Aerospace Supply Chain and Manufacturing

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Outline

- Welcome
- Workshop purpose
- Current Gaps and Challenges
- Opportunities
- Collaboration and next steps
Welcome
Grateful for your passion around one of the largest barriers in aerospace

Cycle Time and Production Rates
Supply Chain Basics

Supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer need.

Aerospace supply chain is an ecosystem of different supplier tiers.

Includes manufacturers, suppliers, transporters, warehouses, etc.

Supply chain management refers to coordination of all activities.
Supply chain impacts entire life cycle from early conceptual design to high volume manufacturing

• All types of aircraft in all phases

• Maintenance, repair, and overhaul

• Skills and talents
Job Search

• Boeing
• Pratt Whitney
• Airports
• Vimana Robotics
• Zipline
• Joby Aviation
• Collins
• Aircraft Propeller Services
• Many more
• 75000+ jobs for all industries
Basic Statistics on Manufacturing

- Boeing and Airbus: 1600+
- General Aviation (piston, turboprop, business jets): ~2000
- Rotocraft: 1020
- Cars: 70M (OICA, 2018)  
  Cars in US: 2.8M
Conventional Aircraft
Current Situation ($800+B backlog)

- Boeing and Airbus have backorders (~5000+, with ~55/month rate)
  - Boeing delivered 806 aircraft and Airbus 800 in 2018
  - Airbus 863 (2019, 7% up)
  - In 2016, Boeing had 5715 undelivered orders and Airbus had 6874

Forecasted production levels of commercial aircraft: 2016 to 2034

Source: Deloitte analysis, Airbus, Boeing
Challenges

- Casings and forging
- Composites
- Auxiliary Power Units
- Printed Circuit Boards
- Actuators
- Software
- High volume manufacturing and assembly methods
- Many others
## Supply Chain Considerations and Challenges

(Credit: EY – A&D Edge, Supply Chain Management in Aerospace and Defense, Feb 2018, slides 8-9)

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### Challenges

- Dependence on large number of sole-source suppliers
- Long lead time
- Financial challenges across the supply chain for new programs
- Large inventory needs
- Collaboration across complex supply chain
- Cyber and security
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Similar challenges for electric or hybrid, supersonic, and hypersonic aircraft – may be even worse
Drones
DOD looks to expand drone industrial base amid supply chain concerns

By Lauren C. Williams  |  Aug 26, 2019
Summer Internship Project:

Hard to find all supplies quickly that will satisfy NASA and other government needs.
Drone industry needs sustainable supply chain and manufacturing capabilities.
Vertical Take-off and Landing
Needs

Many calls, texts, and interactions about looking for suppliers and manufacturers
Overmolding
Actuators
Electric motors
Propellers
Casting
Many other components and manufacturing needs

Need suppliers for entire life cycle:
Design to high volume manufacturing
- **OEM** – Control design, manufacturing and assembly function, the most critical component of value chain
- **Tier 1** – Support Primes by providing them with equipments and systems like engines, Wings, Fuselage
- **Tier 2** – Manufacture and develop parts as per the specifications provided by primes and Tier 1 suppliers
- **Tier 3** – Responsible for supplying basic products, components and other non-core value added services

Opportunity to create a tiered system for eVTOLs
Maintenance, Repair and Overhaul (MRO) Market

- Global industry: $80+ Billion
- Network needed for eVTOLS
Car companies are entering aero industry

Need to understand the production certificate, and aviation grade manufacturing needs

Need sustainable supplier, manufacturer, and MRO network
Putting it all together
Current State of the Art: Risk Archetypes

• Limited/sole sources
• Fragile supplier and market
• Capacity constrained supply market
• Foreign dependency
• Diminishing manufacturing sources and material shortages
• Gap in U.S. human capital
• Product security
Executive Order

• Assessing and strengthening the manufacturing and defense industrial base and supply chain resiliency of the United States

• Executive order 13806, September 2018
  • Decline of U.S. manufacturing capabilities and capacities
  • Competitiveness
  • Diminishing STEM and trade skills
Supply Chain Strategies


