AEROSPACE 4.0 @ SONACA

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Smart Manufacturing 4.0

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SONACA GROUP KEY FIGURES

848 M$
2017 Revenue*

5
Business Lines

Top 10
Aerostructure player

* Sonaca & LMI Aerospace consolidated

WHAT DO WE DO ?

Flap Mechanisms & Fairings

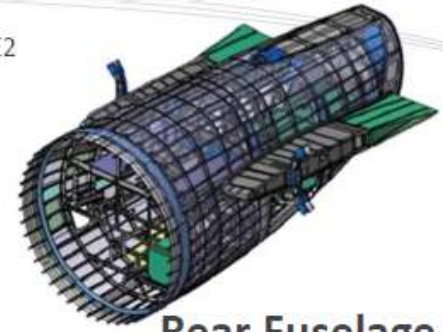
EMBRAER ERJ175/190/195-E2

Flaps

* EMBRAER Legacy 500
* EMBRAER ERJ175/190/195-E2

Nose Upper Shell

AIRBUS A380

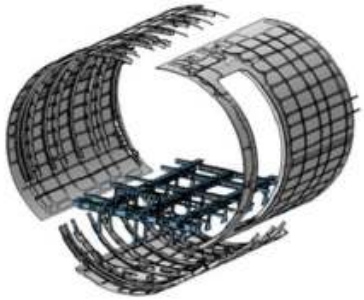


Rear Fuselage & Pylons

* EMBRAER Legacy 500
* EMBRAER ERJ145
* EMBRAER Legacy 650

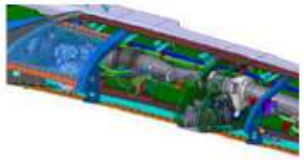
Bird shield

*Airbus A380
*Airbus A350
*Airbus A400M



Main Landing Gear Doors

AIRBUS A400M



Wing Fixed Leading Edges

* AIRBUS A400M
* EMBRAER ERJ145
* BOMBARDIER CSeries
* DASSAULT F7X / F8X
* LEARJET 85
* PILATUS PC24

Wing Slats and Mechanisms

* All AIRBUS from A310 to A350
* EMBRAER ERJ170/190; 175/190/195-E2
* BOMBARDIER CSeries
* DASSAULT F7X / F8X

Center Fuselage I with doors

EMBRAER ERJ145

SMART AEROSTRUCTURES ?

1. Aim of the presentation is not to ‘show off’, but to list our needs
2. Connectivity enters in :
   - Manufacturing (IoT) -> N. Steinier
   - Product -> N. Van Hille

SMART MANUFACTURING

Nicolas Steinier
Head of Manufacturing Numerical Method's
Smart Manufacturing 4.0

WHICH NEEDS FOR THE FUTURE ?

OEM NEEDS

In the context of a **complex and multiprocesses manufacturing value chain**, the part process **traceability** is one of the first step to Machine Learning, Big Data and **SMART manufacturing**.
Either in detail parts manufacturing or complex assemblies, **part traceability** is the key to track and trace the **productivity and quality** improvements.

=> What are the solutions to support this **traceability** in **an aggressive manufacturing process** where parts face high temperature, corrosive environment, high deformation, curing, high pressure…?

=> What solutions exist **to track and trace parts in a complex production process**?

=> What solutions exist to track and trace **assembly steps in an worldwide supply chain**?

WHAT ARE NEXT YEAR'S AIRCRAFTS MANUFACTURING CHALLENGES ?

1. Rate increase where market standards are
    1. *Lowest cost is no more a discussion… it is obvious*
    2. *Highest quality level*
    3. *On time delivery*
2. Optimize value chain in worlwide supply chain
3. Increase flexibility: quick reponse to rate change
4. Increase product customization: quick response to product change implementation

MOVE FROM EFFICIENCY TO EFFECTIVENESS BY KILLING NON ADDED VALUE WORK

How can connectivity help us ?

