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Design and Development of Transport Aircraft Systems

RAeS, DGLR, VDI, HAW Hamburg

Collaborative Engineering in Systems Development

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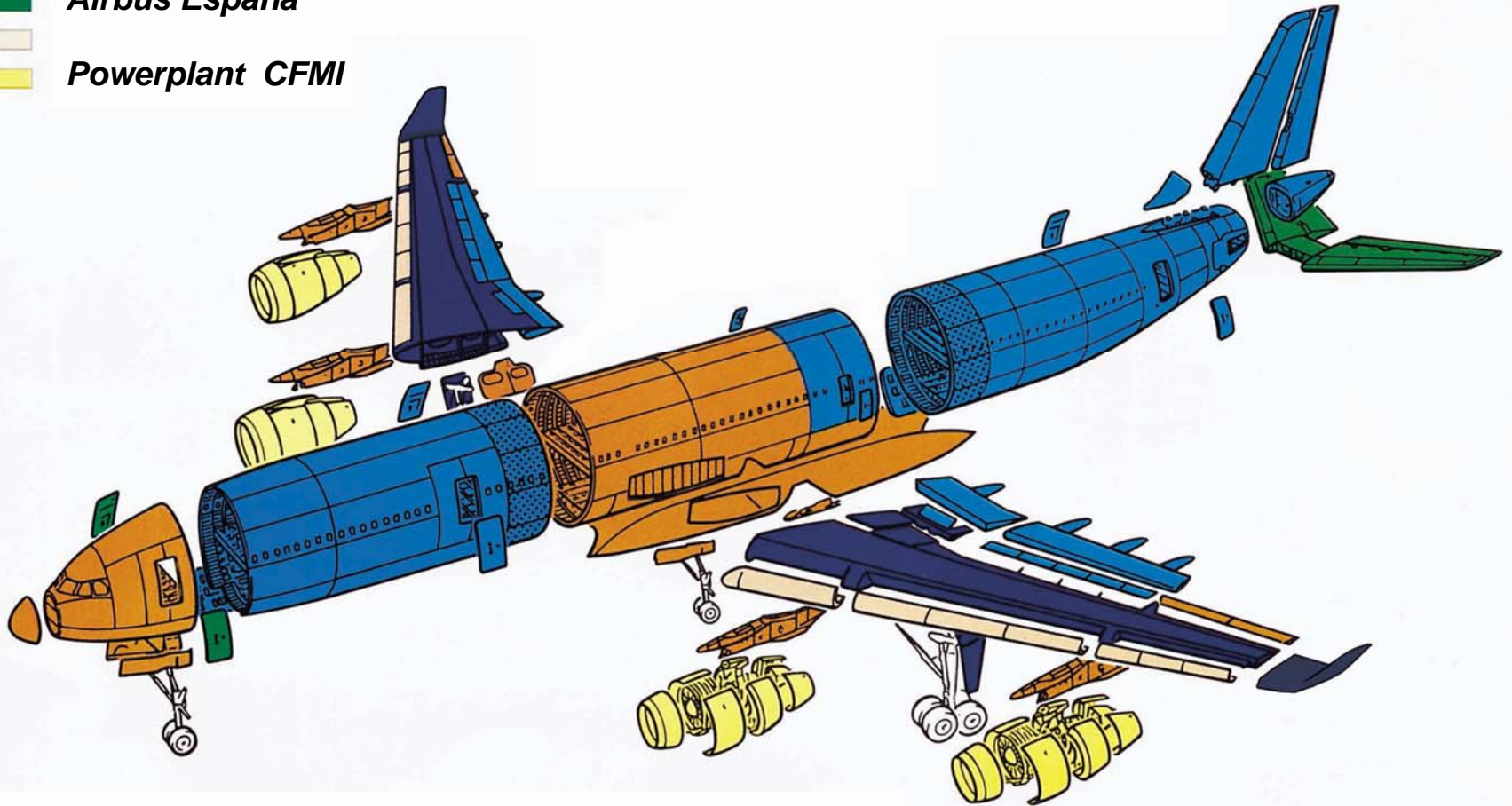
- Objectives and Drivers
- The Systems Development Process and Collaborative Engineering
- Systems Layout integration
- Validation and Verification
- Configuration management, Change Management
- Methods & Tools for environmental hazard protection
- Collaborative systems engineering across different sites

Objectives and Main Drivers for Syst Development

- **Top Systems Goals (Business Drivers)**
 - ▶ **Safe aircraft**
 - ▶ **Mature, Service-Ready Systems, meet customer expectations**
 - ▶ **100% Mission Available Systems**
 - ▶ **A/C operation under all conditions**
 - ▶ **Low cost of Ownership Systems**
- Ensure integration with **Airbus Industrial Processes**
 - Take account of full end to end processes:
Development, Definition to individual aircraft for delivery
 - Ensure quality of process and deliverables
- Early involvement of **Suppliers** and their capabilities
- World class **Technologies** and **Capabilities**
- Master **Collaborative Engineering**

Production work sharing A340

-  **Airbus France**
-  **Airbus Deutschland**
-  **Airbus UK**
-  **Airbus España**
-  **Powerplant CFMI**
- 



Systems Complexity

- Higher operational functionality are integration of more functions are leading to **more complex systems** (hardware, software, loadable software, more interfaces)
- **Increasing trend of SIS (Software Intensive Systems)**
- More active and controlled communication between systems
→ **Interface Management**. **Inter-system communication** is rapidly increasing
- The systems organisation is wide spread over different sites and countries
- Earlier and more intense **Systems Suppliers** involvement.

