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SKF Aerospace

Fly-by-Wire sub-system development

Presented to Rhone-Alpes Aerospace cluster seminar

by Thierry Robin

SKF Fly-by-Wire – Product development Manager

2009-dec- 17th

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SKF Fly-by-Wire

1) Fly-by-Wire in SKF group

2) FbW Product Technology

3) FbW Product Development processus

4) Conclusion

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1

Fly-by-Wire in the SKF group

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SKF Group in 2009

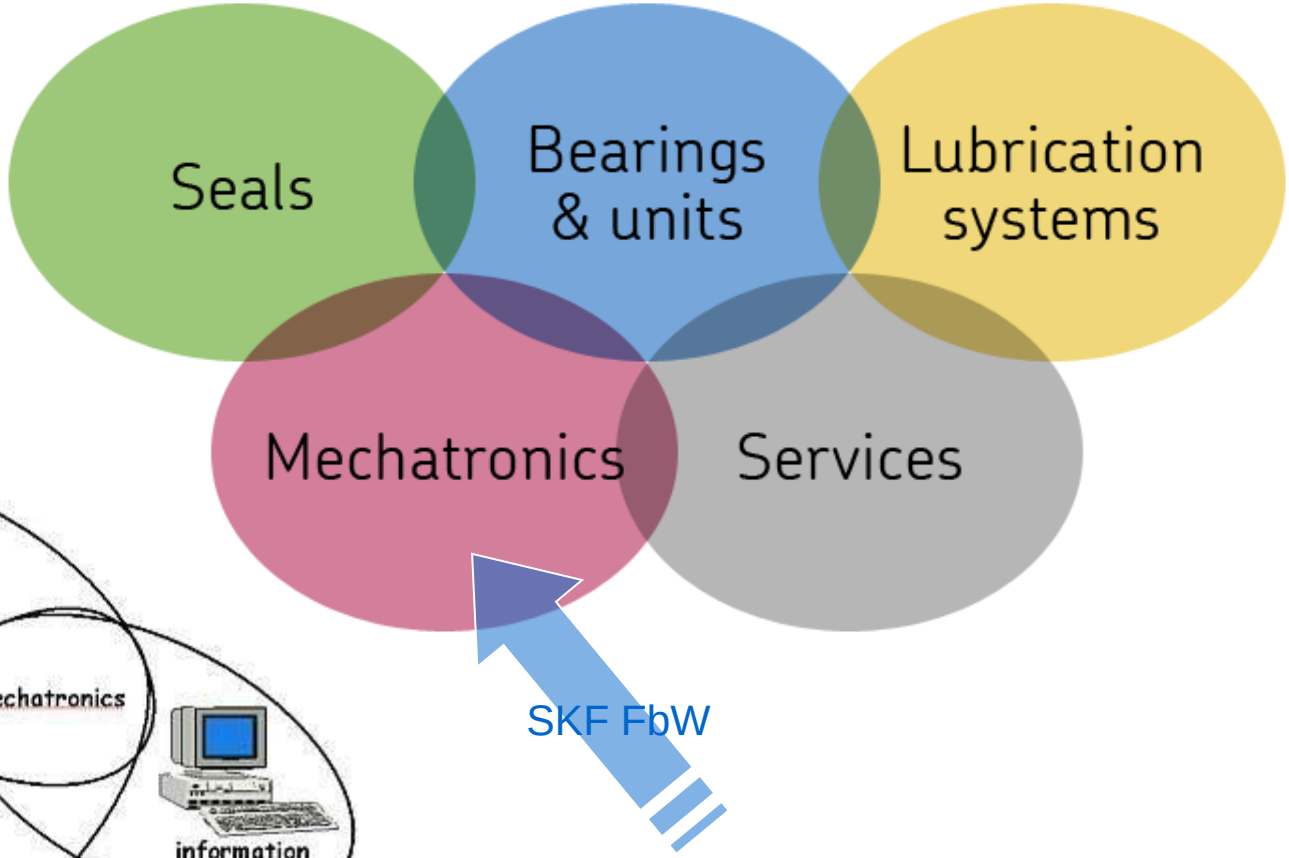
- 1907
  Date of creation

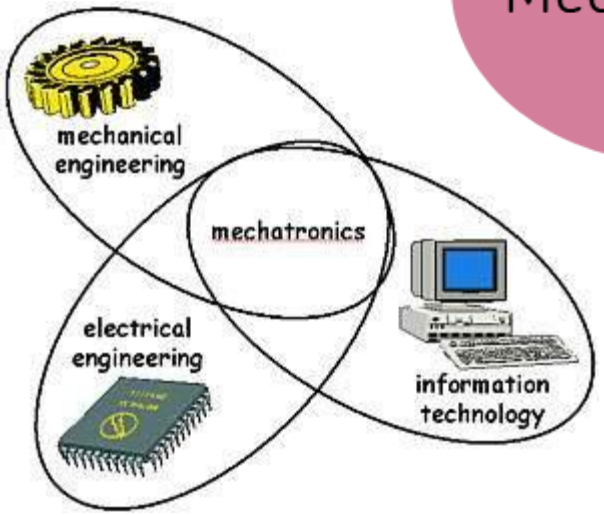
- Over 40,000 employees

- Over M$ 5,000 annual turnover

- 150 companies
- 105 production facilities
- 22 countries

SKF technology platforms





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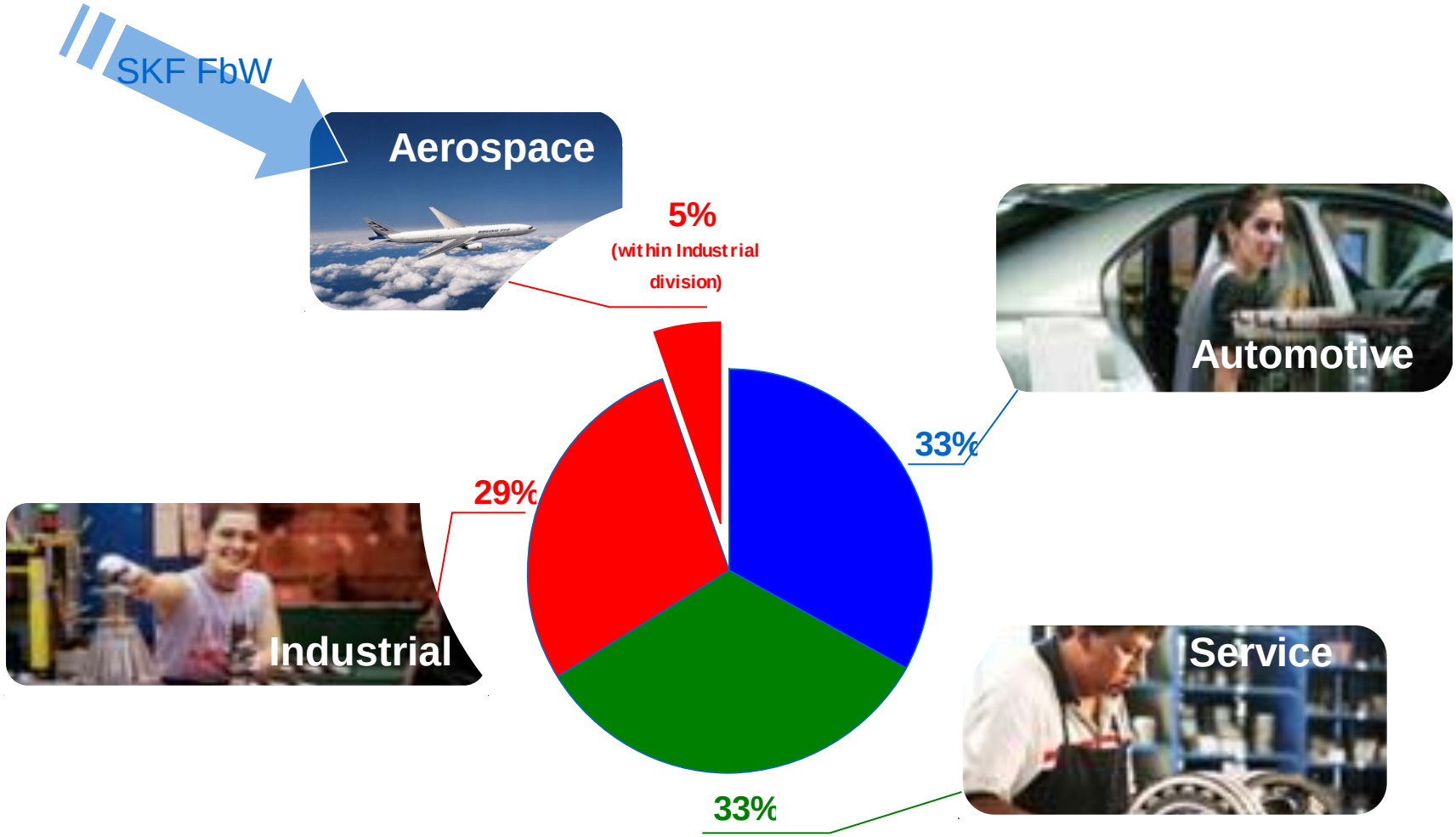
SKF Group Divisions



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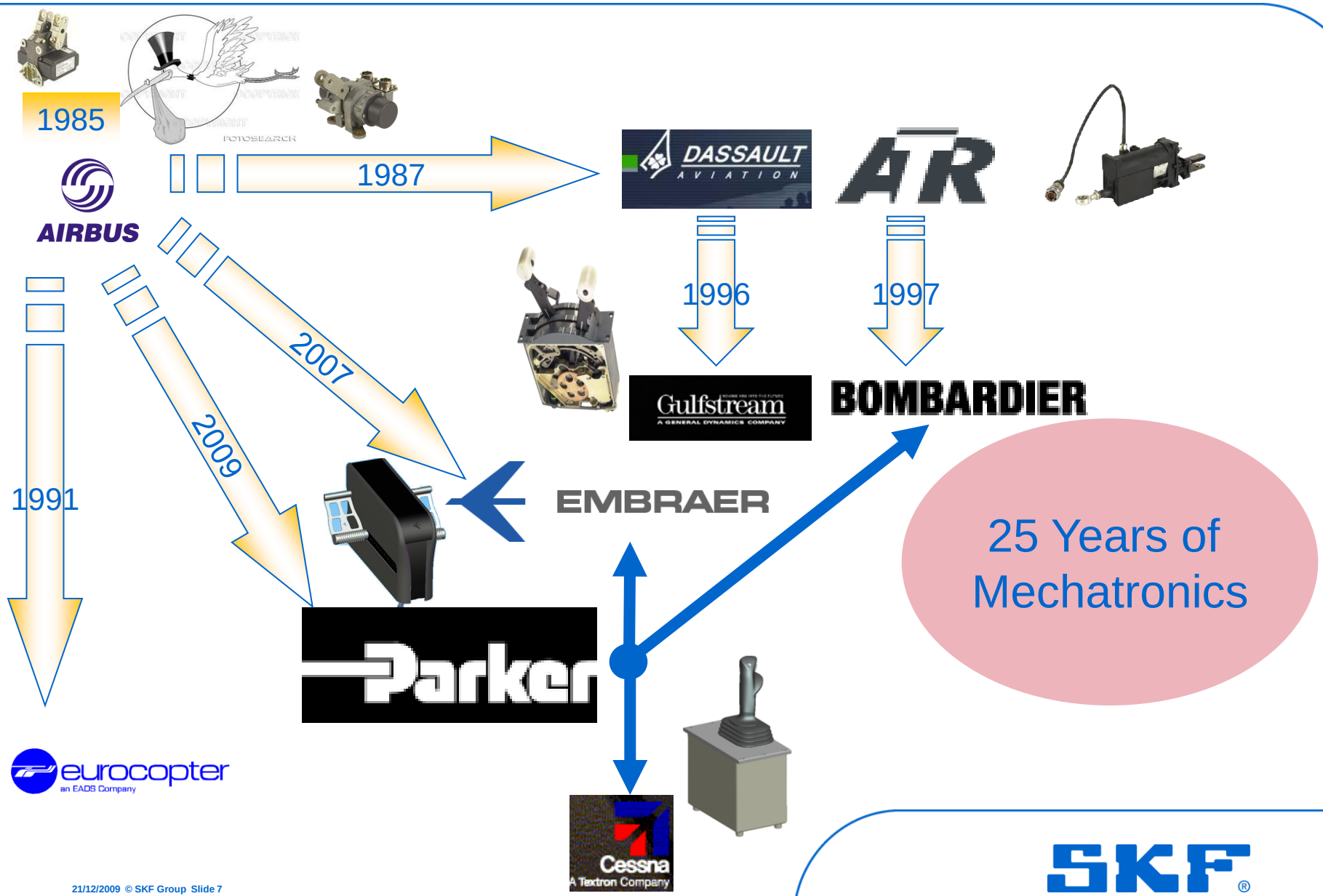
SKF Fly-by-Wire business history



