The Archerfish

Design of a Firefighting Aircraft

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Polytechnique Montréal

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AIAA's requirements

General Requirements	Mandatory Requirement	Goal
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Design objectives
• Minimize operations and support cost by designing modularity into the structure and key components facilitating rapid repairs and replacements based on a chosen support strategy
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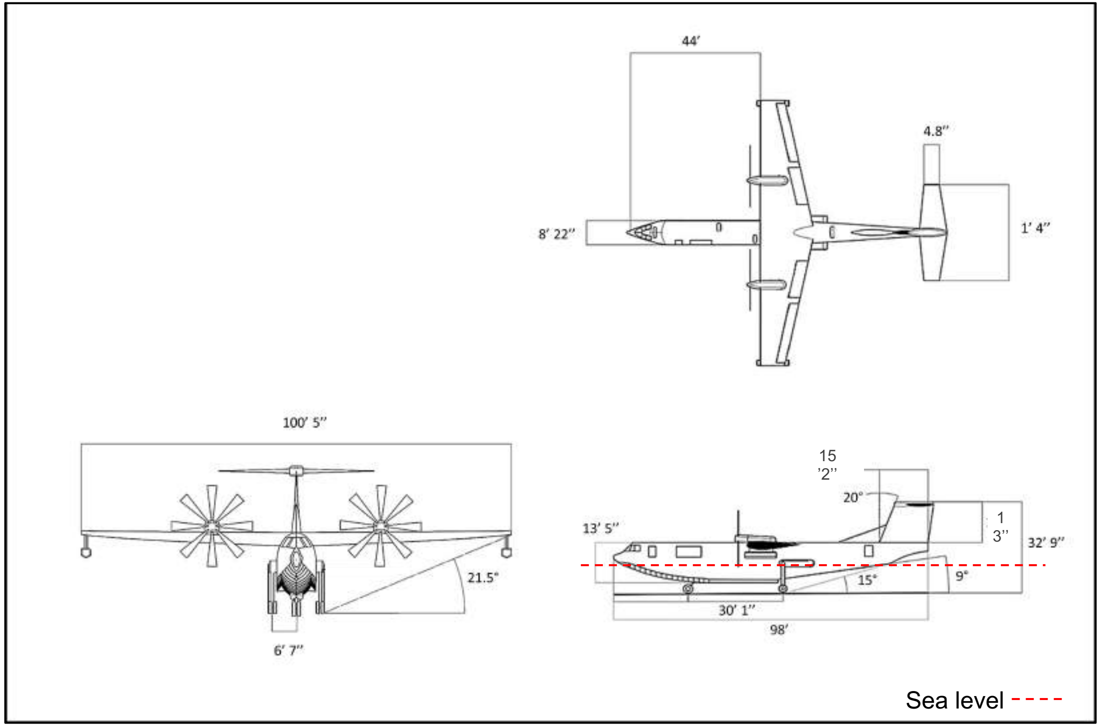
3 views



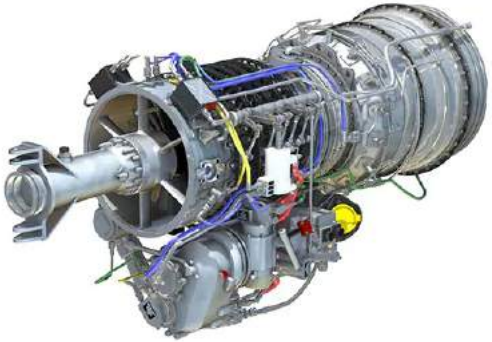
Layout






	Archerfish	CL-415	AG600	Antonov An-32P	Beriev Be-200	ShinMaywa US-2
Aircraft type	Flying boat	Flying boat	Flying boat	Land-based	Flying boat	Flying boat
Engines	Twin-turboprop	Twin-turboprop	Quad-turboprop	Twin-turboprop	Twin-turbofan	Quad-turboprop
Empennage	T-tail	Cruciform	T-tail	Conventional	T-tail	T-tail
Landing gear	On fuselage	On fuselage	On fuselage	On wing	On fuselage	On fuselage
Engine placement	Over wing	Over wing	Wing- centered	Over wing	Over wing	Wing- centered
Wing	High	High	High	High	High	High