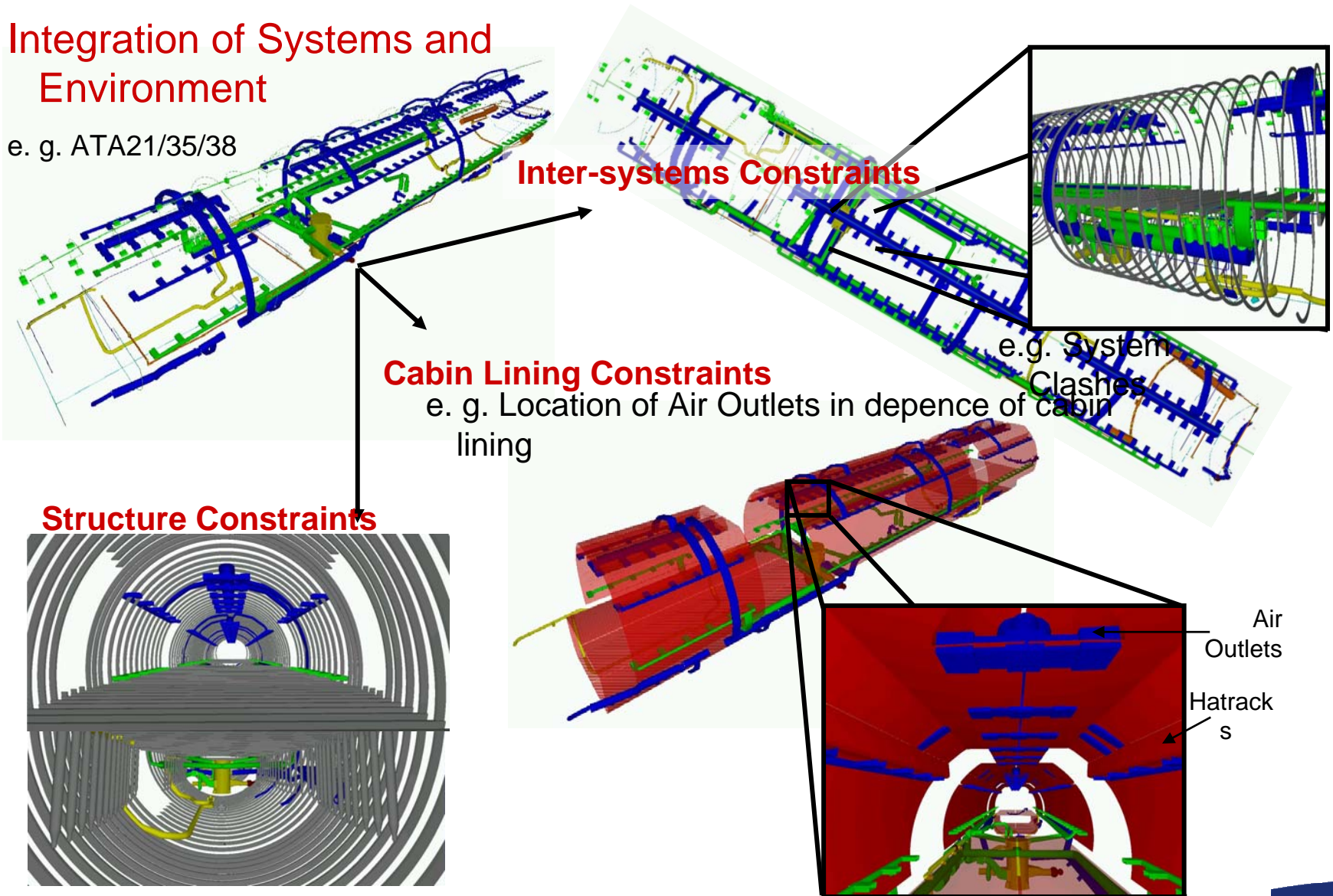
As a consequence: Need to adapt **processes** and **way of working** :

- **Structured development process, fully synchronised with the programme**
- **Global view approach (rather than only sum of individual Systems)**
Role of **A/C Systems Architects** having a functional global view a different levels/sub-levels
- **Systems configuration Management** (from upstream phases – concept & definition phases - including, requirements, design, material, and production)
- **Manage complex software** and demonstrate reliability and manageability for certification
- Take account of **Human Factors**

