

Discovering PLM – Sector aeronáutico
Madrid, 10 de marzo de 2015

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Madrid – March 2015

PRESENTATION



Short biography

- Fernando MAS (1959) is Industrial Engineer, Ph. D. and Airbus Group Senior Expert in “Advanced Manufacturing Processes Methods & Tools” and “Virtual Product Engineering”.
- He is in charge of the ‘PLM Processes & Tool Solutions Department’ of Airbus Military and he is Associate Professor at the University of Sevilla.
- He and owns patents in the EU and US and is author or co-author of more than 35 research papers in international journals and congress and has act as speaker at several keynotes and conferences.

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OBJECTIVES

- To review the Basic concepts in PLM Methods & Tools for the Aerospace & Defense Industry.
- To know the PLM Methods & Tools used today in Airbus Group: Airbus, Airbus Helicopters and Airbus Defence and Space.
- To have a look to the future trends in PLM Methods & Tools for the Aerospace & Defense Industry and in particular for Airbus Group.

Airbus Group: one Company, three divisions

Airbus Group, an European Company: The first Aerospace Company in the world.
Founded in 2000 by DaimlerChrysler (G), Aerospatiale-Matra (F) and CASA (SP).

Business parameters in 2012

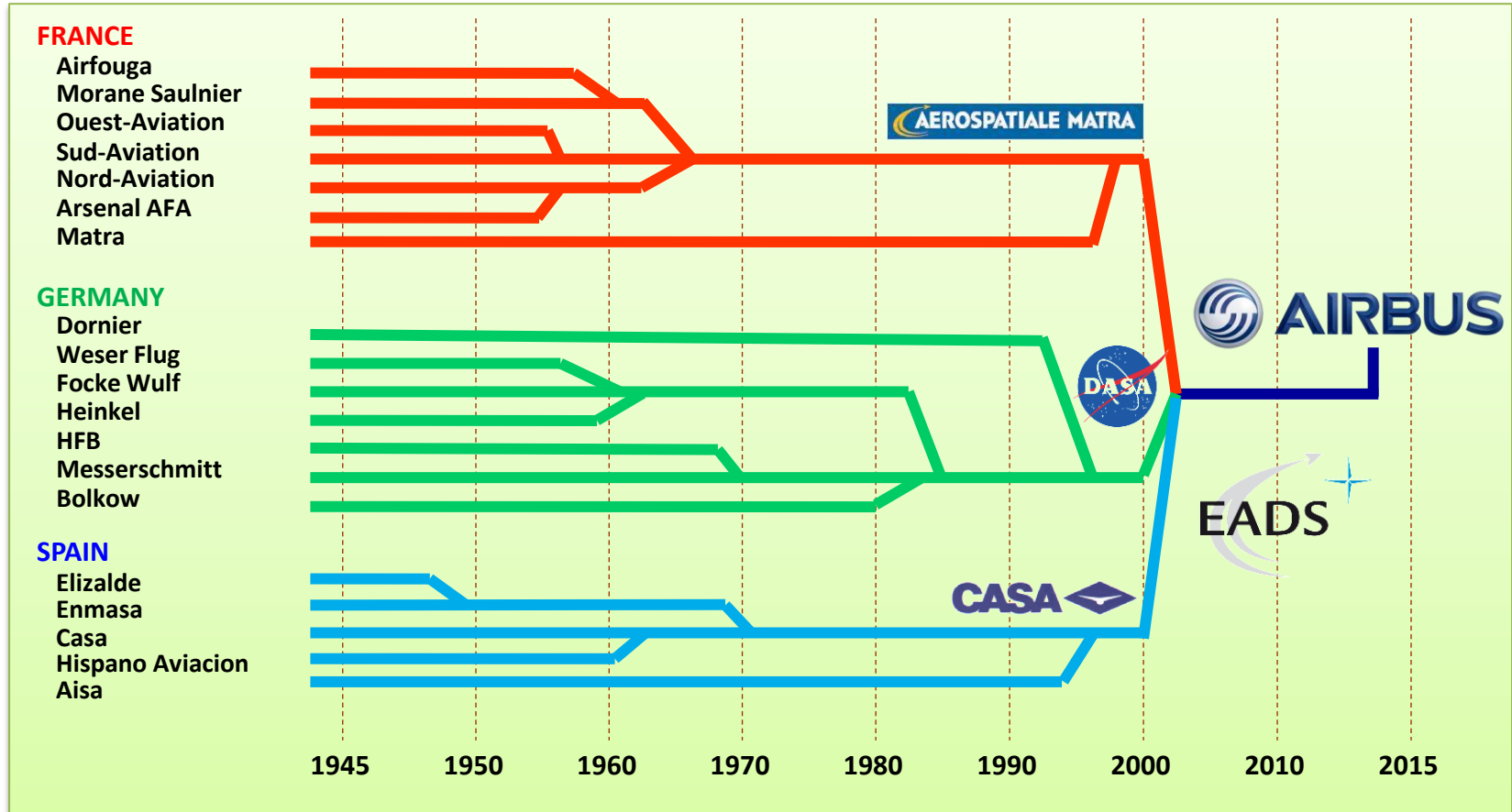
– Order book	566.500 M€
– Aircrafts delivered	700
– EBIT	3.000 M€
– R + D	3.100 M€
– Employees	140.000
– Employees (in Andalucía)	3.000



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

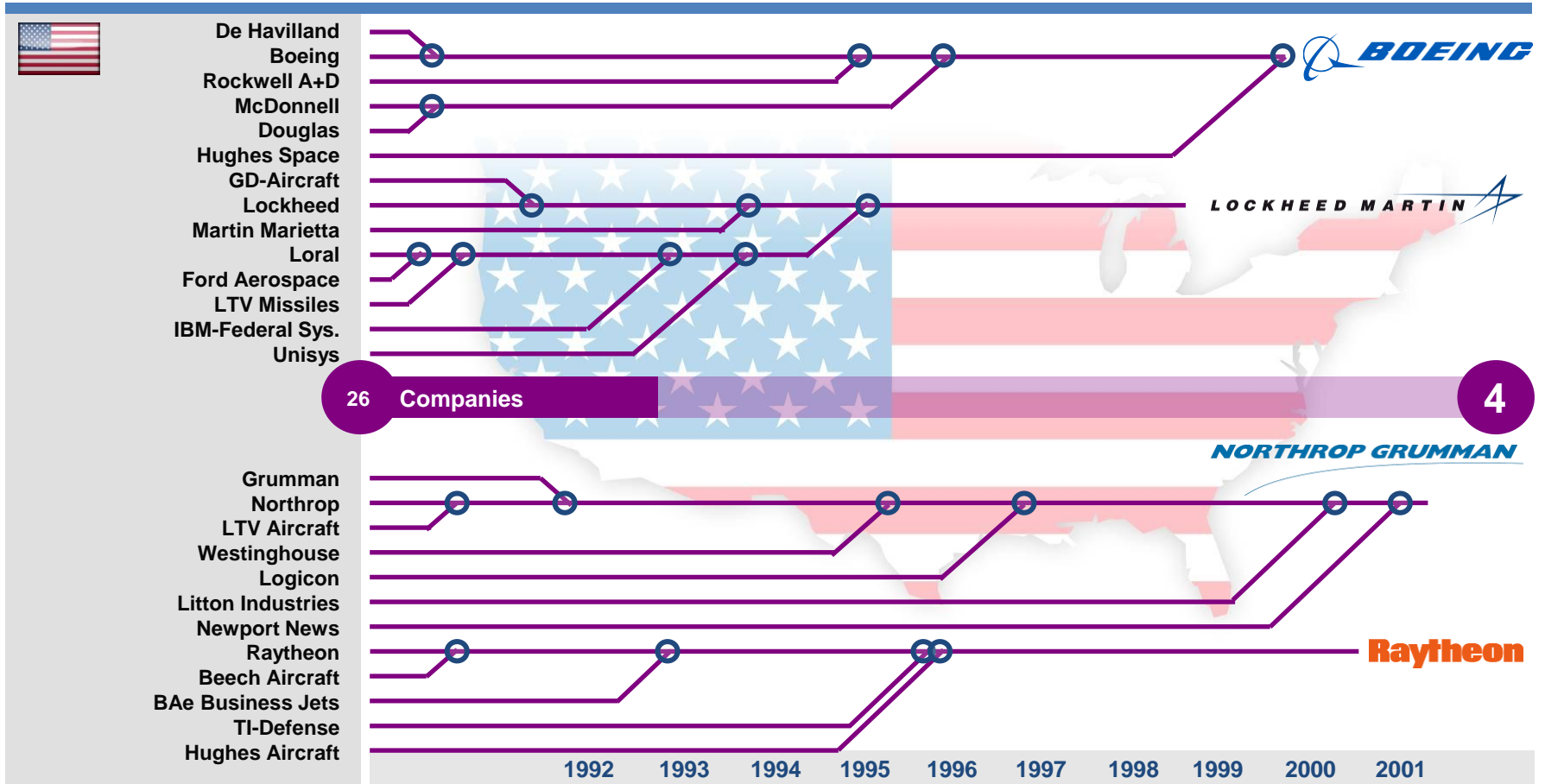
Aerospace industry in Europe: a long history



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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

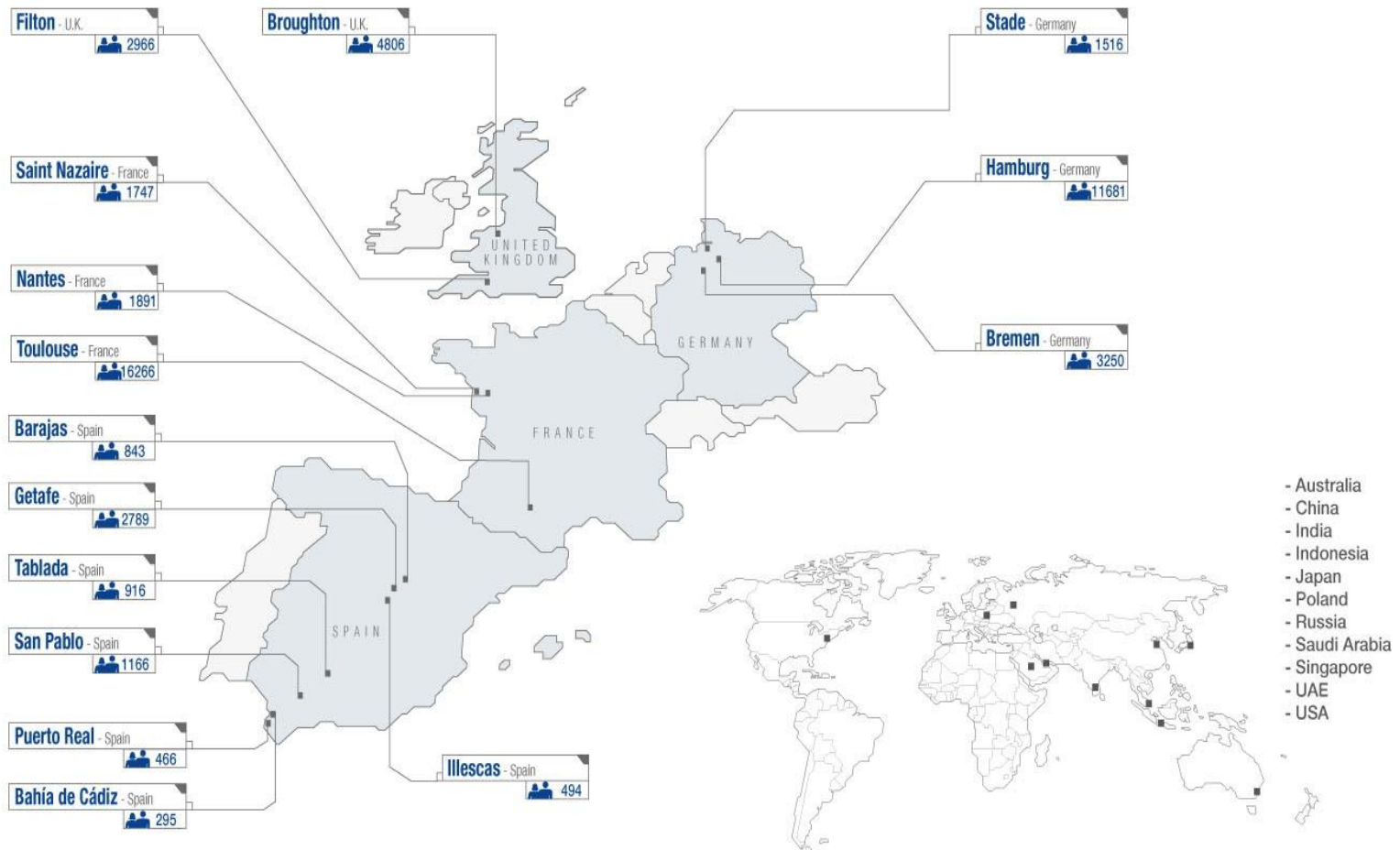
Consolidation in the US



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Airbus in the world



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Airbus in Spain

ILLESCAS



BARAJAS



GETAFE



ALBACETE



PUERTO REAL



CADIZ

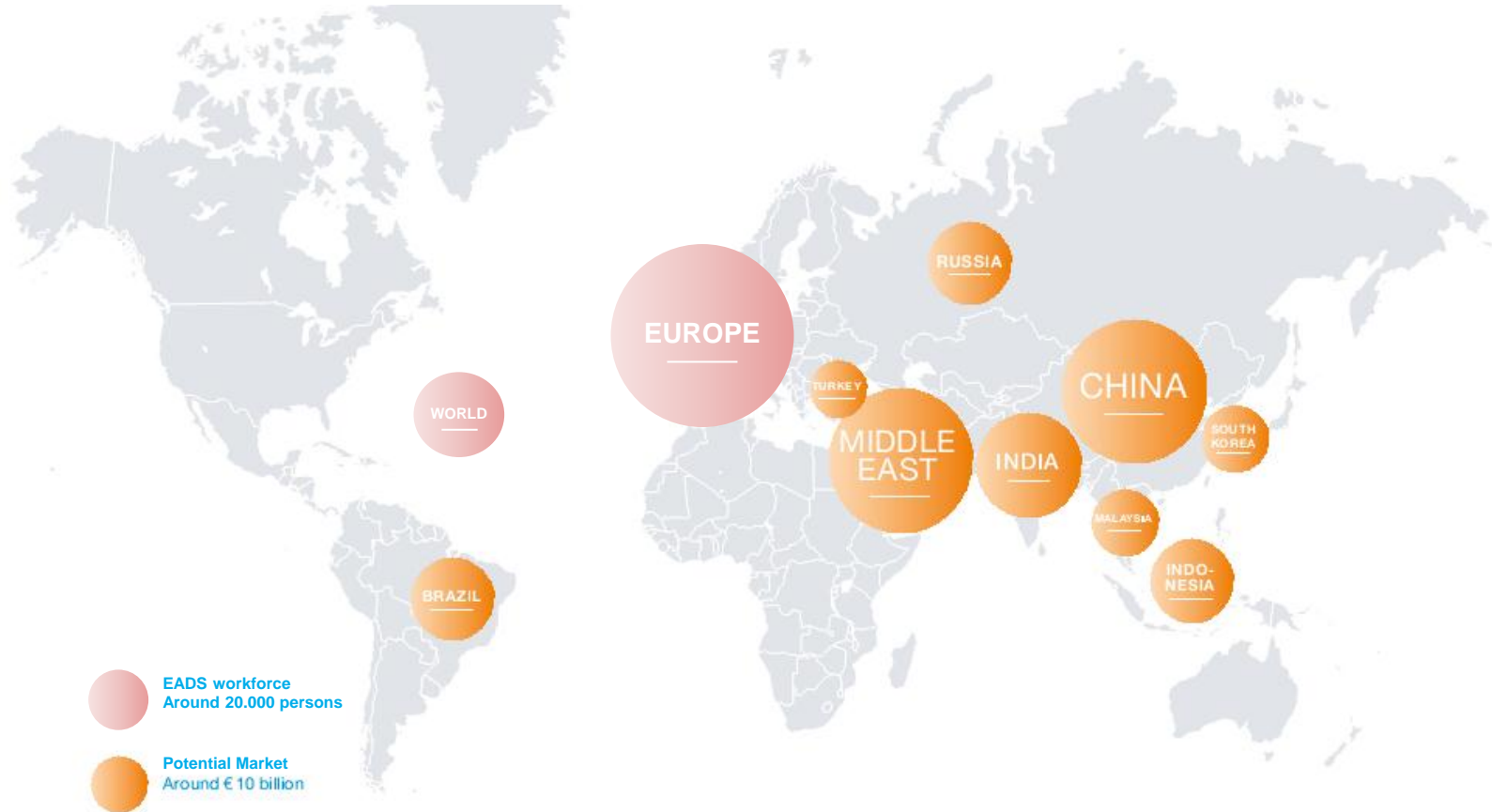


SAN PABLO (Norte y Sur)



TABLADA

Market and Employ

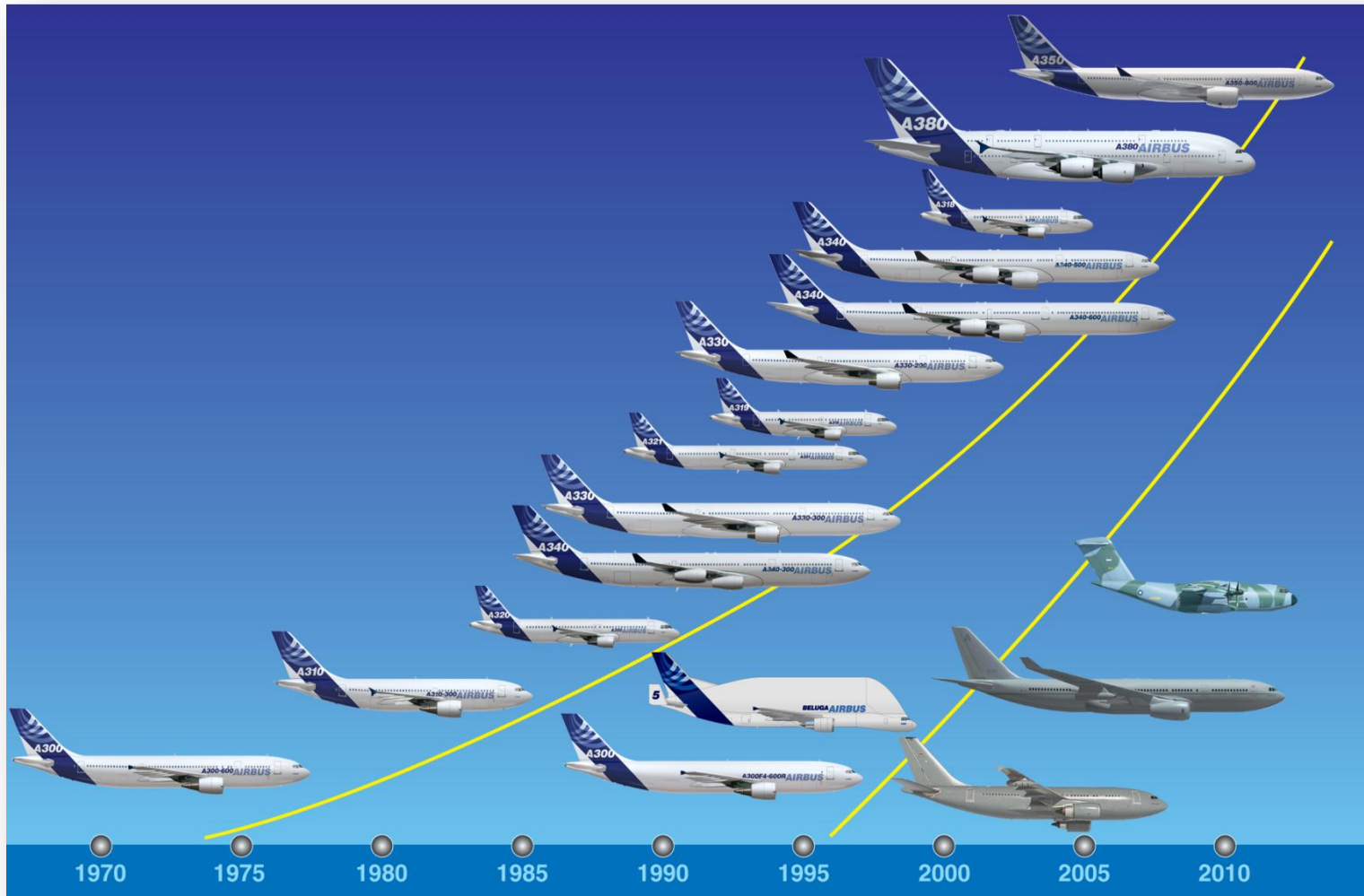


Based on Airbus Global Market Forecast 2011-2030 and internal estimates


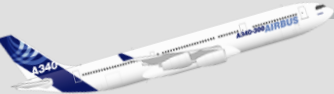

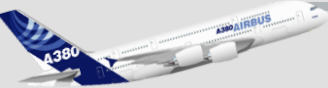


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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Airbus Commercial and Defense Aircrafts



AIRBUS. Orders and deliveries

	Total orders	Total deliveries	In operation
Total	10,057	6,581	6,263
 A320-Family	6,939	4,582	4,496
 A330/A340-Family	1,487	1,140	1,129
 A350-Family	571	0	0
 A380-Family	244	43	43
 A300/310-Family	816	816	595
 Executive & Private jets	175	124	149

Airbus Military Aircraft



C-212
(480 aviones)

- 3 Tm. de carga.
- 2 Pallets



CN-235
(250 aviones)

- 6 Tm. de carga.
- 4 Pallets



C-295
(72 aviones)

- 9 Tm. de carga.
- 5 Pallets



A400M
(192 aviones)

- 32 Tm. de carga.
- 9 Pallets



A330 MRTT
(32 aviones)

- 45 Tm. de carga.
- 139.000 litros de fuel

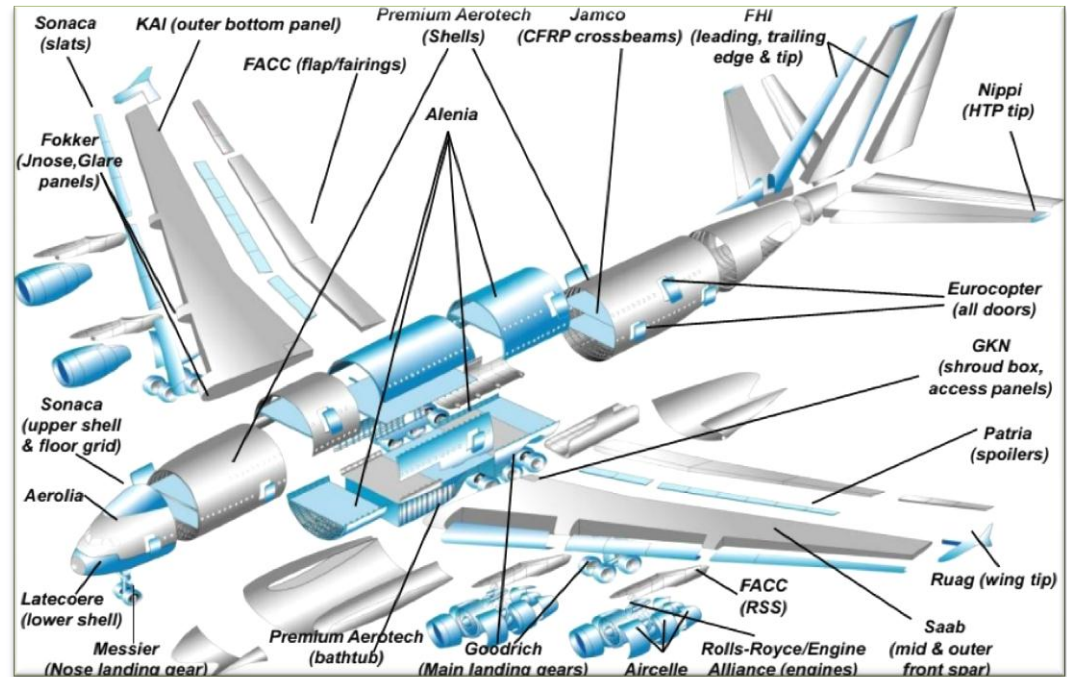
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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO



Aerospace Industry Complexity

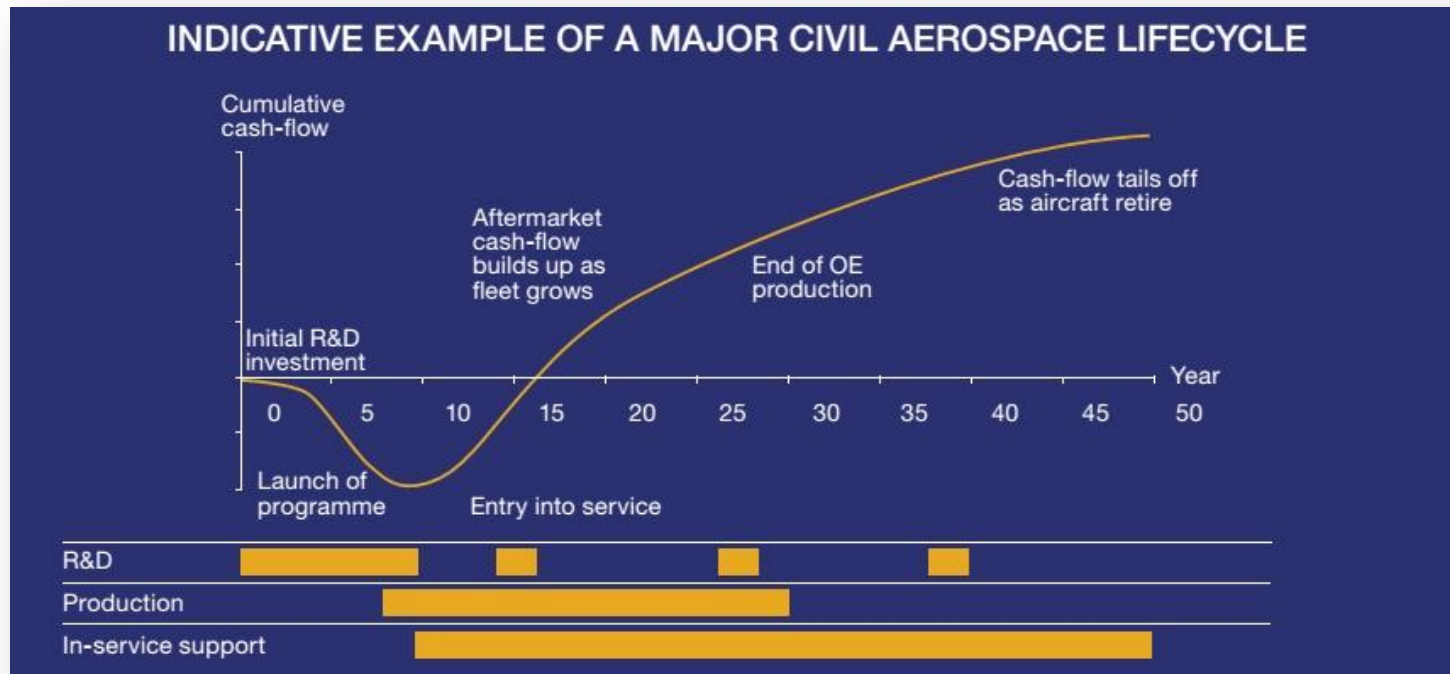
- Very long lifecycle >50 years
- Huge number of parts > 1.000.000
- Design around the world
 - 1500 partners
 - 30 countries
 - 70 % of the aircraft
- Many changes and modifications.
- High level of customization.