- Many suppliers
- Few suppliers
- Vertical Integration
- Joint Ventures
- Horizontal Integration
- Keiretsu Networks (part collaboration, part few suppliers, part vertical integration)
- Virtual Companies
Known Aero Supply Chain Related Issues (California Manufacturing Network, 2018)

- Sourcing of raw materials – aluminum, steel, copper, etc.
- Mitigating supply disruption risks (e.g., geopolitical considerations)
- Coping with Modernization and Emerging Technologies (e.g., wiring problems, software issues, late deliveries of lavatories)
- Shortage of skilled workers (Tim Cook’s view on outsourcing)
Recommendations: Supply Chain for Urban Air Mobility Vehicles

- Time to start building an entire new eco-system
- Take advantage of other manufacturing (e.g., auto)
- Rebuild/train auto, heavy industries, traditional aerospace suppliers to consider VTOL
- Get regional manufacturing and supply chain associations exposed to emerging aero needs
Recommendations: Supply Chain for Urban Air Mobility Vehicles

- Build an electronic exchange platform to connect VTOL customers with suppliers
- Prototypes
- Job production
- Mass production
- Quality management based on FAA production need
- Training workforce: curriculum, skills, and entrepreneurs
- Establish tiered system
- Establish MRO network
Immediate Success:

Grow emerging aerospace ecosystem

- Convert non-aero suppliers and manufactures
- Expand current aero suppliers and manufacturers in new areas
- See opportunity and identify areas to contribute
- Create a tired system and electronic platform for eVTOLs
Conclusions

- **Build supply chain and manufacturing base for aero needs** – particularly for emerging vehicles
- **Support OEMs with supplier and manufacturing base and MROs**
- **Increase production rate and delivery as compared with today’s aerospace manufacturing and assembly state of the art**
- **Parts access will need to be rapid for MROs**
- **Build electronic platform with authenticated parts and certified supplier and manufacturer base**
- **Time to rebuild skills, talents, digital enterprise and attract new manufacturers to scale deliveries**
https://arc.cnf.io

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BACKUP
Scalability is Fundamental Need for UAM

• Many pilots (or acceptable and reliable autonomy)

• Spectrum availability

• Airspace operations (e.g., Unmanned Aircraft System Traffic Management type construct)

• Acceptable noise

• Mass production of electric or hybrid VTOLs

• Infrastructure (including recharging systems)
Mass Production of VTOL Vehicles

• Production rates need to be closer to cars than conventional aircraft
  • Manufacturing and assembly methods
  • Supply chain network and ecosystem
Air Traffic is expected to **DOUBLE** in the next 15 years.

The number of passengers is predicted to rise from 2.9B in 2012 to 6.7B by 2032.

The passenger fleet will grow by 109% from 2012 – 2032.

- **Rising from 16,093 to 33,651 aircrafts**
Current State of the Art in Aero Supply Chain

- Boeing and Airbus have backorders (~5000+, with ~55/month rate)
  - Boeing delivered 806 aircraft and Airbus 800 in 2018
  - In 2016, Boeing had 5715 undelivered orders and Airbus had 6874

Source: Deloitte analysis, Airbus, Boeing
Current State of the Art in Aero Supply Chain
Reference: Oliver Wyman Global Fleet & MRO Forecast Commentary 2019 - 2029

- In 2017, the U.S. accounted for 49% of the global aerospace industry

- The future growth in aviation will be concentrated in Asia and the developing world, particularly China and India
  - By 2035, the Civil Aviation Administration of China projects the number of airports in the nation will double
  - By the end of the decade, China will become the biggest global market for air travel and Asia will be the new center of global aviation activity
Current State of the Art in Aero Supply Chain


• Due to globalization, the Western companies will capture short-term cost-reduction opportunities

• This provides opportunity to refocus resources and capabilities on higher-value activities (specialization of the industry’s supply chain)
  • E.g. develop the next clean-propulsion technology or composite assemblies
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