Systems Layout Integration (1)

Integration of Systems and Environment

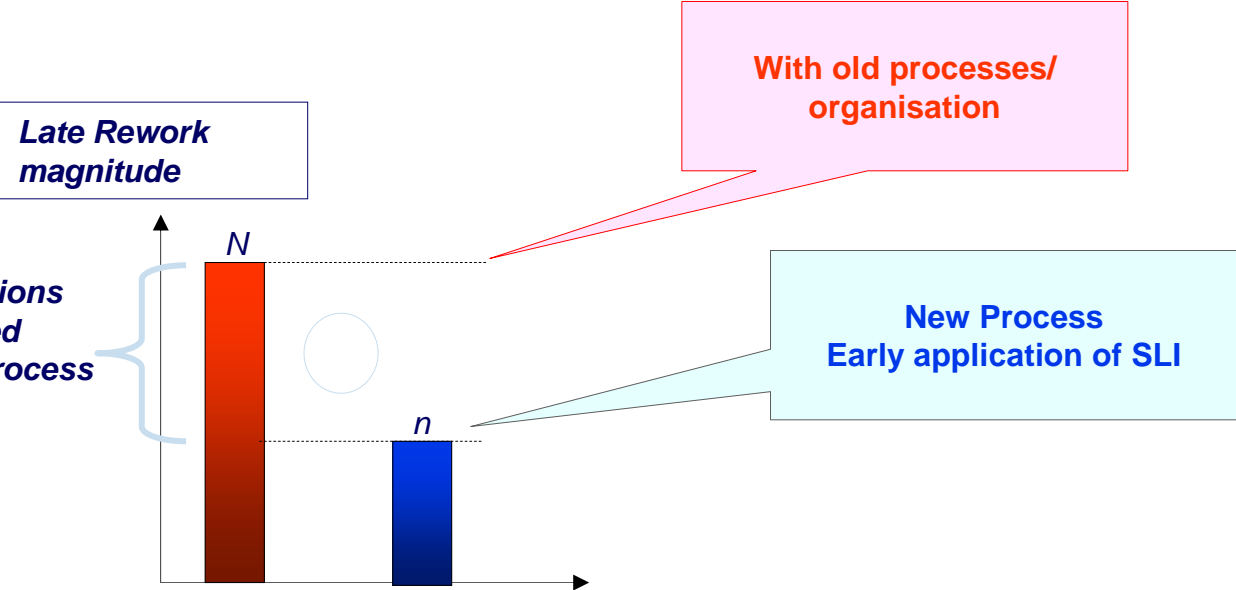
e. g. ATA21/35/38



Systems Layout Integration: Benefits

➔ *Avoid late rework*

➔ *Target the "right first time": System definition maturity*

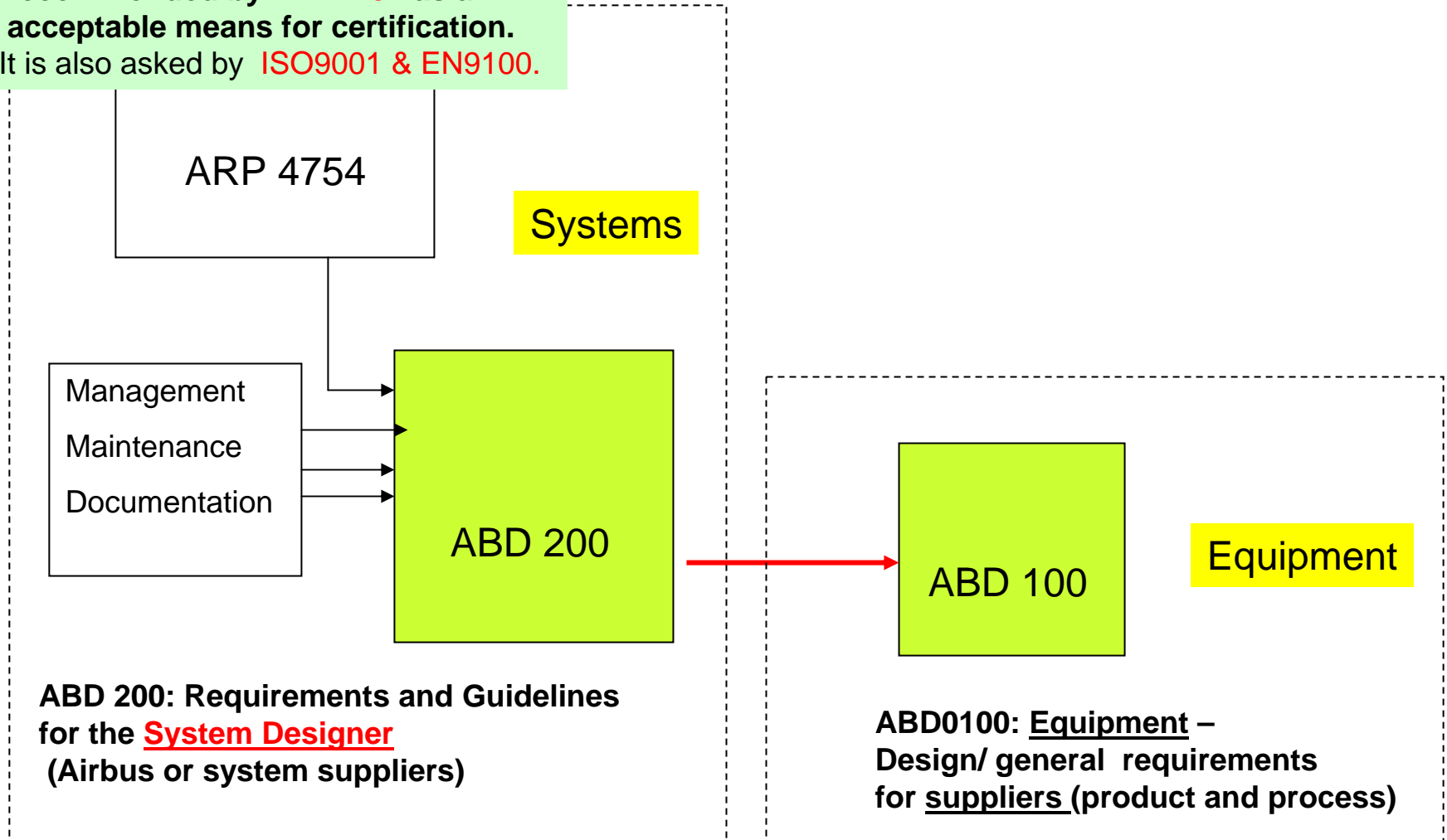


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Structured Development Process and Internat Rules

A structured development process is recommended by **ARP4754** as an acceptable means for certification. It is also asked by **ISO9001 & EN9100**.