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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Long lifecycle: more than 50 years

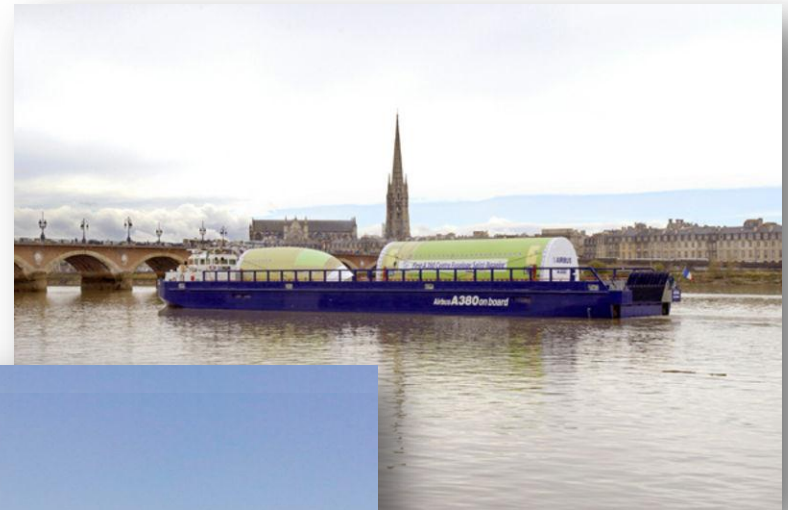


- A320** Development starts late 70s. (40 years)
First flight in 1987.
Today 6000 sold and 4000 in order book. The first one was delivered in 1988.
- A400M** Development starts early 80s (30 years)
First flight in 2009
Today 190 sold and 188 in order book . The first one was delivered in 2013.

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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Airbus A380 Transportation Plan



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Increase of complexity. Cádiz 1928



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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Thank You
Vielen Dank
Merci Beaucoup
Duō Xiè
Muchas Gracias

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INDEX

PLM BASIC CONCEPTS

PLM & ERP. Definition and differences.

Product Lifecycle.

Product Structure.

IT infrastructure, PDM, CAX y DMU.

PLM Definition

PLM – Product Lifecycle Management

PLM (Product Lifecycle Management) cover all Methodologies & processes to create & manage product-Process-Resources lifecycle. Lifecycle extend from the first feasibility studies to the retired phase.

PLM: Manages data resources



ERP Definition

ERP – Enterprise Resource Planning

ERP (Enterprise Resource Planning) cover all Methodologies & processes to create & manage information about the manufacturing & assemble of the Product. Includes the management of Human & Industrial resources as the supply chain and the MRP.

ERP: Manages physical resources

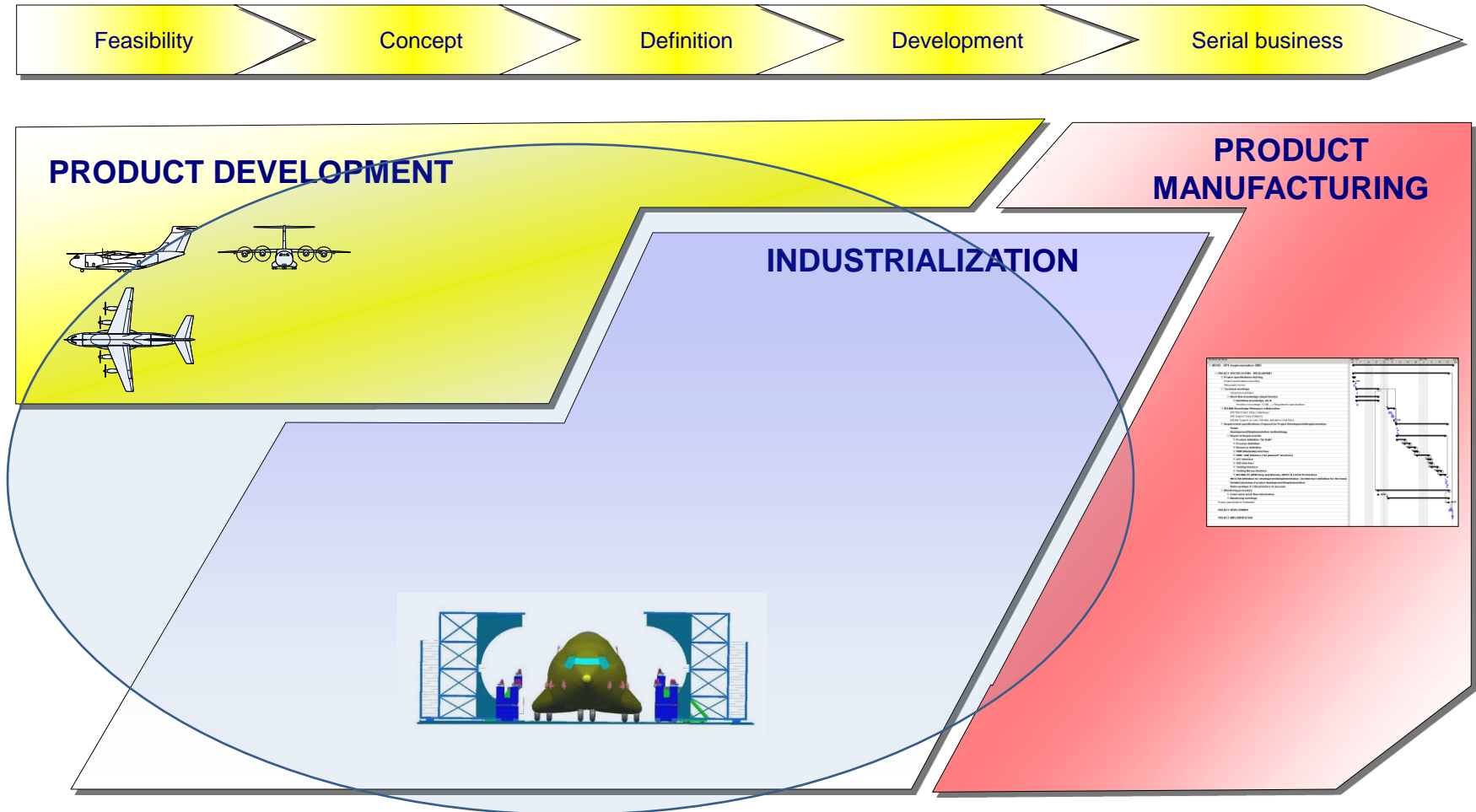


Enterprise Resource Planning (ERP)

DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

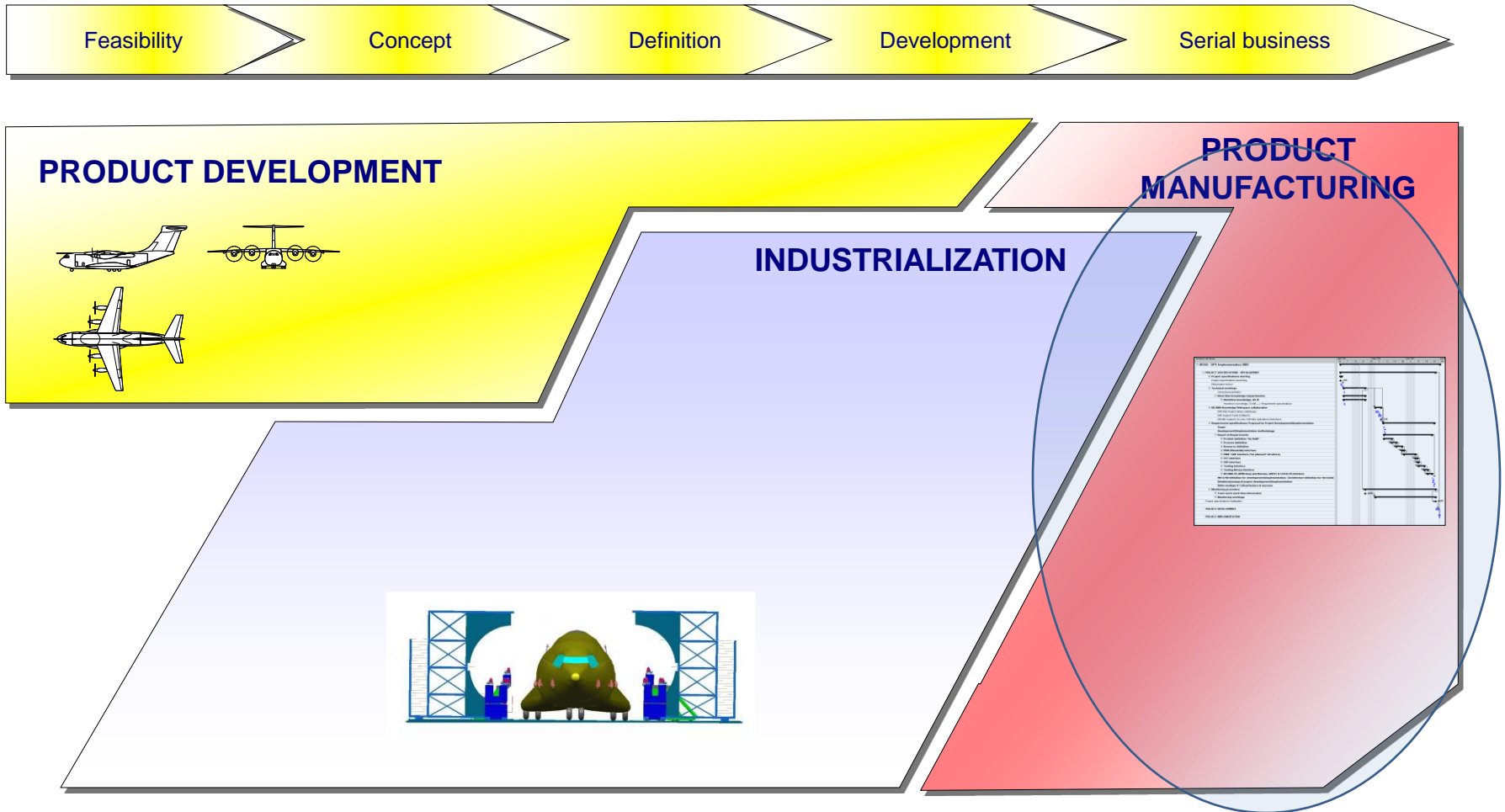
PLM Scope



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

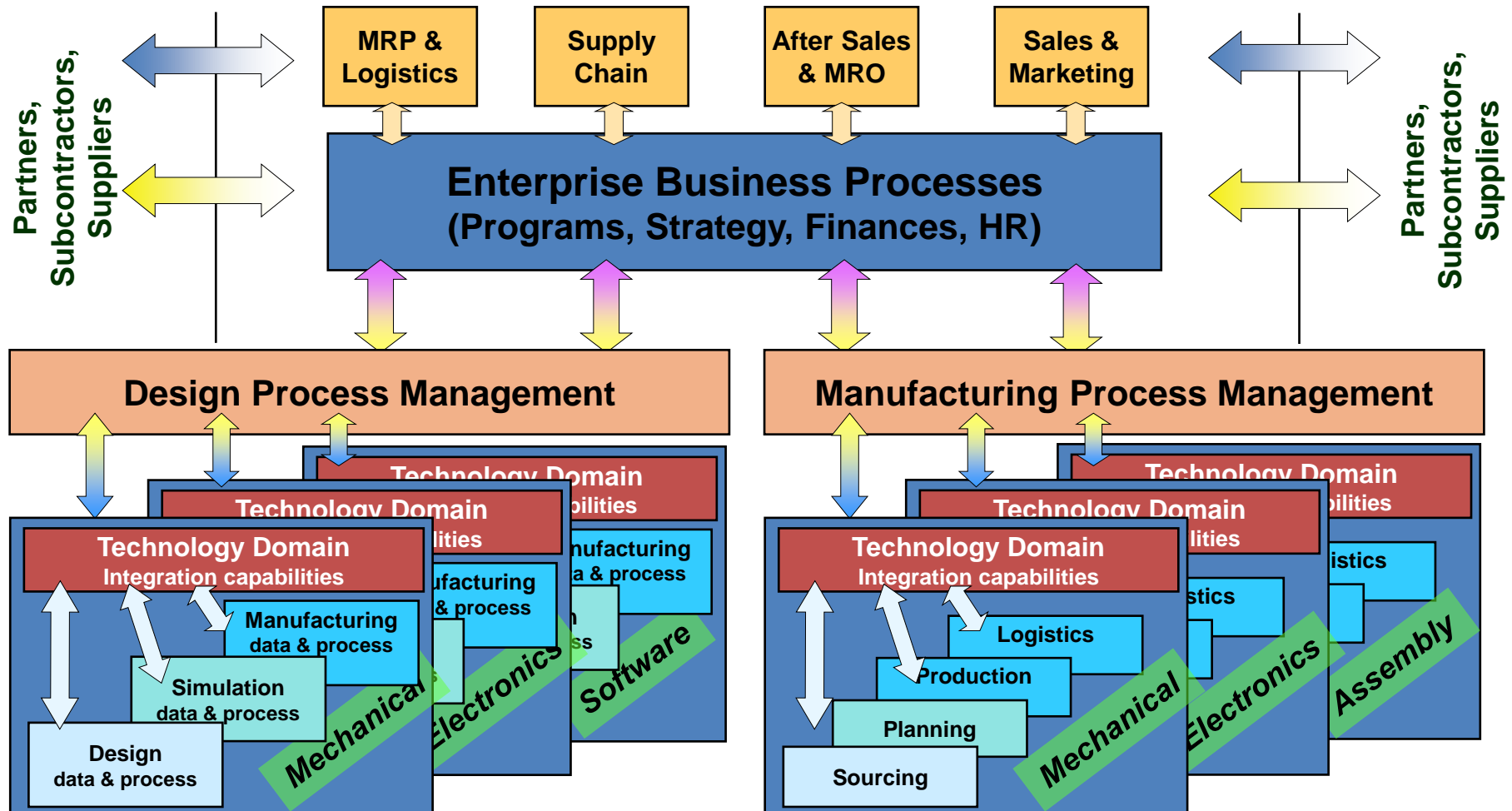
ERP Scope



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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

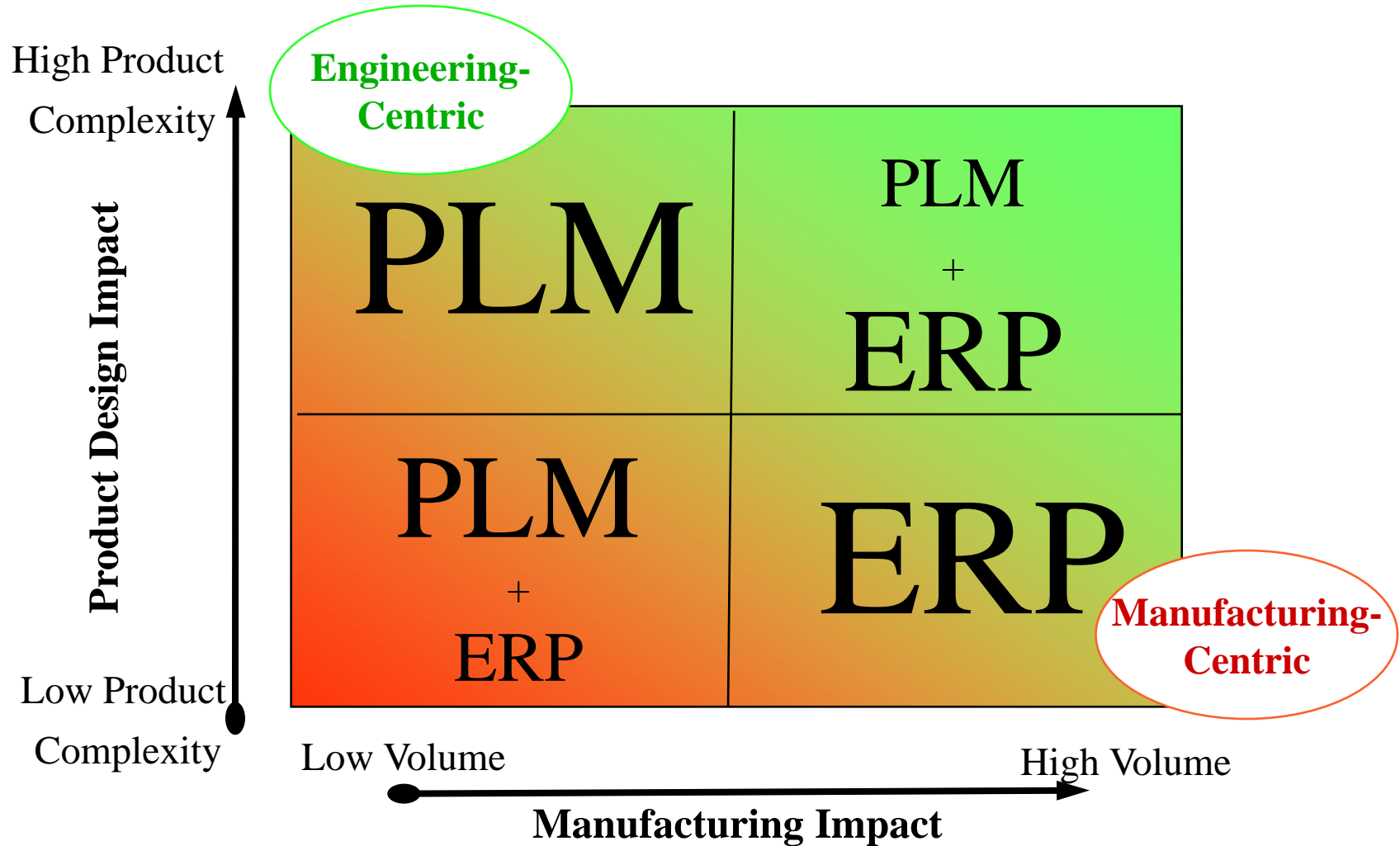
A general view



DISCOVERING PLM

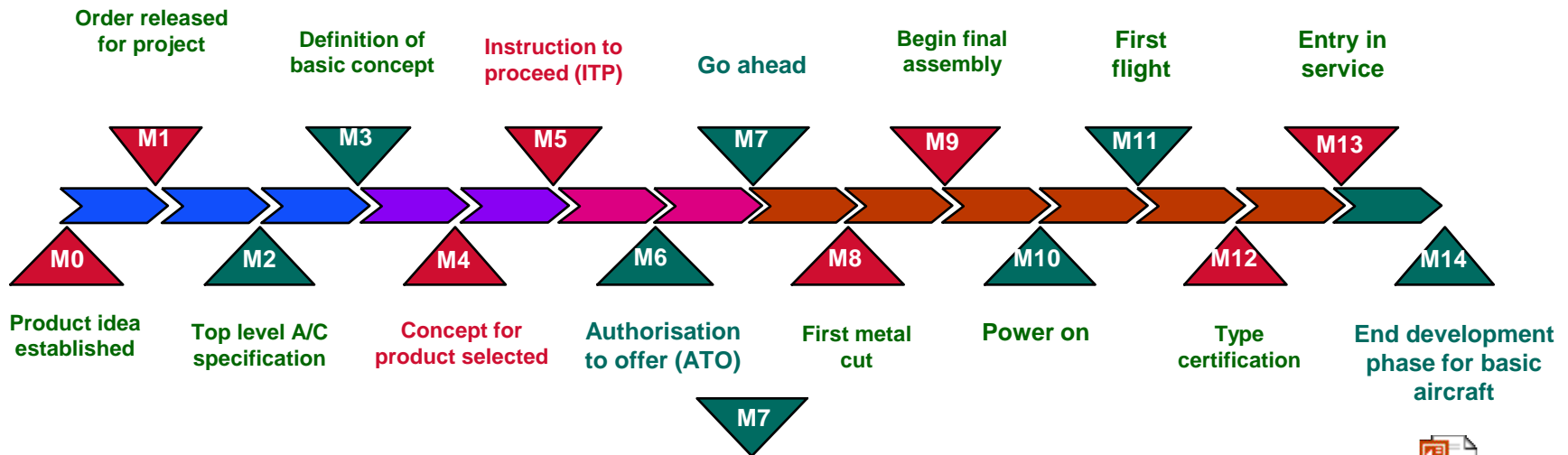
GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Product complexity and Volume are the key determinants