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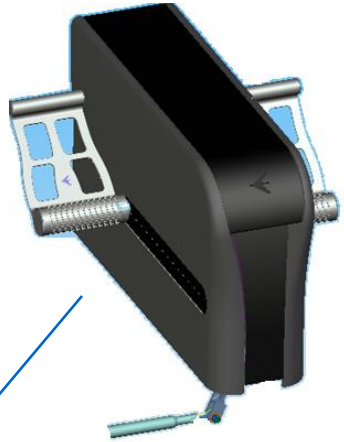
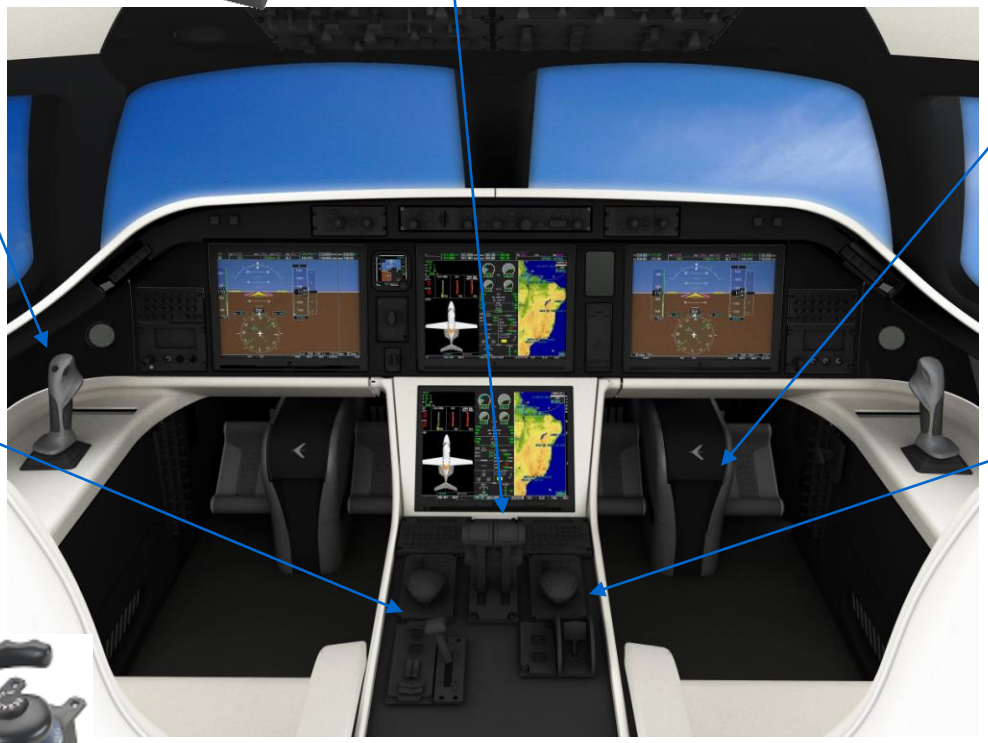
SKF Fly-by-Wire – A global offer

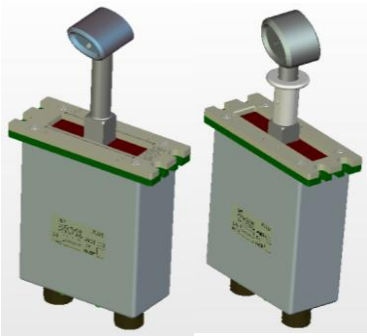
Side Sticks

Thrust Control Unit



Pedal Unit





Flap & Slat Levers

Speed Break

Nose wheel steering

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SKF FbW product technology

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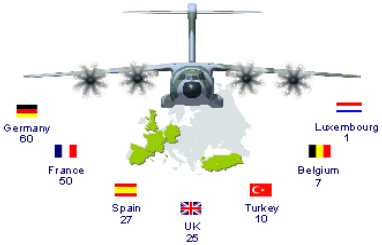
SKF Fly-by-Wire

Functions Integration Cockpit Control

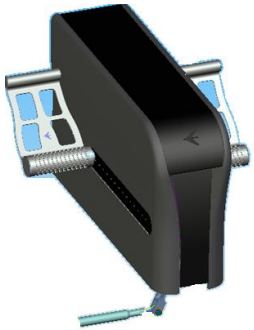


Generic Cockpit units

2009

Airbus A400M

2006



2000

Ergonomics and Electronics

1995

Mechanic integration

Sensors

1985

Fly by Cable

1970

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For Internal Use Only

Product Innovation : Side Stick integrated design

A320 :

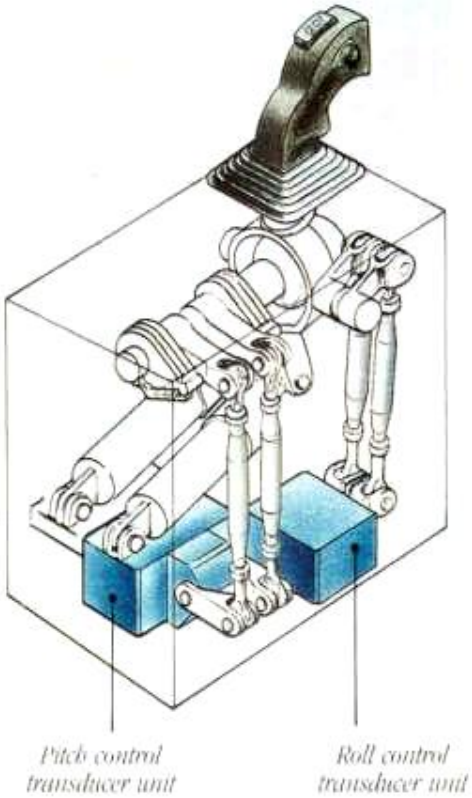
Modular technology

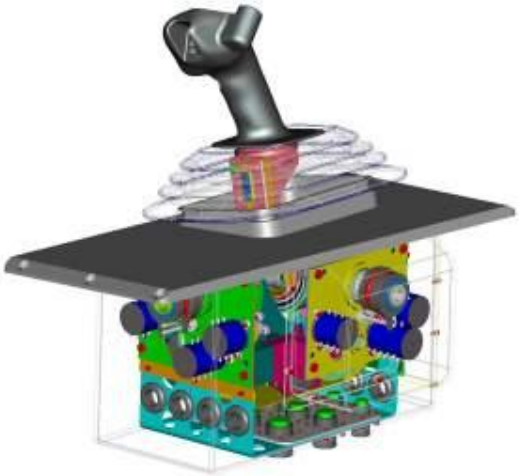
Volume : -60%

Weight : - 40%

A400M :

Integrated technology





SKF

A400M SSU : Description

Mechanical functions

Analogic : sensors & motors

Electronic

Ergonomic feeling :
Handle equipped with switches and tactile motor

Mechanical articulation (pitch & roll direction)