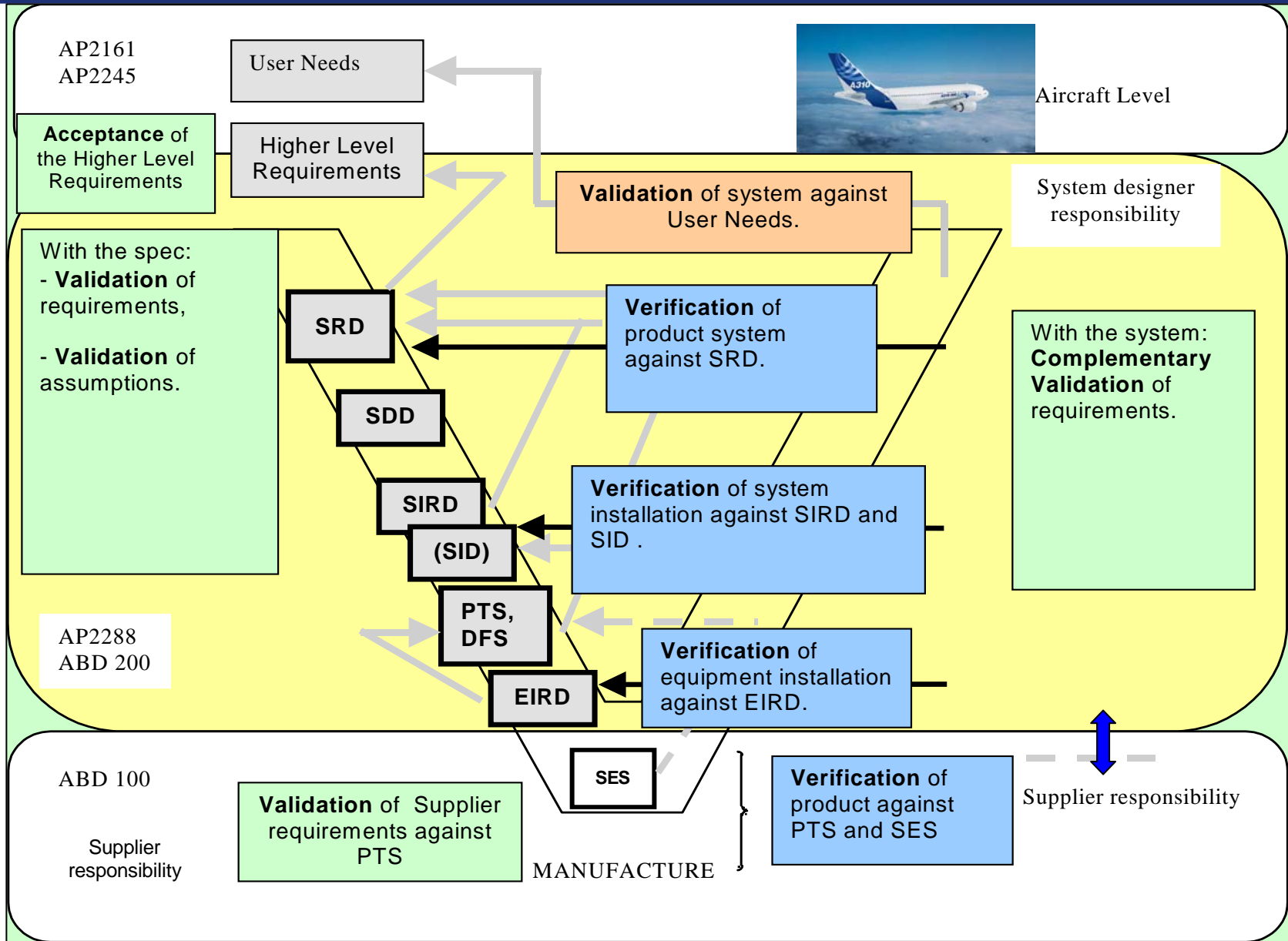


ABD 200: Requirements and Guidelines for the System Designer (Airbus or system suppliers)

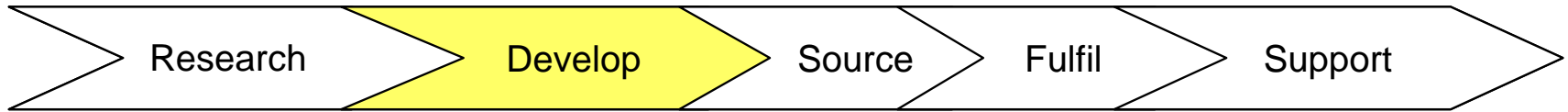
ABD0100: Equipment – Design/ general requirements for suppliers (product and process)

Validation & Verification, Standards

Example



Systems and Integration Tests - Development Process and Standards

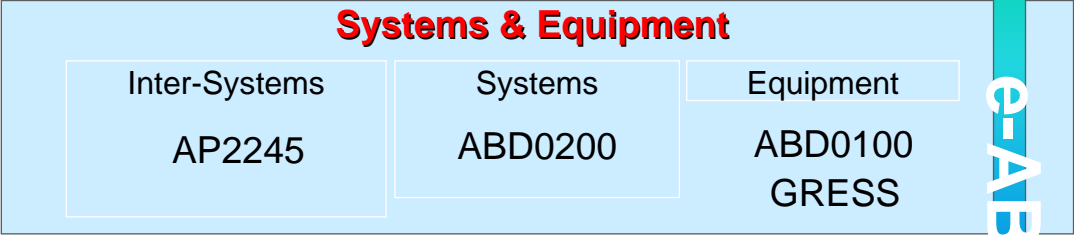


Design Overall a/c

Top Level Aircraft Requirements (TLAR)