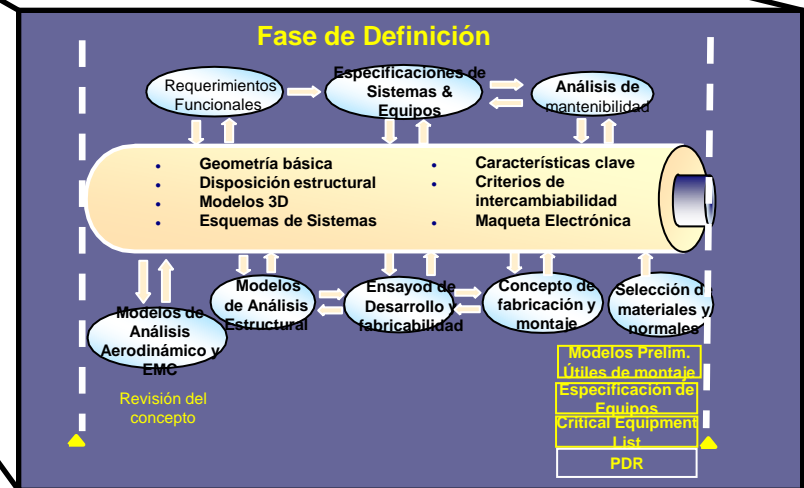
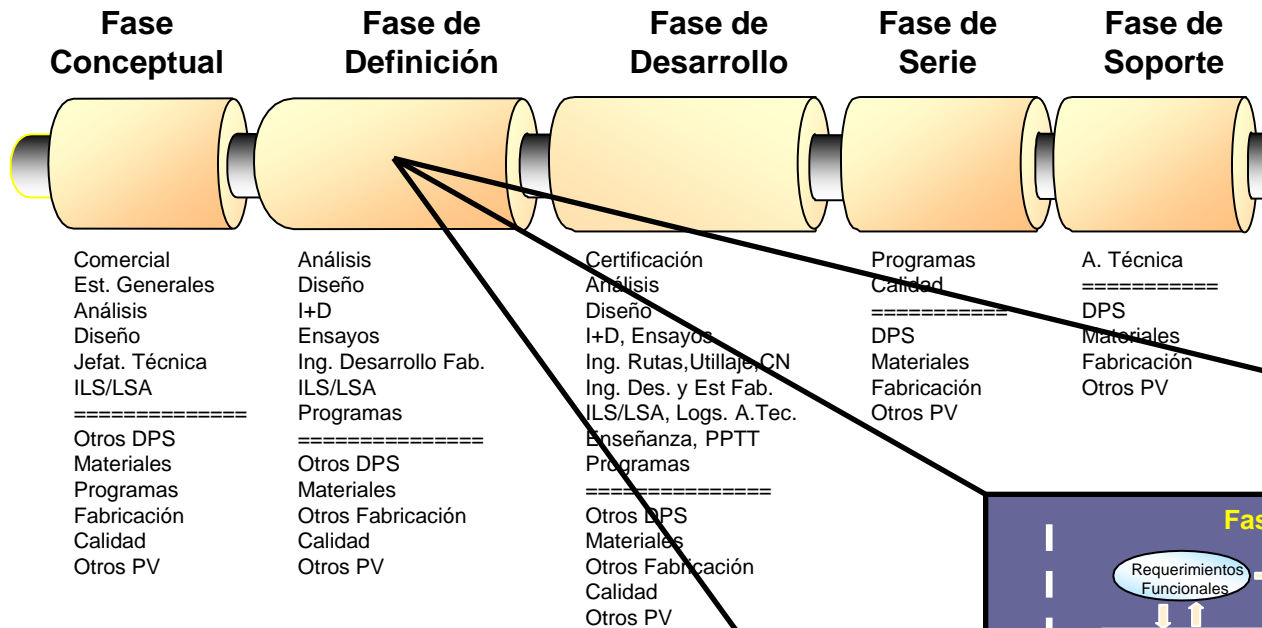
Lifecycle Model in Airbus

- ▶ Milestones definition, now “MG – Milestone Gate”.
- ▶ Each MG fits a lifecycle state defined.
- ▶ MG Reviews. Review board and GO/ No GO.
- ▶ Formal procedure & documentation in each MG.
- ▶ Example. AIRBUS



Microsoft
PowerPoint Presentati

Lifecycle Model in Airbus Military



▶ Example. EADS-CASA

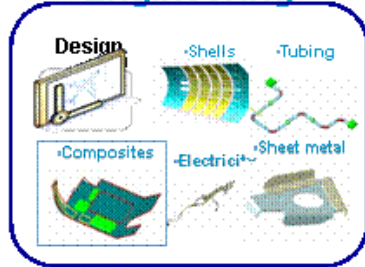


DISCOVERING PLM

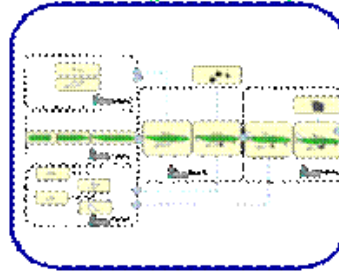
GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Products Views

Engineering



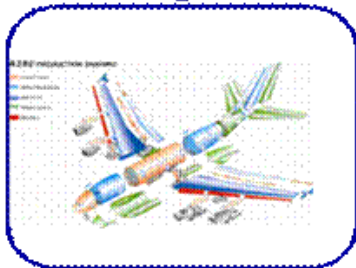
Manufacturing Engineering



Customer services



Programs



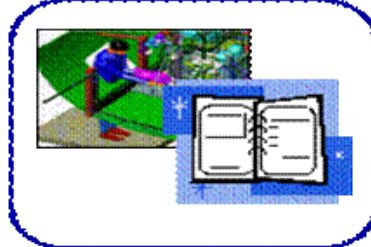
Procurement



Sales & Airlines



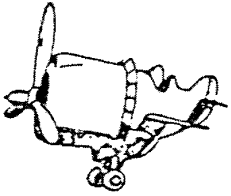
Manufacturing shop-floor



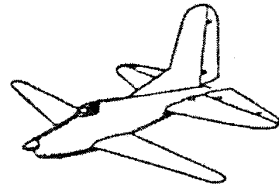
Finance



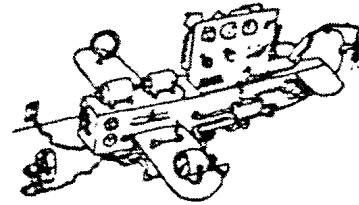
Products Views



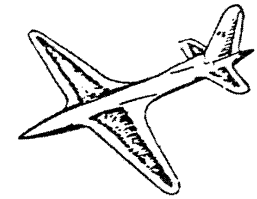
Power plant Group



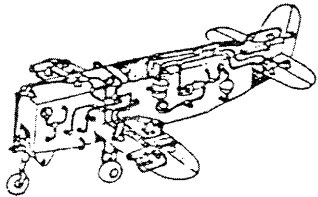
Empennage Group



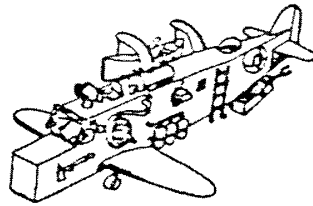
Electrical Group



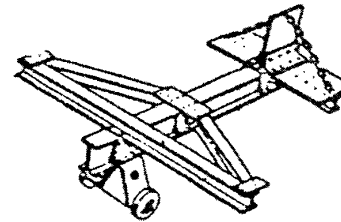
Aerodynamics Group



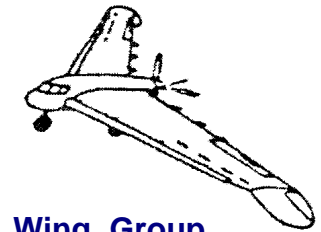
Hydraulics Group



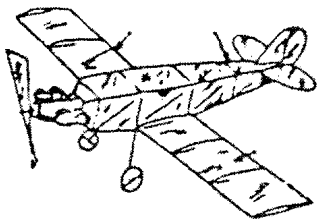
Equipment Group



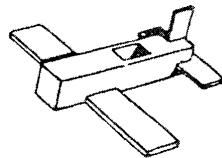
Stress Group



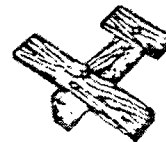
Wing Group



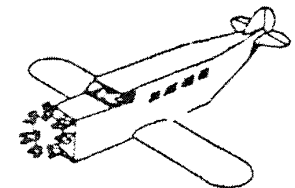
Controls Group



Loft Group



Production Group



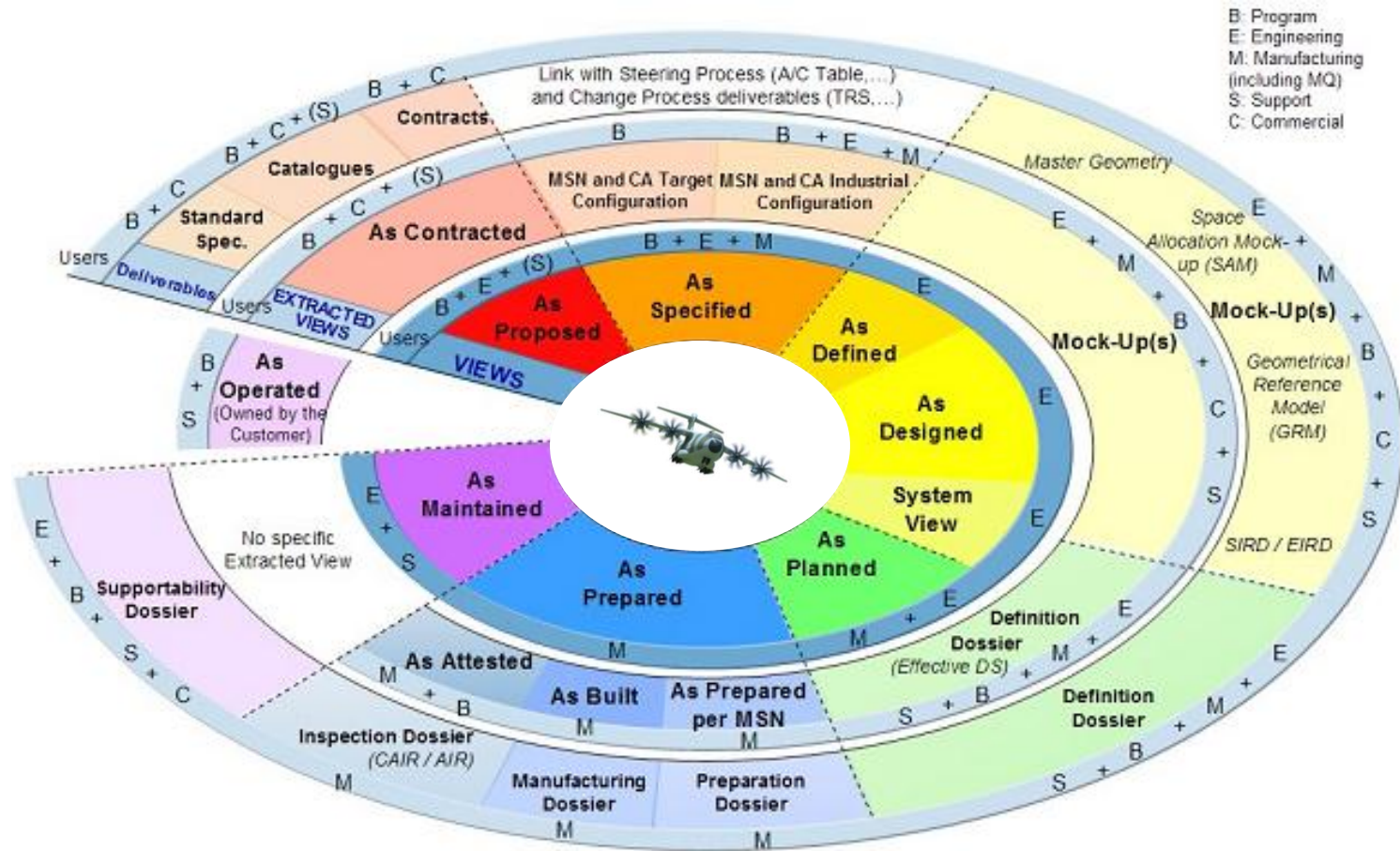
Fuselage Group

Adaptado de « Dream Airplanes » by Mr. C. W. Miller

DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

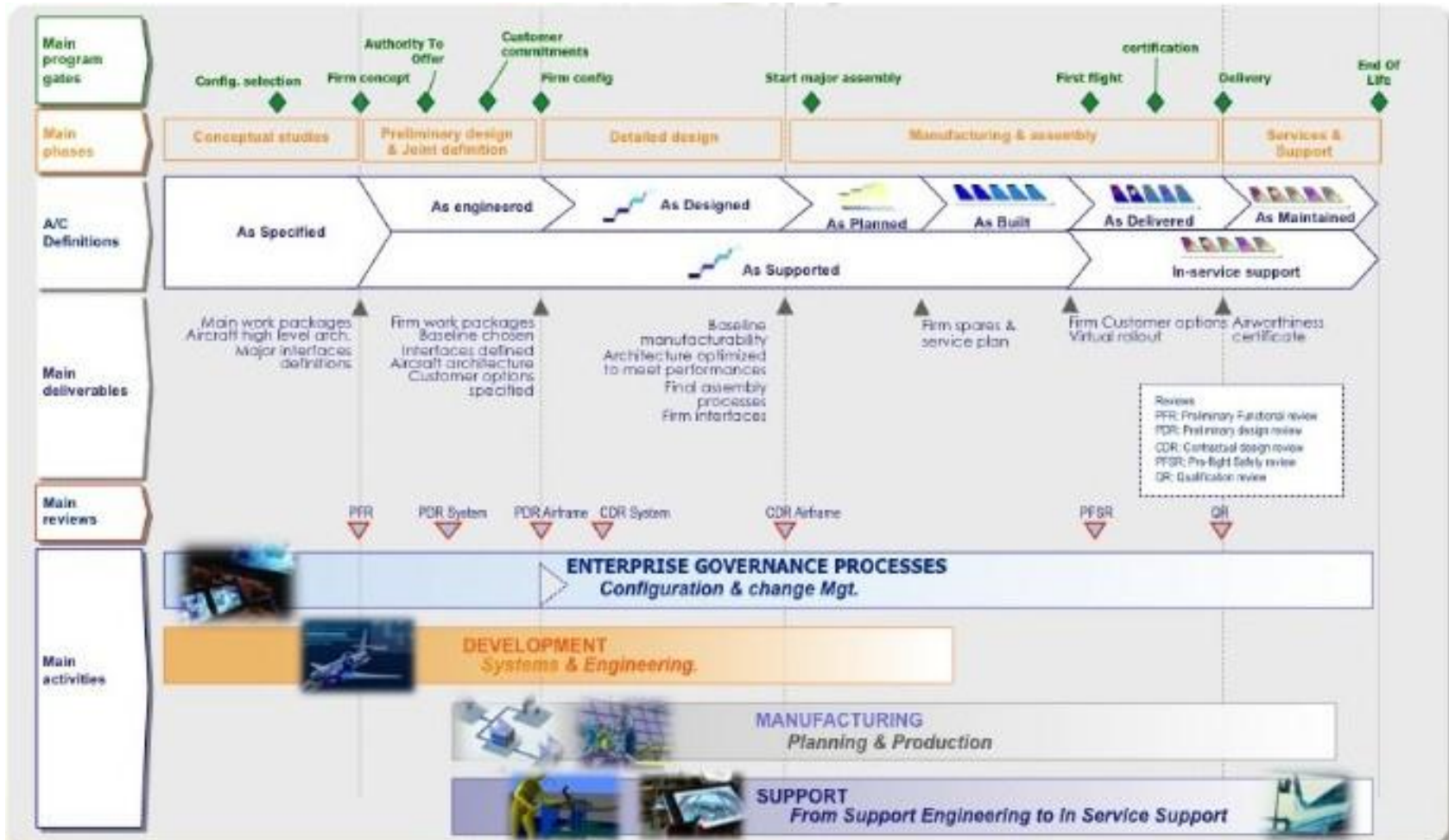
PS – Product Structure in Airbus



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

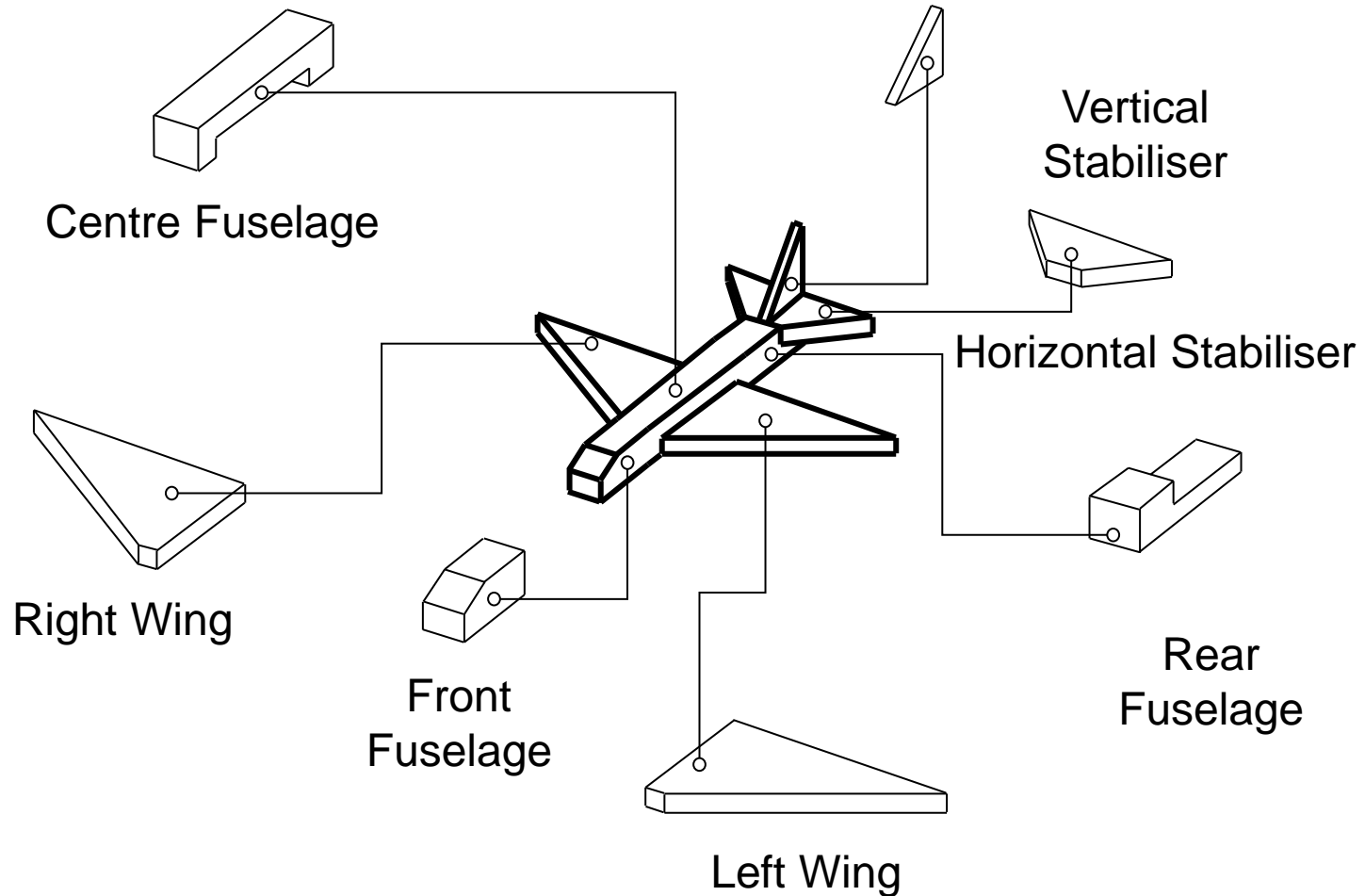
PS – Product Structure in Dassault Aviation



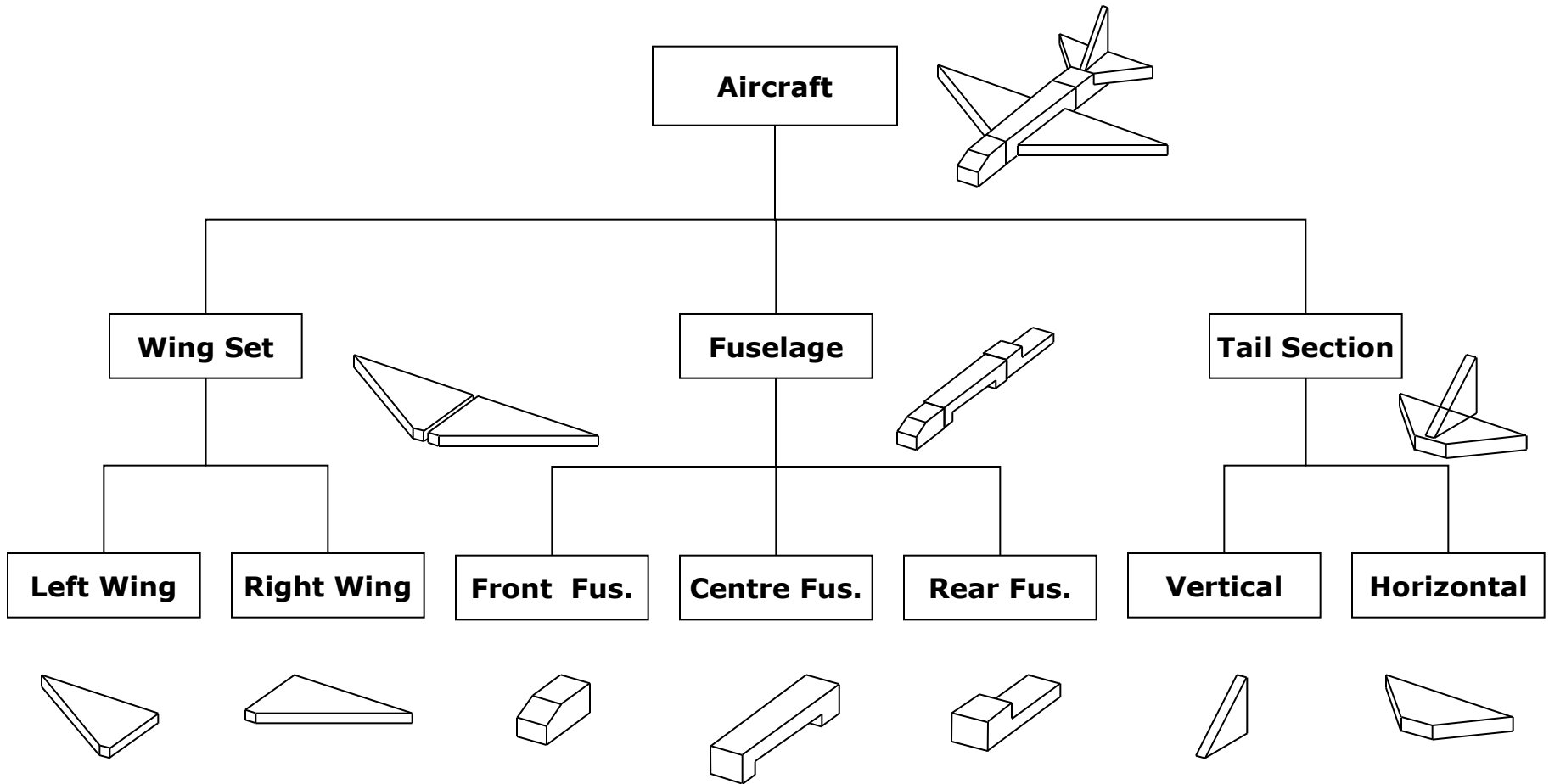
DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

