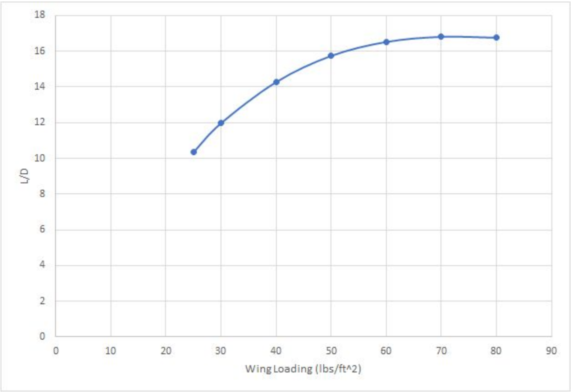


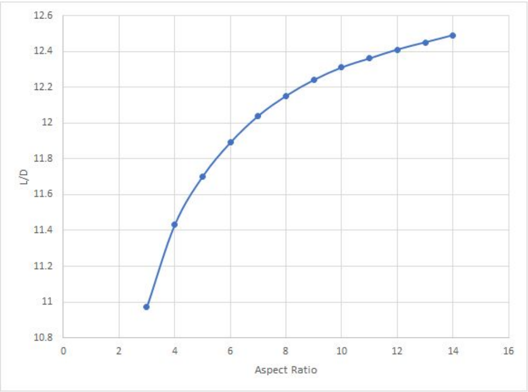
Pressure Distribution

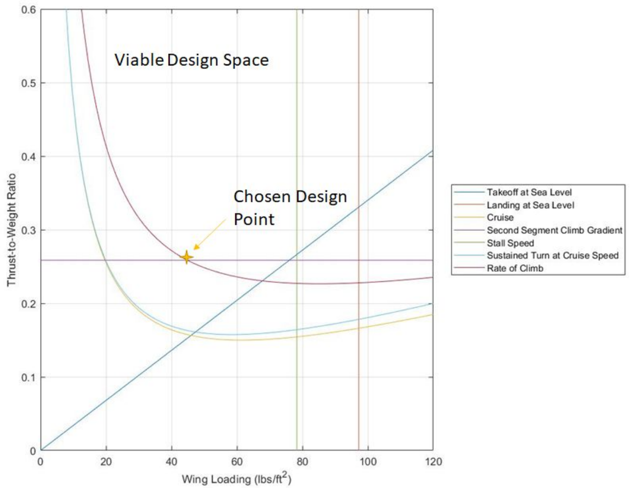
Front region of the aircraft has low pressure - majority of lift produced

Rear region producing negative lift because of reflex airfoil - acting as a tail

High Performance Design







Parametric Study for Optimization

Higher Wing Loading - Higher Performance

Higher Aspect Ratio - Higher Performance

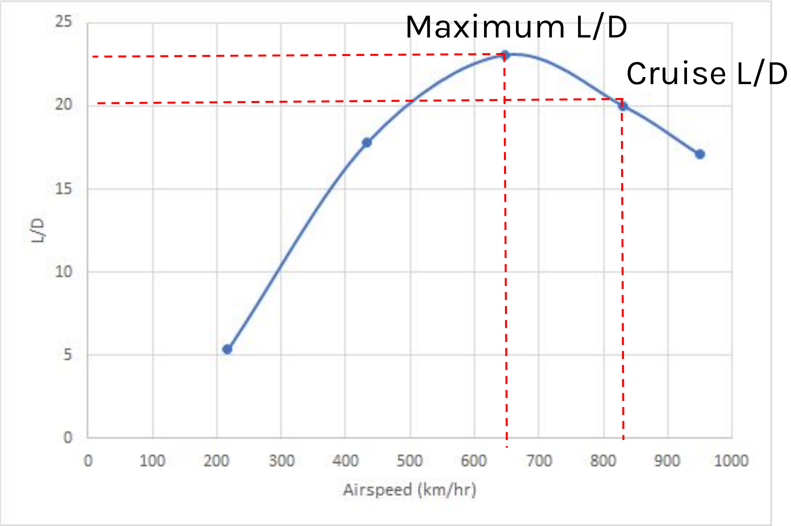
Performance Constraint Analysis to ensure adherence with performance goals

Chosen Parameters

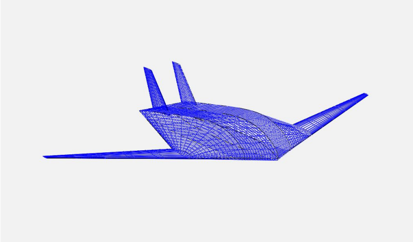
43 lbs/ft^2 and 5.58 chosen as wing loading and aspect ratio to provide optimum performance and meet cabin requirements