1. Process tracking in a complex production process
2. Parts tracking in a complex worlwide supply chain

PROCESS TRACKING IN A COMPLEX PRODUCTION PROCESS

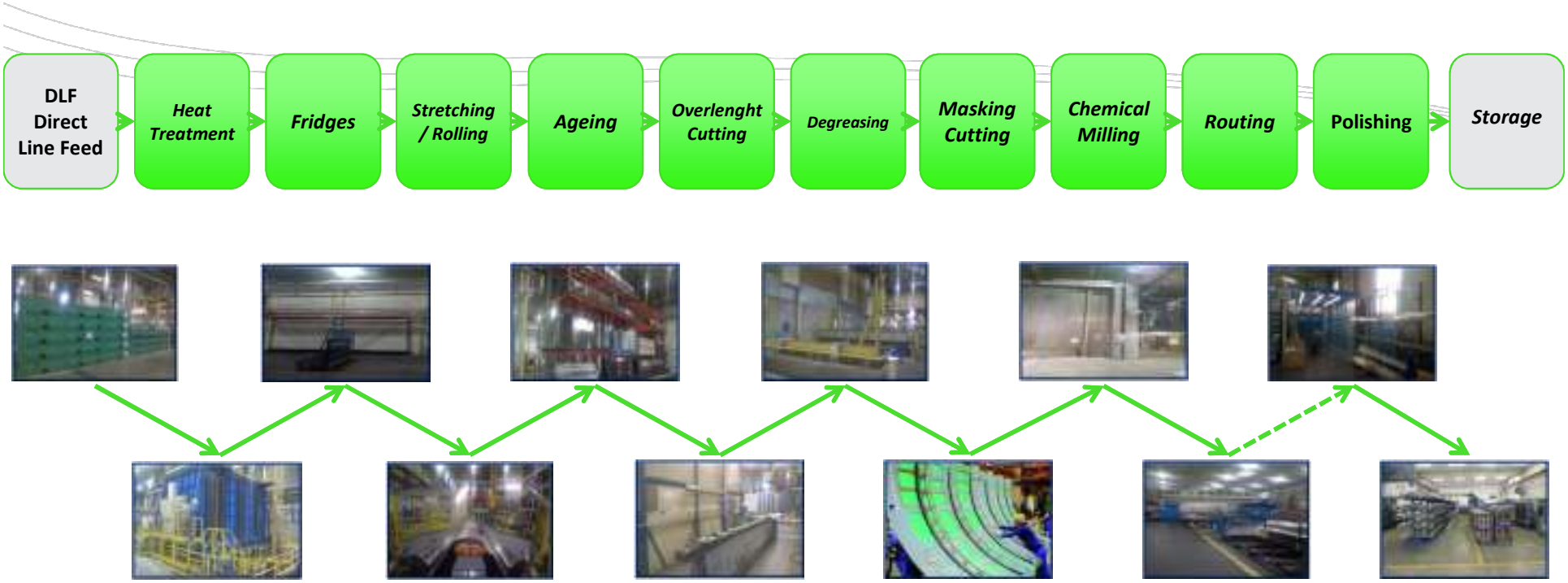
PROCESS TRACKING IN A COMPLEX PRODUCTION PROCESS

- Parts Process tracking is the basement for:
  - Work In Progress improvement
  - Production Bottle neck's decrease
  - Production Asset's optimization
  - Improve Overall Equipment Efficiency
- Parts Traceability is key to improve customer service:
  - Quality improvement
  - End to end Root cause analysis
  - Genealogy tracking of products
  - Non Quality cost cut
  - Reaching operational excellence with Six Sigma processes