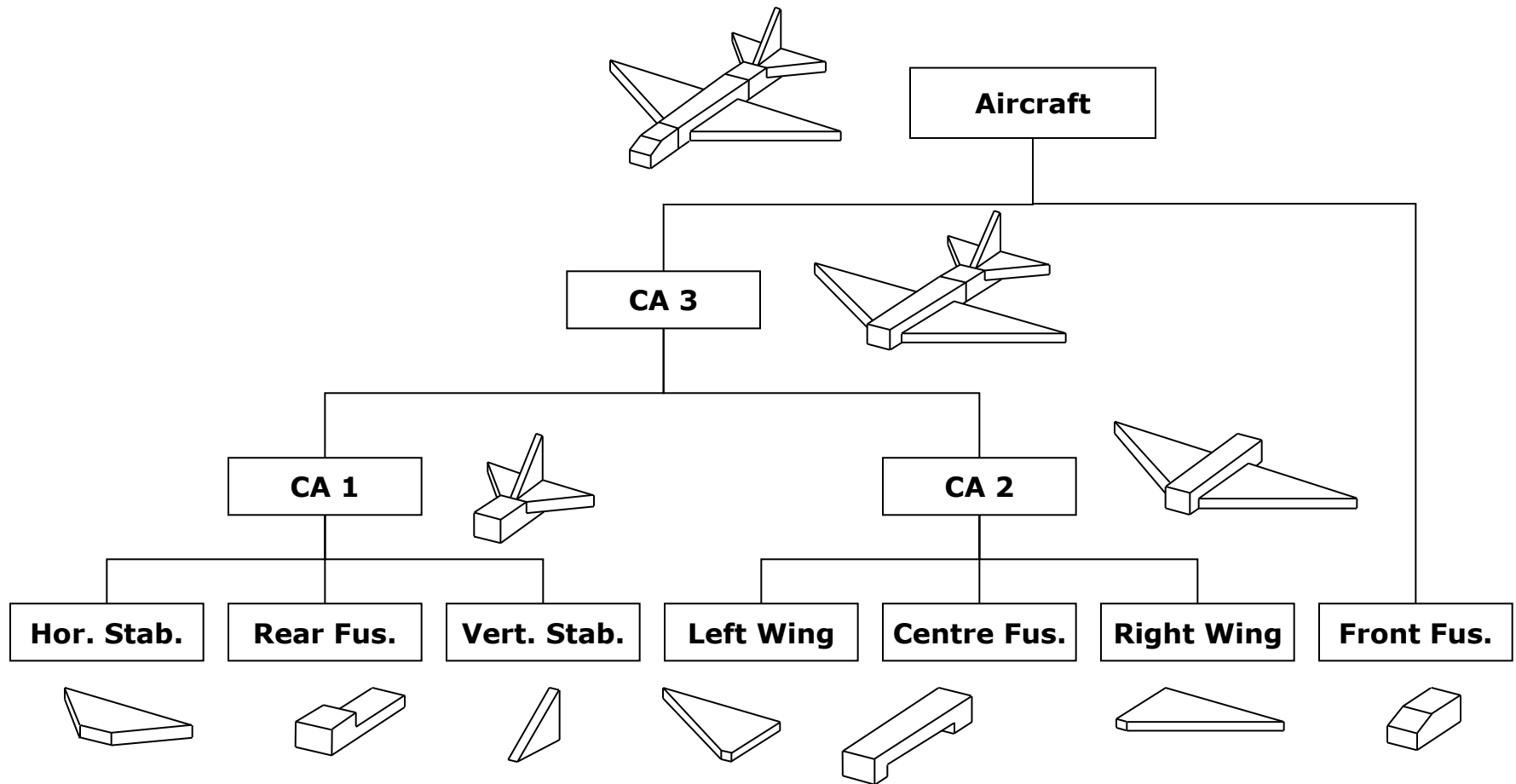
An aircraft



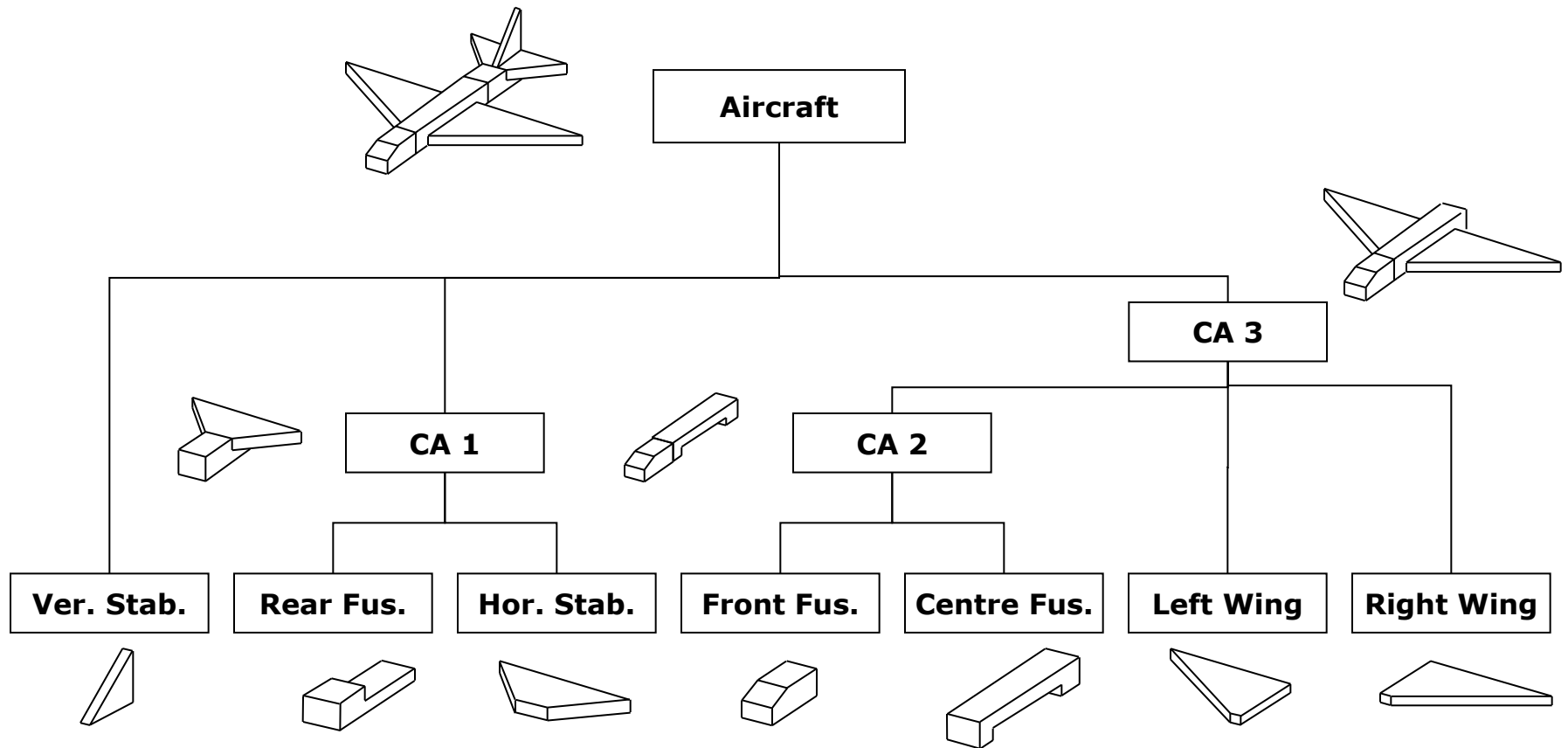
Functional Design Structure (As – Design)



Industrial Design Structure (As – Planned) (i)



Industrial Design Structure (As – Planned)(ii)



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

As- Desguazed



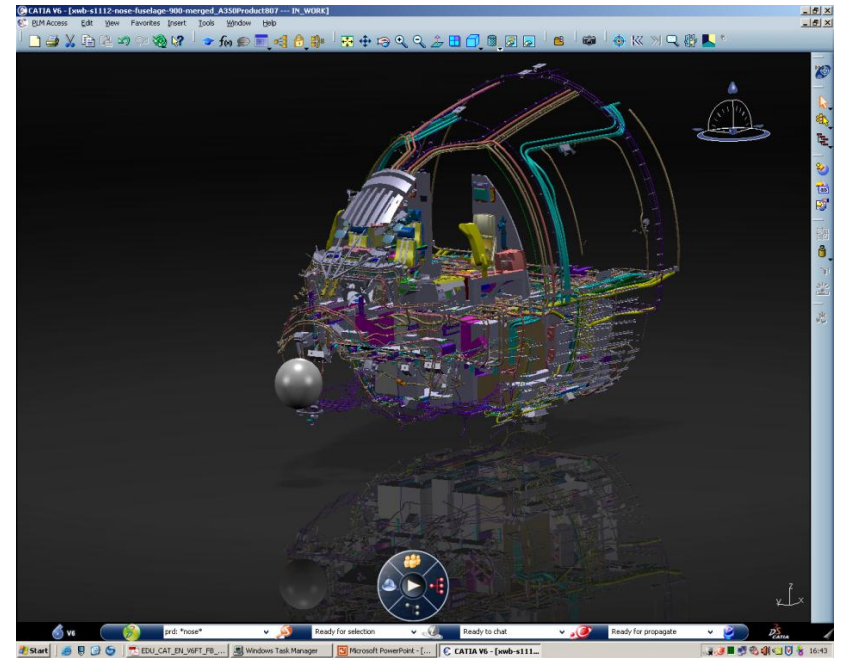
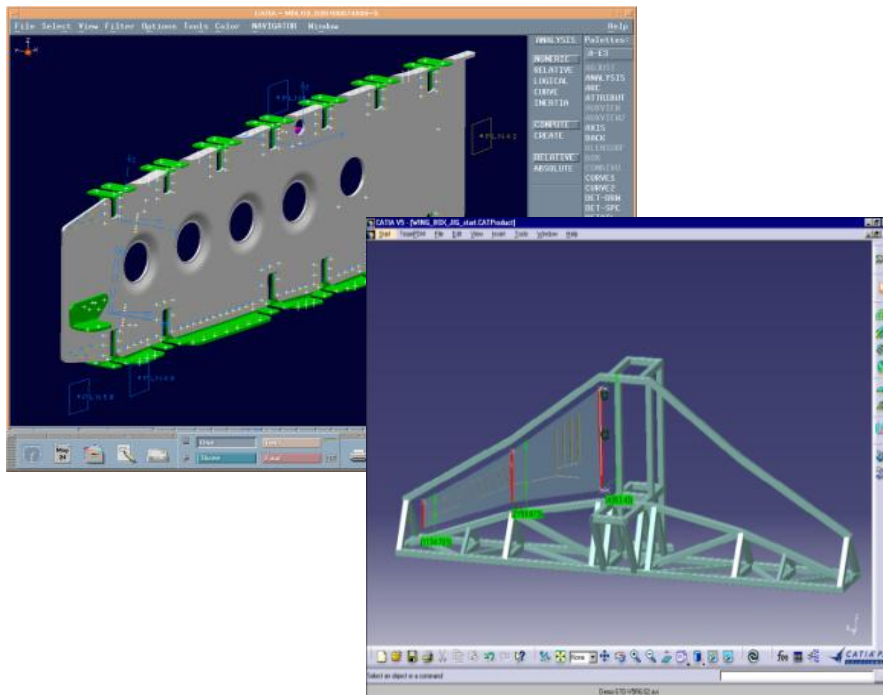
Le premier Boeing 777 déconstruit... à Tarbes ! First Boeing 777 Dismantled in Tarbes!

Le site de déconstruction d'avions de Tarmac Aerosave à Tarbes vient de recevoir un Boeing 777. C'est le second Boeing à arriver à Tarbes pour être déconstruit, après un 737, réceptionné en mars dernier. C'est aussi le premier appareil de cette catégorie à être démantelé dans le monde. Tarmac Aerosave, qui emploie une trentaine de salariés, a accueilli depuis son lancement en

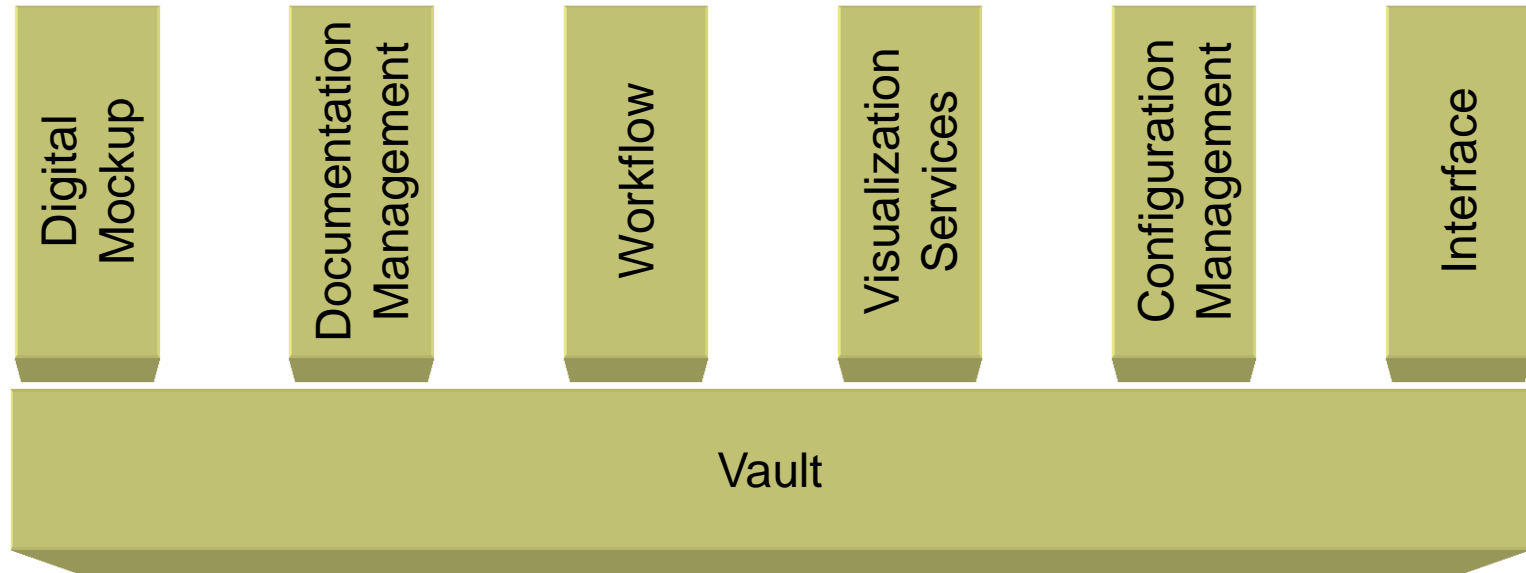
février 2009, 7 appareils à déconstruire. Outre cette activité, ce site assure également des prestations de stockage et de maintien en conditions opérationnelles d'avions commerciaux. The Tarmac Aerosave dismantling site in Tarbes has just received a Boeing 777. This is the second Boeing to arrive at Tarbes to be dismantled, following a 737, received last March. It is also the first aircraft in this category to be dismantled in the world. Tarmac Aerosave, which employs about 30 employees, has received seven aircraft destined for dismantling since its launch in February, 2009. This site also provides storage and operational maintenance services for commercial aircraft.

CAX – Computer Aided X

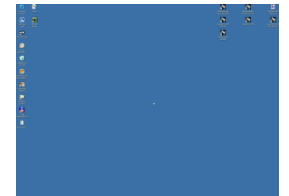
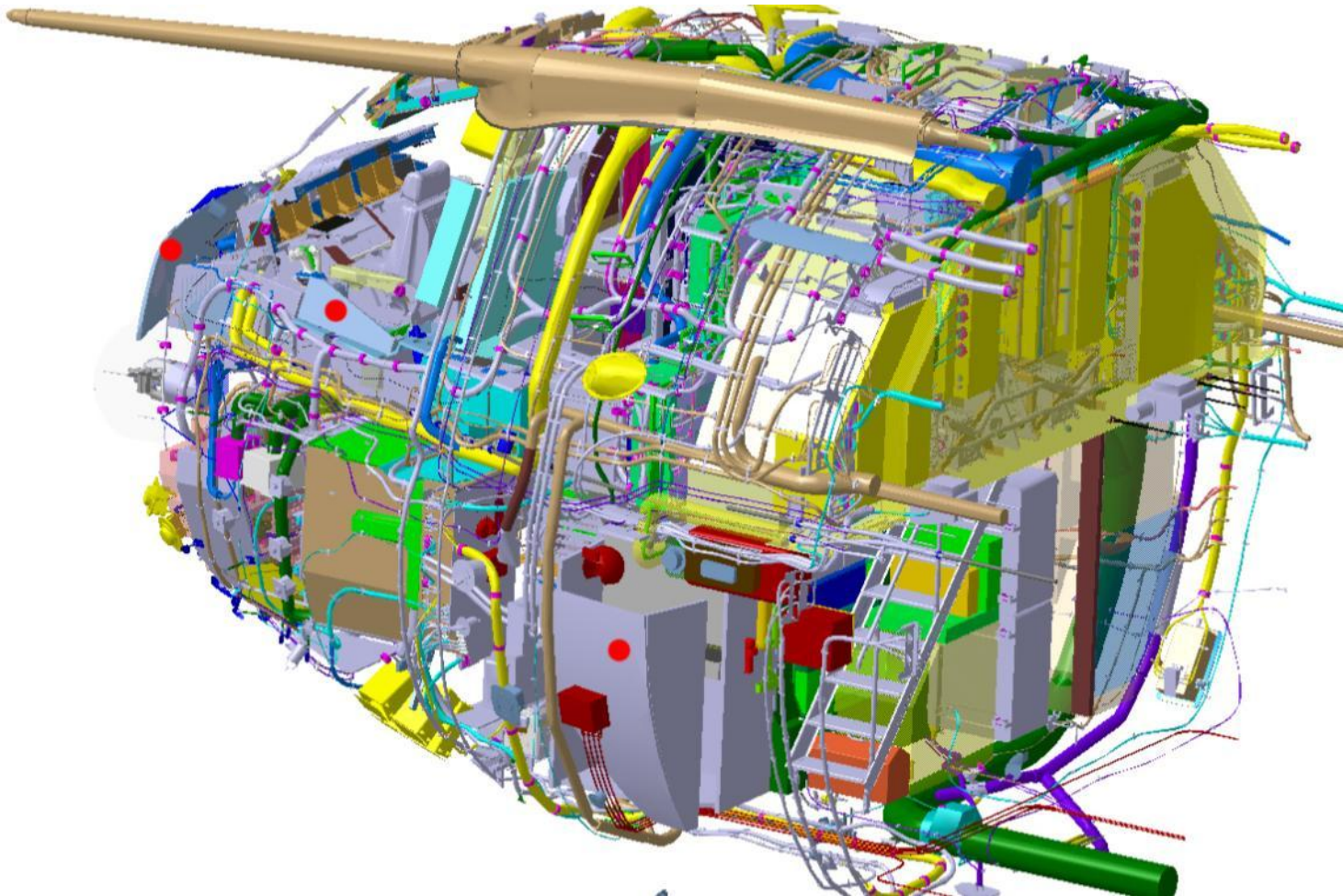
- Authoring tools
- Ready to perform Functional & Industrial design.



PDM – Product Data Management



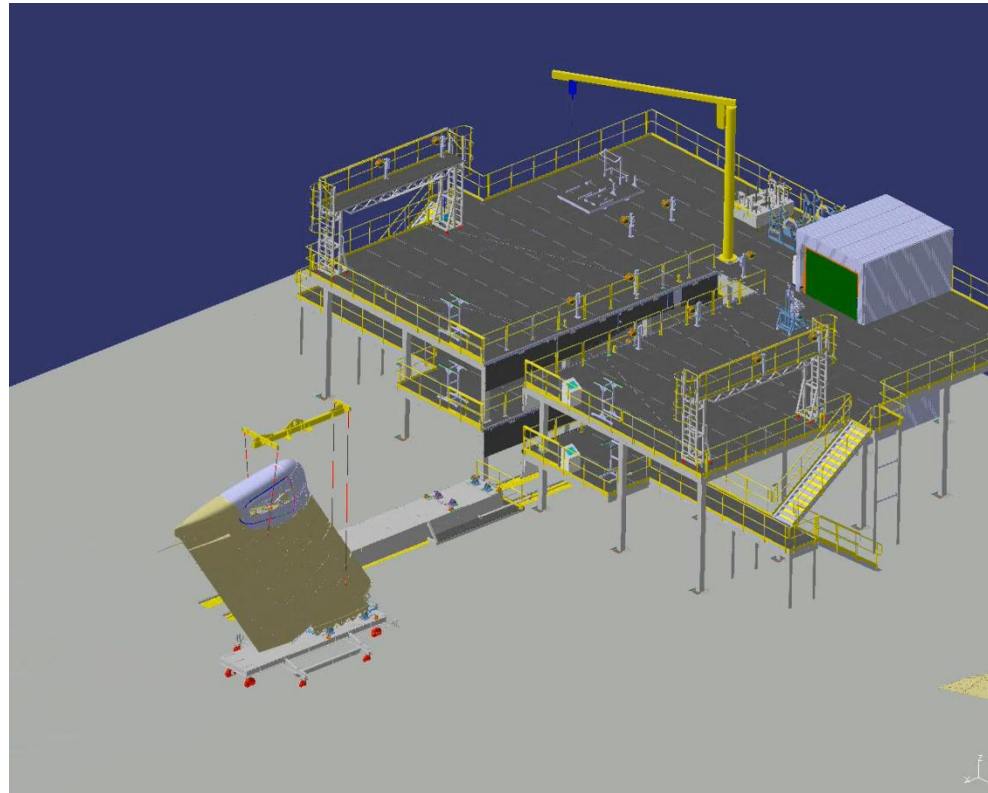
cDMU (configured DMU)



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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

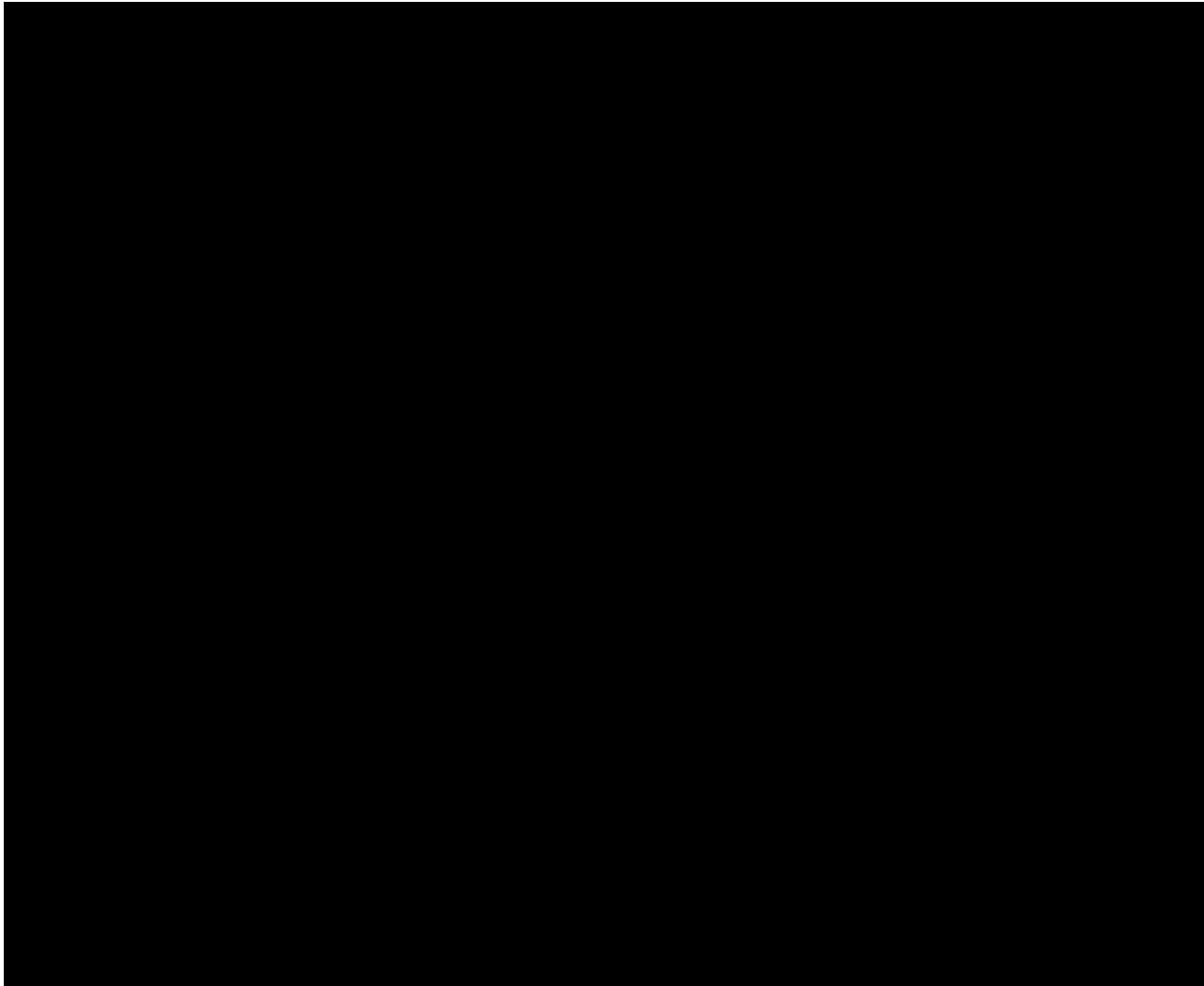
iDMU (industrial DMU)



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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