Thrust-to-weight ratio of 0.258 needed to meet all performance requirements

Aerodynamic Performance



Complex Drag Calculations
Parasite drag of wing-body and vertical tail combination calculated through OpenVSP



OpenVSP

Superior Aerodynamics
Cruise L/D = 20.04
Maximum L/D = 23.10

Analytical Drag Calculations
Accounting for Engine Nacelle Drag and Induced Drag

Lower pressure drag due to more streamline airfoil shape of entire aircraft
Lower skin friction drag due to removal of horizontal stabilizer

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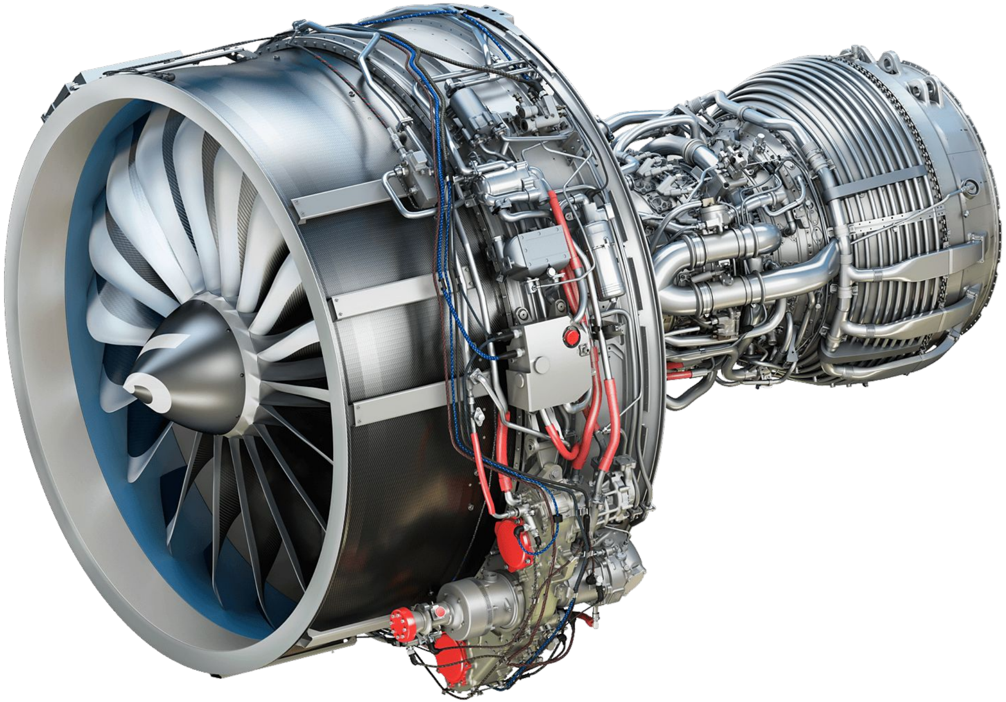
Propulsion