Artificial feeling : torsion springs

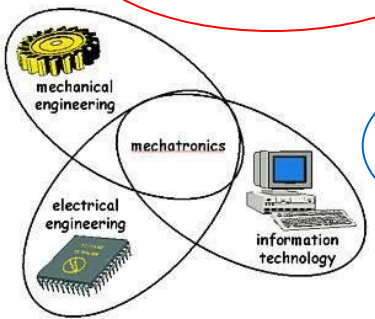
Artificial feeling : traction springs

Damping feeling : Electronic board

Angular position : Potentiometers

Damping feeling : Motors

Torque transmission : Gears



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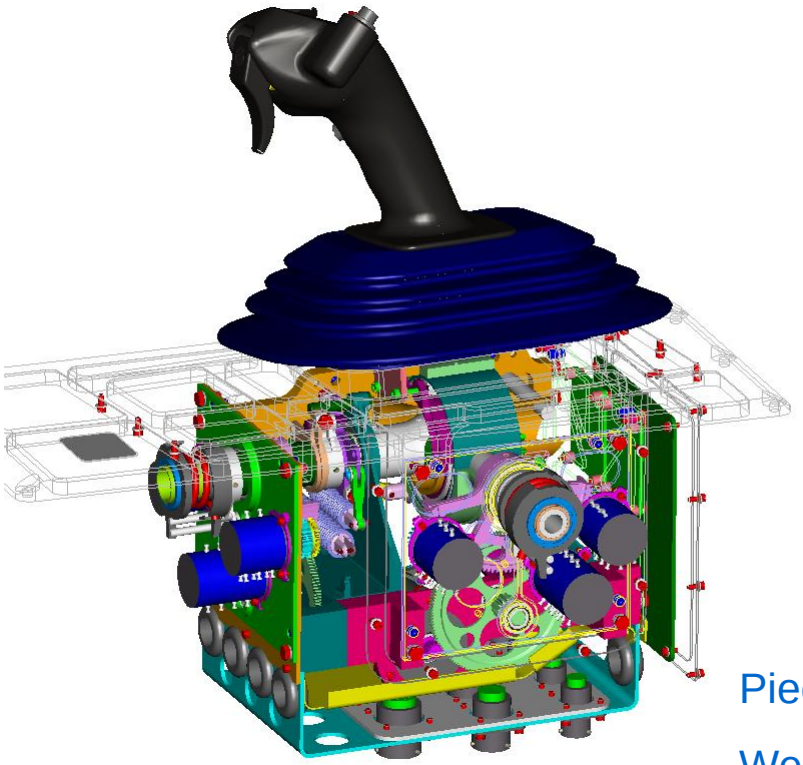
Design to cost : operational application

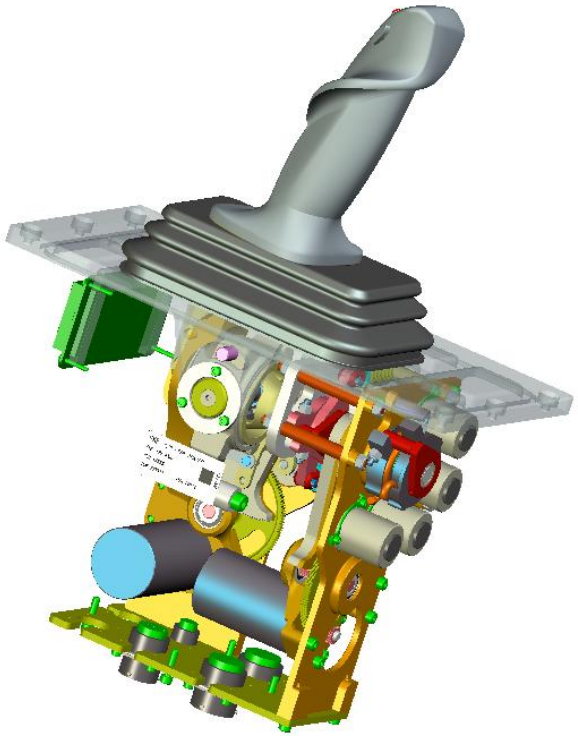
SSU A400M



Sub/Functions

- segregation
- optimization
- standardisation

SSC Embraer



Piece part qtty : ½

Weight & volume : -15%

Unit cost : -50%

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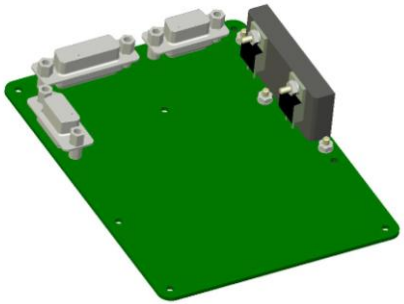
Product development : Partnership strategy

To delegate design authority to S/Functions suppliers

- Risk sharing
- Innovation on components
- Technology benchmark
- Design cost sharing



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3

SKF FbW product development processus

R&D Department organisation

Product Introduction Management Processus (PIM) :