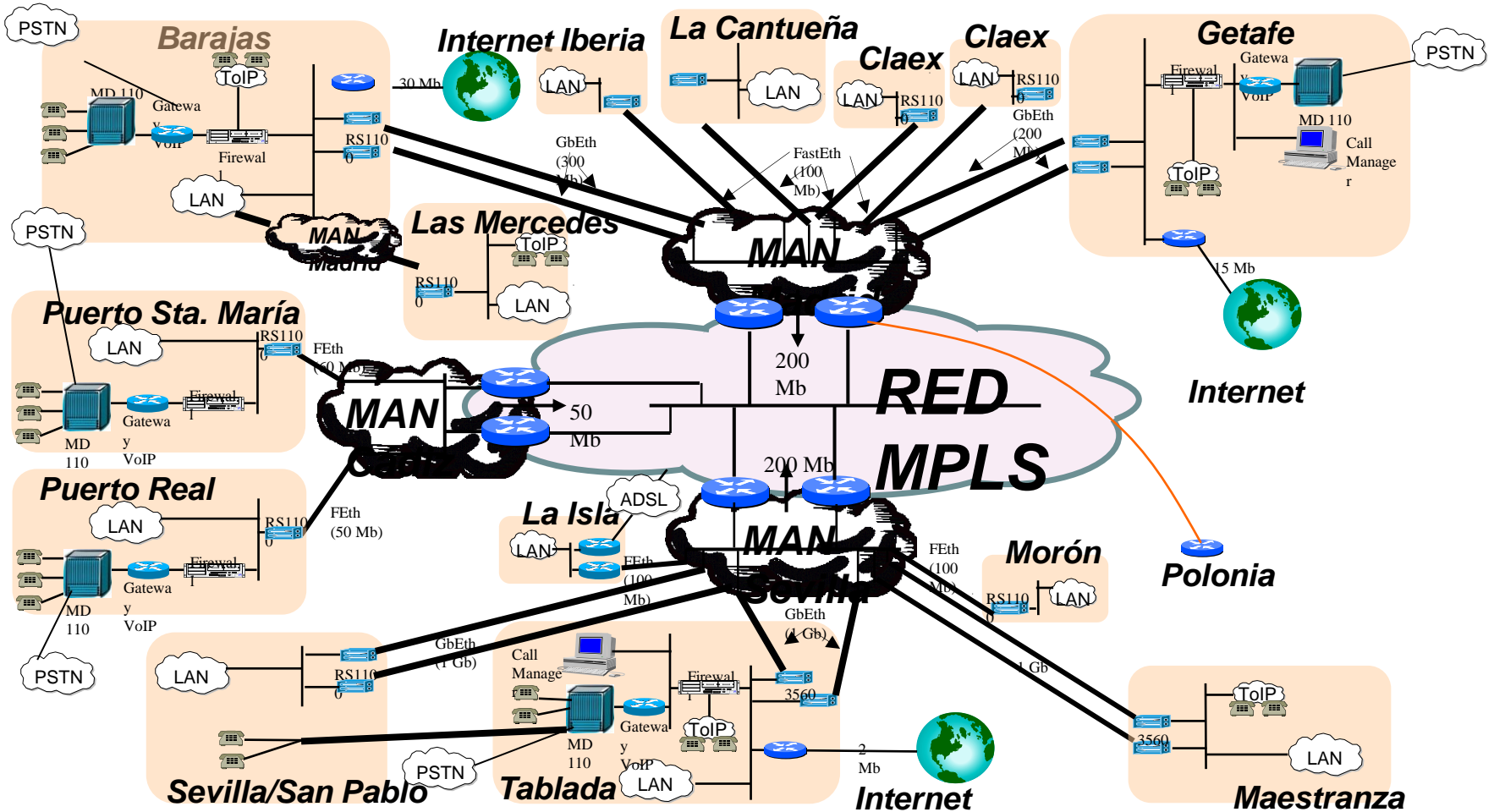
A350 DMU



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

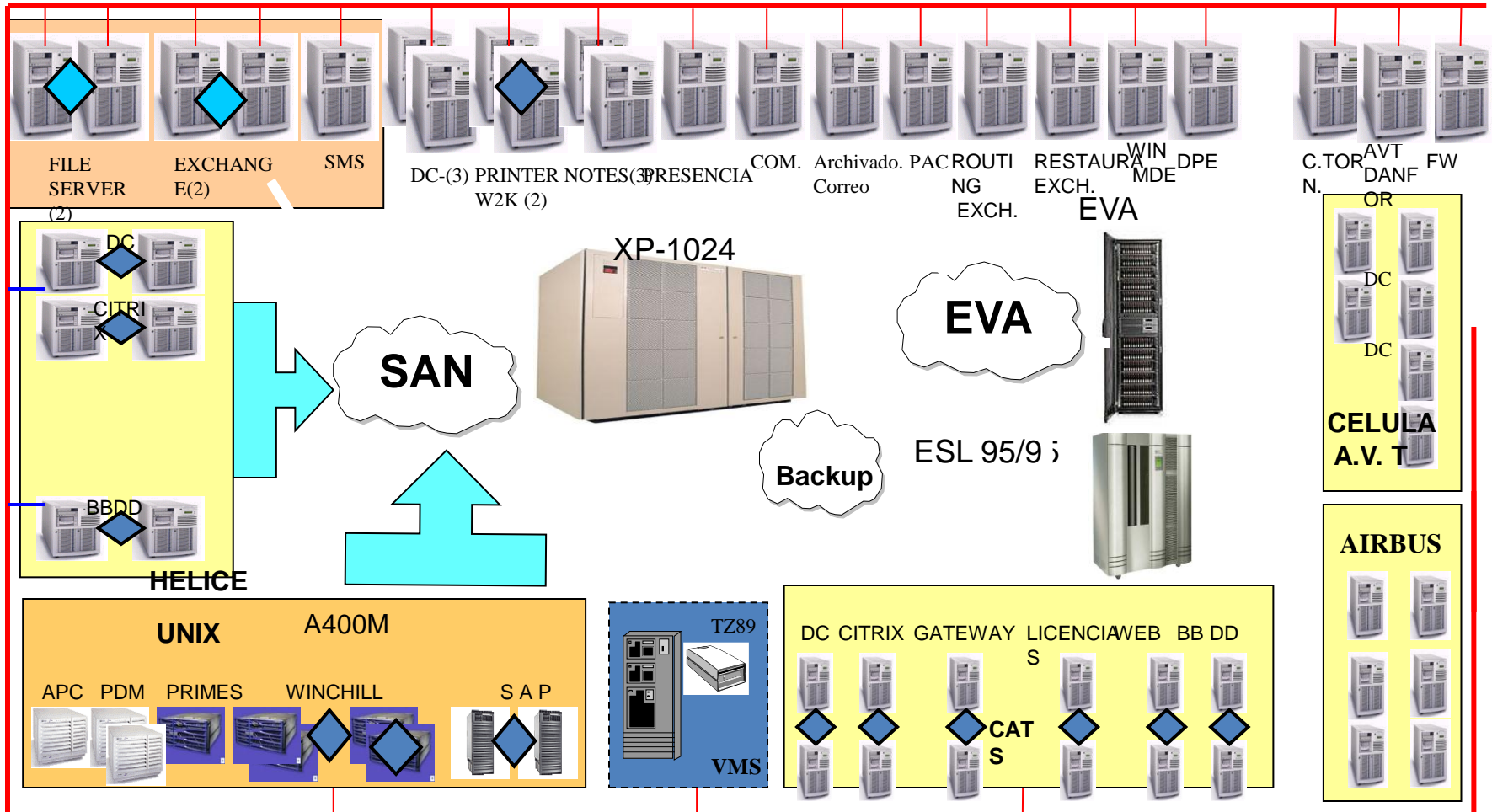
EADS IT Network



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

EADS IT Server Infraestructure



Significative IT data

Dassault licenses

	Airbus	Airbus Helicopters	Defence & Space
CATIA	7000	600	800
Winchill /VPM	No limit / 6000	No limit / 500	No limit / 700
DELMIA	250	25	25

Airbus own more than 68.000 PC.





Airbus Military own more than 600 PC for CATIA v5

Airbus Military own more than 60 WINTEL servers and 20 UNIX servers.

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GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Current PLM situation in Airbus Military

	Light & Medium	AIRBUS Derivatives	A380	A400M
				
PDM	Optegra	Optegra	Optegra	Primes
Configuration Management	Sprint.net	Sprint.net	Sprint.net	Primes / ICC
Functional Design	Catia v4/v5	Catia v5	Catia v4/v5	Catia v5
Industrial Design	Catia v4/v5 Delmia v5	Catia v5 Delmia v5	Catia v4/v5 Delmia v5	Catia v5 Delmia v5
Visualization	Visualizador Optegra Product View	Visualizador Optegra Product View	Visualizador Optegra Product View	Product View Catia v5 / Others

Current PLM situation in Airbus



- CAD for surfaces (CV)
- Drawings 2D and CN. (CV)
- NO DMU. NO PDM



- CAD for surfaces (CV / CATIA v4/v5)
- Drawings 2D and CN. (CV / CATIA v4/v5)
- Partial DMU. Partial PDM.



- PLM. VPM / CATIA v5 Airbus & Extended Enterprise



- CAD for surfaces (CV / CATIA)
- Partial DMU (fuselaje). PDM (metadata)

DISCOVERING PLM
GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Thank You
Vielen Dank
Merci Beaucoup
Duō Xiè
Muchas Gracias

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Madrid – March 2015

INDEX

INTRODUCTION

Historical context. PLM in General and in Airbus.

The Main Suppliers.

The current PLM situation.

PLM in General (i)

- **1950 – 1960 Plotters and NC programming.**
 - **1950** The first graphic system in the US Air Force, SAGE (Semi Automatic Ground Equipment). APT (A Programming Tool) launched.
 - **1951** Born of Gerber.
 - **1957** First Commercial NC system PRONTO (PROgramming Numerical TOol)
 - **1959** Born of CalComp.
 - **1960** Born of McDonnell Douglas Automation Company (McAuto).
- **1961 – 1970 Initial CAD systems.**
 - **1961** Ivan Sutherland PhD. The Sketchpad.
 - **1967** Born of SDRC.
 - **1969** First version of ECUCLID from MATRA DataVision.
 - **1969** Born of CV (ComputerVision).
- **1971 – 1980 Proprietary systems. Aerospace and Automotive Industry.**
 - **1971** Born of MCS Software.
 - **197x** Big Companies writes is own CAD systems (General Motors, Ford, Chrysler, Daimler, Lockheed).
 - **1975** Born of EDS.
 - **1977** The first CADAM commercial versions.

PLM in General (ii)

- **1981 – 1990 Main Suppliers. Proprietary PDM systems.**
 - **1981** Born of Dassault Systemes. CATIA v1.
 - **1981** Born of Unigraphics.
 - **1982** Born of Autodesk.
 - **1982** IBM PC Presentation.
 - **1984** Commercial launch of CATIA v2.
 - **1985** Dassault Systems own CADAM.
 - **1986** Born of PTC.
 - **1988** Commercial launch of CATIA v3.
- **1991 – 2000 Cax interactive systems. First steps on PDM. UNIX as OS.**
 - **1991** PELORUS development between ComputerVision and Daimler Benz.
 - **1993** Commercial launch of CATIA v4.
 - **1993** CV launch Optegra. EDS launch Metaphase. DS launch VPM
 - **1998** Commercial launch of CATIA v5 – Solids design.
 - **1998** PTC own ComputerVSION.
 - **1999** Dassault Systemes own MATRA DataVision.
 - **2000** Dassault Systemes own DELMIA.

PLM in General (iii)

- **2001 – 2009 Concentration. PDM maturity. PLM. PC as standard platform.**
 - **2001** EDS own SDRC.
 - **2001** Commercial launch of Windchill by PTC.
 - **2002** Dassault Systemes own KTI.
 - **2007** Siemens own Unigraphics.
 - **2007** EADS selected Windchill and CATIA as PLM.
 - **2008** Commercial launch of CATIA v6.
- **2010 – 2019 Collaboration. PLM integration in the “Extended Enterprise” ?**
 - **2010** EADS test CATIA v6 inside PHENIX (PLM Harmonization) Project.
 - **2011** Airbus Military starts Collaborative Engineering pilots.
 - **2012** Astrium start working on CATIA v6
 - **2012** Airbus Military launch Collaborative Engineering for FCA320neo.

PLM in Airbus (i)

1923 - 1970 Aviones bajo licencia y algunos desarrollos propios.



- **1923** Constitución de Construcciones Aeronáuticas, S. A.
- **1928** Inauguración del Centro de Cádiz.
- **1929** Primer vuelo del Dornier-Wall Numancia. Primer vuelo de la avioneta CASA-I.
- **1940** Inauguración del Centro de Tablada.
- **1969** Instalación del primer ordenador CAE IBM 1130 (8 Kb / 5 Mb).

PLM in Airbus (ii)

1971 - 1982 Fundación de AIRBUS. Oficina de Diseño para desarrollos propios.



- **1971** Fusión con HISPANO AVIACION. Adquisición por el INI. Primer vuelo del C-212.
- **1972** CASA pasa a ser miembro del Grupo de Interés Económico Airbus Industrie.
- **1973** Instalación del APT 360 sobre un HOST IBM 1401 (8 Kb).
- **1977** Primer vuelo del C-101.
- **1981** Instalación del primer sistema CAx, DEC VAX PDP 11.
- **1982** Instalación seis pantallas CV con CADD3. Eclipse DG (32Kb/300MB).
- **1982** Lanzamiento del programa FLA (A400M).

PLM in Airbus (iii)

1983 - 1999 Sistemas CAx, Desarrollo propios y diseño para AIRBUS.



- **1983** Primer vuelo del CN-235. Las superficies se diseñaron en CAD.
- **1984** Instalación de CATIA v2.2 como sistema de CAD/CAM para CASA.
- **1987** Primer vuelo del A-320. Instalación del CRAY 1S en Proyectos.
- **1988** Inauguración del Centro de Puerto Real. Fabricación del HTP del MD-11.
- **1990** Primer vuelo del MD-11.
- **1991** Primer vuelo del A-340.
- **1992** Primer vuelo del SAAB-2000. Avión 100% digital. Superficies, 3D y planos.
- **1993** Instalación de CATIA v4.
- **1994** Primer vuelo del Eurofighter. Acuerdo de utilizar CATIA v4 con sólidos en EFA.
- **1997** Primer vuelo del C-295. Instalación de CATIA v4 en UNIX.
- **1998** Retirada de HOST y migración a estaciones UNIX en CASA.

PLM in Airbus (iv)

2001 – 2009 Europeización y globalización. Grandes Proyectos Europeos.



- **2000** Comienzo de la Fabricación Digital utilizando Productos Virtuales.
- **2000** Fusión de Aérospatiale Matra, CASA y DASA.
Nace EADS (European Aeronautic Defence and Space Company).
- **2001** Instalación de CATIA v5 sobre plataformas PC.
- **2001** EADS (75 %) y BAe Systems (25 %) crean la Compañía AIRBUS.
- **2002** Inicio del uso de CATIA v5 en AIRBUS para el A380.
- **2003** Proyecto de Fabrica Digital para el A400M. A400M, primer AIRBUS CATIA v5.
- **2005** primer vuelo del A-380.
- **2006** EADS compra a Bae Systems el 25 % de AIRBUS.
- **2007** Inauguración de la Factoría de Albacete (Eurocopter).
- **2008** Proyecto PHENIX. Armonización PLM en EADS.
- **2009** Primer vuelo del A-400M.

PLM in Airbus (v)

2010 – EADS 2.0



2000
A-380



2003
EC-135



2006
A-350



2008
A-330 MRTT



2009
A-400M



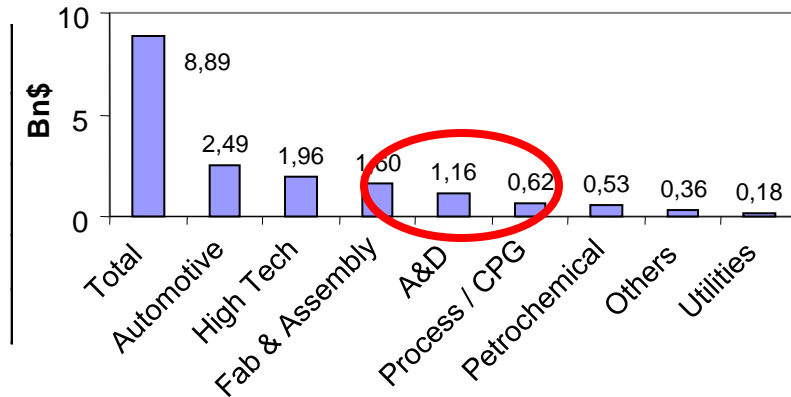
2011
Talarion UAV



2011
C-295 AEW

- **2010** PHC armonización PLM en EADS.
- **2011** Lanzamiento del A320neo
- **2012** Intento de fusión con Bae. Cambio accionarial. Empresa privada.
- **2013** Primera entrega a cliente del A400M. Primer vuelo del A350.
- **2014** Airbus Group. Airbus Defence and Space.

PLM Market



Source : Extrapolation based on CIMdata 2010 analysis and IDC data

PLM budget 2008 (B\$)	EADS Weight in providers Revenue
0,062	5%
0,027	2%
0,007	1%
0,095	3%

Source : EADS internal assessment

A&D represents 13% of PLM market

EADS weight 3% of Revenues of main PLM providers



EADS represents ~ 10% of Aerospace and Defense PLM Market

DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

PLM Evolution

PERIODO	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	2010-2020
Oportunidad	Dibujo 2D	Diseño 2D	Productividad	Innovación	Concurrencia	Colaboracion
Ordenador	No	Mainframe	Miniordenador	Workstation	PC	Indiferente
Personal	Delineantes	Operadores CAD	Proyectistas	Ingenieros	Grupos de trabajo	Global
Arquitectura	No	16 bits	32 bits	64 bits	Estandar	Indiferente
Programación	No	Ensamblador	FORTRAN	C++, LISP	Scripts/Macros	Customizacion
Interface	No	Comandos	Menú	Gráfica	Windows	Intuitiva
Modelizador	Planos (papel)	Geometría 2D	Superficies 3D	Sólidos	Knowledge	Realistica
Intercambio	Ninguno	Escaso	IGES, VDA, ...	STEP	Nativa	No hay
Fabricación	Plantillas/Manual	APT	Automatización	Integración	Ext. Enterprise	Virtual

DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

PLM Evolution

	Generation 0 1960	Generation 1 1990	Generation 2 2005	Generation 3 Future
<i>Personnel/Skills</i>	Loftsmen	Engineers	Concurrent Engineering	Collaborative Engineering
<i>Information Model</i>	Surfaces and 2D drawings	3D models and 2D information	Solids. Model Based Definition (MBD)	Knowledge Based Engineering (KBE)
<i>Engineering definition</i>	Forms based data entry	Product Data Management (PDM)	Master Product Definition (MPD)	Integral Digital Mock-up (iDMU)
<i>Product configuration</i>	Explicit configuration	Multi-configuration	Mono-configuration	Configuration by specimen (Tale Number, MSN)
<i>Mock Up</i>	Physical mockups	Basic simulations	Advanced simulations	Full digital manufacturing
<i>Manufacturing</i>	Manual work. Templates.	NC, CIM	Extended Enterprise (EE)	Virtual Factory
<i>PLM Tools</i>	In-house applications		Customized COTS. In-house applications	API Store
<i>Infrastructure</i>	Mainframe systems	UNIX	Windows system	Indifferent: PC, Tablet, Phone.
<i>Data model format</i>		Proprietary formats (vendors)		International standards
<i>Data exchange format</i>	Limited data exchange.	IGES, VDA, SET, DXF, STEP	Native. Proprietary formats	International standards
<i>Long Term archiving (LOTA)</i>	None exists, paper based.		STEP	International standards

The main Suppliers

- Dassault Systems (CATIA v4/v5/v6, Delmia, VPM, Enovia)
- Siemens (Unigraphics (NX), Teamcenter, Tecnomatix)
- PTC (CADD5 5, Pro/E, Optegra, Windchill)
- SAP (SAP/R3, mySAP)

Aerospace PLM Market

CIVIL		MILITARY		HELICOPTER	
<i>Company</i>	<i>System</i>	<i>Company</i>	<i>System</i>	<i>Company</i>	<i>System</i>
BOEING	CATIA	BOEING	UG/CATIA	BOEING	CATIA
AIRBUS	CV/CATIA	EADS	CATIA	EUROCOPTER	CATIA
RAYTHEON	CATIA	LOCKHEED	CATIA	SIKORSKY	CATIA
EMBRAER	CATIA	Bae	CV/CATIA	WESTLAND	CATIA
BOMBARDIER	CATIA	NORTHROP	UG/CATIA	AGUSTA	CATIA
DASSAULT	CATIA	DASSAULT	CATIA		
GULSTREAM	CATIA	ALENIA	CATIA		

Aerospace PDM Market

CIVIL		MILITARY		HELICOPTER	
<i>Company</i>	<i>System</i>	<i>Company</i>	<i>System</i>	<i>Company</i>	<i>System</i>
BOEING	VPM	BOEING	Metaphase	BOEING	Metaphase
AIRBUS	PTC/VPM	EADS	PTC/VPM	EUROCOPTER	VPM
RAYTHEON	PM	LOCKHEED	Metaphase	SIKORSKY	PM
EMBRAER	VPM	Bae	PM	WESTLAND	??
BOMBARDIER	CDM	NORTHROP	Metaphase	AGUSTA	??
DASSAULT	VPM	DASSAULT	VPM		
GULSTREAM	VPM	ALENIA	VPM		

DISCOVERING PLM
GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Thank You
Vielen Dank
Merci Beaucoup
Duō Xiè
Muchas Gracias

Discovering PLM – Sector aeronáutico
Madrid, 10 de marzo de 2015

Fernando MAS - *fernando.mas@airbus.com*
Madrid – March 2015

INDEX

SIMULATION.