FROM ALUMINUM SHEET TO FINAL PRODUCT

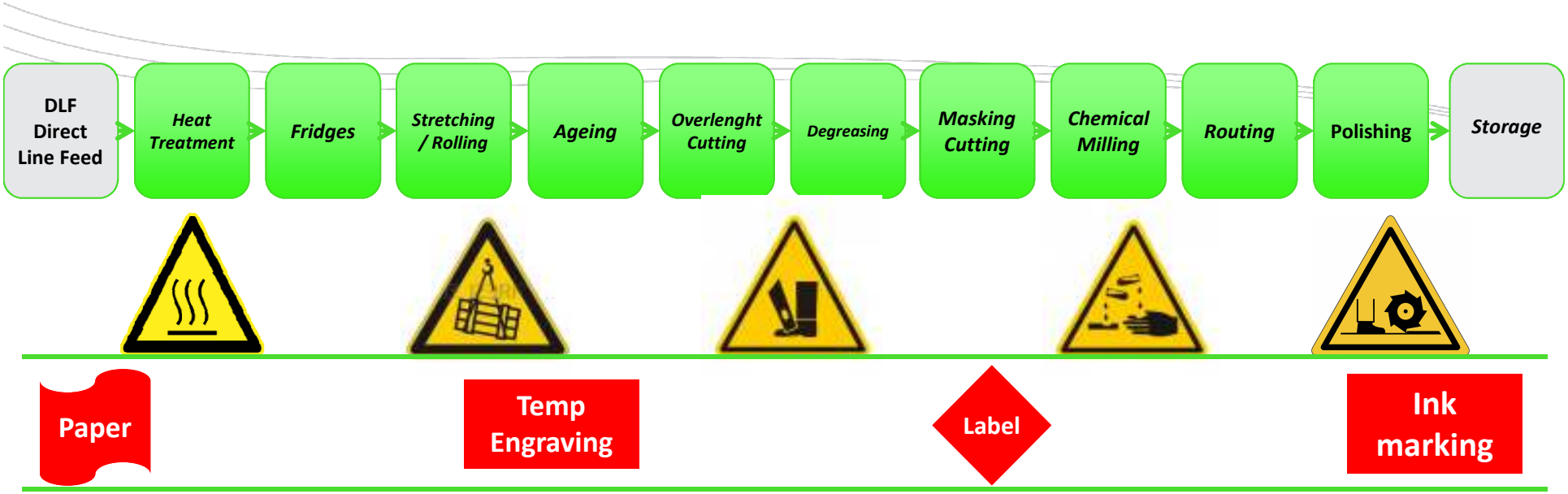
➲ **Example of primary part complex production process**

EXAMPLE OF A COMPLEX PROCESS FLOW (STRETCH FORMING SKIN)



=> What solutions exist to track and trace parts in a complex production process?

EXAMPLE OF A COMPLEX PROCESS FLOW (STRETCH FORMING SKIN) TRACEABILITY



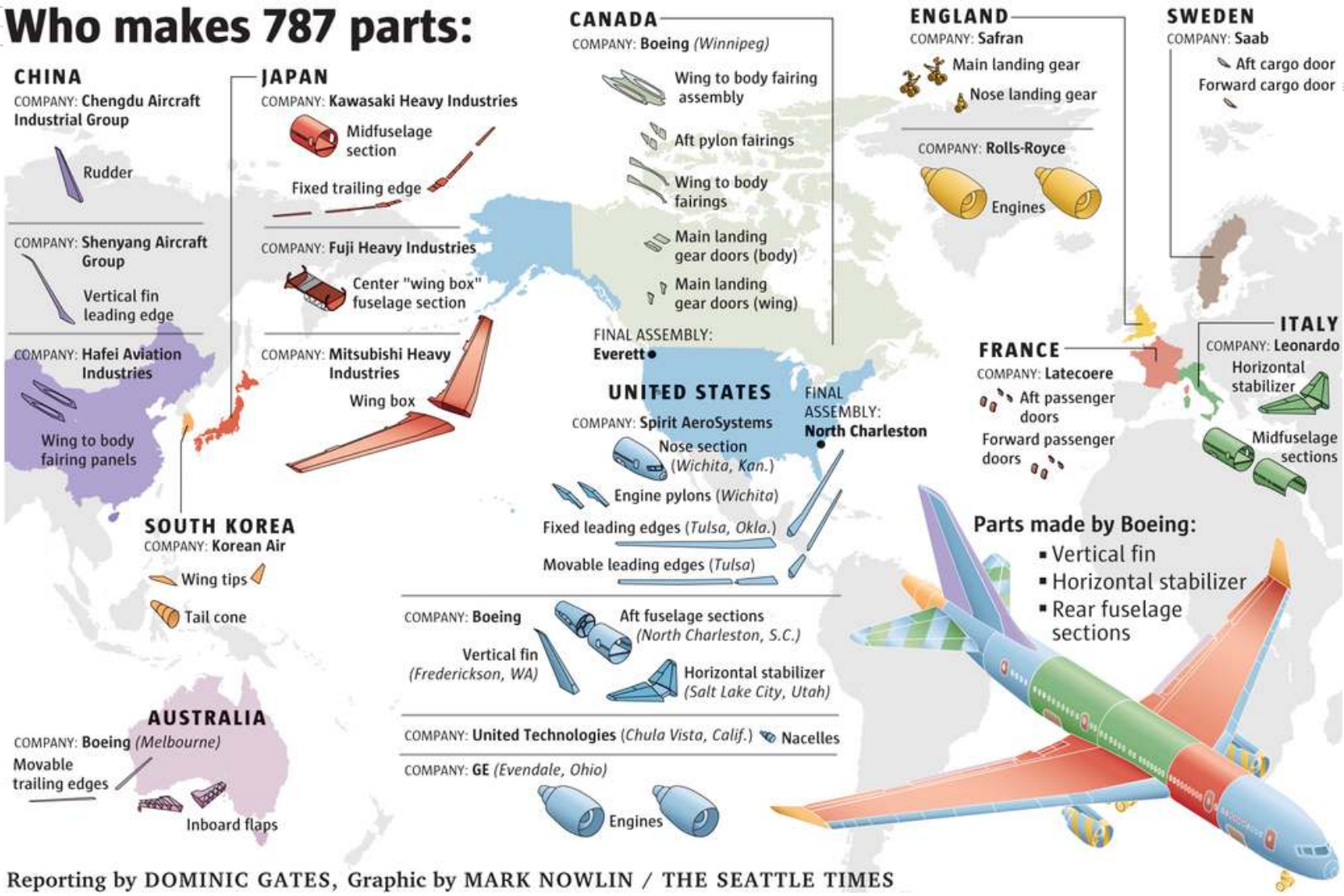
Multi support marking depending on process constrains

