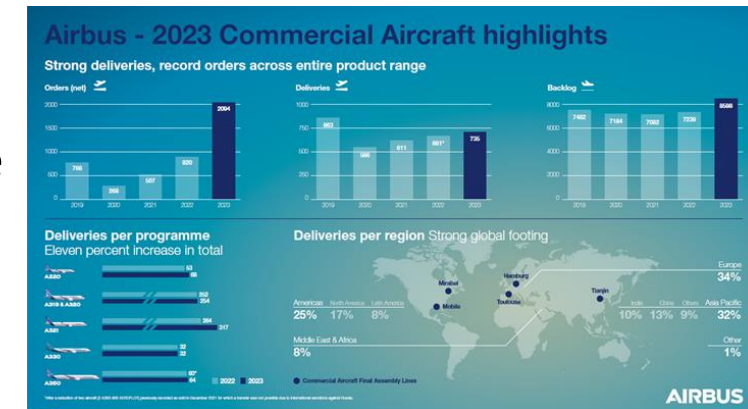


Prospect of Forming Industry into Aerospace Sector

1. Aerospace Market
2. Indian Aerospace industry
3. Forming Technology
4. forming Capability & Prospect
5. Challenges & way forward

1. Aerospace Market

- **The Aerospace Market-** A global industry for design, manufacturing & maintenance of aircraft, spacecrafts & related systems
- The global Aerospace market is estimated at **+300 B USD** is projected to **+650 B USD** (2032)
- **Asia pacific** is rapidly expanding-
 - Growth in commercial aviation due to rising passengers
 - Heavy govt. investment in Defense & Space
- Results into increased aircraft production, innovation & collaboration in Space
- Growth due to heightened global defense & security requirements
- Size insight: **Narrow body 78%**; Wide body also growing at faster rate
- End use: Private sector with 65% market share



2. Indian Aerospace Industry

- A&D market in India is estimated to reach around **\$70 billion by 2030**
- **Passenger traffic** in India growing rapidly **>15%/yr.** (70 to 200 M in last 10 yrs.)
- From a single carrier (Air India) there are many strong private airlines today

Component Manufacturing:

- This makes a strong case for global OEMs to examine India to play a vital role in the global supply chain for aerospace components and parts
- Technical and Engg. expertise available for high-precision & quality components
- In past, the progress of Aerospace products has largely been limited to the government-owned entities like HAL, NAL, ISRO etc.
- Today, Tata, Mahindra, L&T and Godrej have made a successful entry into the Aerospace industry
- Developing India for aero structures, compo., sub-assly. & complex system assly.

- OEMs have established JVs in India for the mfg. of Aerospace parts & assemblies

2. Indian Aerospace Industry

Defence procurement and offset obligations

- Today, Indian Aerospace industry for **component mfg.** is very small (\$250 million)
- Aggressively growing with-
 - Large acquisition of defense aircraft with offset obligations
 - Growth in traffic of 20%+ leading to large orders for commercial airplanes
 - Availability of engineering skills and talent
 - Enabling policy framework by the Government towards “**Make in India**”

Other Services

- Increasing need for MRO and related services in India
- Many OEM's like Boeing are looking at the opportunities available for the same
- The MRO market for repairs and maint. expected to touch **\$4 billion** by 2025

In conclusion, the Indian Aerospace industry is close to catapulting into a global arena with rapid

rise in demand for **aircraft and components**

Market update: Indian Civil Aviation industry

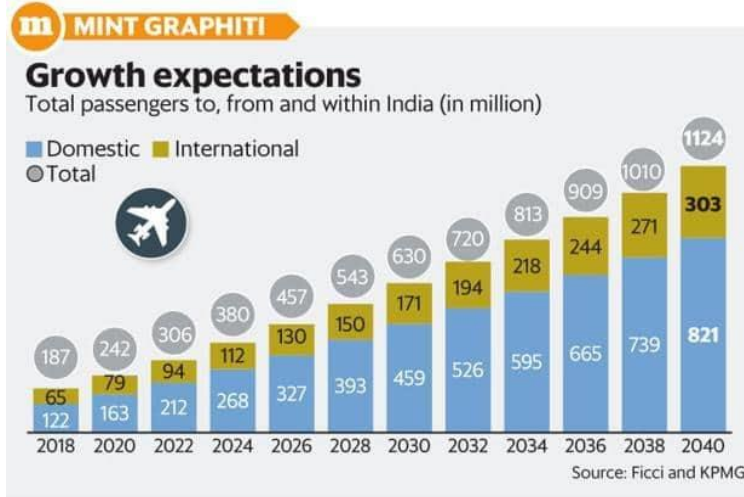
Jyotiraditya M Scindia • Following
 Union Minister of Civil Aviation & Steel, ...
 1h • 0

Another day, another record! Congratulations!