Daniel Hendri

Propulsion Engineer

Engine Design and Selection



Modern engines

Two CFM International LEAP-1A engines

One of the best fuel efficiency in class

Engine Design and Selection

Under-wing mount

Under-wing engine placement for quicker and simpler maintenance and replacement

Sustainability

Today: Jet-A1 Fuel

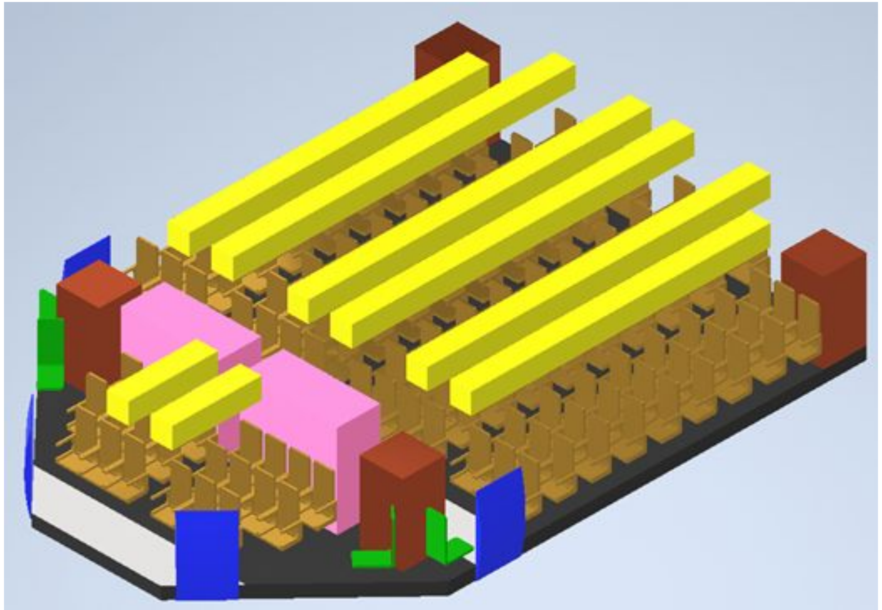
Future: 100% Sustainable Aviation Fuel

Structural Design

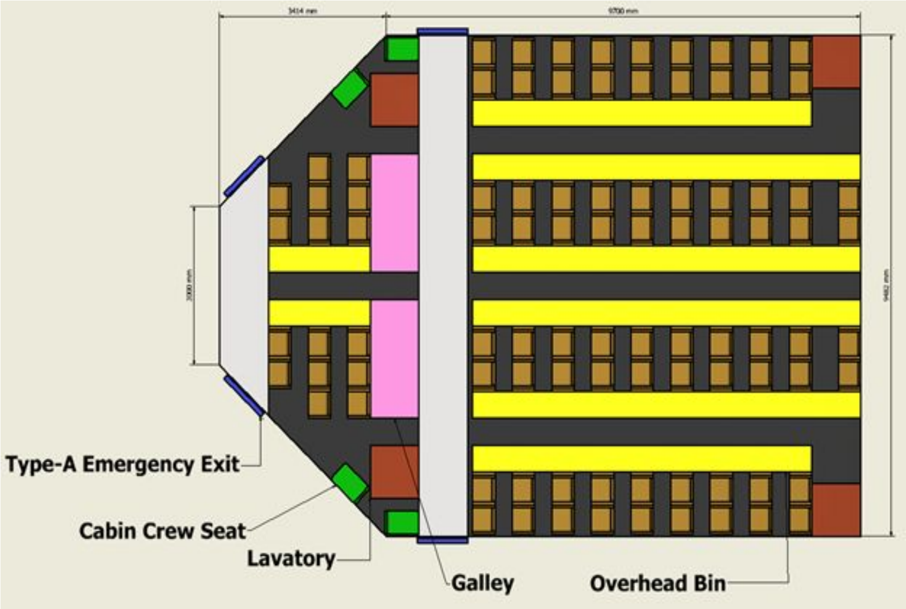
Ong Kai Le

Structural Engineer

Cabin Design



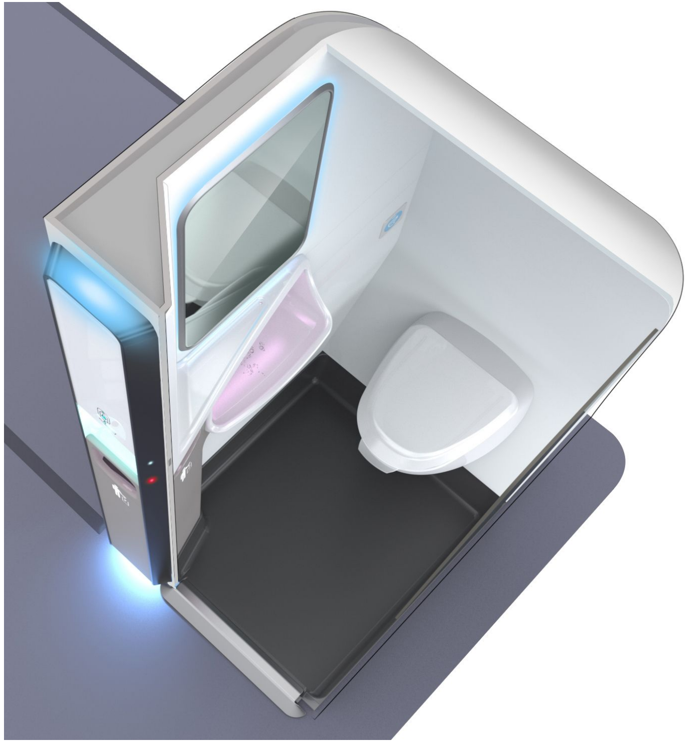
Isometric View (Cabin interior)



