SAAB
Clean Sky 2 demo & SWE Demo projektet

INNOVAIR Årskonferens 2018

Maria Weiland

Saab Aerostructures

SweDemo

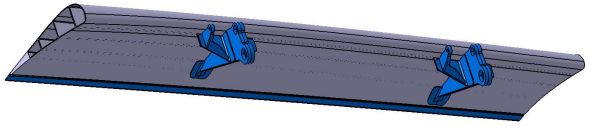
Maria Weiland, Projektledare Saab Aerostructures

2018-05-23

The research leading to these results has received funding from VINNOVA under program n°2015-06057

SWEDEMO

Next Generation Structures, Systems, Integrated Sensors and ATM technologies for Commercial Aviation Market

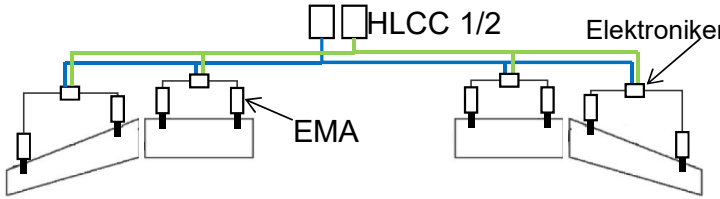


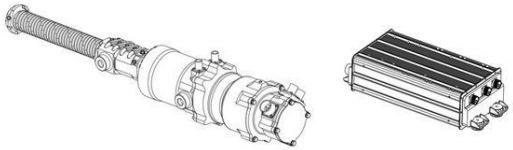
Areas

Advanced structure and manufacturing of aircraft structures

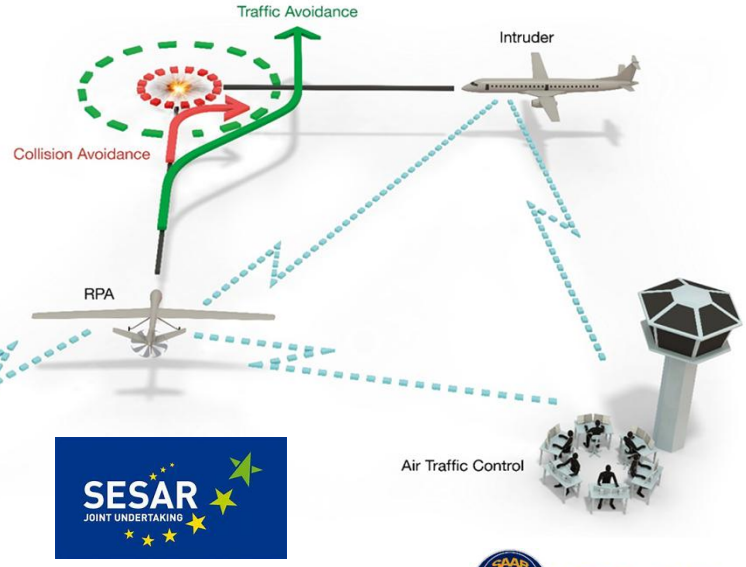
Intelligent onboard systems for high lift devices

Detect and avoid systems for Air Traffic Management (ATM)