It's a HAT TRICK!
 Domestic passenger traffic breaks the record
Three Times In A Row

DOMESTIC PASSENGERS

20th November 2023	4,59,526
19th November 2023	4,56,910
18th November 2023	4,56,748



- India is one of the fastest-growing aviation markets and currently the **third largest** civil aviation market in the world
- 1748 foreign airlines flights and 1440 domestic airlines flights are connecting India globally.
- **1000 new aircraft** have been estimated to be added to the Indian civil aviation Sector
- International tourist arrivals are expected to reach 30.5 million by 2028
- For last mile connectivity, under **UDAN 4.2**, 184 routes awarded – 16 for Helicopters, 50 for seaplanes and 118 routes for small aircraft



FLIGHT PATH

Order for Airbus

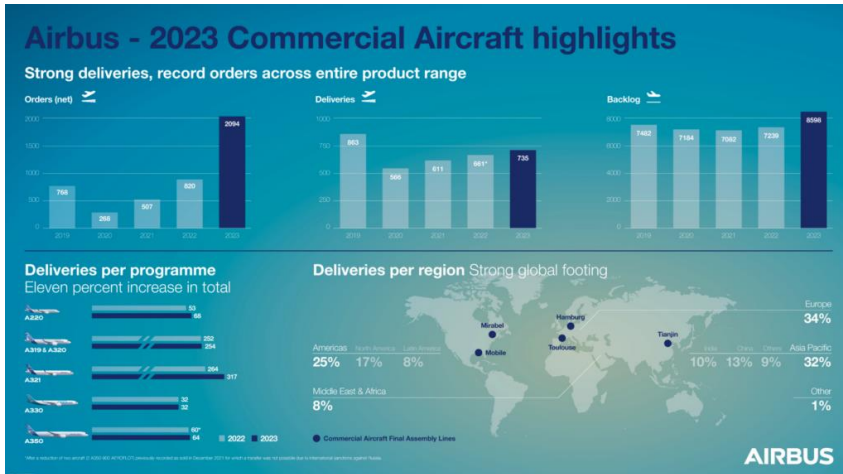
210 A320/321neo/XLR	40 A350-900/1000
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Order for Boeing

190 B737MAX	20 B787	10 B777
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▶ A350s and B777s will primarily be used on India-North America routes
 ▶ B787s will be operated on remaining long-haul destinations and on some short-haul destinations

Global OEM'S investing in Indian Supply- Chain



- Airbus Expands Manufacturing Hub In India, Signs Contract With Local Suppliers

- Boeing to invest \$100 million in infrastructure, pilot training in India

- Production Rates:

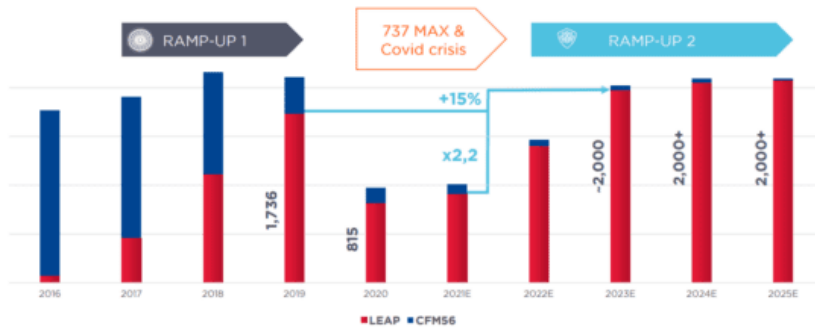
- Airbus: **A320** program is expected to reach a monthly rate of **65** by **late 2024** and **75** aircraft per month in **2026**