Overall Dimension and Labels

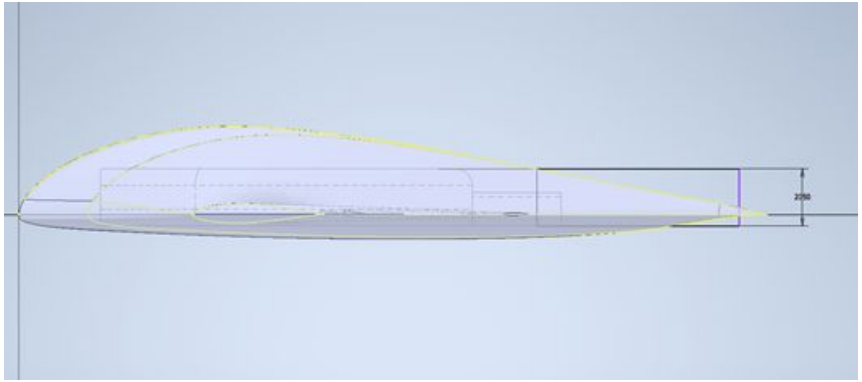
Furnishing Design

Interspace Lite



Beacon Clean Lavatory

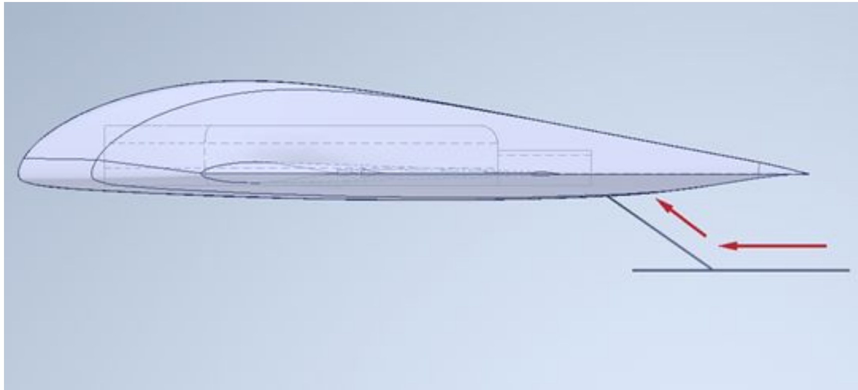
Cargo Design



Side View (Manta - P1)

Height constraint at aft section

Loading Ramp (Maximize utilisation of space)



Side View (Manta - P1)