OEM



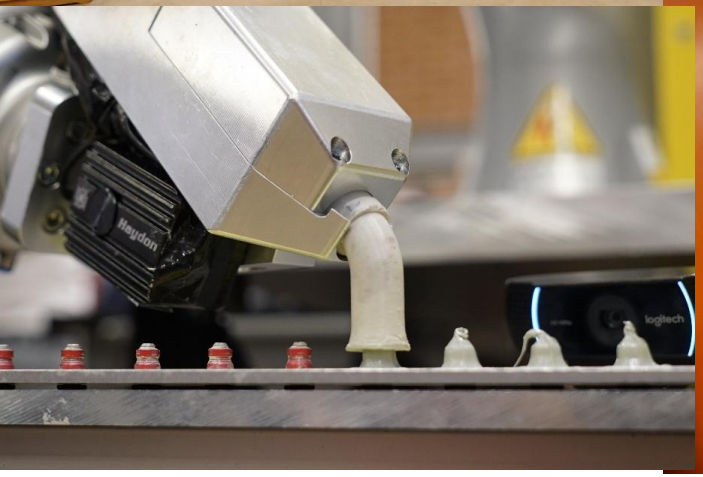
Clean Sky 2

SESAR JOINT UNDERTAKING

SAAB TECHNOLOGIES SAAB

SWE Demo Seminarie Chalmers
23 maj 2018

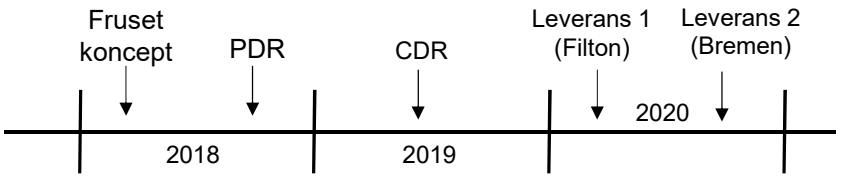


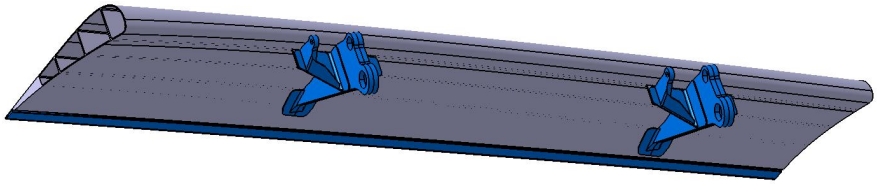




Clean Sky 2 ITD AIRFRAME WP A-3.1 ”Flaperon”

- Utveckling och tillverkning av en styryta, ”Flaperon”
  - Ska tillverkas med Resin Transfer Moulding process (RTM)
  - Leveras till Airbus Wing of Tomorrow i UK

- Tekniker som utvecklings tillsammans med partners inom Clean Sky 2
  - NDI tillsammans med kollaborativa robotar (CRO-INSPECT)
  - Analytisk prediktering av laminatkvalitet (TRANSITION)
  - Komposithärdning med flexibla, justerbara, verktyg (FLEX)