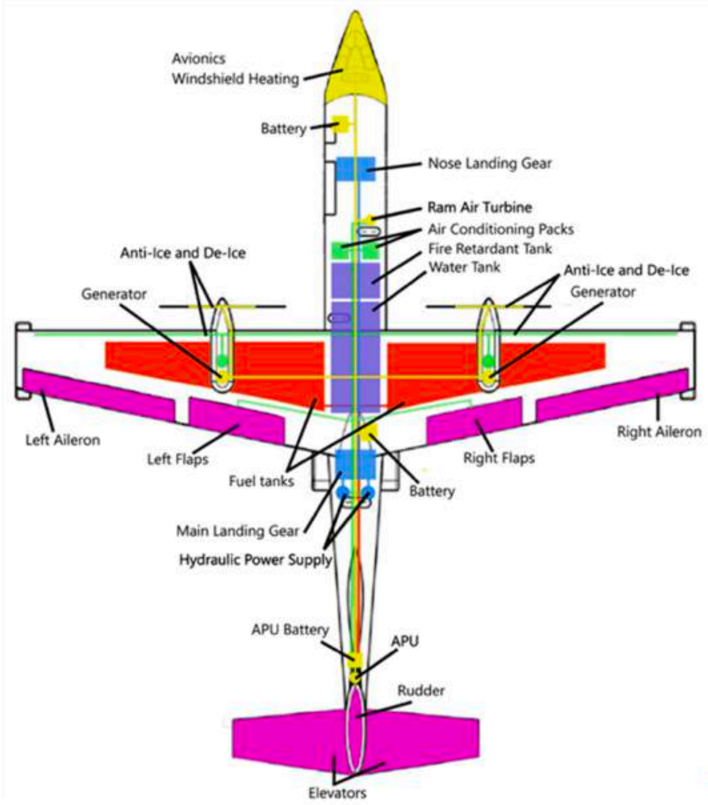
Engine choice



Rolls-Royce AE1107

Source : Rolls-Royce

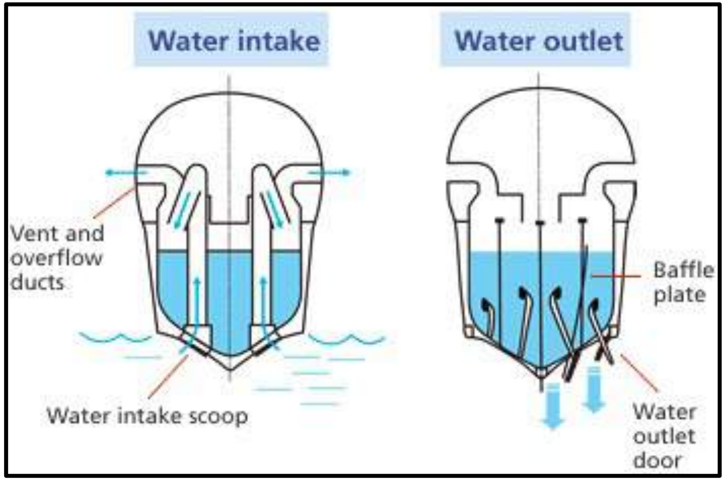
Systems



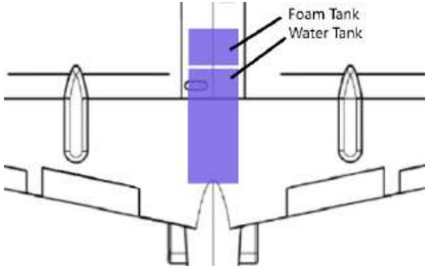
LEGEND

- Hydraulic system
- Pneumatic system
- Electrical system
- Fuel system
- Flight controls
- Payload

Water Collection and Bombing



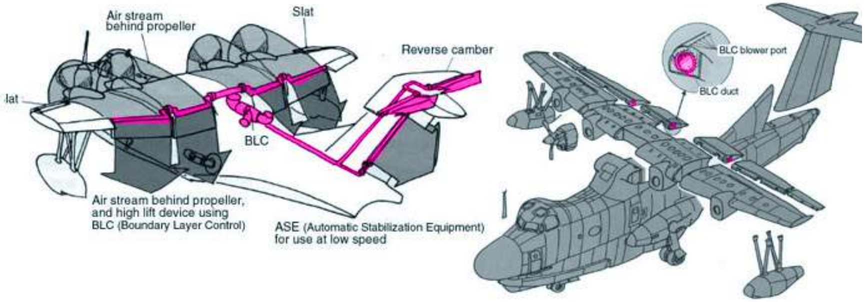
Aircraft	Payload
Antonov An-32	2,000 gal
Beriev Be-200	3,200 gal
CL-415	1,600 gal
ShinMaywa US-2	3,500 gal
Archerfish	4,000 gal