1) Matricidal platform organization

2) Multi-project Group

3) Iterative development processus

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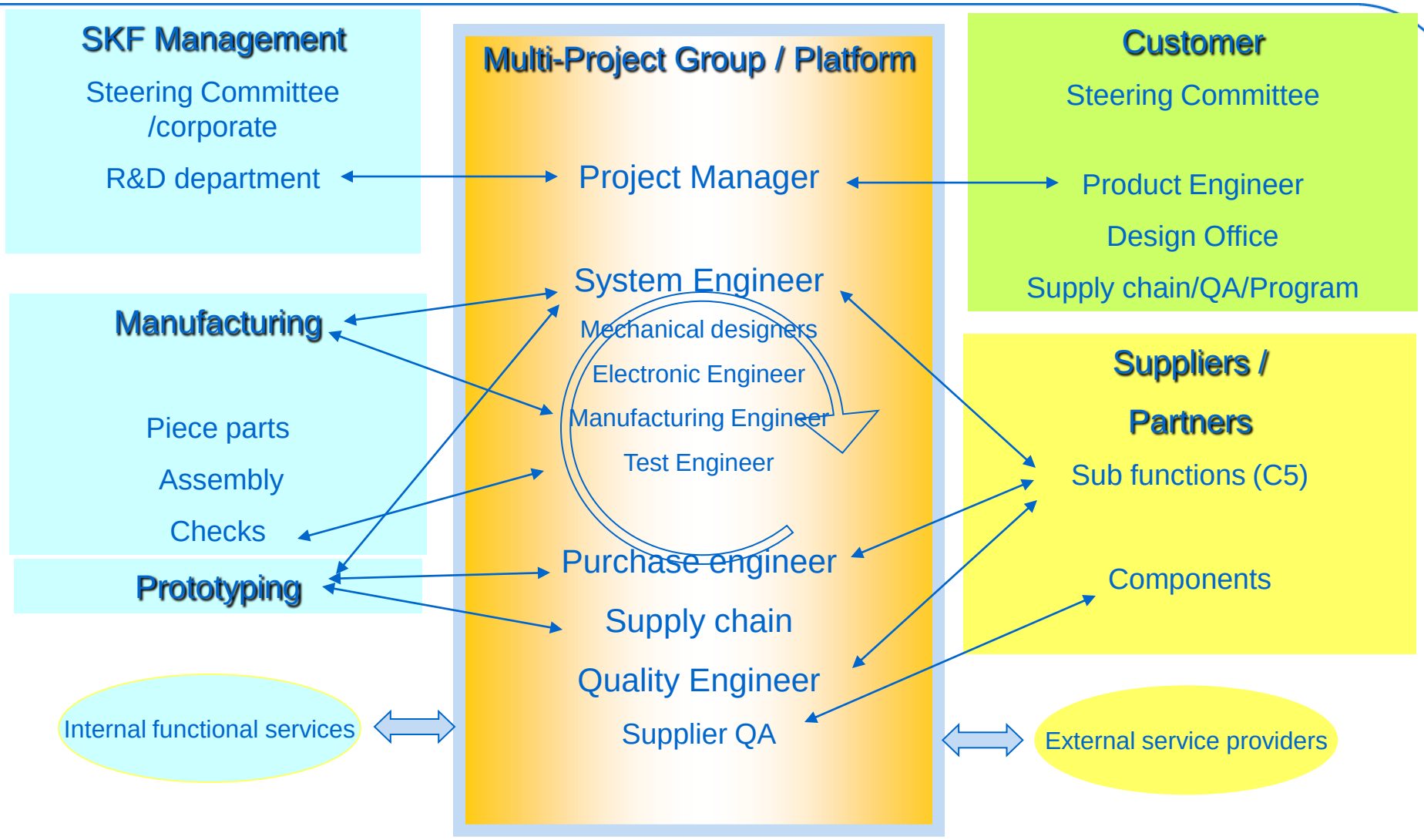
R&D Department organisation



team organization :

Matricidal organization incuding R&D department + Engineering / QA / purchasing & supply chain resources in a dedicated workshop

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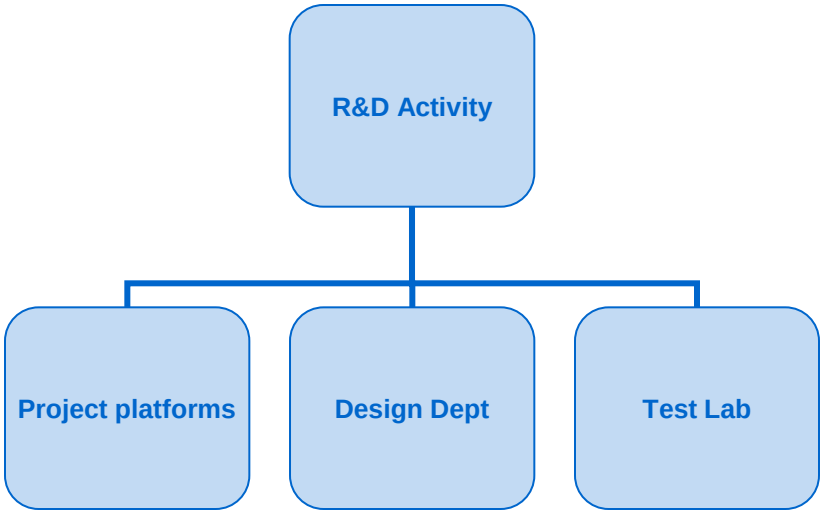
R&D Department organisation



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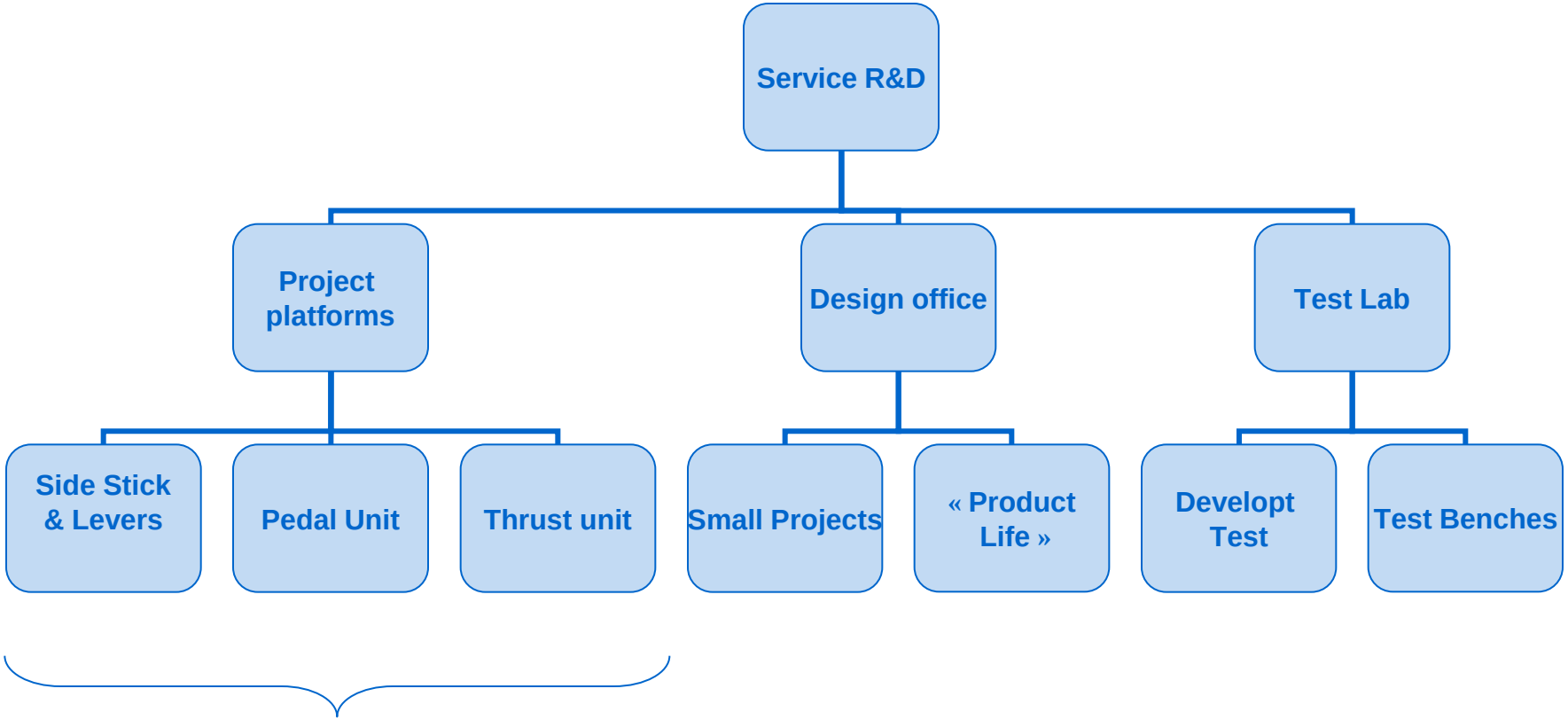
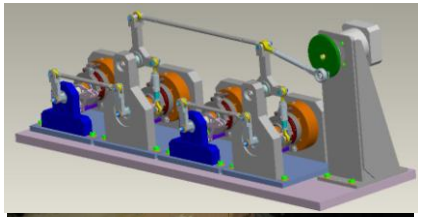
R&D Department organisation