Programmes

Overall Systems Procedure
AP2288



EY Engineering

Systems and Equipment Top Level Requirements

PTS

XIRD's



Systems Guidance & Templates
Systems

AM2388

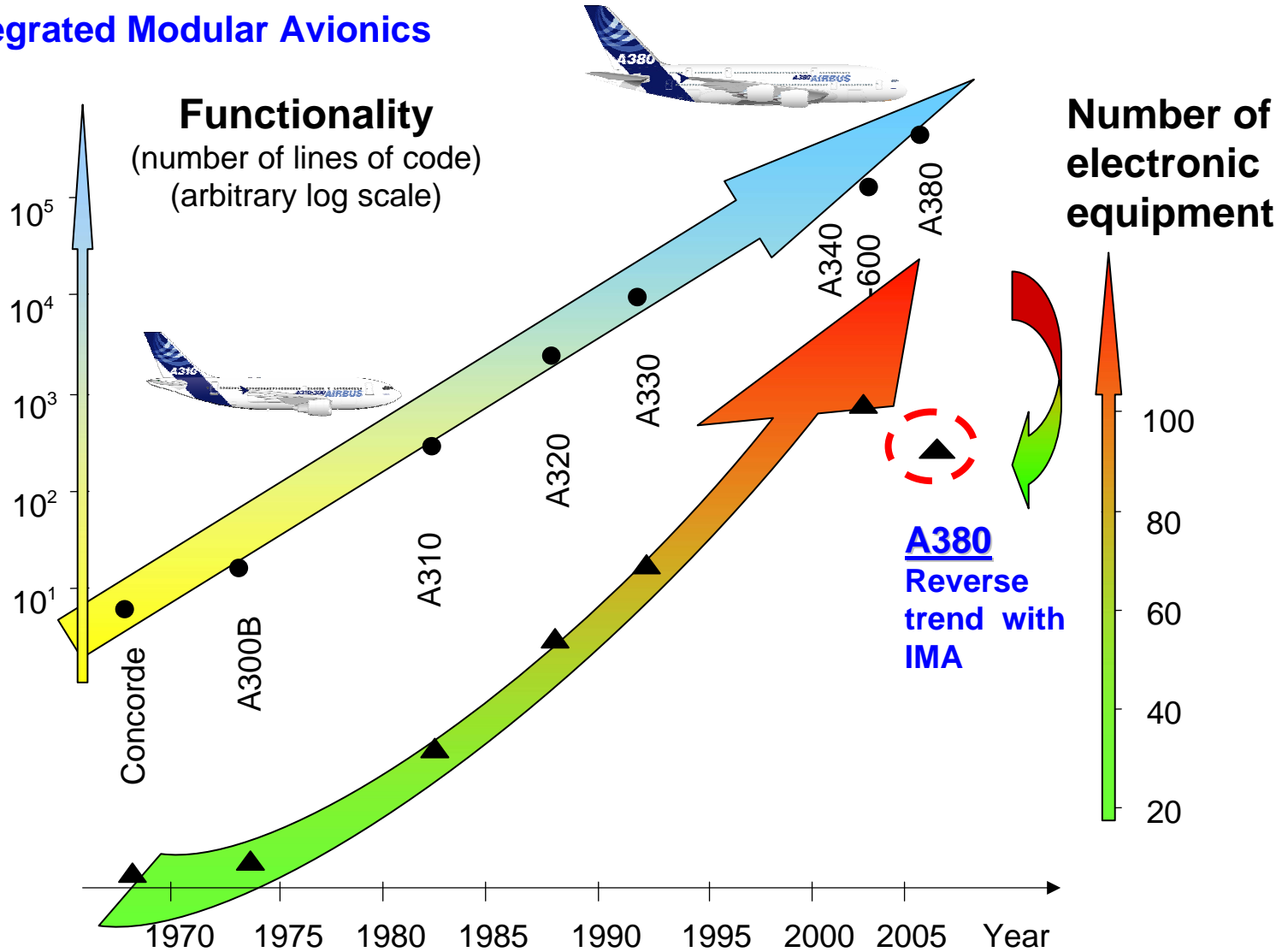


AP1013
GRESS: General Requirements
for Equipment and System
Suppliers

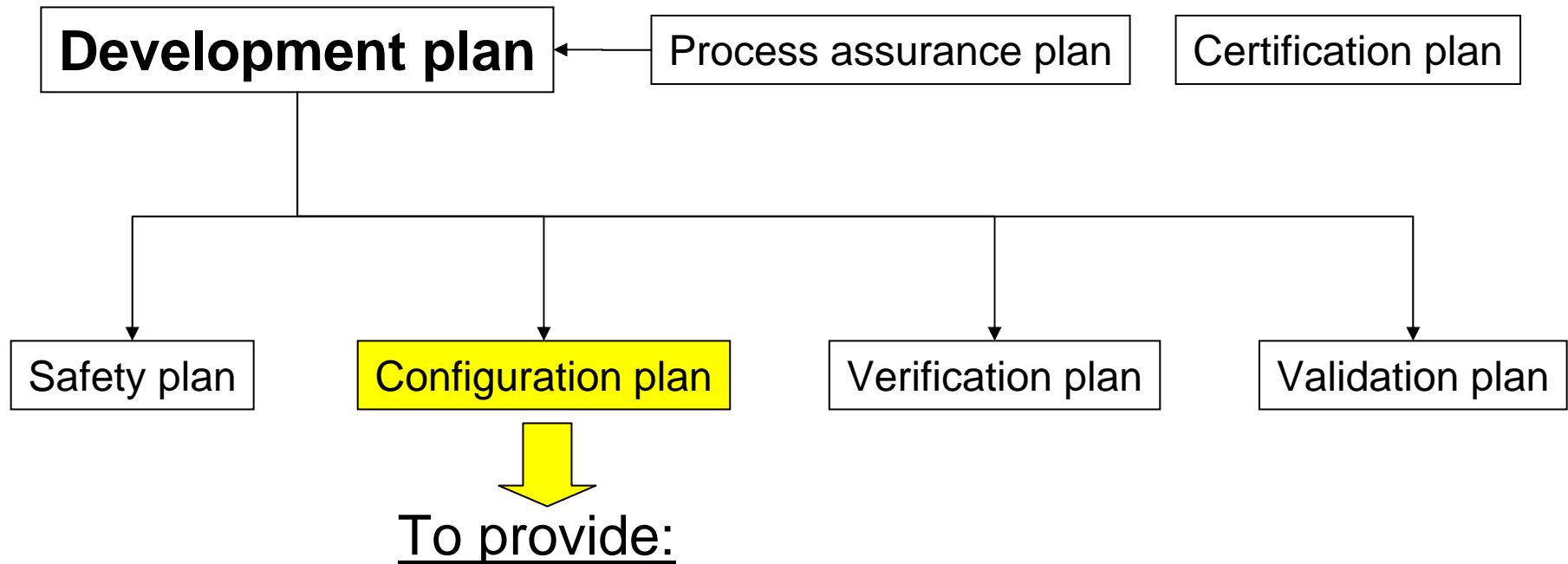


IMA: An illustration of Complexity Management

IMA: Integrated Modular Avionics

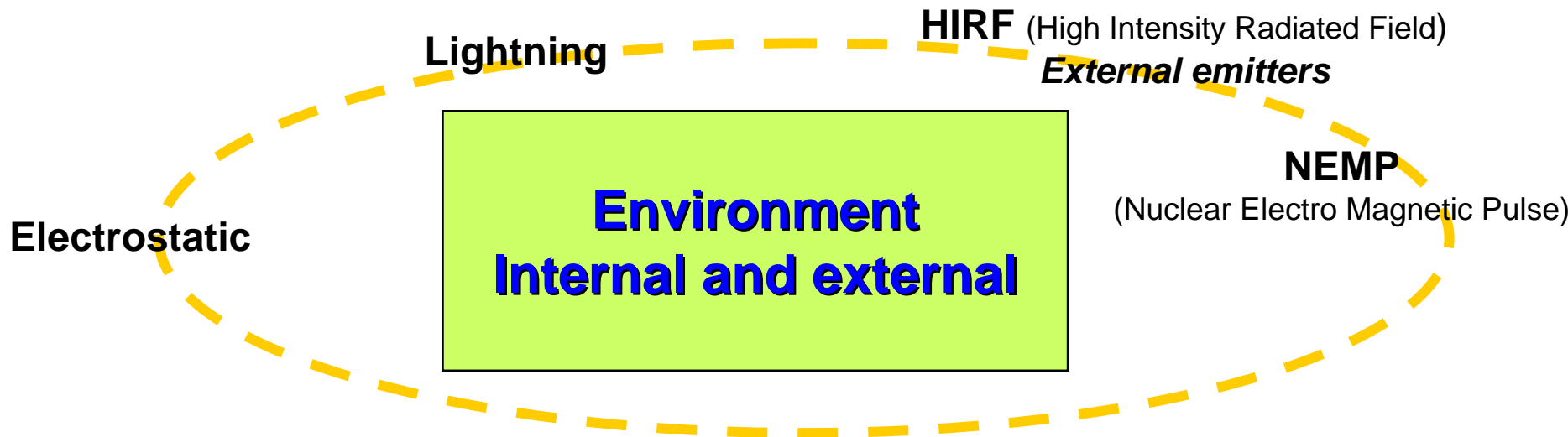