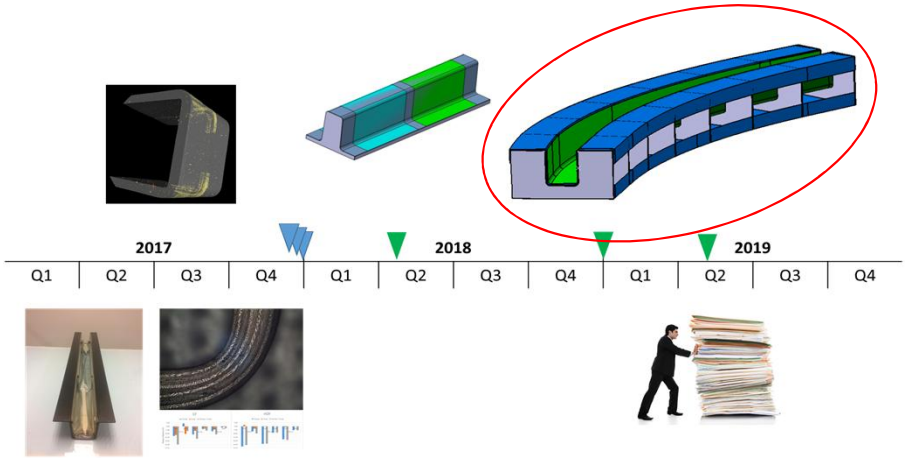




SWEDEMO

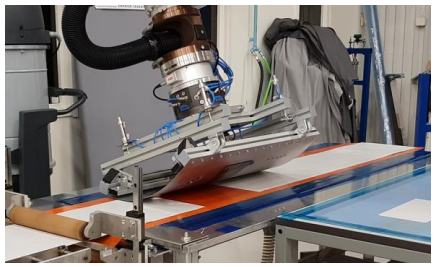
SWE Demo WP1.1

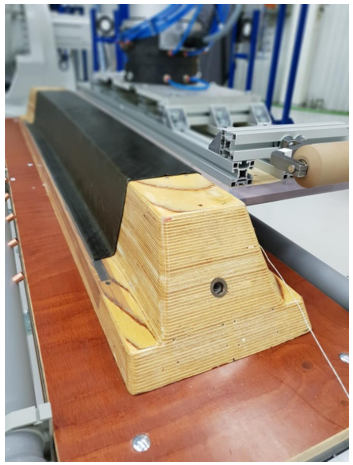
- Tillverkning av kompenserat kompositverktyg med hög driftstemperatur
  - Ett formgivande verktyg behövs för all kompositttillverkning
  - Verktygen kan vara gjorda av väldigt många olika material
  - Verktyg i kompositmaterial har många fördelar……men också vissa nackdelar
  - Ju högre härdtemperatur, desto större krav på verktyget
- Krav
  - Form
    - hela kedjan från färdig yta till plugg
    - CTE
    - Isotrop eller anisotrop
  - Temperaturtålighet
    - över 180 °C
  - Formstabilitet
    - vad händer vid uppvärmning
  - Processegenskaper
    - autoklav
  - Livslängd
    - serietillverkning i flygsammanhang
  - Totalkostnad

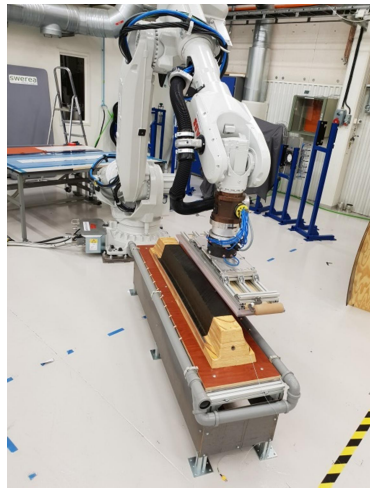


SWE Demo WP1.3 Kompositautomation

- **Vidareutvecklad hanteringsmetod för prepreg (förimpregnerad kolfiber)**
- Kurverat verktyg för att kunna plocka kladdigt material
  - Utvecklat inom examensarbete på Linköpings Universitet
- Integrerat sensor för adaptiv plock- och nedläggning
- **Kraftstyrd formning av Omega-balk**
  - Driftagning av kraftstyrning i robotcell
  - Utveckling av formningsdon för formning av Omegabalk
  - Programmering av kraftstyrd formning av omegabalk

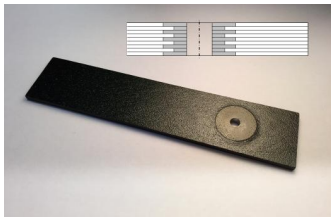




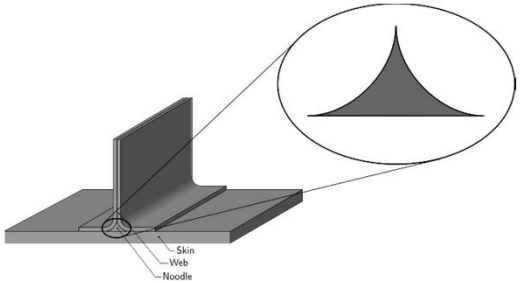


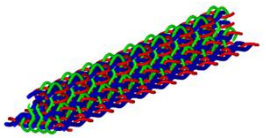
SWE Demo WP1.4 Hållfasthet/restspänning

- Integrated metal inserts
  - Layer-wise integration in prepreg
  - Metal-metal bolt/hole interface
    - Simpler hole drilling
    - Could enable bolt clamping pressure
  - Great potential for weight saving
  - Great potential for tailoring and optimization

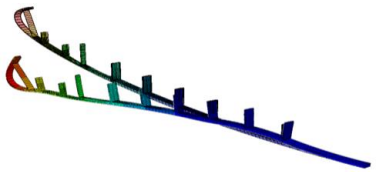


- 3D-woven noodles in composite T-joints
  - Reference noodles show higher failure load than 3D-noodles
  - 3D-noodles show more consistent failure loads than reference noodles



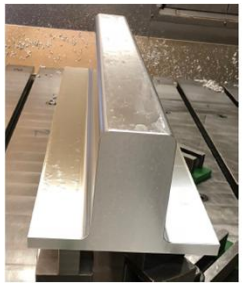


- Shape distortions in curved laminates
  - Higher geometrical accuracy of composite articles
  - Refined tools for prediction of residual stresses
    - Wight reduction
    - Increased performance
  - Decreased need for shimming operations