=> What are the solutions to support traceability in an aggressive manufacturing process where parts faces high temperature, corrosive environment, high deformation, curing, high pressure…?

PARTS TRACKING IN A

WORLDWIDE SUPPLYCHAIN

AN AIRCRAFT IS LEGOBOX WITH WORLDWIDE SUPPLY CHAIN…



Reporting by DOMINIC GATES, Graphic by MARK NOWLIN / THE SEATTLE TIMES

WORLDWIDE SUPPLY CHAIN…

- Worksharing in a global organization is defined with multi constraints
  - Cost optimization
  - Production plant's specialities
  - Customer location and constraints
  - Production Capacity
  - Legals and customs constraints
  - …

Today trough ERP data collection and planification the « On Time Delivery » has become a key success factor for SONACA…

… but will it be still possible in the future by keeping a cost competitive organization?

=> What solutions exist to track and trace parts & assemblies in a worldwide supply chain?

WE SEE OBVIOUS BENEFITS…

- By using connected technologies, the extended supply chain monitoring will allow us to:
  - connect with logistics applications
  - Connect to customers need's through their systems
  - Connect to supplier's systems
  - Decrease obsolescence costs
  - Decrease WIP
  - Decrease logistics costs (direct and indirect costs)
  - …

...AND CHALLENGES

1. **Find the best technologies to support an extended supply chain.**
2. **Find the best technologies to integrate all subsidiaries and maintain their freedom of movement to improve locally**

MOVE FROM EFFICIENCY TO EFFECTIVENESS...

...with the help of connected technologies.