AIRFLYRER

Stability & Control

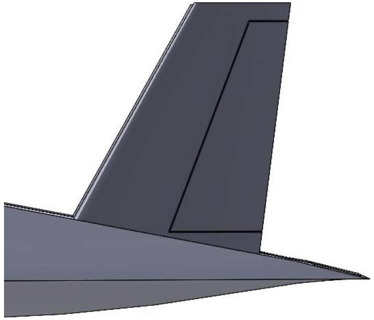
Tham Jay Shen

Stability and Controls Engineer

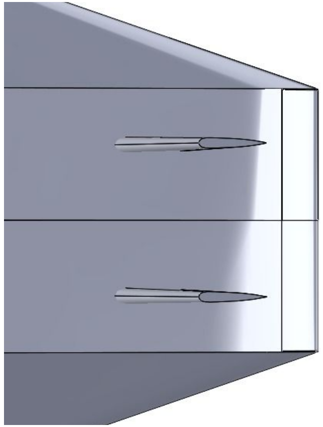
Primary Controls Design

Twin Vertical Tail

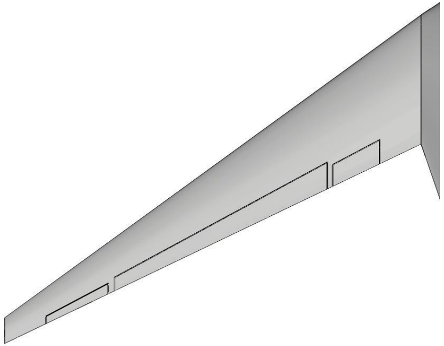
& Rudders



Elevators

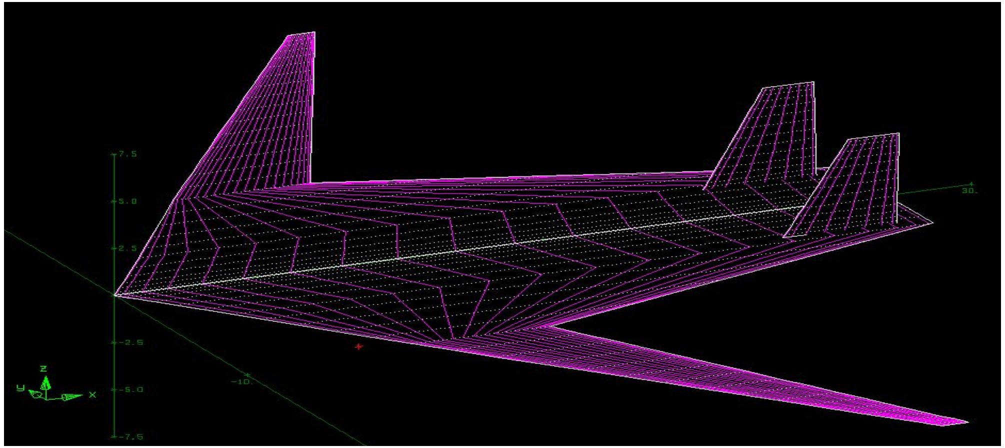


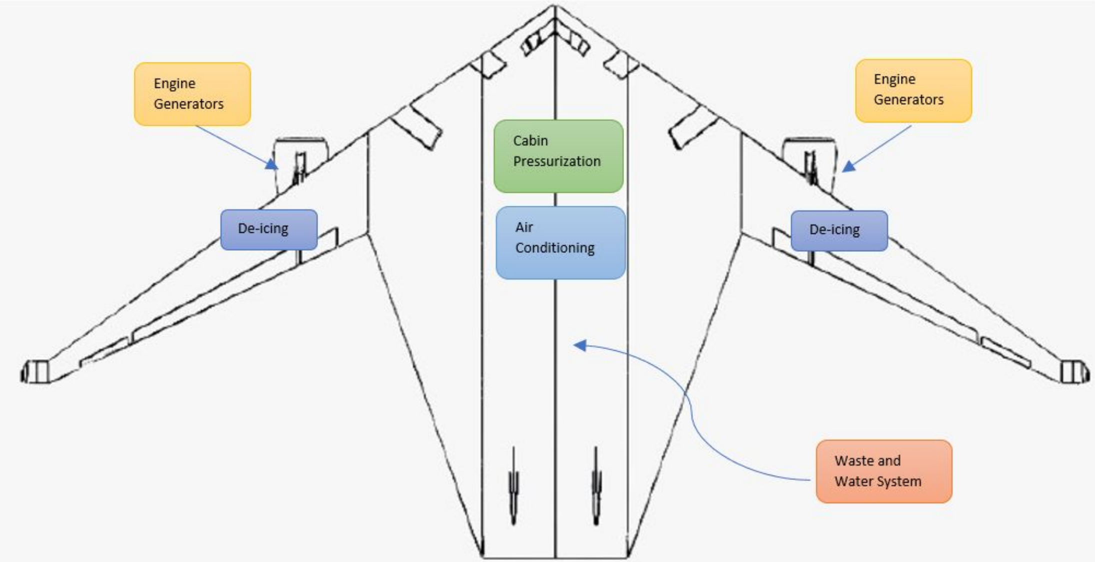
Ailerons



Stability

- CG of the aircraft located ⅓ length from the nose
- Weight distribution ensured such that OEW, MZFW, MTOW CG locations are all ahead of the NP
- Successfully achieved Static Stability for Roll, Pitch, Yaw





AIRFLYRER

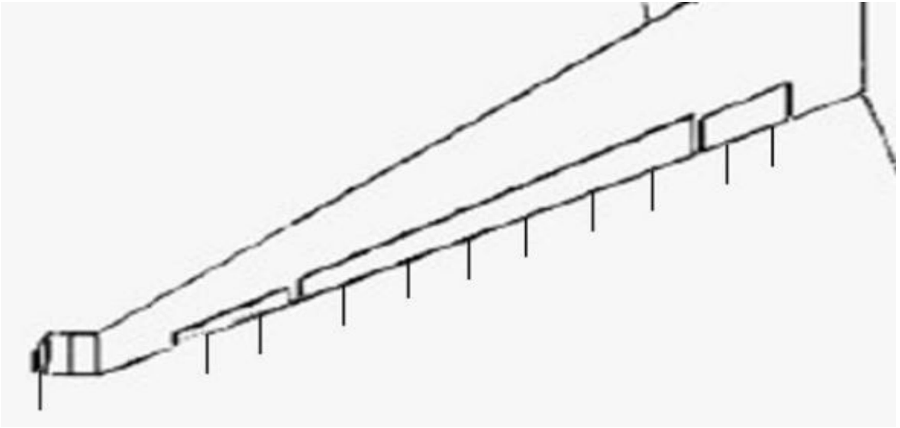
Systems

Peranut Foo Yong Li

Systems Engineer

Weather Systems

- **Static Wicks**
  - Dissipate built up static electricity
  - Located on Trailing edges of aircraft
- **Ultrasonic Deicing**
  - Low Weight
  - Low cost
  - 91% less power consumption compared to electric thermal