- Boeing: **737** production target is **50** per month for the **2025-2026** timeframe

- **Leap engine** production rates have crossed **2000** engines per annum

LEAP production: set to hit 2023 run rate

Double production over the next two years



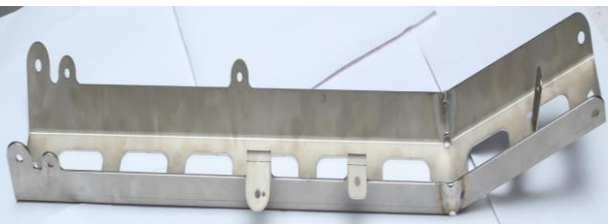
3. Forming Technology

- Forming is a plastic deformation of permanent shape change
- Forming processes-
 - Forging
 - Rolling
 - Extruding
 - Drawing
- Forming technology is an economic production of large quantity with accuracy
- Aerospace industry forming processes:
 - Hydraulic Press forming/ Deep Drawing
 - Press Break forming
 - Hydro forming
 - Fluid Cell forming
 - Stretch forming

4. Godrej Aerospace forming capability

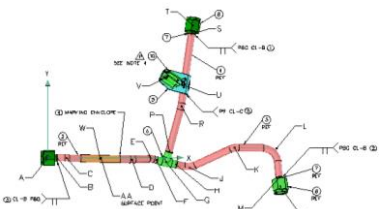
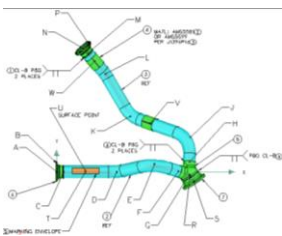
- Press Brake forming
- Hydraulic press forming
- Warm/ Hot forming
- Deep drawing
- Flow forming
- Expander forming
- Rolling
- Roll forming
- Tube bending

Center of Excellence: Engine Brackets



- Mainly Press Brake forming
- Material: Aluminum, Steel, Inconel, Titanium
- Thk.= 0.5 mm to 6.0 mm
- Laser/ Router cutting → Bending → Welding → M/c'ing → Rivetting
- Manufacturing +400 Brackets per day
- Revenue: **approx. USD 0.4 % of global market**
- Present global market= USD 1524 M
- Expected Global market = USD 2435.7 M (by 2032)
- Key players: Spirit Aerosystem, Arconic, Premium Aerotec
- Application: Fuselage, Wings, Landing gears, Engine mount

Tubes & Ducts



- **Ducts** forming with hyd. Press with cushion
- Material: Aluminum, Steel, Inconel, Titanium
- Thk.= 0.5 mm to 6.0 mm
- Ducts Laser/ Router → Forming → Welding → M/c'ing → Testing
- **Tubes** → Bending → End fitting welding → NDT & Testing → Swaging
- **3% of global aircraft parts**
- **Tubes & Ducts** global market: USD 1300 M (USD 2650 M by 2023)
 - Rising research activities which are fuel efficient
 - Rise in MRO of old aircraft fleet
 - Growing investment in Defense
- Godrej Aerospace contributing to approx. 1.0 % of global market

Rolling & Roll forming



- **Platform:** Commercial, Military, General Aviation, Spacecraft
- **Product:** Sheet, plates
- **Material:** Aluminum & Alloy, Steel, Titanium
- Parts are extensively used for wing covers, fuselage, bulkheads & internal fuselage structure
- Opening of assembly plants by Boeing & Airbus
- Increase production of aircrafts
- Rise in indigenous aircraft manufacturing C919
- Rolled products to rebound to reach **USD 6.3B** in 2028 (5.1% CAGR)

Complex fabrication: Engine module

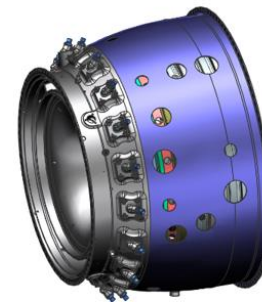
- First time aircraft engine modules are being manufactured by private Indian industry
- Involve complex sheet metal forming, welding & machining
- Involve sp. Processes like- Heat treatment, Surface treatment, Plasma Spray coating, Plating
- Received AFQMS certification (Approval of Firm & its QMS) from DGAQA



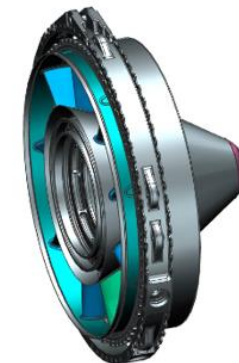
GTRE Engine 50KN



Fan Assembly



Combustor



Exhaust Cone

Godrej contribution in Chandrayaan-3



PUNCH USED FOR 90% FORMING OF CONES. 100% FORMING IS DONE ON EXPANDER.



