Aerospace 4.0: Implications of the New Manufacturing Ecosystem

Presentation to:
Aircraft Builders Council
Miami, Florida
September 2018
Dr. David Pritchard
Focus of the Research

• The next generation single aisle aircraft (late 2020s) could be adopting advanced manufacturing technologies with robotic applications (Cobots, Mobots) for structures, automated fiber placement, thermoplastics and additive manufacturing.

• The aircraft's clean sheet designs will integrate advancing robotic technologies with transforming the assembly process by eliminating traditional monument style production equipment/tooling with automated guided vehicles.

• The new clean sheet aircraft design will be standardizing the practices of additive manufacturing components (3D printing) which obsoletes many traditional machining technologies.
Agenda

- **Fuselage Production**
  - Boeing 787 Composite Barrel
  - Airbus A350XWB Composite Panel
  - COMAC CR929 Composite Panel (China)
  - MTorres Moldless Monocoque Fuselage

- **Wing Production**
  - Composites-Autoclave
    - Airbus A350XWB
    - Boeing 777X
  - Composites-Non Autoclave
    - United Aircraft Corporation MC 21
    - United Aircraft Corporation CR929 (Russia)

- **Thermoplastics**
  - Ten Cate-Toray
  - Stelia Aerospace Thermoplastic Fuselage
  - Premium Aerotec Thermoplastic Bulkhead

- **Robotics**
  - Boeing 777 FAUB
  - Composite Robots
  - Human Robot Collaboration

- **Additive Manufacturing**

- **Factories of the Future**
  - Stelia Aerospace
  - A320NEO Final Assembly Line
Fuselage Production
Boeing 787 Composite Barrel
Airbus A 350XWB Premium Aerotec
MTorres Moldless Monocoque Fuselage
Wing Production
Airbus A350XWB Composite Wing
Boeing 777X Composite Wing
United Aircraft Corporation MC 21 Composite Wing
Next Generation Single Aisle Wing Production

• “Will the required low takt times be achieved with capable manufacturing technologies? Looking at the state-of-the-art autoclave production value chain, I’m skeptical that this will be the path forward.”

• “This is doable with autoclave technologies. But, imagine if six wings per day for the single aisle planes, A320 and B737, had to be manufactured with CFRP. How should this be achieved? Who could and would afford such investments?”

• “Highly automated, out-of-the-autoclave technologies must be implemented to achieve low takt times”

Andreas Wüllner, chairman, Business Unit Composites – Fibers and Materials at SGL Group, Keynote Address at the Aerodef Manufacturing Conference 2017
Thermoplastics Composites
Ten Cate – Toray Thermoplastic Composites
Stelia Aerospace Thermoplastic Composites
A320 Rear Pressure Bulkhead - Thermoplastic Composites
Welded Thermoplastic Composite-Rivet-less
Premium Aerotec A320 Bulkhead-Thermoplastics
Robotic Solutions
Boeing 777 FAUB (Fuselage Automated Upright Build)
Composite Robot Automated Fiber Placement
Cobot Verification of A350XWB Brackets
Additive Manufacturing
What is Additive Manufacturing?
Additive Manufactured Parts (GE Fuel Nozzle)
Boeing 787 FAA Approved 3D Printed Parts
Factories of the Future
“For the finishing of the sections, a "moving line" length of 70 meters and comprising 7 stations was installed. Advances at 2.5 centimeters per minute.”

“More than 35 robots and automatic riveting machines with three moving production lines.”

Flextrack drills and rivets for the assembly of the section and the cockpit.
Stelia Aerospace Advance Manufacturing
Airbus A320NEO 4th Final Assembly Line-Hamburg (FAL)

- FAL comprises seven stations with mobile platforms for positioning fuselage sections and wings and transporting them to the next station.

- NovaTech Engineering (AIT) designed and build the FAL
  - AGV-Nova Tech Engineering
  - Robots-Kuka
  - Drill/Insert Head-Loxin

- Two adjustable-height robots with seven-axis capability drill more than 2,000 individual holes in the circumferential joint and install the rivets.
Airbus A320NEO 4th FAL Hamburg
CRAIC CR 929 Widebody Commercial Aircraft
Thank you
Questions?
Contact Information

Dr. David Pritchard
Associate Professor/Aviation Researcher
SUNY Empire State College
2875 Union Road
Buffalo, New York 14227
United States

Emails: david.pritchard@esc.edu
davidjpritchard@roadrunner.com