The Configuration Management organisation and deliverables



- To provide:
- Technical and administrative **control of the configuration** of the items to be managed
 - Control of changes** to the items that are managed
 - Identification** rules of the items to be managed
 - Assurance that **archiving** and recovery are maintained
 - Demonstration** that items are **compliant** with their requirements

Background: Environment considered



Internal EMC(Electro Magnetic Compatibility)
Avionics, PED (Portable electronic Device)

Electrical Bonding is the main means to consider this environment.

This has a strong link with the electrical power and signal that use the structure as return current path. Need innovative interdisciplinary solutions for composite structures.

Other environments

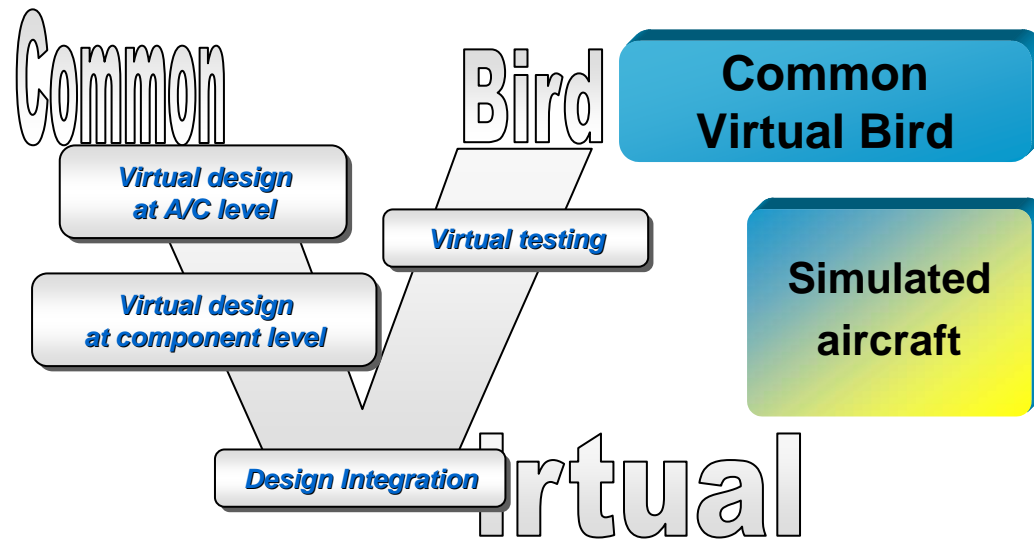
- Cosmic Radiation
- Shocks/ Vibrations/ Acceleration
- Temperature
- Pressure
- Humidity
- Contaminant