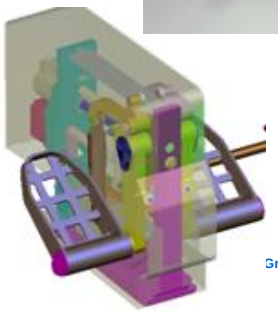


Each dedicated to a product line

Development processus

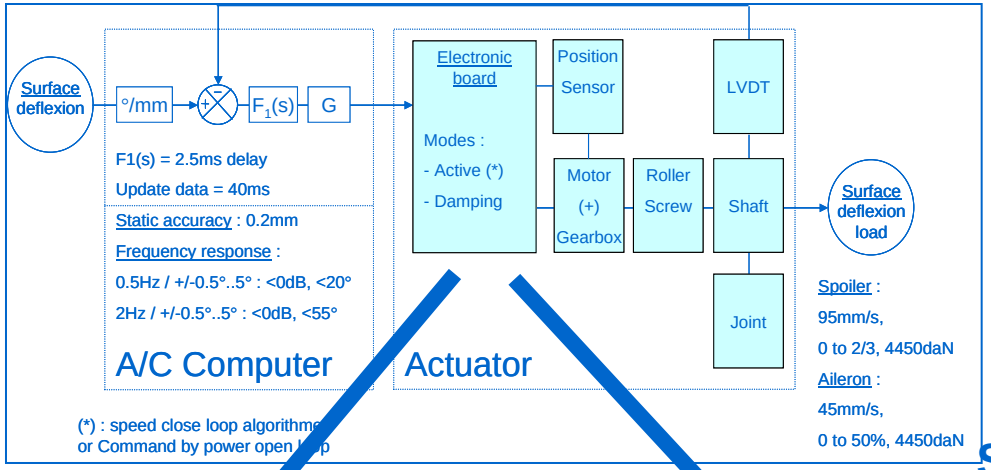
	Offer validation	Architecture validation	Design validation	Industrialisation validation	Capability validation
Phase	**phase 0 : Win business RFP/RFI**	**Phase 1 : Preliminary Design**	**Phase 2 : Design Validation**	**Phase 3 : Product & Process Qualification**	**Phase 4 : Ramp up**
Activity	predesign & quotation technical & financial proposal	preliminary design S/Function evaluation (moke up)	detailled design (DDR) design Validation (prototypes)	Industrialization Qualification test	Ramp-up
Main Documents	DT, DJD, PMP quotation	DD - DJD Mnfg flow charts	DD - VTP/R Mnfg file	DD - DFC - QTP/R - ATP validated Mnfg process serial Reccurng Cost	validated PAQA plan Cost validation
Corresponding review	→ **KoM**	→ **PDR**	→ **CDR**	→ **QPPR**	→ **PER**



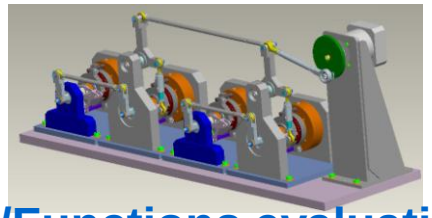


Product Development Processus : phase 1

Modelisation (matlab / simulink)

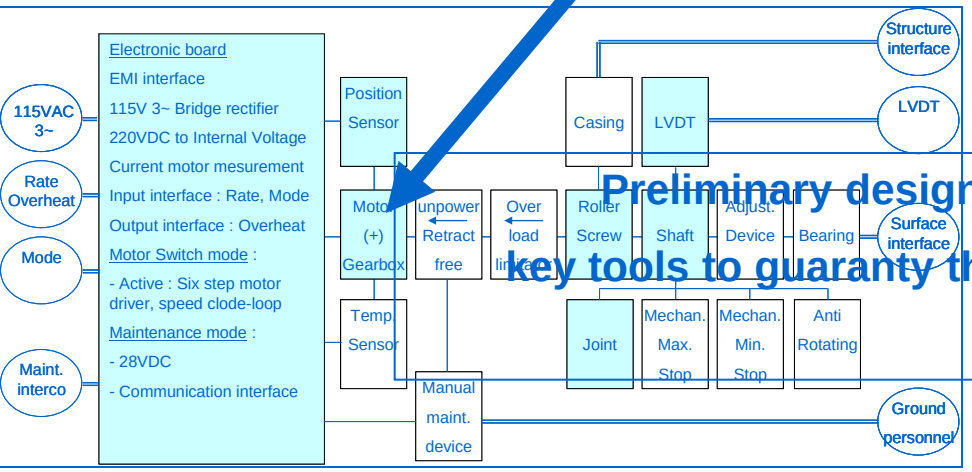


Reliability Analysis (FMEA Safety)