VIKAS ENGINE DIVERGENT ASSEMBLY DONE WITH ROLLING FORMING AND EXPANSION PROCESS OF CONES.



THRUST CHAMBER VIKAS ENGINE USED FOR CHADRAYAN.



Expander for CE20 match forming.



Vikas Engine



Space:

- Earth Storable Engines: Vikas Engines
- Cryogenic Engines
- Semi Cryogenic Engine
- Satellite Thrusters
- Ground System Antenna

Defense:

- Airframe Systems
- Engine Modules
- Primary and Secondary Actuators
- Actuators, valves, pumps Structure for Pods
- Adaptor/Pylon
- UAV Airframe in Composites

Civil Aviation:

- Sheet Metal Fabrications
- Duct & Tubing
- Complex fabrication
- Poppet & Valves
- Composite parts



Complex forming

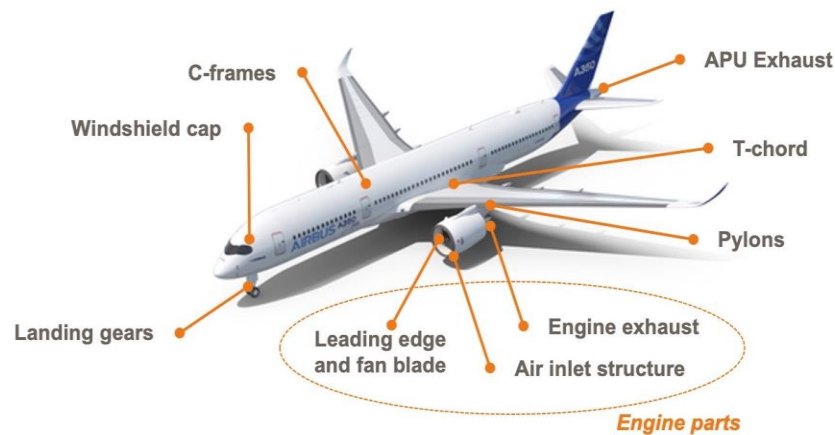


- **Fluid cell forming & Stretch wrapping** are widely used forming technologies in Aviation
- Many complex shaped sheet metal parts are formed
- Fuselage panels, structural parts, extrusions, bulkheads etc. are formed
- No need of complex hardened tools
- Easy tool repair

Challenges for Indian Forming industry

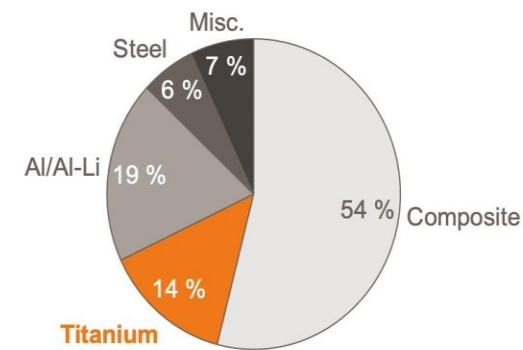
- Ban on Russian supplied raw material
- Increase in cost of raw material & lead-time due to high demand
- Availability of Skilled manpower
- Anticipated increase Oil prices due to volatility in West Asia
- High investment for critical equipment like FCP, SW & related facilities like furnace, surface treatment

Main Ti parts in civil aircrafts



Source: EFESO analysis

Metal utilization in A350 as % of weight



Source: Airbus, EFESO analysis

How to overcome the challenges for future forming prospect.....

- Can industries come together & invest into & use the common facilities ??
- Can take advantage of growing market ??
- Can take advantage of China-Exit policy ??
- Can we develop & indigenize raw material ??
- Can we engage Training Institutes ??

Thank You