SWE Demo WP1.5 Högtemperaturkomposit

- Omvärldsanalyser
  - Högtemperaturkompositer inkl materialval genomförd
  - State-of-the-art inom Out-of-Autoclave tillverkning
  - Trendanalys med tillämpning på en utvald komponent (skevroder)
- Högtemperaturkompositer
  - Polyimid (PI), cyanatester (CE), benzoxazin (BOX), epoxy (EP) och bismalimid (BMI) utvärderat
- Nästa steg
  - Verktyg för framtagning av provföremål, 4 olika BMI-system skall utvärderas
    - Solvay 5250-4
    - Solvay Duratool 450
    - Hexply M65
    - Airtech Betapreg

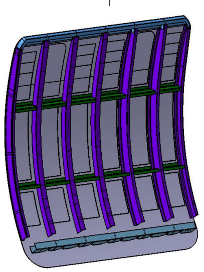


Clean Sky 2 ITD AIRFRAME WP A-3.3 FMCD (Future Metallic Cargo Door)

Complete Movable Demonstrator

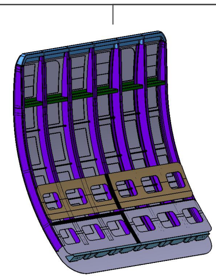
- Collaboration with Saab Avionics (system, sensors)
- Demonstration on CS2 multifunctional fuselage

Technology Demonstrators (TD)



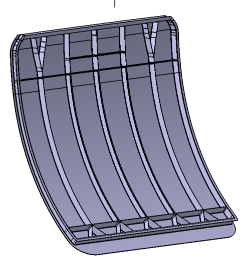
TD 1

- Friction Stir Welding
- Stretch forming
- Additive Manufacture



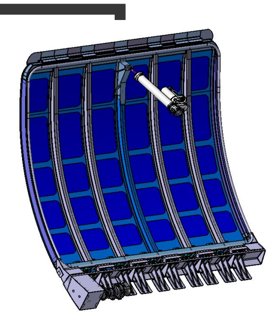
TD 2

- AlMgSc
- Friction Stir Welding
- Laser Welding
- Creep forming
- Additive Manufacture
- Orbital Drilling
- Collaborative Robots



TD 3

- Hydroforming
- Additive Manufacture
- Topology Optimisation
- Powder Coating



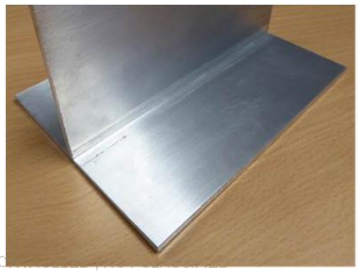
TD 4

- Adhesive Bonding
- Additive Manufacture
- Electromechanical system

Objective

Technology Development

- New & promising manufacture/assembly technologies primarily for metallic assemblies & structures



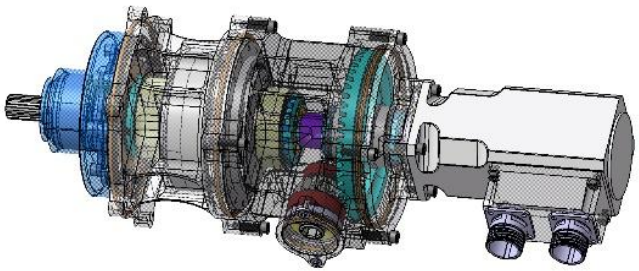
Future Business

- Single Aisle Cargo Doors
- High rate manufacture
- Low cost of production

TD4 overview

Electrical lift, latch, lock system

Simpler and faster operation



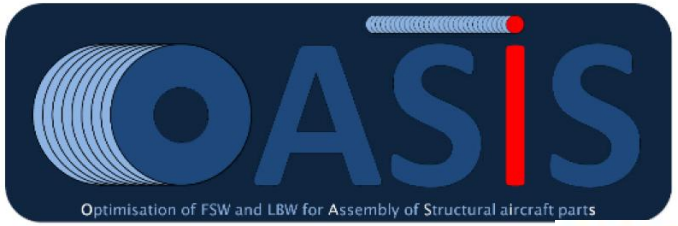
Example of EU collaboration: OASIS Project

2 ½ year project starting feb 2018

1.4m€ **funding** från EU

7 Partners lead by TWI

Saab has role ”Topic Manager”

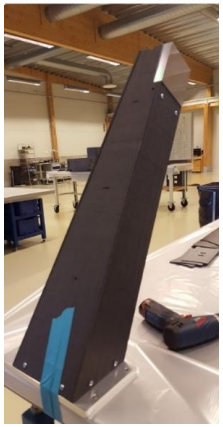


The OASIS project will demonstrate the ability and cost-effectiveness of manufacturing aluminium aircraft structures using the latest developments in FSW and LBW, with appropriate inspection approaches in accordance with aerospace standards.