SMART AEROSTRUCTURES

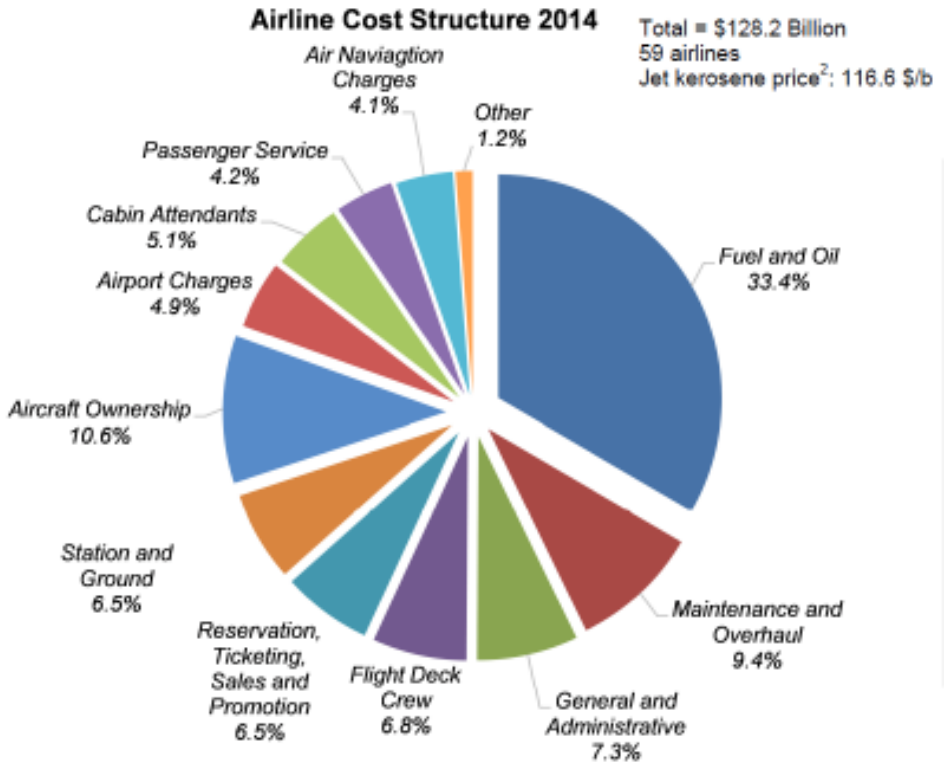
A LOOK TO THE FUTURE

Nicolas Van Hille
Research and Technology Manager

WHICH NEEDS FOR THE FUTURE ?

WHAT ARE AIRCRAFTS FUTURE DRIVERS ?

1. **Total Cost of Ownership (TCO)**
    1. ***The only driver for commercial aircrafts***
    2. ***Increasingly important for business jets (-> + and + through leasing)***
    3. ***Even for military aircrafts***
2. **Environment : reduction of emissions (CO_2, No_x) and noise**
3. **Keeping safety as a priority !**



Airline Total Cost of Ownership Breakdown

How can connectivity help us ?

1. Structural Health Monitoring (SHM)
2. Loads data gathering

AND GOD CREATED SHM…

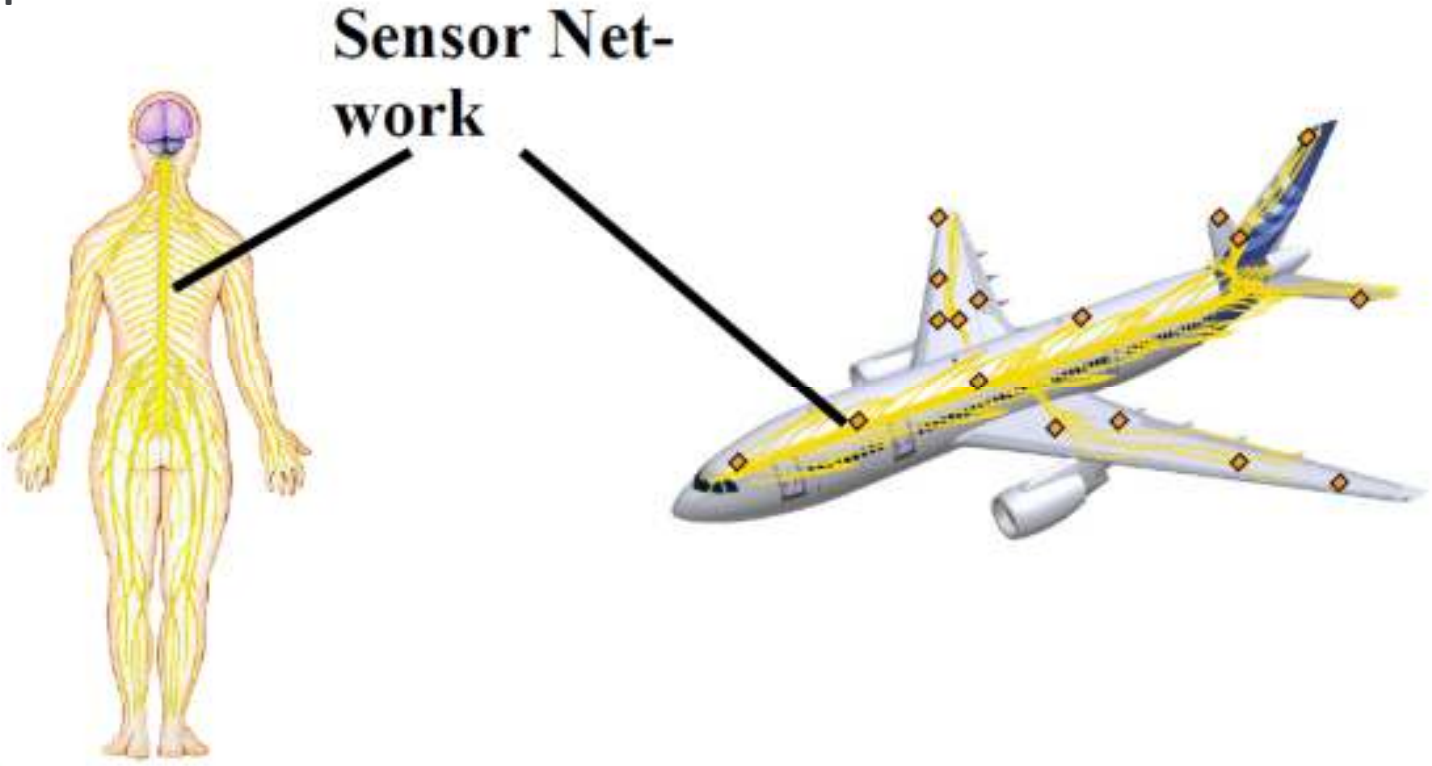
- In 1980's, several flight accidents imposed use of Damage Tolerance on aircrafts :