Source : The Military and Asian Region

Aerodynamic maximum lift coefficients

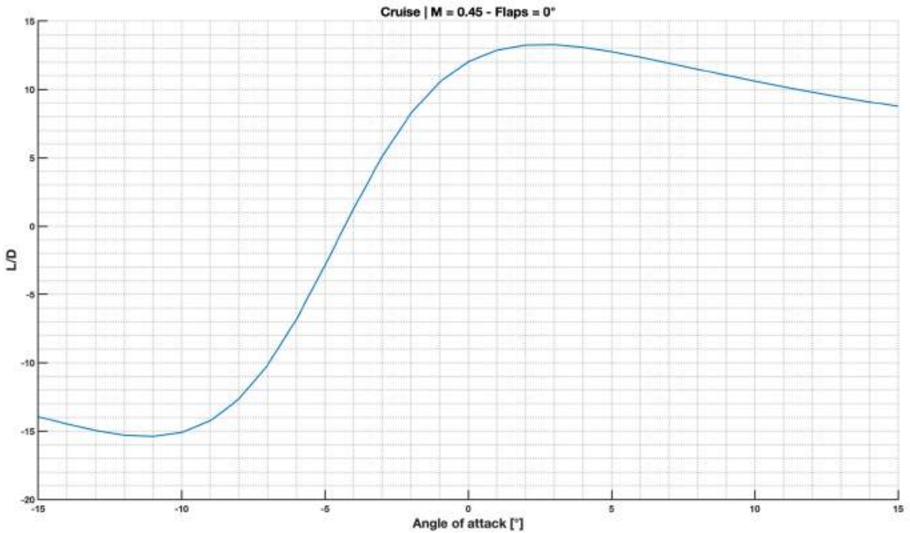
CL_{max}	Canadair CL-415	Archerfish	ShinMaywa US-2
Takeoff (15°)	1.6	1.9	2.1
Clean	1.4	1.5	1.6
Landing (30°)	2.0	2.8	2.9

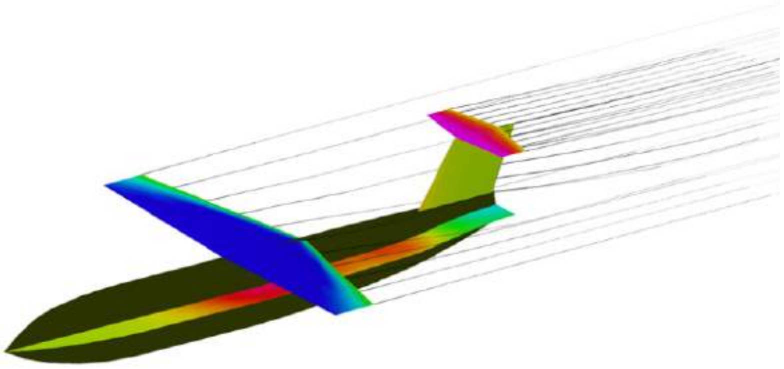


- Values for competitors were found by using OpenVSP lifting line method at same flight conditions : Archerfish complies sizing plot
- Importance of generating lift and drag on landing: selection of slotted blown flaps (used in ShinMaywa model as displayed)

Source : Shinmaywa Industries, Ldt.

Lift-to-Drag analysis





- Following results have been found for cruise conditions (M0.45 at 20 000 ft leveled flight) using lifting line program. Note that floats and engines weren't included for convergence purposes. Below are computed results:

	Max Clean	Takeoff (M0.2)	Landing (M0.172)
L/D	13.2	10.4	10.2

Mission profile

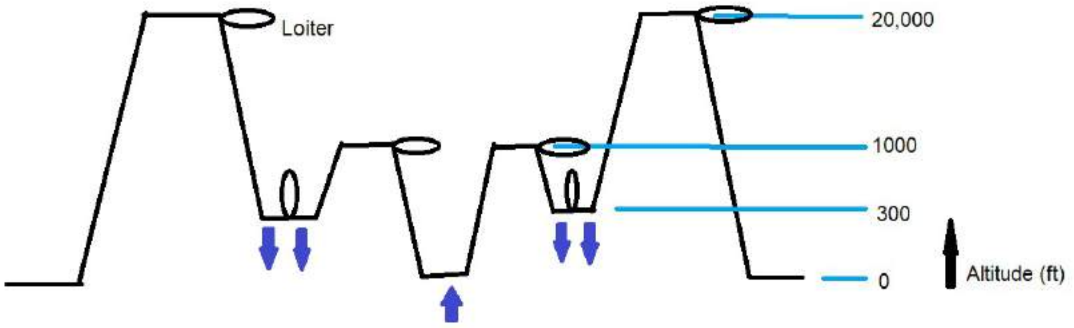
2 water drops per pass

Refill in-between passes

Up to 4 drops of 2,000 gal

Operational range of 200 nmi

Ferry range over 2,000 nmi



Mission performance

Takeoff Performance

- P_{TKF} = 14,451 shp
- T_{TKF} = 19,247 lbf
- V_{TKF} = 208 kts

Cruise Performance

- P_{cruise} = 6,876 shp
- T_{cruise} = 7,618 lbf
- V_{cruise} = 250 kts

Climb Performance

- P_{climb} = 10,214 shp
- T_{climb} = 14,086 lbf
- V_{climb} = 200.8 kts
- ROC = 2,022 ft/min
- Time of climb = 9 minutes 53 seconds

Our main competitor

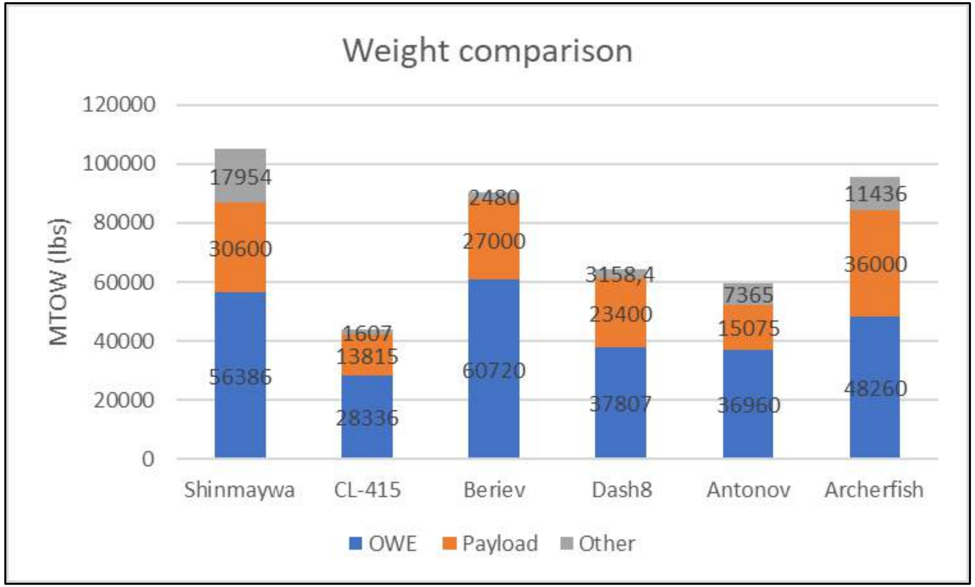
Performances	ShinMaywa US-2
Maximum Speed (kts)	302.4
Cruise Speed (kts)	259.2
Stall Speed (kts)	49
Rate of Climb (ft/min)	2,100
Engine Power (HP)	18,360

In comparison:

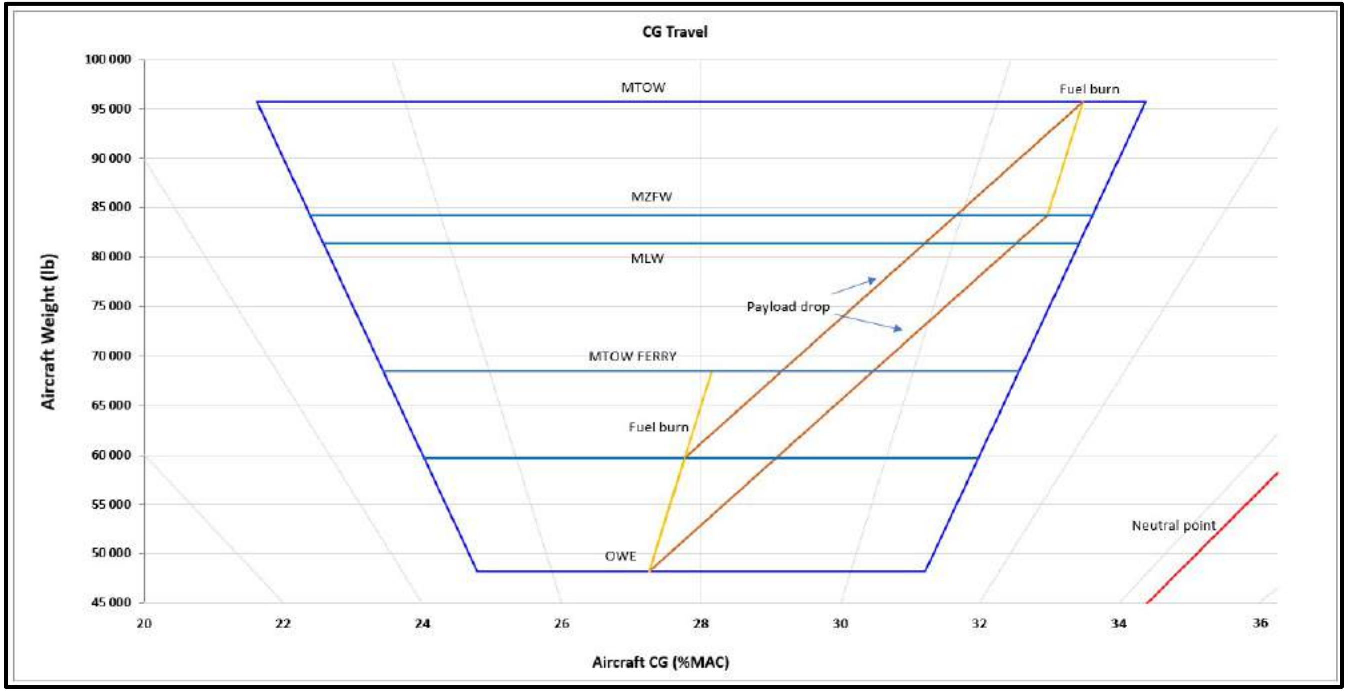
	MTOW (lbs)
Shinmaywa	104,940
CL-415	43,758
Beriev	90,200
Dash8	64,365
Antonov	59,400
Archerfish	95,696