SWE Demo DP2 resultat

- DP21: Demonstration av automatiserad sträng & övertätning till TRL5
- DP22: Vi har tillverkat och demonstrerat styvare komposit jiggar (jämfört med traditionella stål/aluminium)
- DP23: Demonstration av electrical driven pickups for aircraft assembly samt tagit fram en ny styvare CFRP flexapod
- DP25: Topologi optimiserad reperation har definerats och metoden har implementeras I FE program. Demonstration under 2019 på en av Clean Sky 2 demonstrationsdörrar

https://www.youtube.com/watch?v=3gGNnL7-nW8



RPAS Detect & Avoid (DP3)

R5DAA-systemet

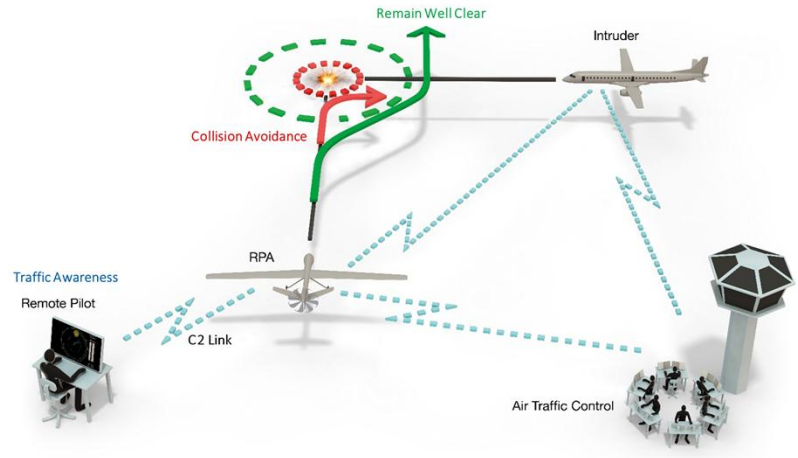
- HMI för presentation av D&A information har implementerats
- Collision Avoidance funktionen har uppdaterats baserat på simuleringsresultat
- Antenn och funktion för att bestämma bäring (Direction Finding) testad
- Riggtester med R5DAA-systemet genomförda

Flygprov med Skeldar

- R5DAA-systemet har integrerats på Skeldar
- Markprov och samfunktionsprov genomfört innan sommaren
- Hittills har ett 15-tal flygningar genomförts
- Analys av data från flygningarna pågår
- Nästa steg är flygning med ”målflygplan” i olika scenarier

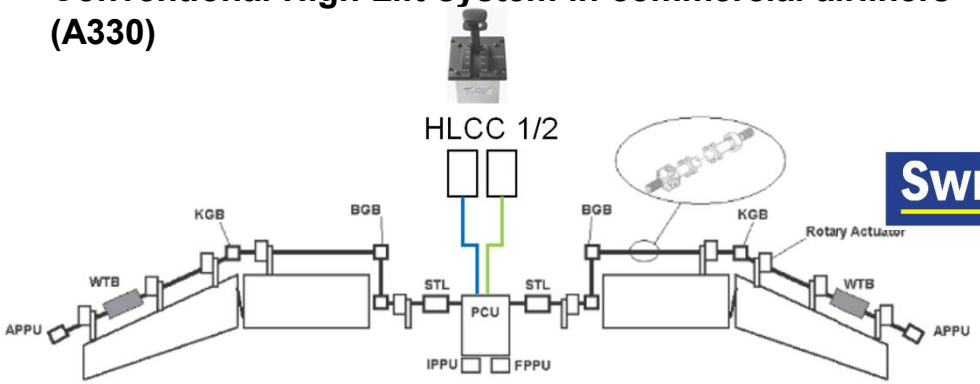
ATC-simuleringar på Sturup

- Detaljerade trafikscenarier för simuleringarna definierade
- Integration av modeller i Sturup-simulatorn pågår
- Simuleringar och Demonstration genomförs 22-24 oktober 2018