AND GOD CREATED SHM…

- Currently, inspection is mainly manual and implies grounding aircraft
- Related costs (including grounding time) estimated to 70 bn$/y

AND GOD CREATED SHM…

- Idea is to have ‘self diagnosing’ structures
  - ⇒ Structural Health Monitoring was born…
  - ⇒ With the intention to shift from a <u>time</u> based inspection to a <u>condition</u> based inspection



AND GOD CREATED SHM…

What must be monitored ?

- **Cracks in metallic structures**
- **Delaminations/fiber failures in composite structures (impact damages)**
- **Shocks**
- **Extensive vibrations (due to excessive freeplay for instance)**

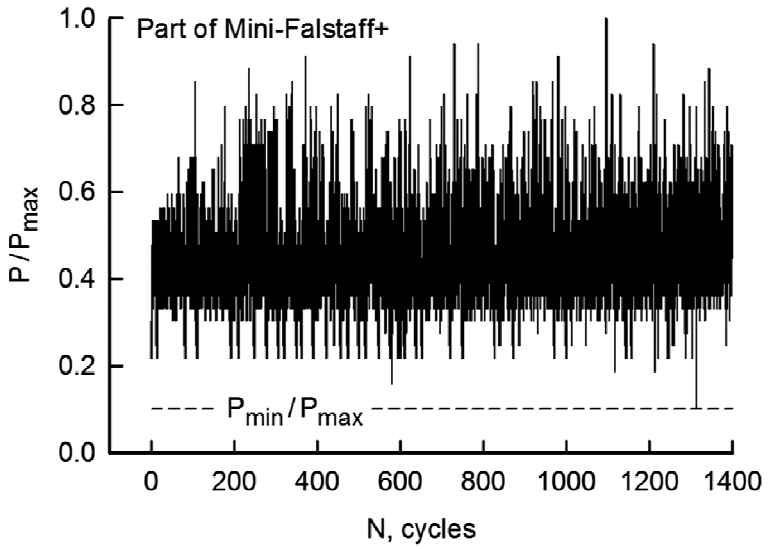
...AND LOADS DATA GATHERING

➲ **Philosophy :**

- **Currently, loads used for design are defined by simulations and verified by flight tests (=> e.g : safety factor of 1.5 used)**
- **If loads history was gathered, this would lead to :**
  1. Conservatism reduction
  2. More reliable loads (less risk during development of new aircrafts)
  3. Possibility to measure the part ageing

⇒ **Clear interest for a reliable and accurate way of measuring loads or stress levels :**

- **Accelerations**
- **Aerodynamic pressures**
- **Temperatures**
- **Interface loads**
- **Stress in critical components**
- **Deflections**