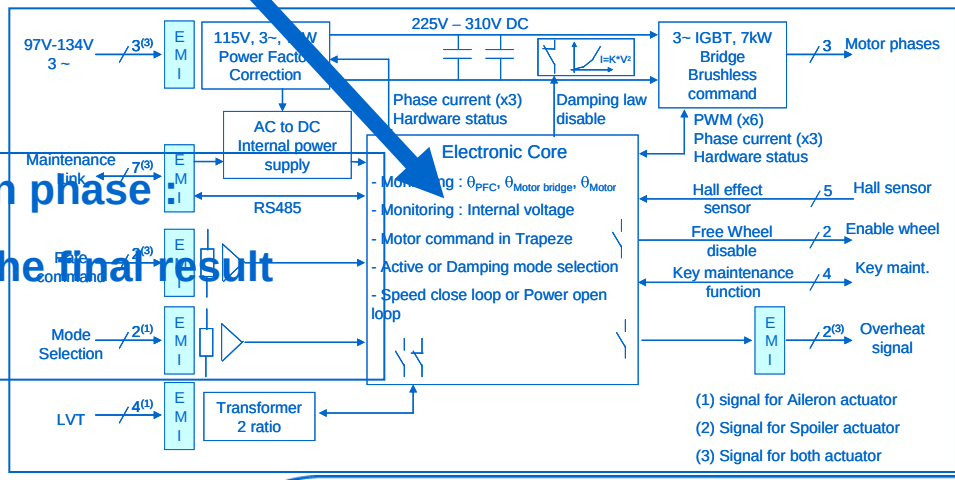


S/Functions evaluation

Product architecture



Electronic architecture



Preliminary design phase

key tools to guaranty the final result

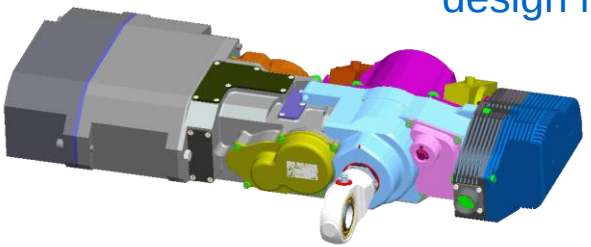
Validated architecture ⇨ **PDR Milestone**

Product Development Processus : phase 2

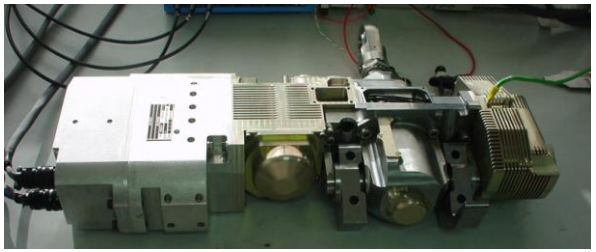
Detailled Design

Design Validation

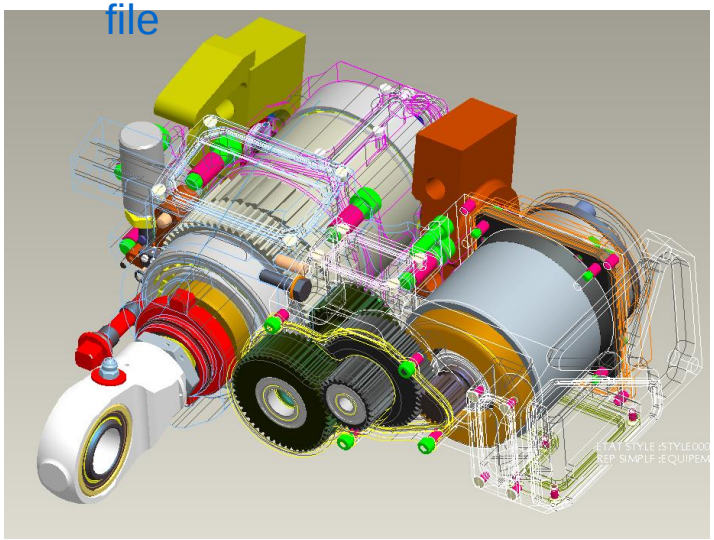
design file



Representative prototype



Justification file



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Mnfg file

Pre-Qual sequence

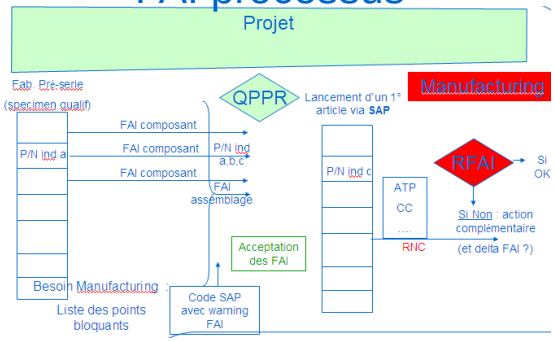
Validated design → **CDR Milestone**

Product Development Processus : phase 3

Process qualification

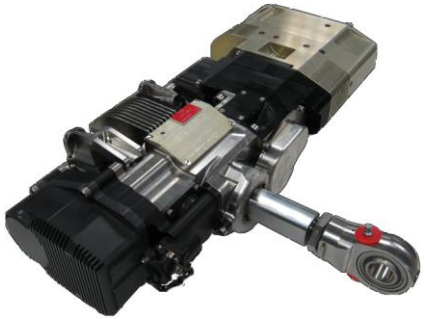
Mnfg means

Supply Chain / FAI processus



Product qualification

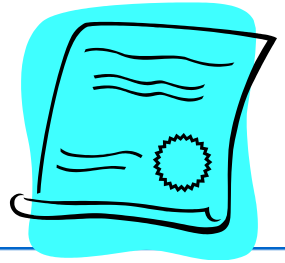
Pre-series Mnfg



Qualification sequences

DDP First Flight

DDP/TC→EASA form1



qualified process/ design → **QPPR Milestone**

Innovation management- Aerospace drivers

R&D cost > 60 ship sets

Re-engineering in case of performances degradation

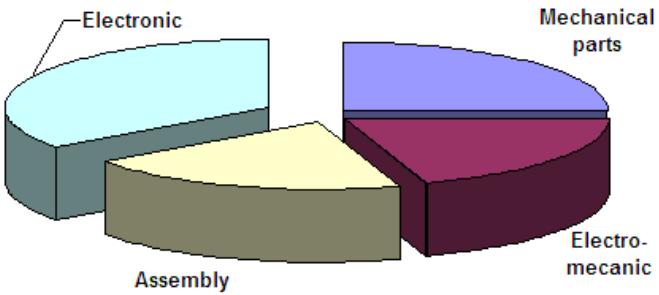
Payback > 7 years

Practice in the field > 20 years

Electronic importance evolution

Increase of electronic share in cost :

In Reccuring cost



+ + + in

Non Recurring Cost

Increase of electronic impact in development process :

→ DO254 implementation

Flight Control System ↔ Cockpit Control Sub-system ↔ Electronic LRU

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Conclusion

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SKF FbW market segment

SURFACE MOTION

AIRCRAFT MONITORING

sensors

FLIGHT CONTROL

Computer software

COCKPIT CONTROL

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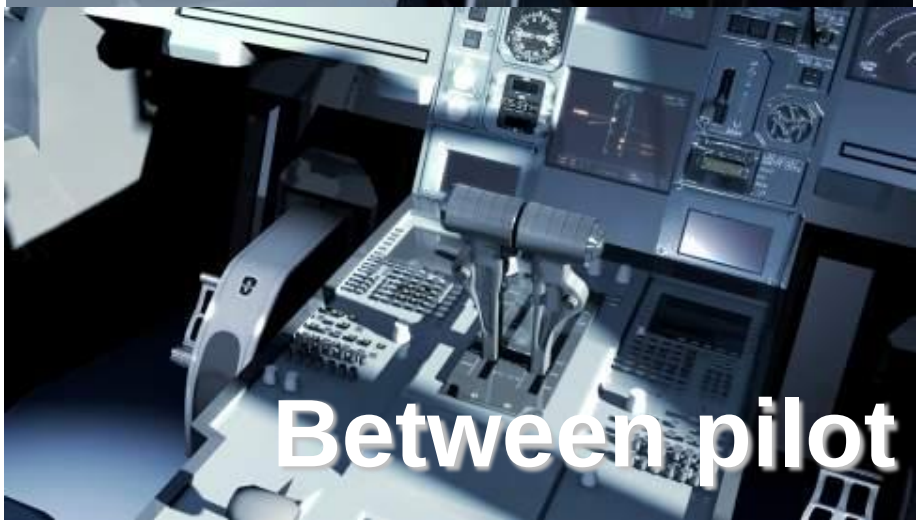
SKF Fly-by-Wire