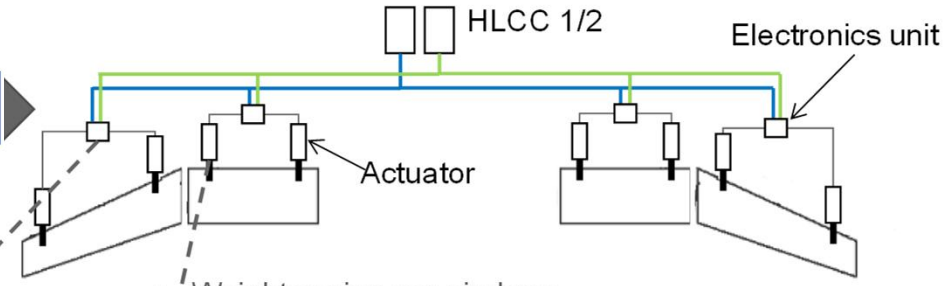
High Lift System (DP4)

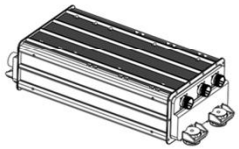
Conventional High Lift-system in commercial airliners (A330)



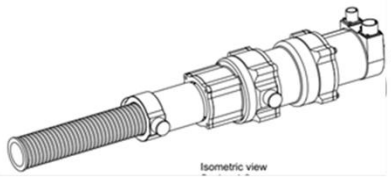
- Complex and heavy mechanical design
- Heavy hydraulic infrastructure required
- Mechanical single failure cause loss of High Lift
- Maintenance demanding
- Environmentally hazardous hydraulic oil

Electric and distributed High Lift-system





Electronics unit (draft)



Actuator (draft)

- Weight saving per airplane
  - > 500 kg for single aisle Large Comm. Aircraft (B737, A320)
- Facilitated assembly on airplane
  - 50% reduced assembly time
  - 66% reduction of parts
- Increased availability of High Lift
- Enables aerodynamic optimization during flight
- Power on demand

SWEDEMO

Status DP4 Aug 2018

SAAB TECHNOLOGIES

swerea|IVF

HDD High Density Drives

Completed:

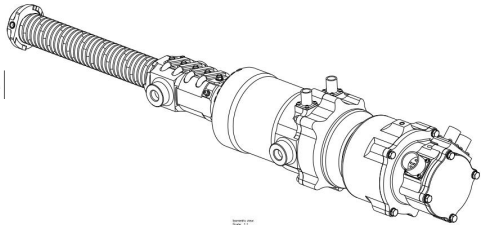
- REU, (Control computer) prototype 1 complete
- Test rig complete
- EMA, (Actuator) prototype sourcing complete
- Limited verification on REU and EMA sub-assembly level complete

Ongoing

- REU, (Control computer) prototype 2 design
- EMA, (Actuator) combined prototype 1 and 2 in assembly
- Design of test circuit board for REP test, (life test of temperature cycling)

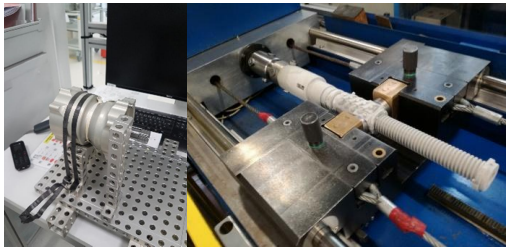
Remaining

- REU prototype 2 manufacturing
- System verification
- HALT test on REU prototype 2 at SWEREA IVF
- REP test at SWEREA IVF

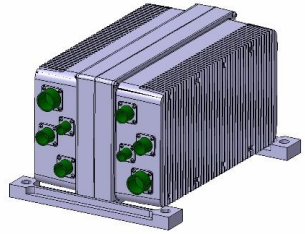


EMA combined prototype 1/2

REU prototype 1



Verification test of EMA sub-assy.



REU prototype 2

SAAB TECHNOLOGIES

Questions?