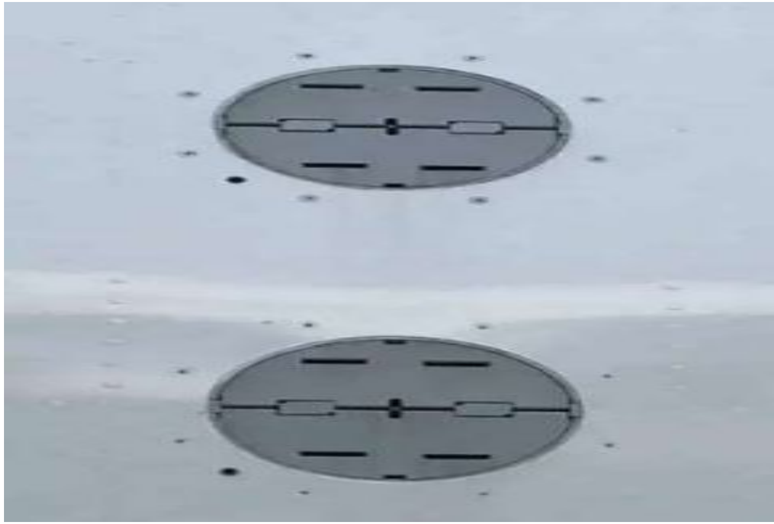


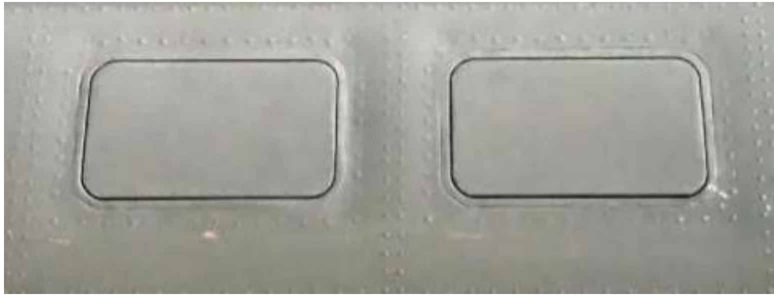
Ultrasonic excitation

No ultrasonic excitation

Environmental Control Systems

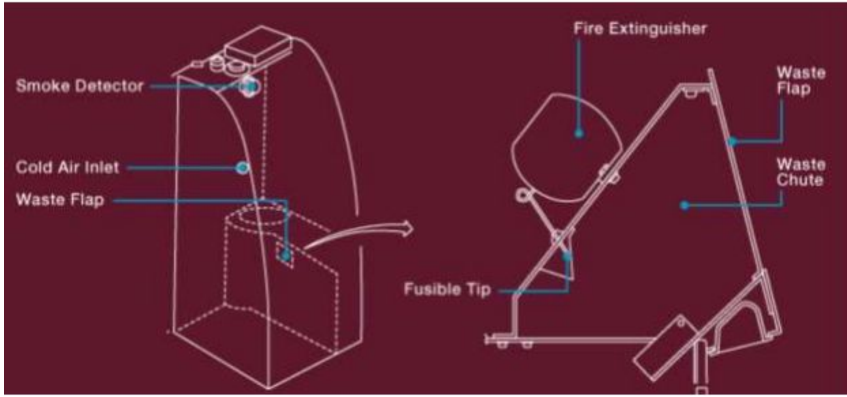
- **Refrigeration Systems**
  - Air Cycle
  - Doesn’t require refrigerant
  - Safe for the Environment
- **Pressurization System**
  - Utilizes bleed air
  - Positive pressure release valves
  - Negative pressure release doors

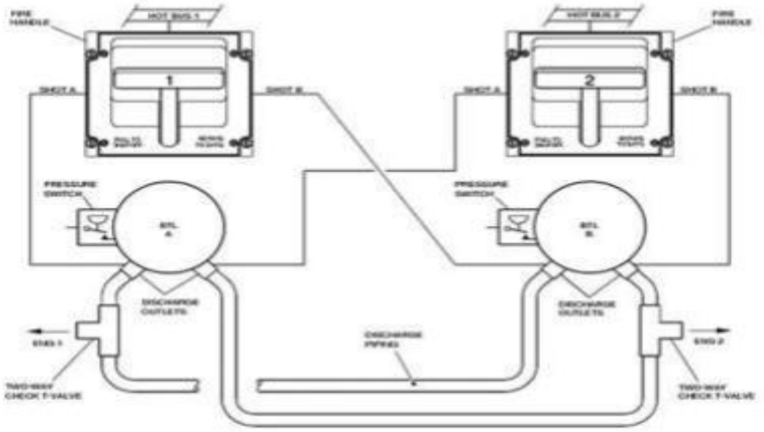




Fire Suppression and Prevention

- **Hold and Lavatories of aircraft**
  - Uses Halon 1301
  - Continuously deployed in the hold
- **Portable Fire Extinguishers**
  - 3 in cabin, 1 in flight deck
- **Engine and APU**
  - Manually activated
  - Extinguishant Bottles are connected so both engines can be accessed