DIGITAL FACTORY & VIRTUAL MANUFACTURING

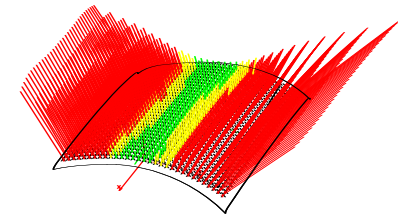
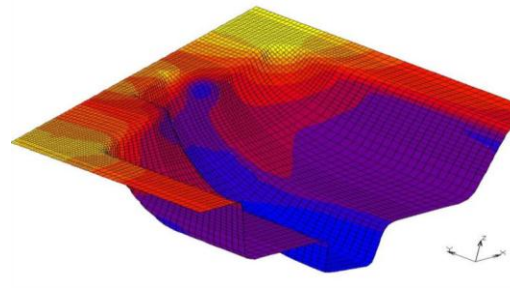
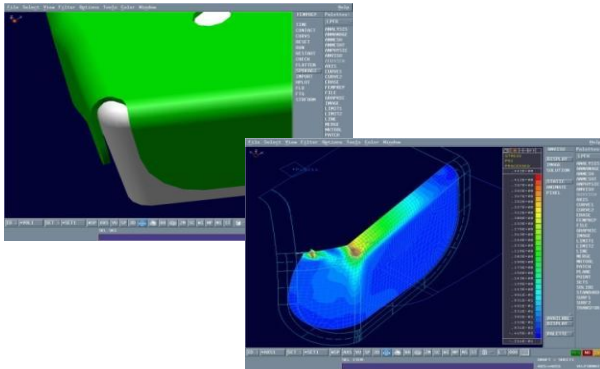
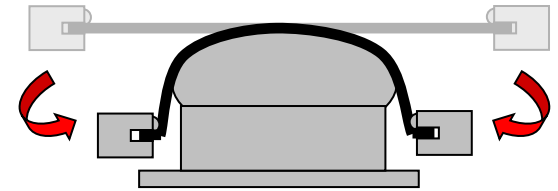
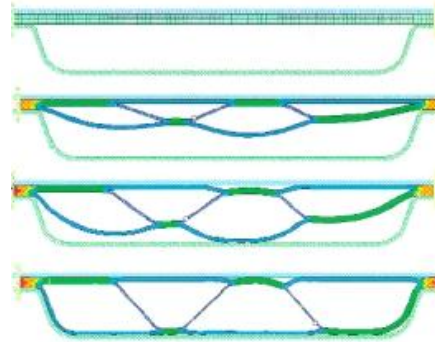
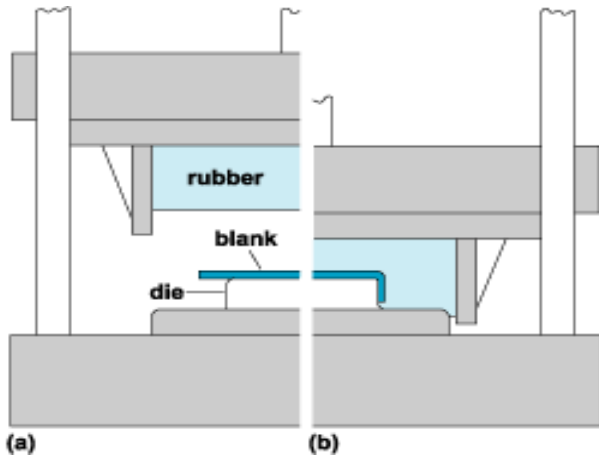
Single parts simulation

Assembly processes simulation

DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

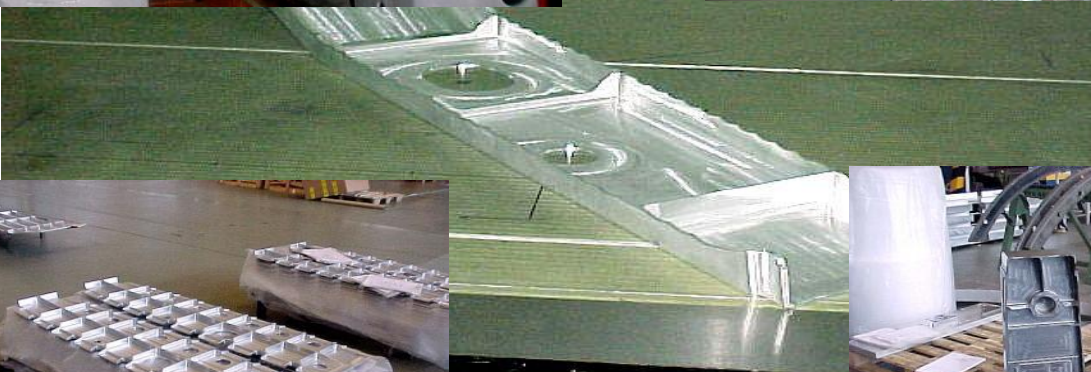
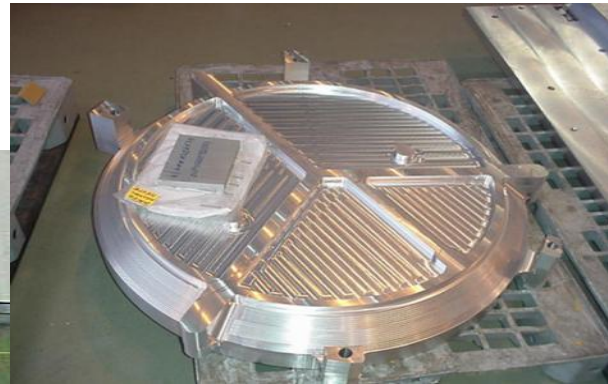
Sheet Metal. Hydroforming, Titanium and Stretchs



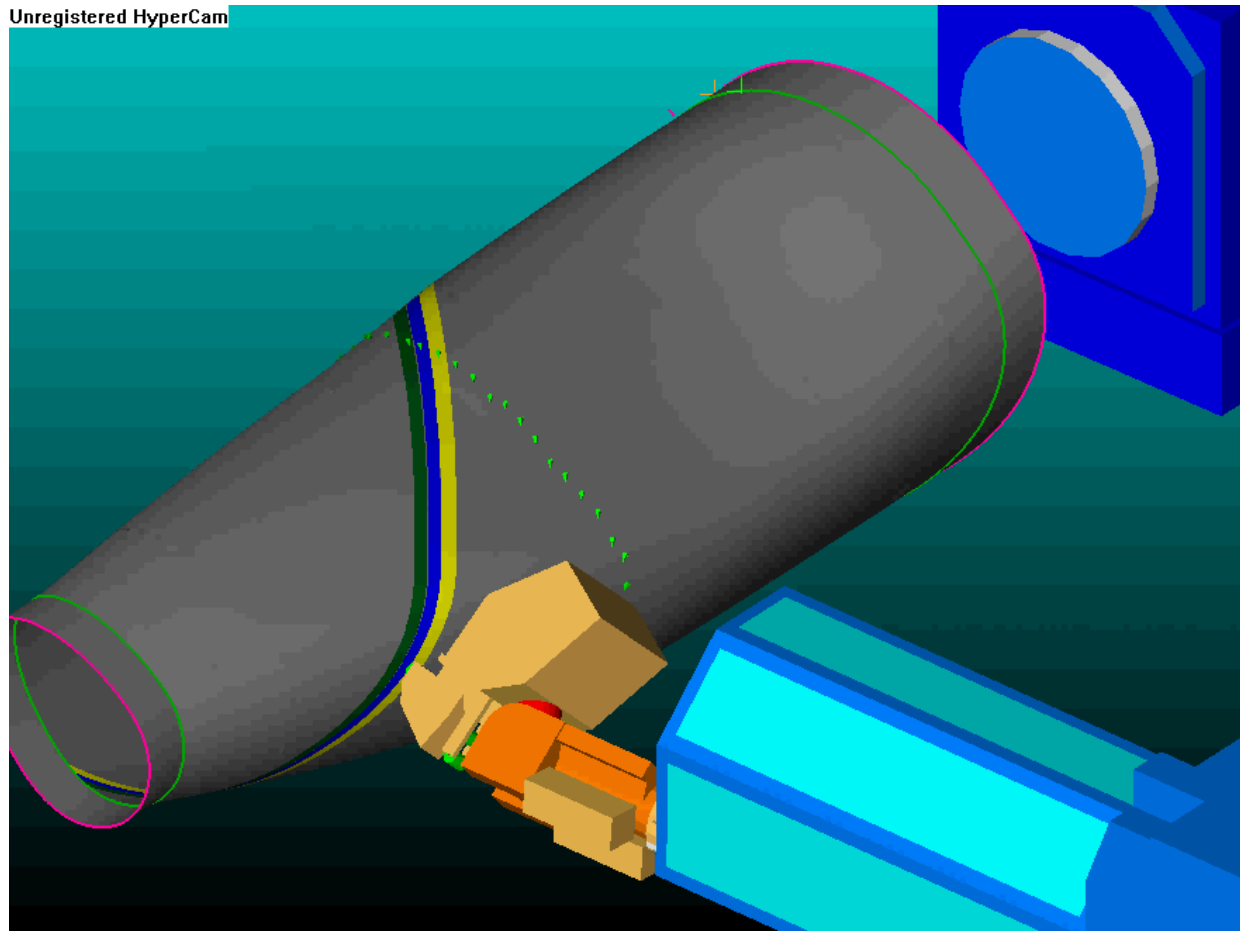
DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Numerical Control simulation.



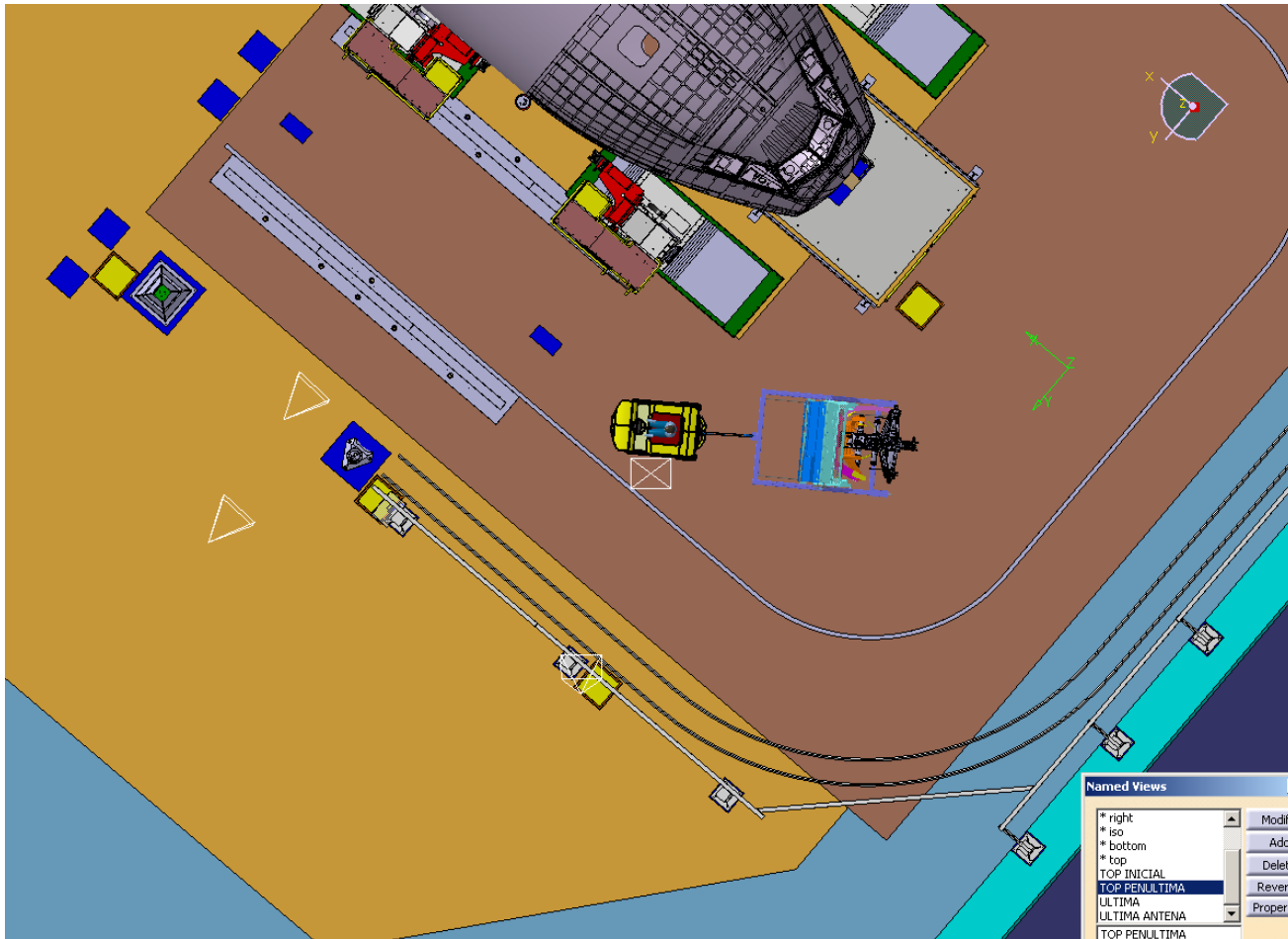
Composite parts simulation



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

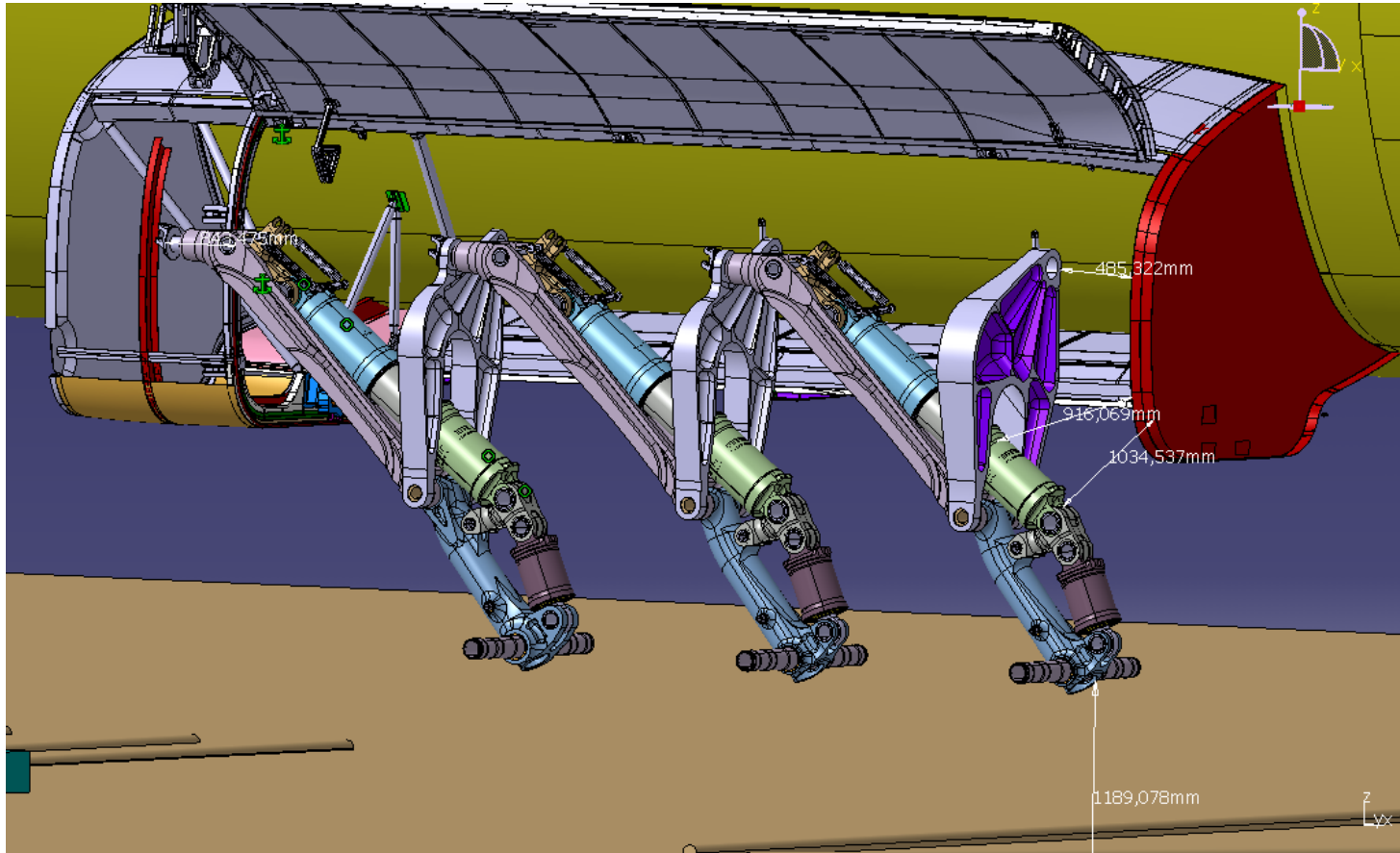
Assembly



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Accessibility



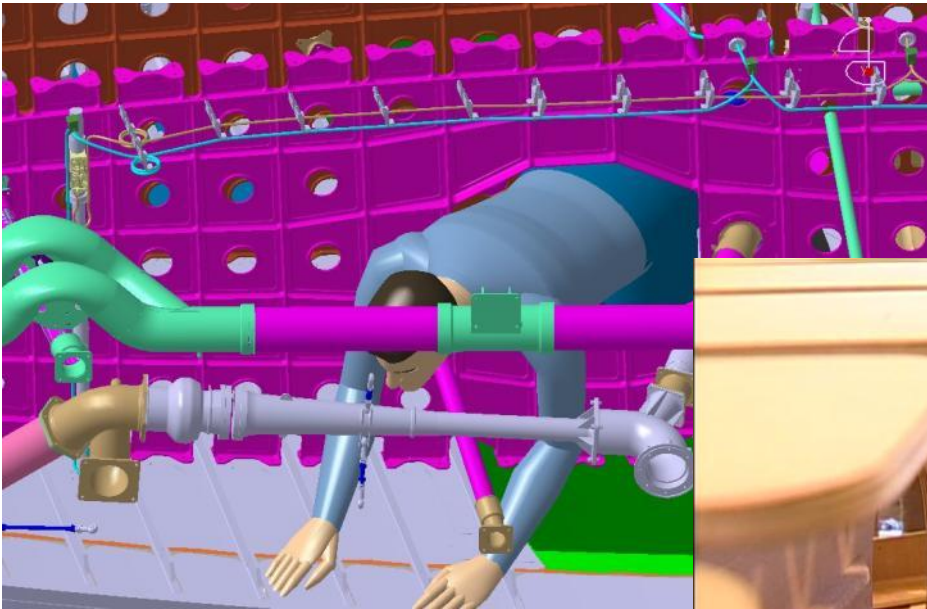
Virtual Mockups vs. Real Mockups (i)



Virtual Mockups vs. Real Mockups (ii)



Virtual Mockups vs. Real Mockups (iii)

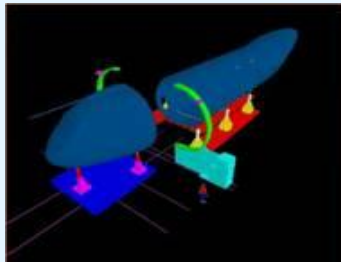


Virtual Mockups vs. Real Mockups (iv)



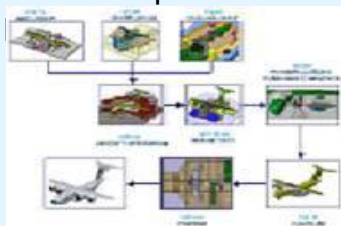
Digital Factory: PHASES

PHASE 1



PRELIMINARY INDUSTRIAL DMU to test and define:

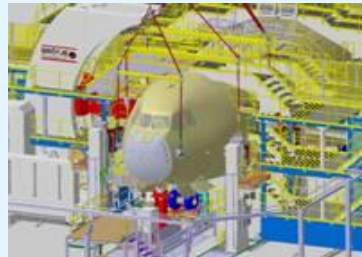
- Design principles.
- A/C main components Interfaces definitions
- Assy Line Layout
- Workers capacity estimations
- Assembly technologies
- J&T concepts



PHASE 2

Detailed and configured **INDUSTRIAL DMU** to define in **CONCURRENCE** and validate:

- Detailed processes.
- Detailed J&T
- Detailed workers capacity
- Detailed Logistics



Detailed **Process and Resources** validated by:

- Assembly simulations
- Ergonomics simulations
- Stations virtual balancing
- Assembly Line flow virtual balancing

PHASE 3

FINAL INDUSTRIAL DMU

to validate:

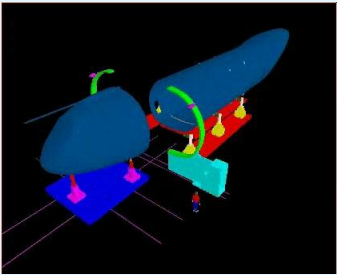
- MAP modifications

and to draw:

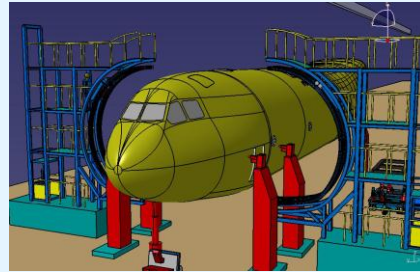
- Detailed work instructions
- Manufacturing BOM
- 3D documentation
- Augmented reality applications



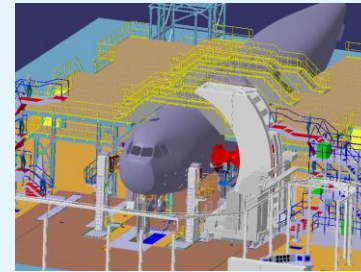
iDMU industrial Digital MockUp



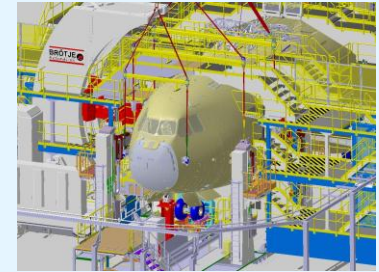
2002



2004

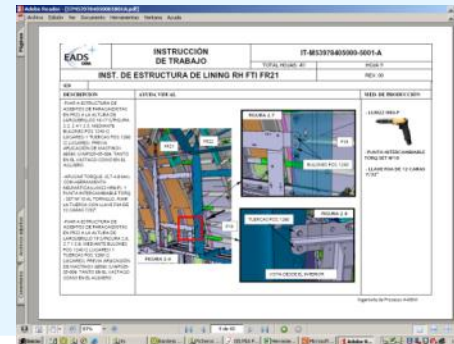


2006

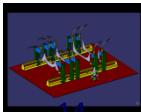
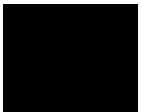
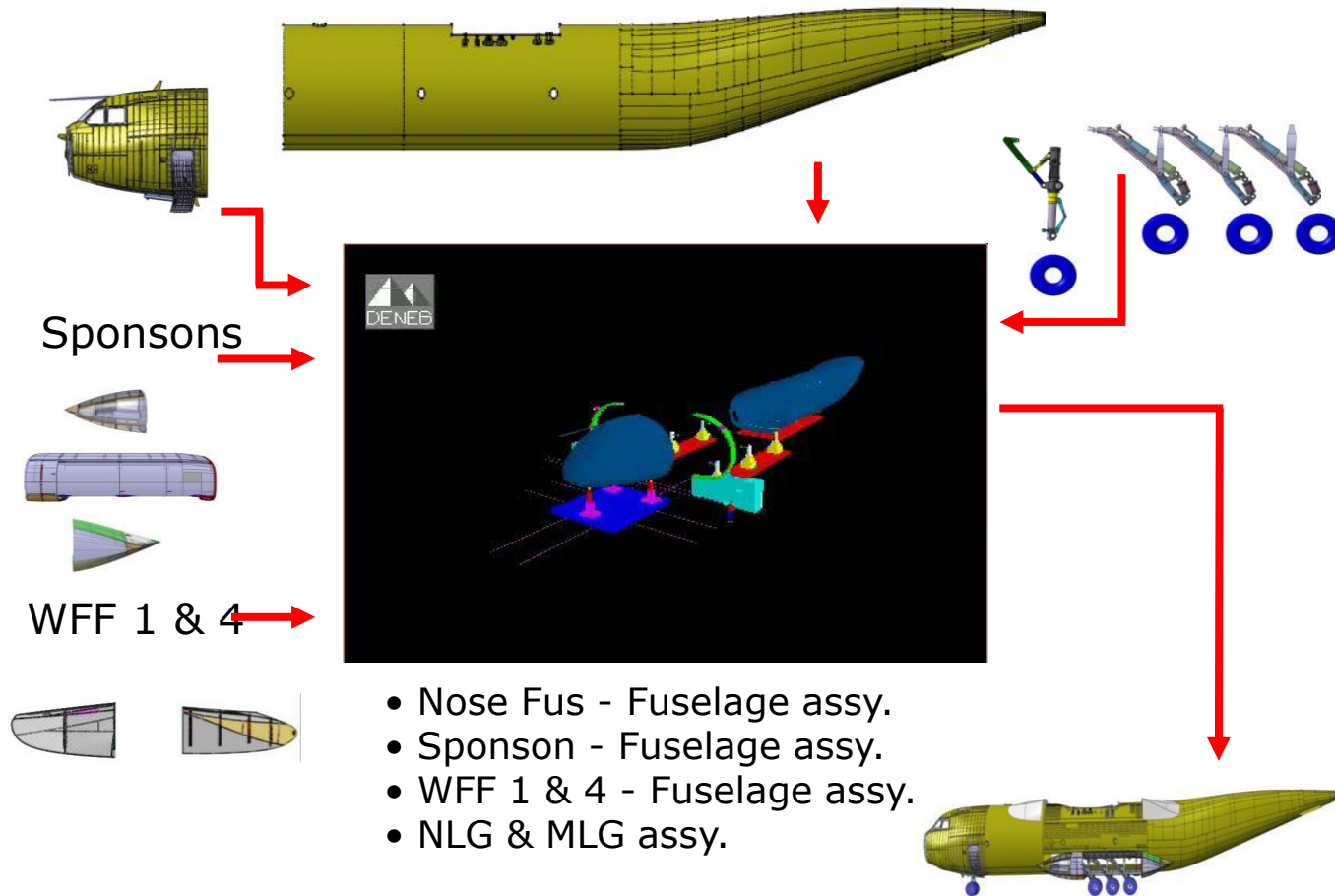


2007

Processes & Resources definition play a decisive influence in the Product definition and evolve with it. iDMU is the master to generate de Shopfloor documentation and the master to calibrate tools & jigs.