Integrated Pilot Control Units



SKF COCKPIT CONTROL OFFER

Between pilot and computer

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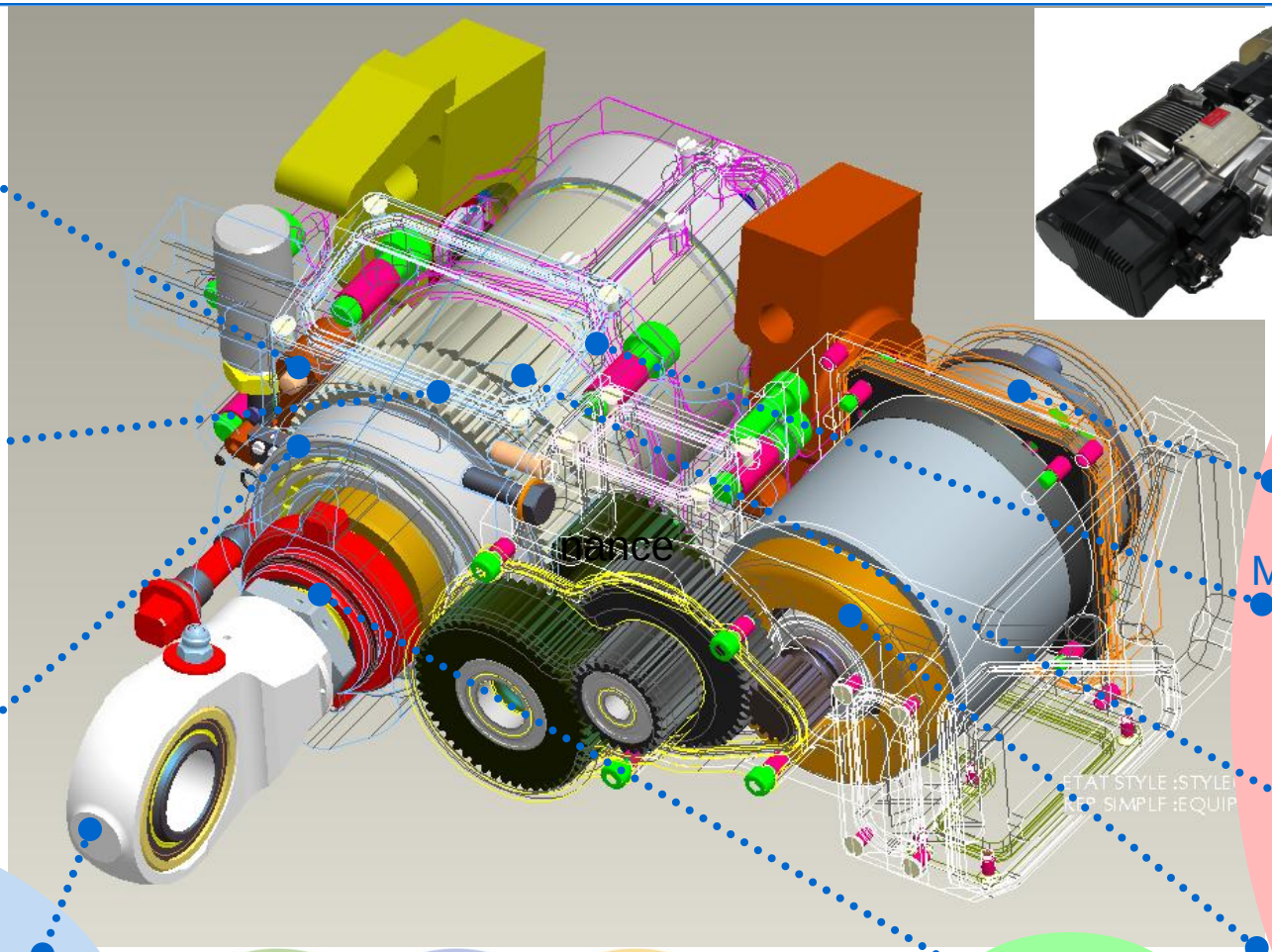
Alternative opportunity : SKF technology cluster and the EMA

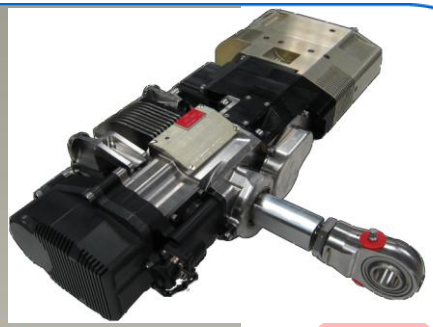
Health monitoring & Maintenance

Life time lubrification

SKF bearing

SKF-Lons roller bearing





Power electronic

Electric brake

Magnetic torque limiter

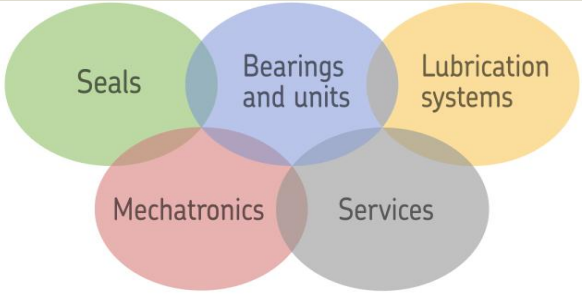
SKF-Transroll roller screw

LVDT

linear sensor

Custom design motor

Seals



More Electric & Fly-by-Wire : a general trend

FbW existing aircraft : Airbus / Boeing / Dassault BJ

→ With prospect for Power by Wire

New incoming in Fly-by-Wire :

Regional jet / Business Jet

→ Embraer / Bombardier

New market for Fly-by-Wire : Helicopter applications

→ actual : assistance / Next gen. : real FbW

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SKF Group Vision

To equip the world with SKF knowledge

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