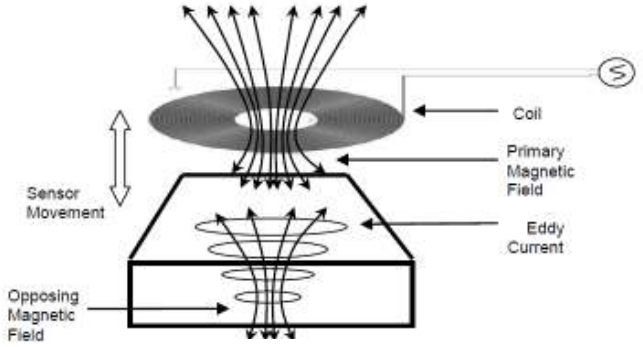
WE SEE OBVIOUS BENEFITS…

- Major short term benefits :
  1. Reduction of A/C grounding time
  2. Elimination of costly disassemblies and inspections
  3. Automatize inspection => increase safety (reduce risks of human errors)

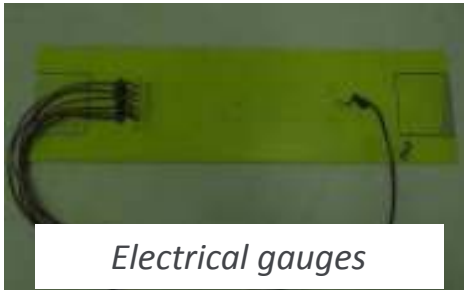
- Major long term benefits :
  1. Weight reduction thanks to :
     - Damage tolerance change of philosophy (from time based inspection to condition based inspection)
     - More accurate loads

EXISTING TECHNOLOGIES

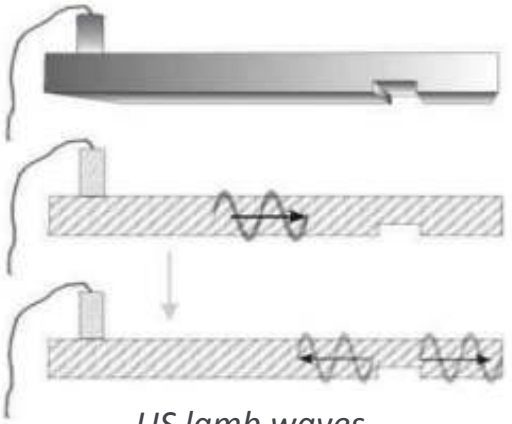
- Eddy current
- Electrical gauges (signal disrupted when crack appears)
- Comparative Vacuum Monitoring
- Ultrasonic Lamb waves (wave reflected in case of a damage)
- Optical fiber sensors (wavelength of signal modified when deformation appears)
- …



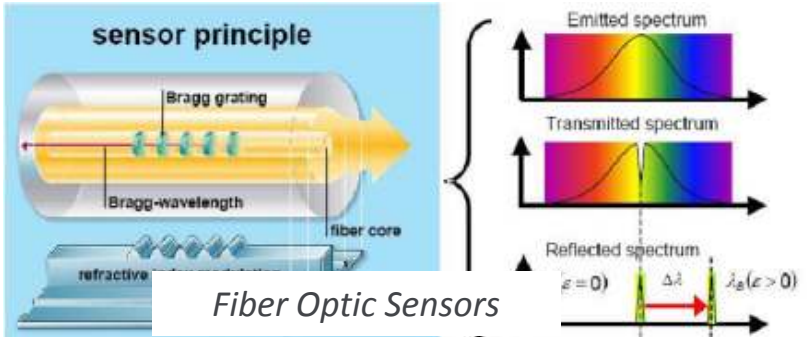
Eddy current coils



Electrical gauges



US lamb waves



Fiber Optic Sensors

...AND CHALLENGES

➔ ~~Major challenges~~ Opportunities to be worked on :

1. Cost of sensors too high for positive business case
2. Coverage area : small details (flaws) must be detected in a very large structure
3. Validation / certification :
   - Reliability must be demonstrated
   - Damage tolerance philosophy will be changed
4. Standardization of sensors will be needed
5. Security related to wireless (hacking)

THE BEST WAY TO PREDICT THE FUTURE IS TO INVENT IT…