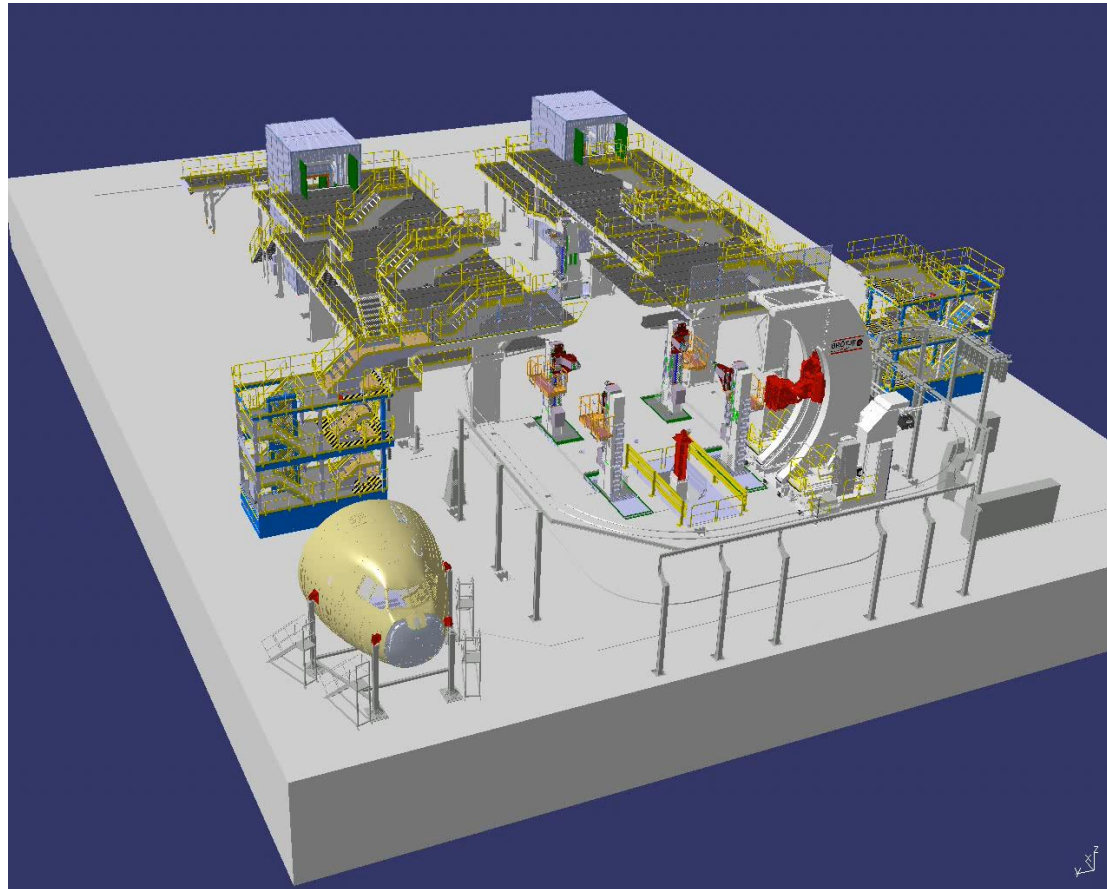
Example Fase I. A400M Fuselage Station



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Example Fase II. A400M Fuselage Station



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Virtual vs. Real

VIRTUAL

REAL

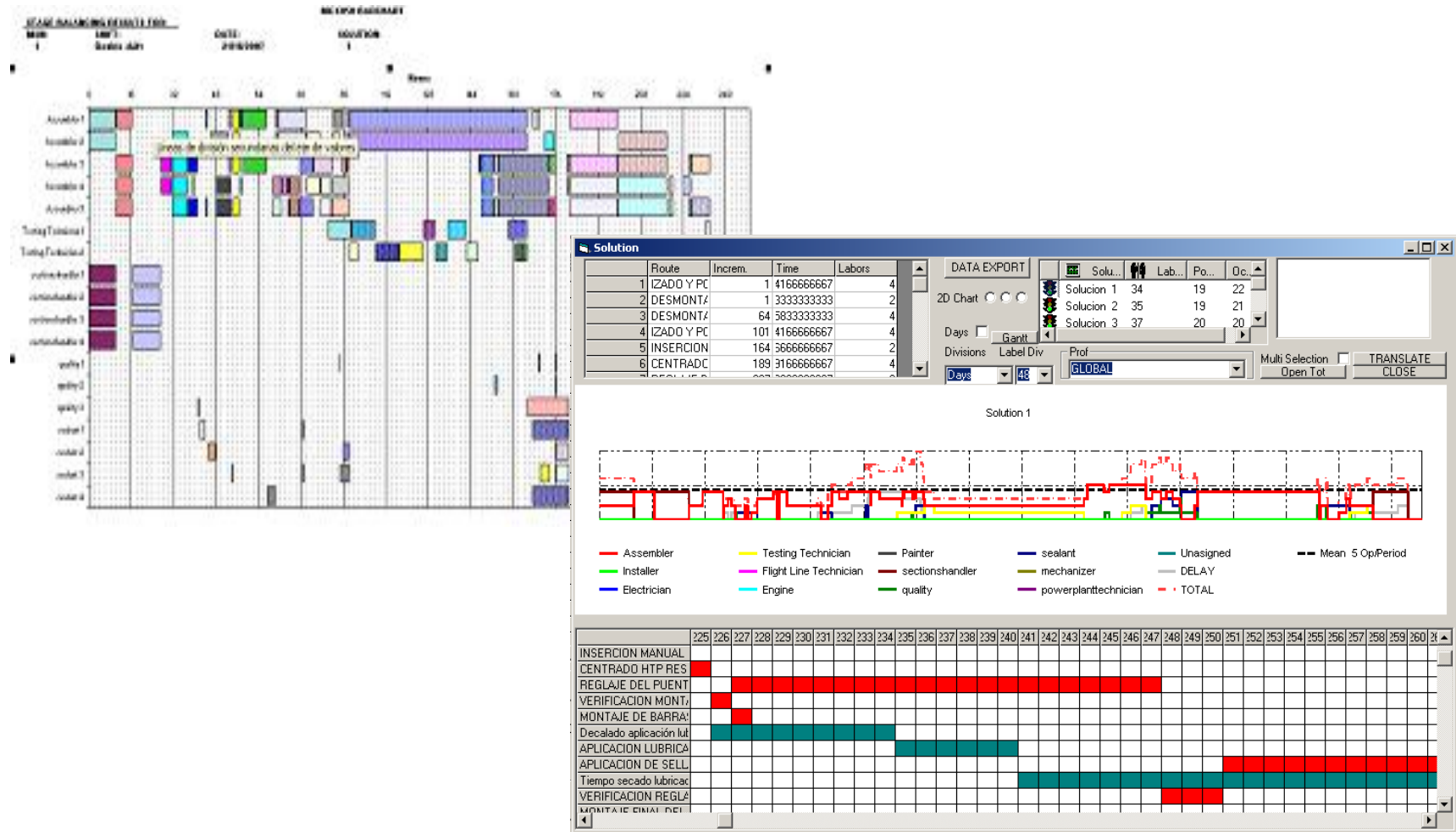


Assembly starts

DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Assembly station optimization



A400M. Complete Assembly Process



30-10-2006

DISCOVERING PLM
GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

**Thank You
Vielen Dank
Merci Beaucoup
Duō Xiè
Muchas Gracias**

Discovering PLM – Sector aeronáutico
Madrid, 10 de marzo de 2015

Fernando MAS - *fernando.mas@airbus.com*
Madrid – March 2015

INDEX

FUTURE TRENDS

CATIA v6.

Industrial Reality.

Virtual Training.

Mixed Reality.

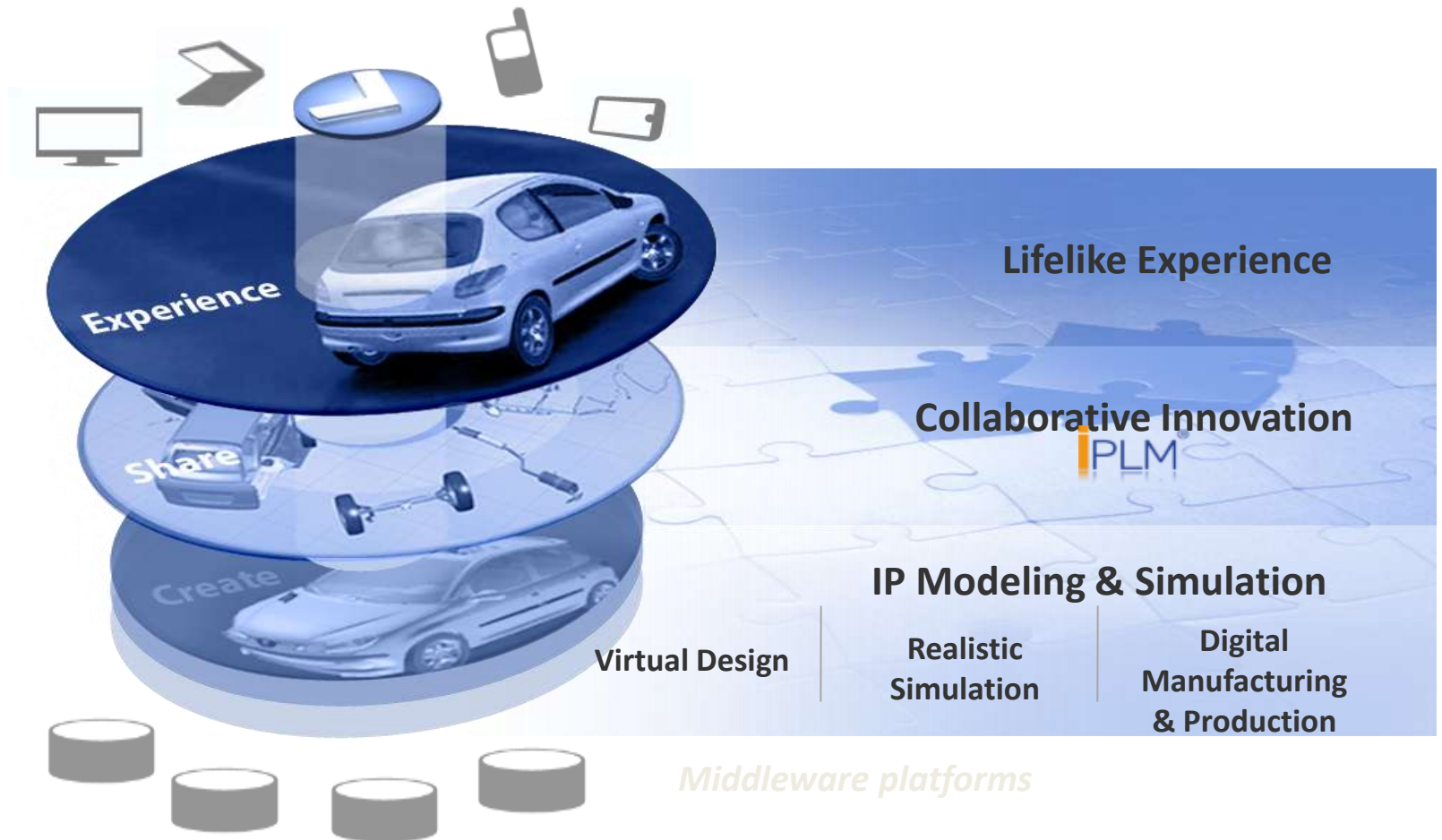
Harnesses Simulation.

Collaborative Engineering

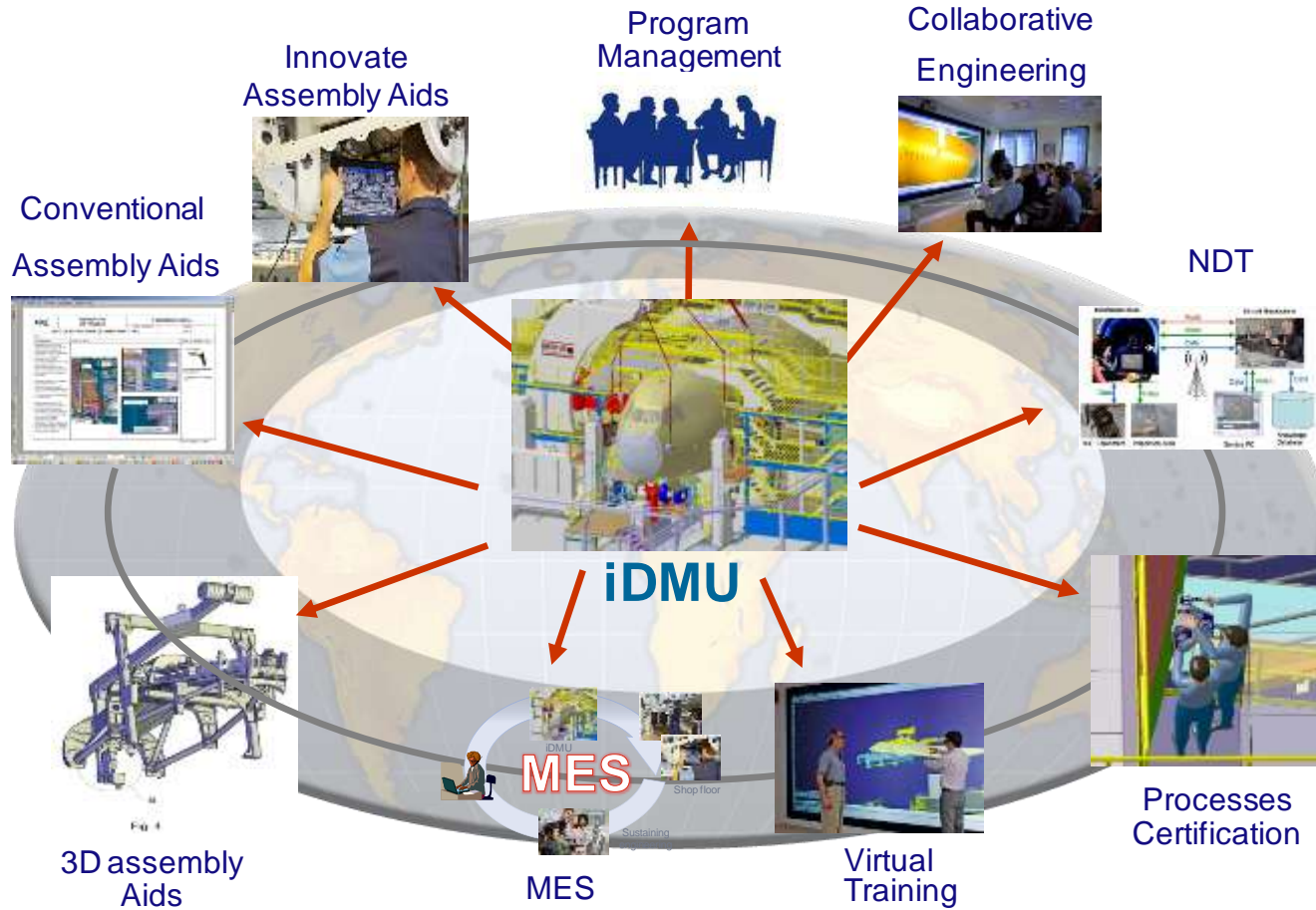
DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

CATIA / DELMIA v6



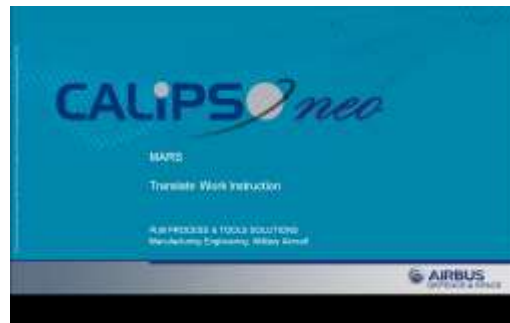
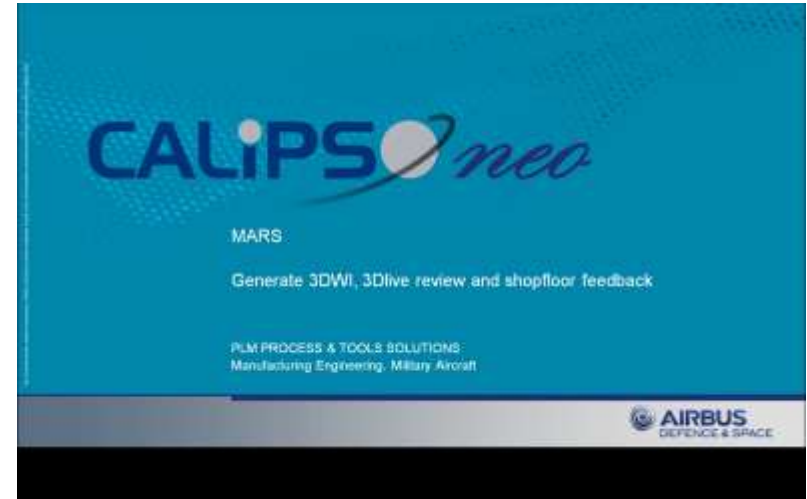
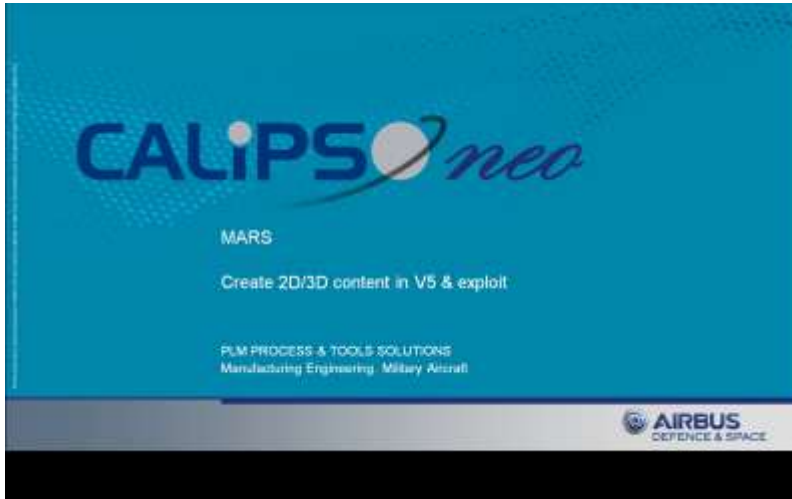
iDMU (industrial Digital Mock Up)



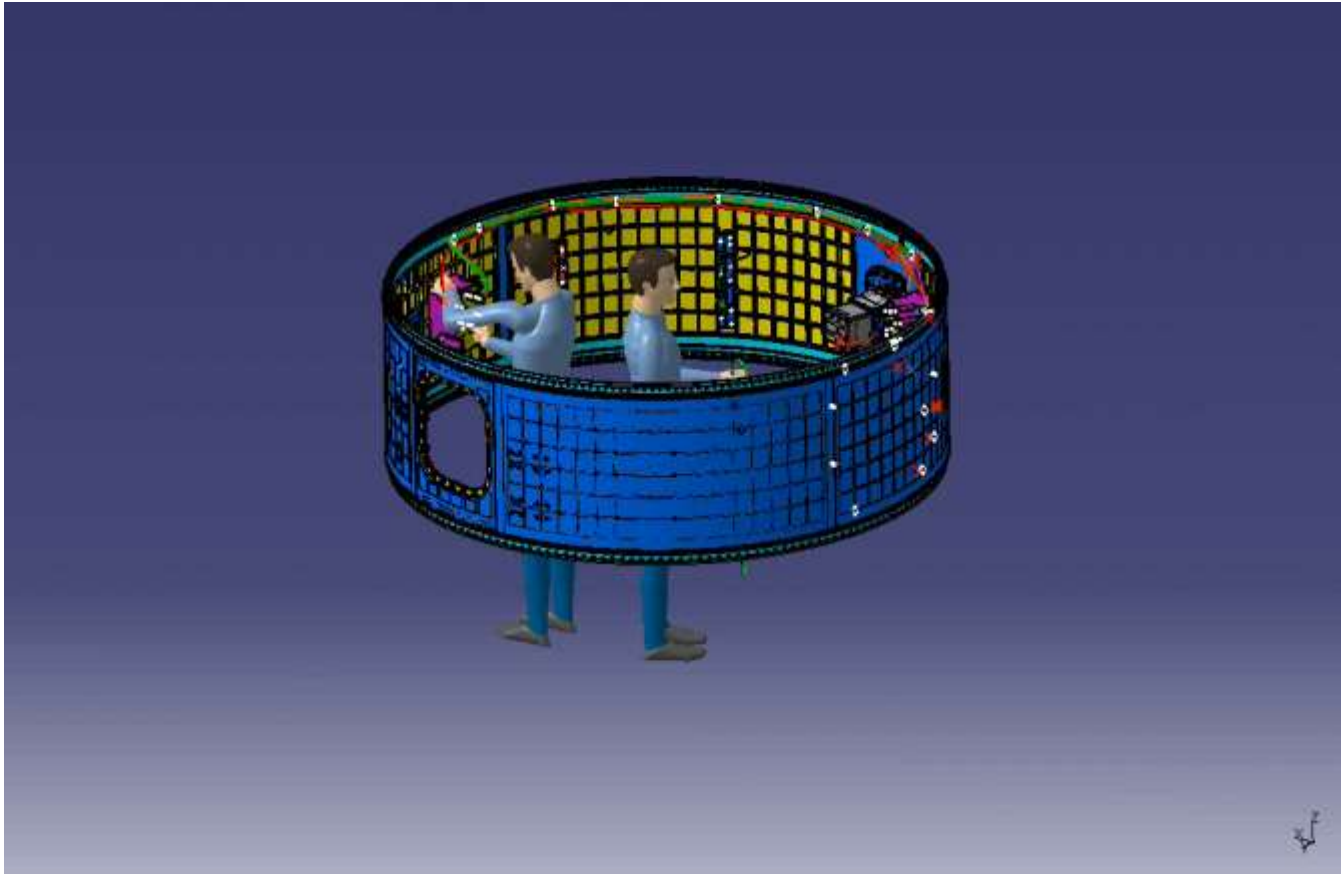
DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Shopfloor documentation 2D & 3D / Translation



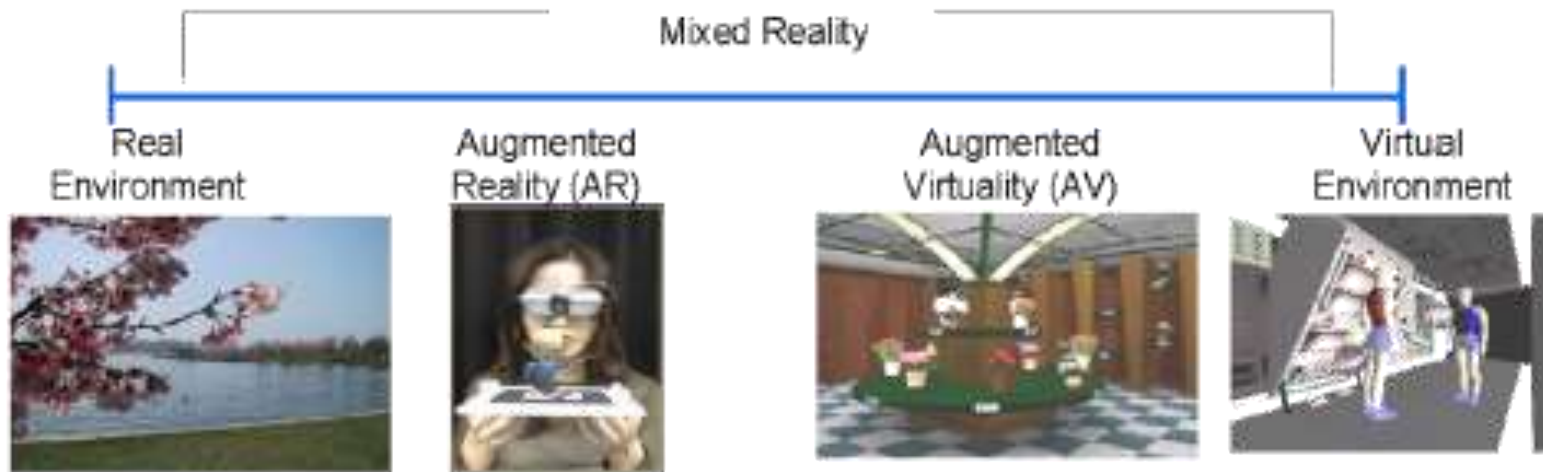
Electrical Harnesses assembly simulation



Mixed Reality. The Concept.