Highest payload capacity

Highest payload-to-MTOW ratio



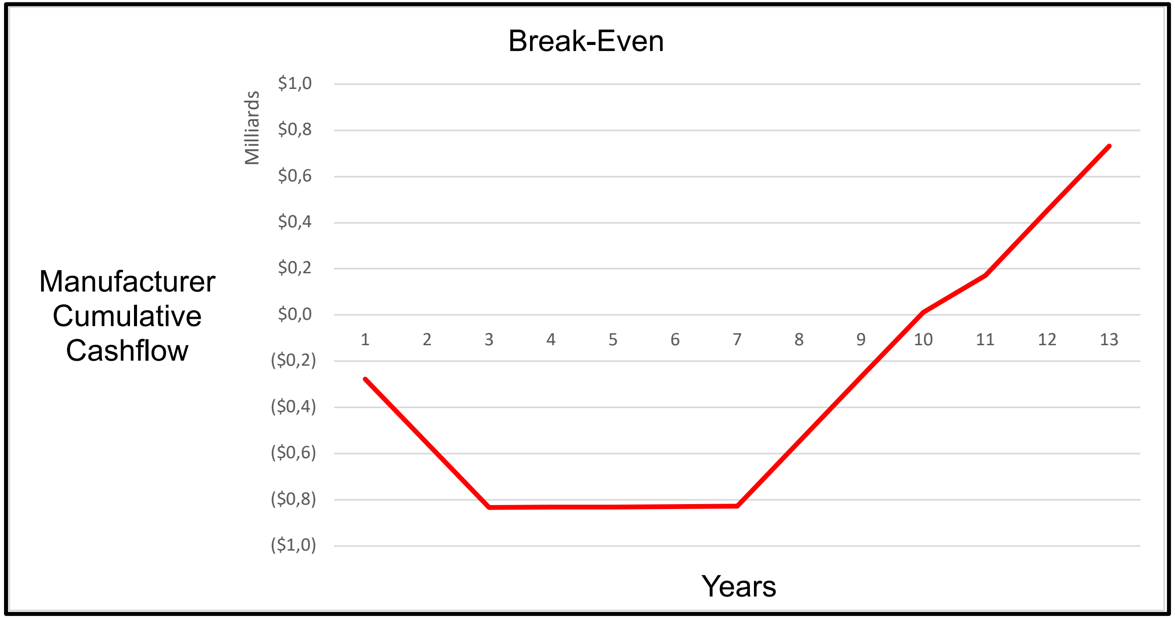
Envelope diagram



Rear limit is 5% in front of the neutral point

Front limit at 25% MAC

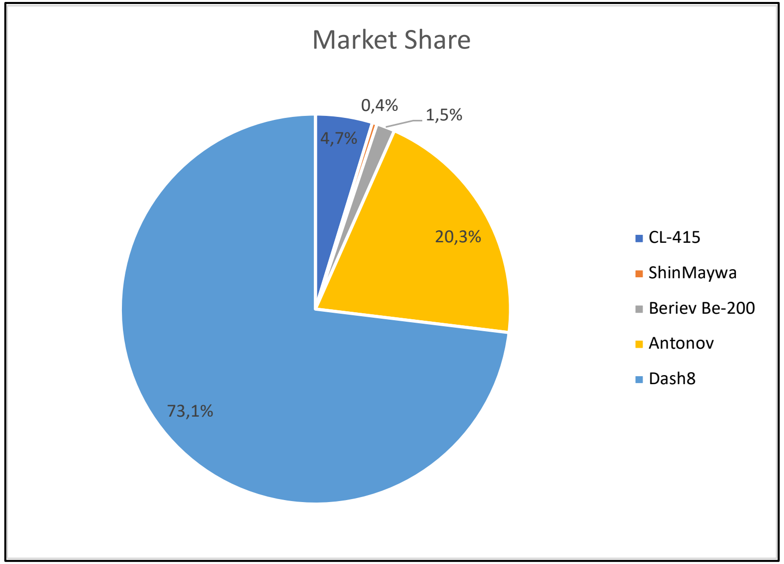
Break-Even Analysis

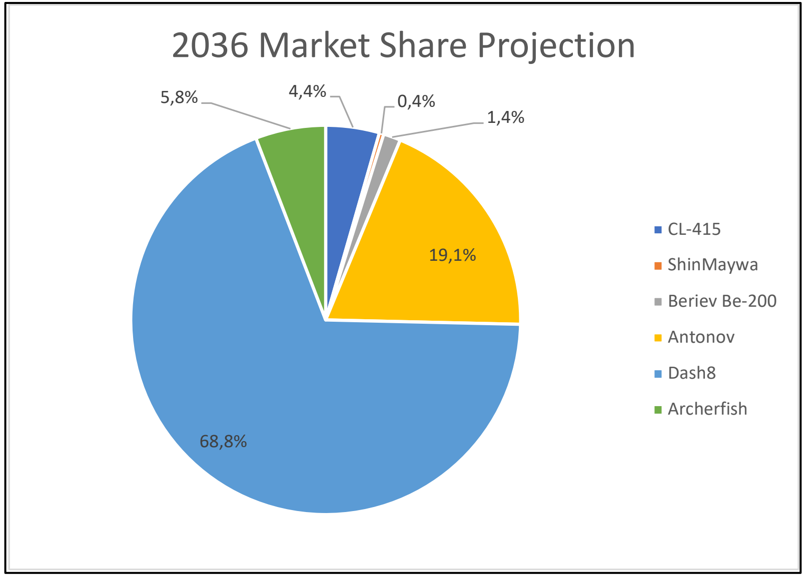


First Trade Study - Wing Surface

Wing surface (ft^2)	MTOW (Raymer Method - lb)	Available Volume for fuel (gal)	Estimated Drag (counts)	Range for full payload mission (nm)	Tradeoff from baseline config
1,030	95,160	4,300	273	249	Not optimal choice (range)
1,130	95,380	4,717	296	268	Necessary fuel volume for ferry range (minimum)
1,230	95,700	5,134	321	288	-
1,330	96,080	5,550	357	307	Weight of aircraft creates instability
1,430	96,510	5,969	382	326	High drag with engine config

Market Share Analysis





Achievements

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