Avionics

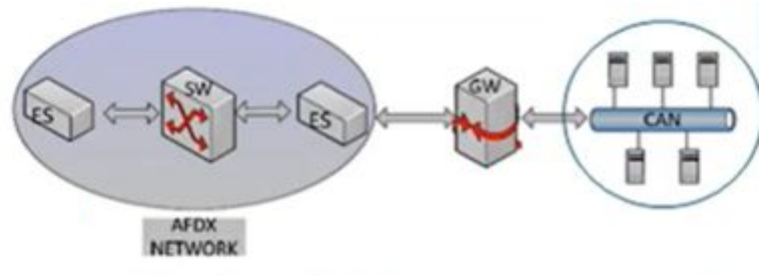
Ong Han Yang

CEO, AirFlyrer

Avionics Engineer

Data Bus Architecture

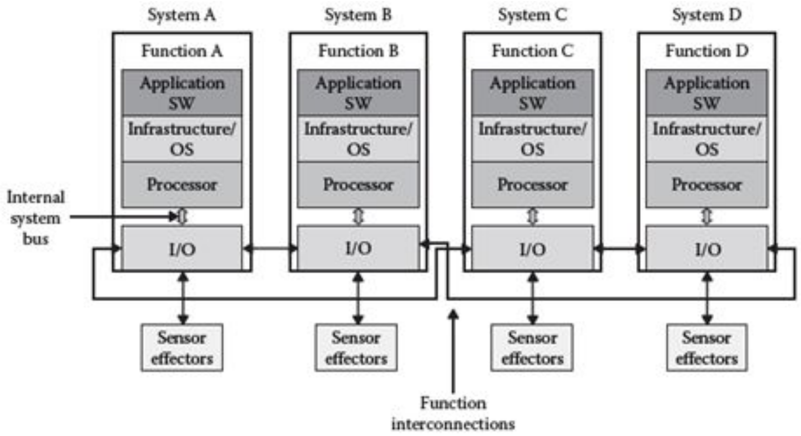
Central Main System



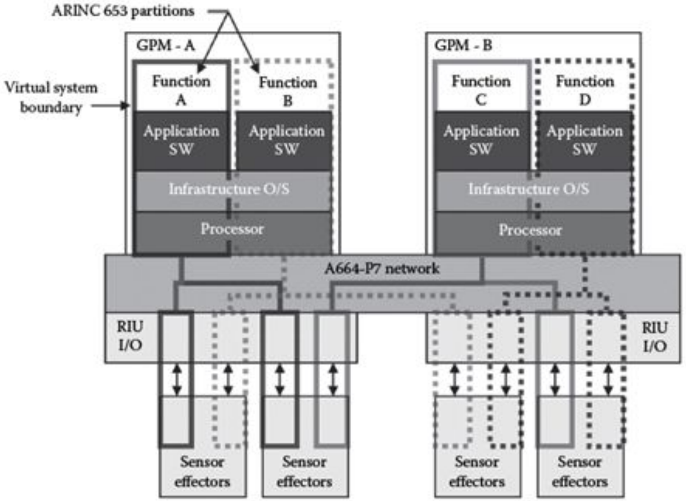
Repetitive
Engineering Data

Combination of ARINC 664 Part 7 and ARINC 825 Architecture

Integrated Modular Architecture



Federated Avionics Architecture



Integrated Modular Architecture

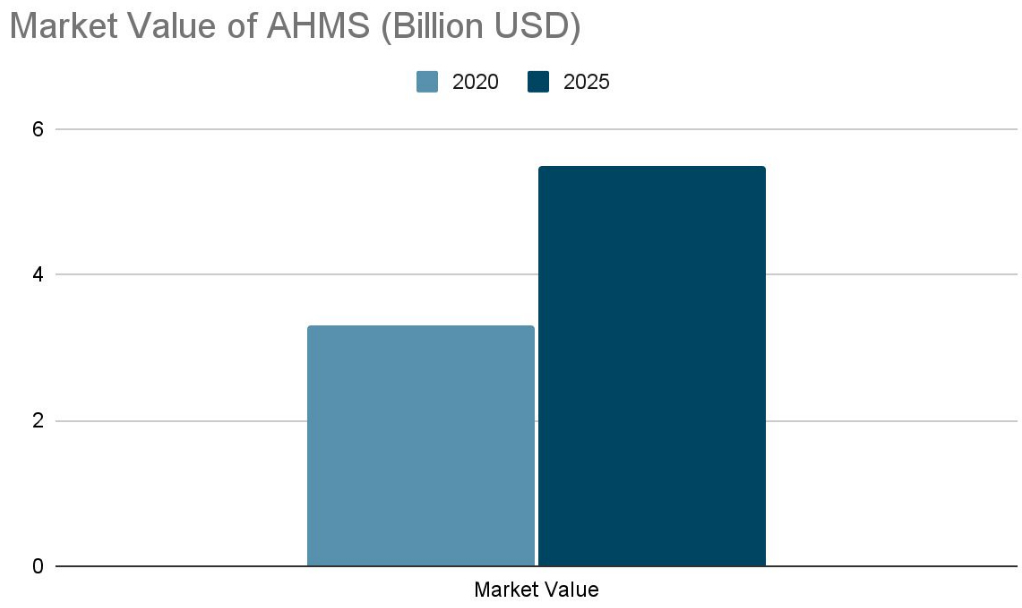
Integrated Modular Architecture to reduce cost and weight