Implementation of Collaborative Engineering

- Smart collaborative system engineering for large commercial aircraft engineering requires consideration of **Interaction of complex systems**, and **Integrability of the aircraft** in the full operational spectrum
- Collaborative system engineering must be **Architect driven**, and must enable to support 2 key concepts:
 - ▶ Aircraft Architect
 - ▶ Systems Architect
- Implementation of collaborative system engineering requires thorough consideration of **People and Processes (Human Factors)** aspects
- Roadmaps: to be the result of a **Convergence Process (end-to-end)** between aircraft manufacturer and solutions providers

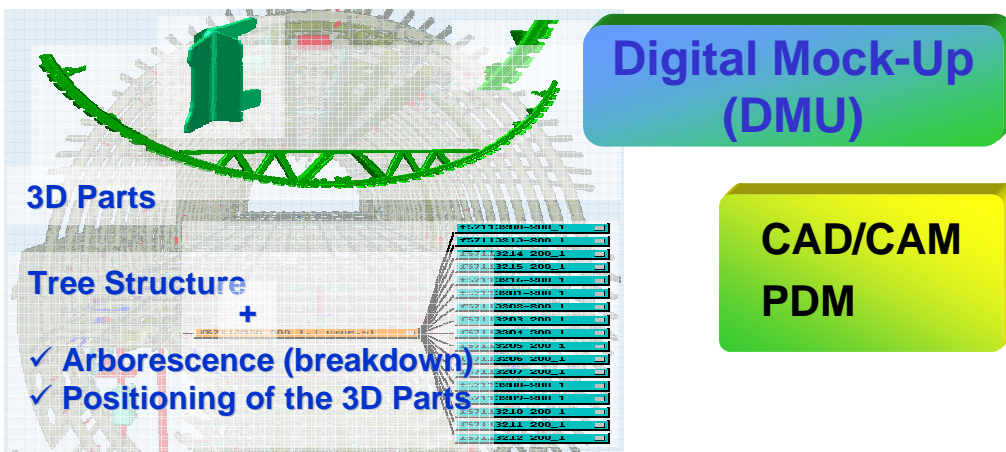
Collaborative System Engineering

Product Model based Capabilities concepts



Product Models:

- Multiview concepts
- Traceability of product information along lifecycle
- Strategies for attributes:
 - Reflect A/C performance oriented design
 - Enables management at the earliest
 - Interactions and autonomy
 - A/C physical behavior
 - Geometry
 - Technology
 - Cost
 - ...



Advanced Product Models for enhanced Architectural Design capability

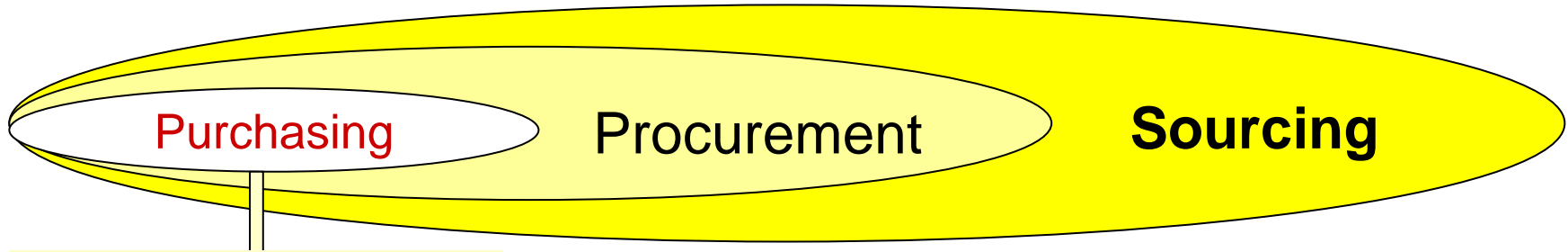
Sourcing : more than Purchasing or Procurement

Common supplier strategy between Procurement, Programme and Engineering

60's - 70's

80's - 90's

00's



Negotiation + Logistics

Integration of internal functions
in a process-oriented approach

**In-depth integration of external sources
in the Supply value chain
with mature Suppliers**

Concluding Remarks

- Focus on complete **aircraft** product as a whole
- Work **interdisciplinary and transnational**
- Early definition and **validation** of systems architecture
- Ensure support for Collaborative Engineering by proven and committed **standards** at company level and compatible with international standards and requirements
- Early identification of **interfaces & risks**. All systems, structures, ..;
- Maintain competence and experience to control as Establish extended enterprise and **Architect and Integrator**