Flight Deck

- HUD to improve pilot situational awareness

- Thales FlytX integrated flight deck with touch screen controls

Aircraft Health Monitoring System



Aircraft Health Monitoring System

- Consists of on-board sensors which transmit data to ground stations
- Data analytics and algorithms which assist in predictive maintenance and resupply
- Provide cost savings to airlines

1. INTRODUCTION
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4. **BUSINESS DEVELOPMENT**

AIRFLYRER

Business Development

Chia Wei Fong

Chief Financial Officer

S Strength

High Fuel-savings

-26%
(Past-Gen)

-6.7%
(Current-Gen)

Easier Cargo Operations

Rampdoor Access for Faster Loading

No Fall Hazard from Cargo Lift Operations

Customer Satisfaction

Safe Environment Features

Protect Personal Space

W Weakness

Uncertain Cabin Experience

Virtual vs Physical Windows

Lack of Customization

Single Change Require Redesign in Multiple Areas

Difficulty Meeting Individual Airline Special Request

O

Opportunities

T

Threats

ESG Funding

15% Annual Growth
of ESG Assets

Easier Fund-Raising
Exercises

Rise in Investor Activism

Management Desperate
for Green Solutions

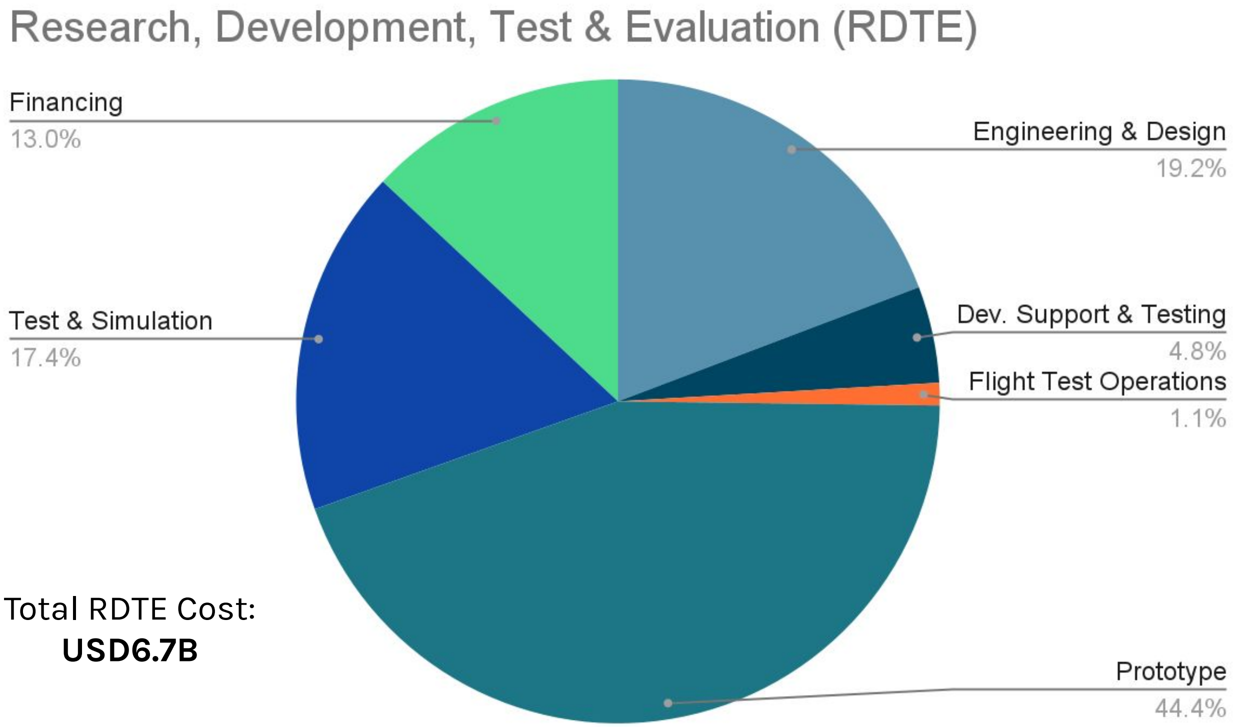
Competition

From More Well-Funded
Aircraft Programs

Regulations

Certification Challenges
for BWB Design

Cost Breakdown



Total RDTE Cost:
USD6.7B

- Expected 5Y Production: **800**
- Unit Production Cost: **USD109.8M**
- Unit Selling Price: **USD120.8M**
- Breakeven Unit: **536**

Target Production Schedule

5Y-Monthly Output:
13.33

Year	1	2	3	4	5
Output (annum)	80	160	180	190	190
Output (monthly)	6.67	13.33	15	15.83	15.83

- By Year 2, optimize production to average 5Y monthly output
- By mid-Year 4, reach our breakeven point


MANTA-P1
“If it can be dreamt, it can be built.”