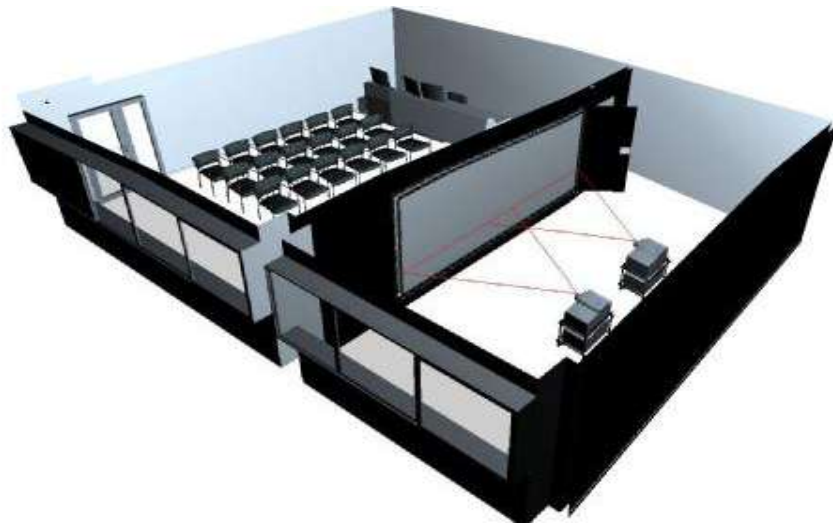
Virtual Reality (VR): Artificial environment generated by computer.

Augmented Reality (AR): To enhance reality with information generated by computer.

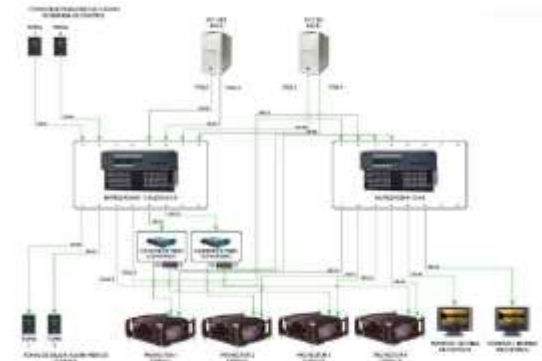


Milgram, Paul, Haruo Takemura, Akira Utsumi, and Fumio Kishino. "Augmented reality: A class of displays on the reality-virtuality continuum." In *Photonics for Industrial Applications*, pp. 282-292. International Society for Optics and Photonics, 1995.

Industrial Reality Room



- ▶ Launch in 2004: the first IR room in Europe.
- ▶ 5,0 x 2,3 m screen back projection
- ▶ High luminosity stereo imagen.
- ▶ Native CAD formats: CATIA
- ▶ No translations: unique product definition.
- ▶ No new tools: CATIA for all.
- ▶ Economic hardware. (PC 64 bits, 32Gb)
- ▶ > 256 MegaTriangles



DISCOVERING PLM

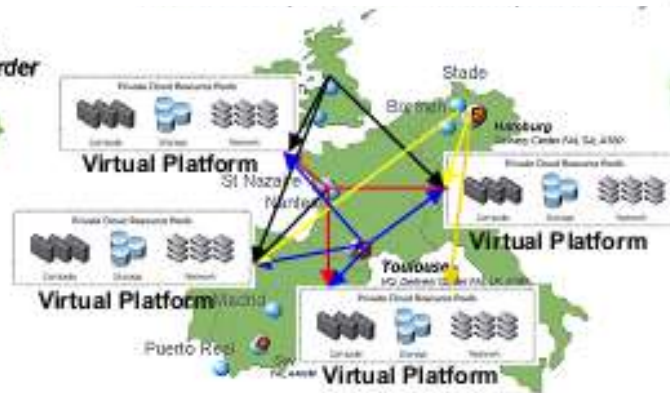
GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

Airbus status (2013)

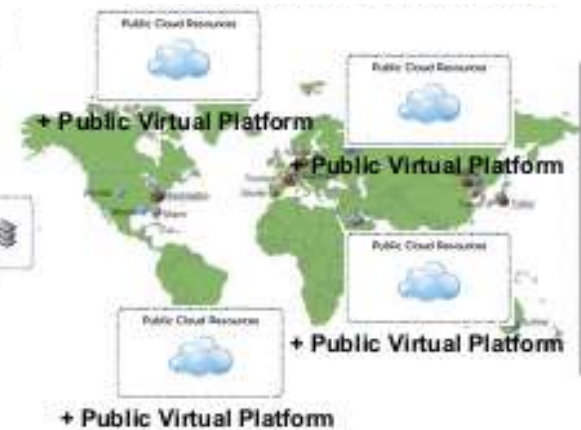
Today
(Specific technologies)



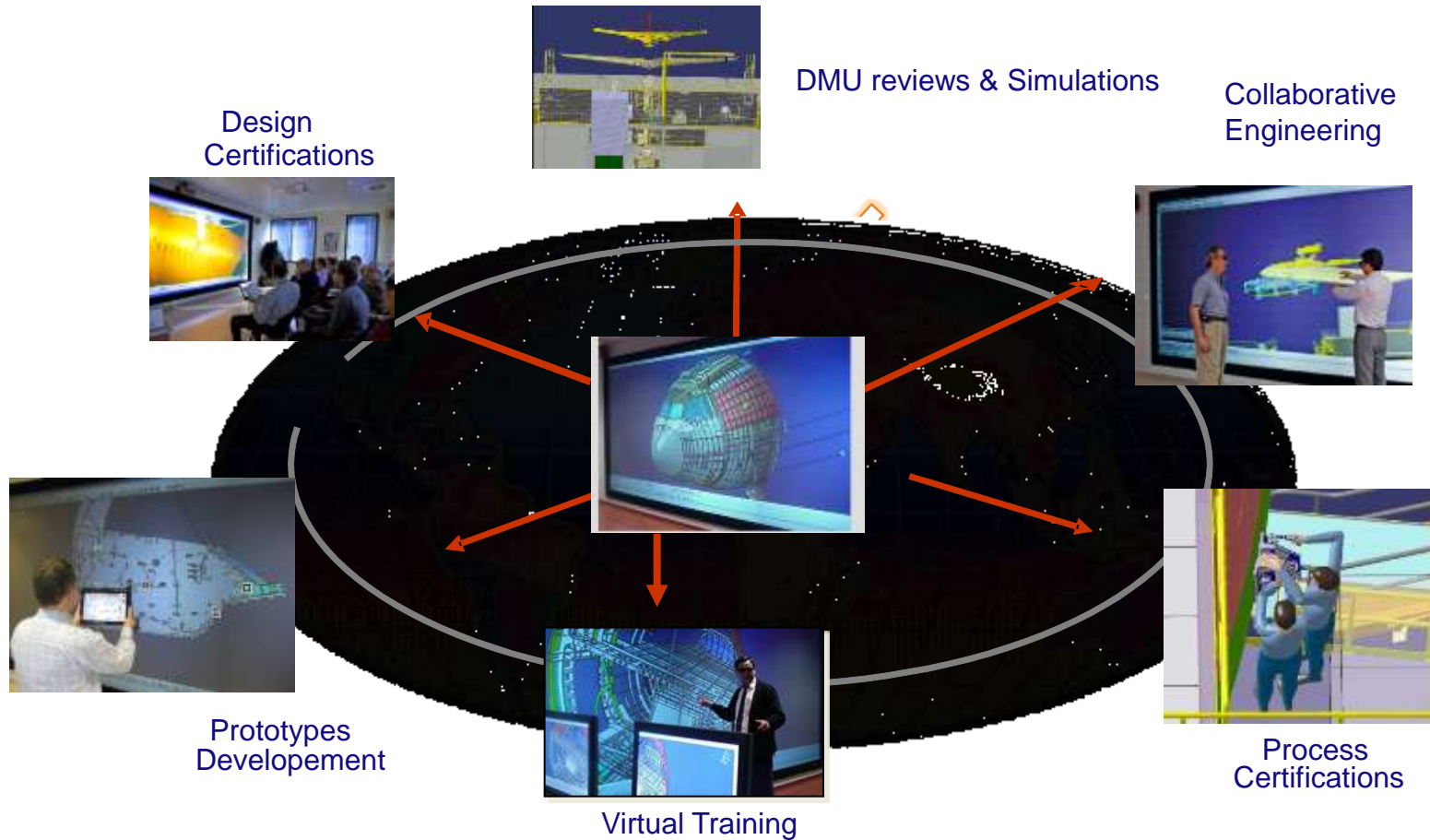
Tomorrow
(Airbus standard)



Tomorrow
(Enhancement)

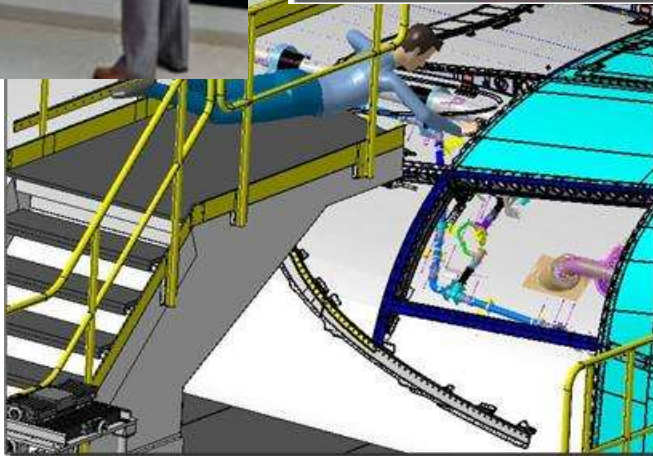
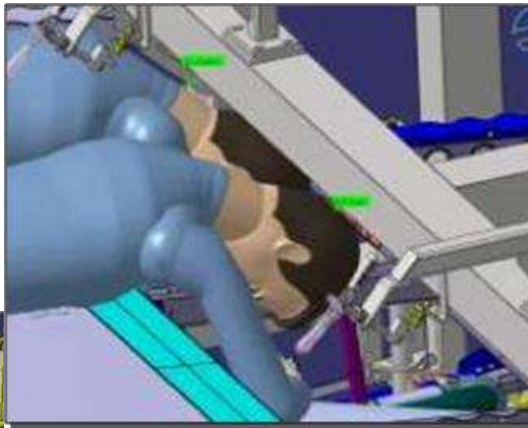


Industrial Reality Room uses.



Virtual Training

Industrial Reality environment where assembly processes can be verified by Engineering and Assembly Line blue collars in a concurrent and iterative process.



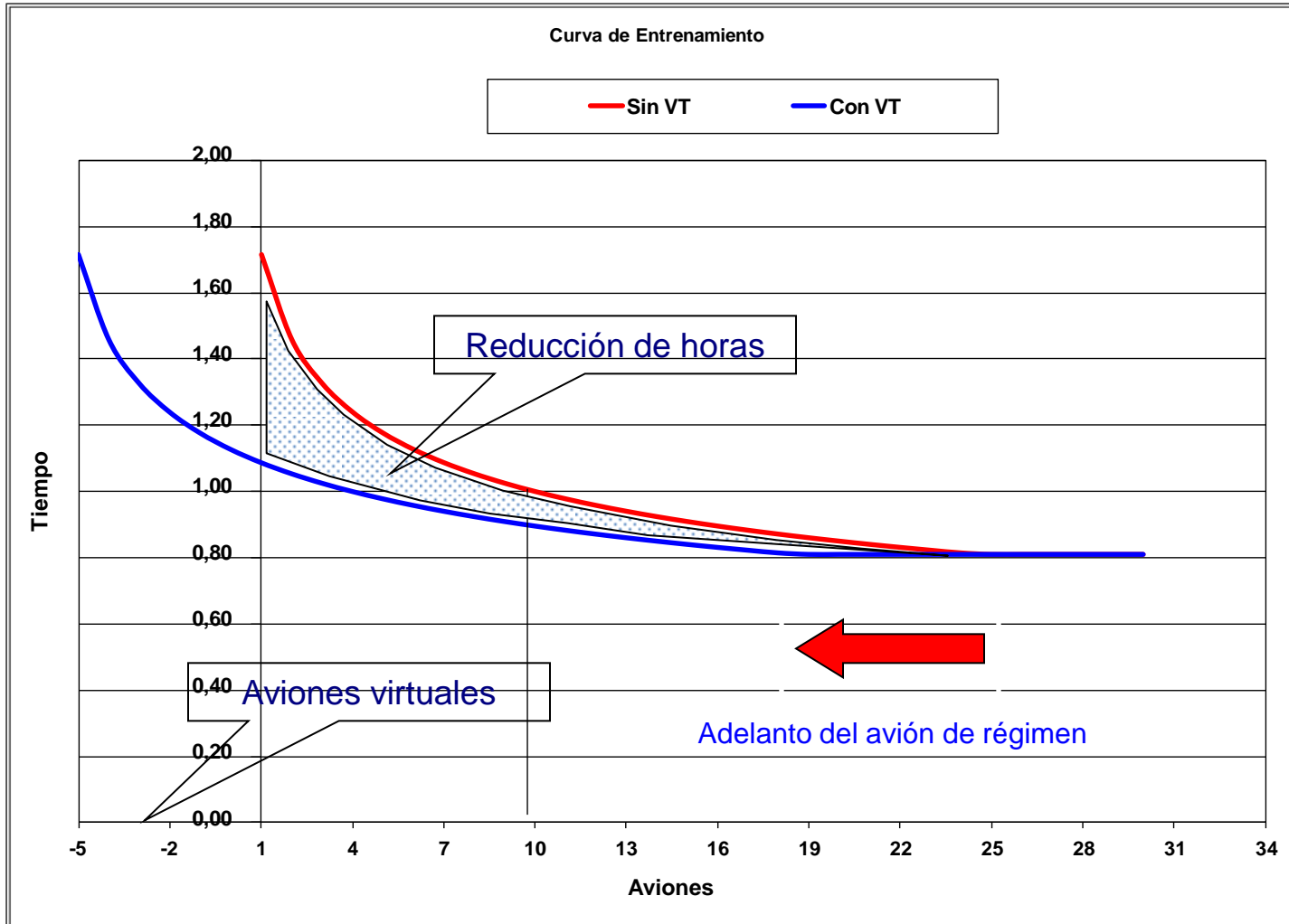
Resources:

Industrial Reality 3D room.
Industrial DMU.
DELMIA simulations.
Shopfloor documentation.
Process Engineering.
Assembly Line blue collars.

Benefits:

Assembly Processes optimized and validated in concurrence using 3D simulations.
Assembly Line blue collars virtually trained.
Improved reputation of being an innovative corporation.

Virtual Training



Mixed Reality. The history

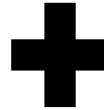
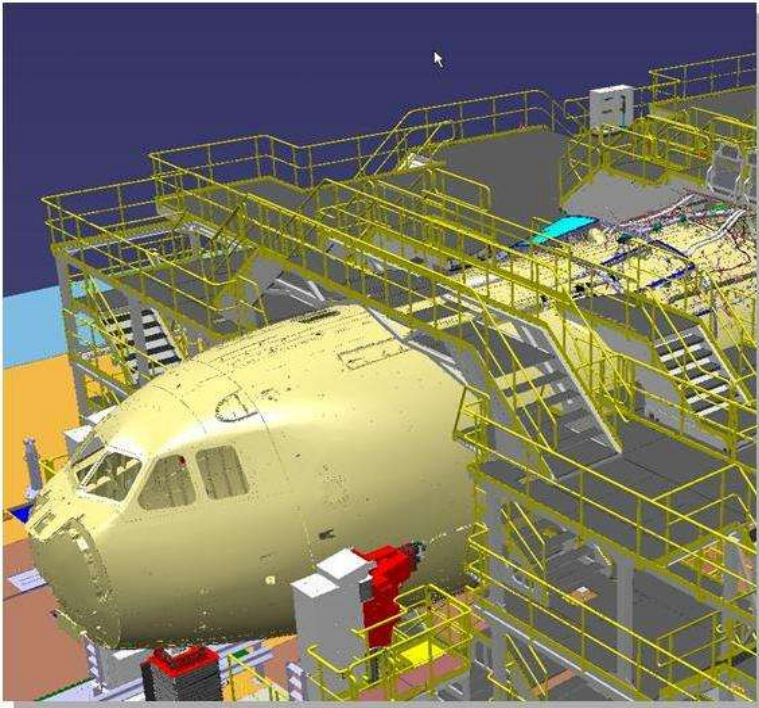
- **1956** Morton Heilig. Sensorama
- **196x** Sutherland & Sproull's. HMD
- **198x** USAF helmet displays.
- **199x** Tom Claudell, Boeing. Digital HMD to guide workers through assembling electrical wires in aircrafts
- **2005** Airbus launch a first AR project in Spain
- **200x** Saatchi & Saatchi. First mobile phone based AR advertising application for Wellington Zoo
- **20xx** Google glass ??



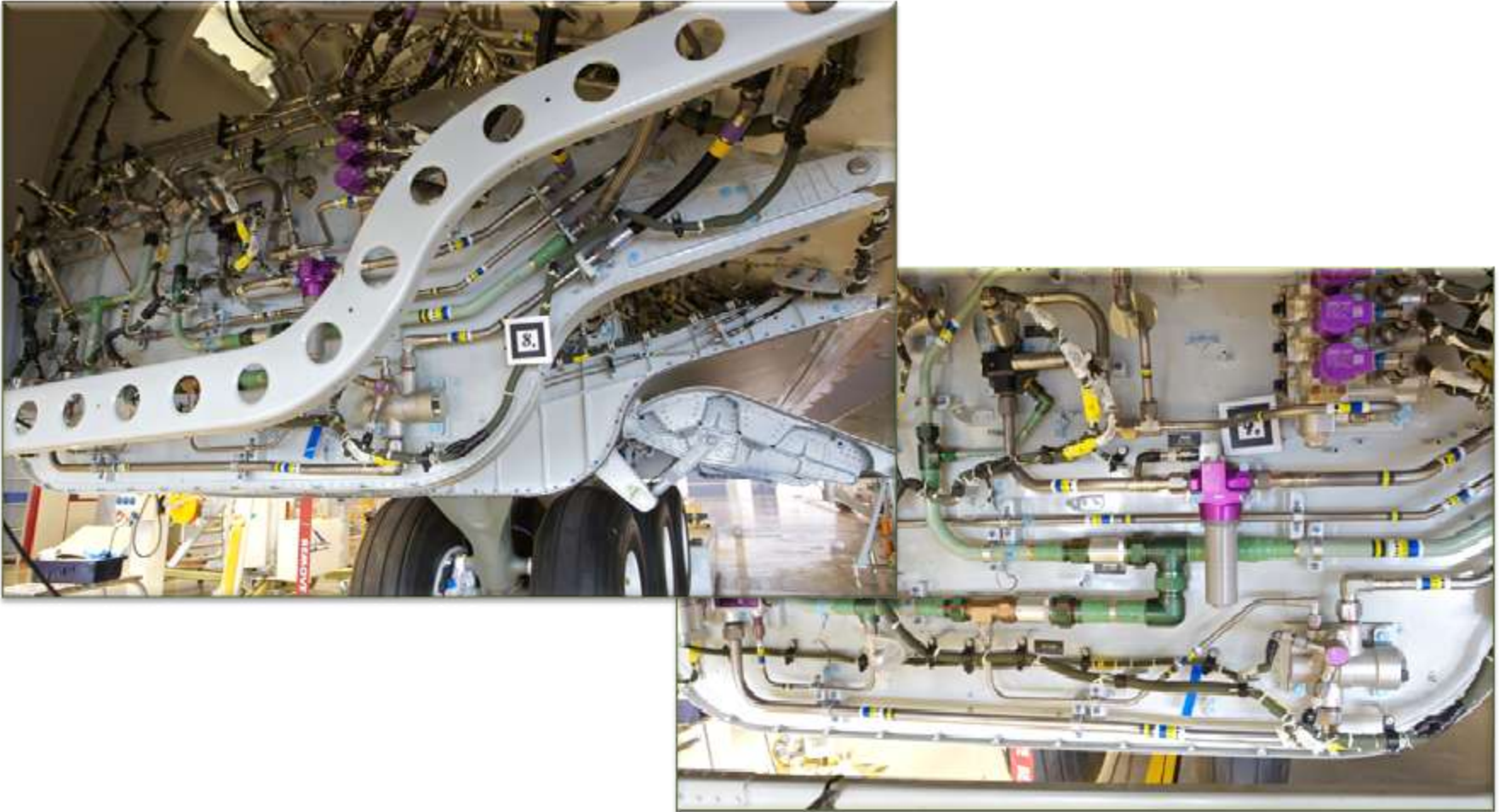
Augmented Reality – An ancient technique



Augmented Reality. Virtual World + Real World



The assembly scenario in a FAL (Final Assembly Line)

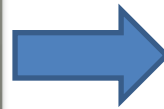
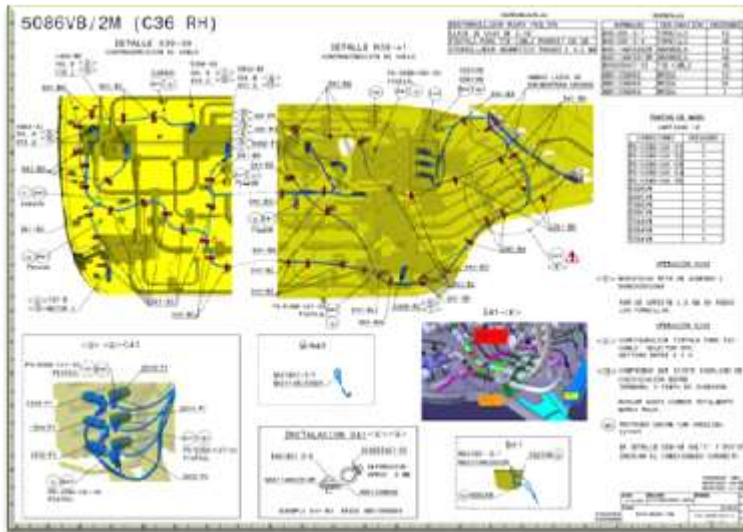


The current way using Augmented Reality



Classical vs. Augmented Reality

Classical Assembly Support



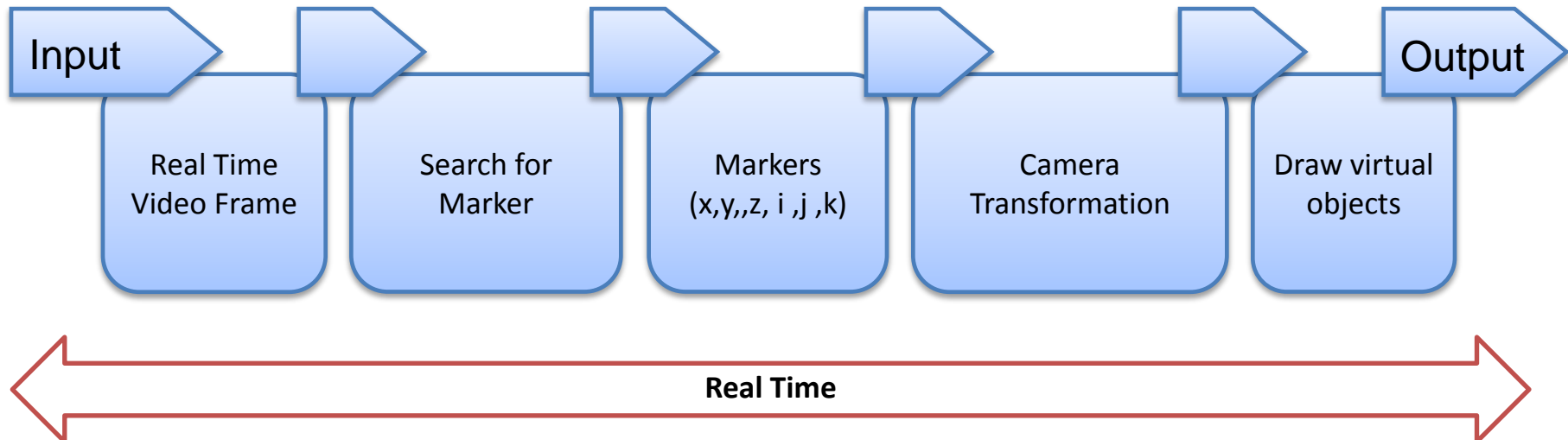
Augmented Reality Assembly Support



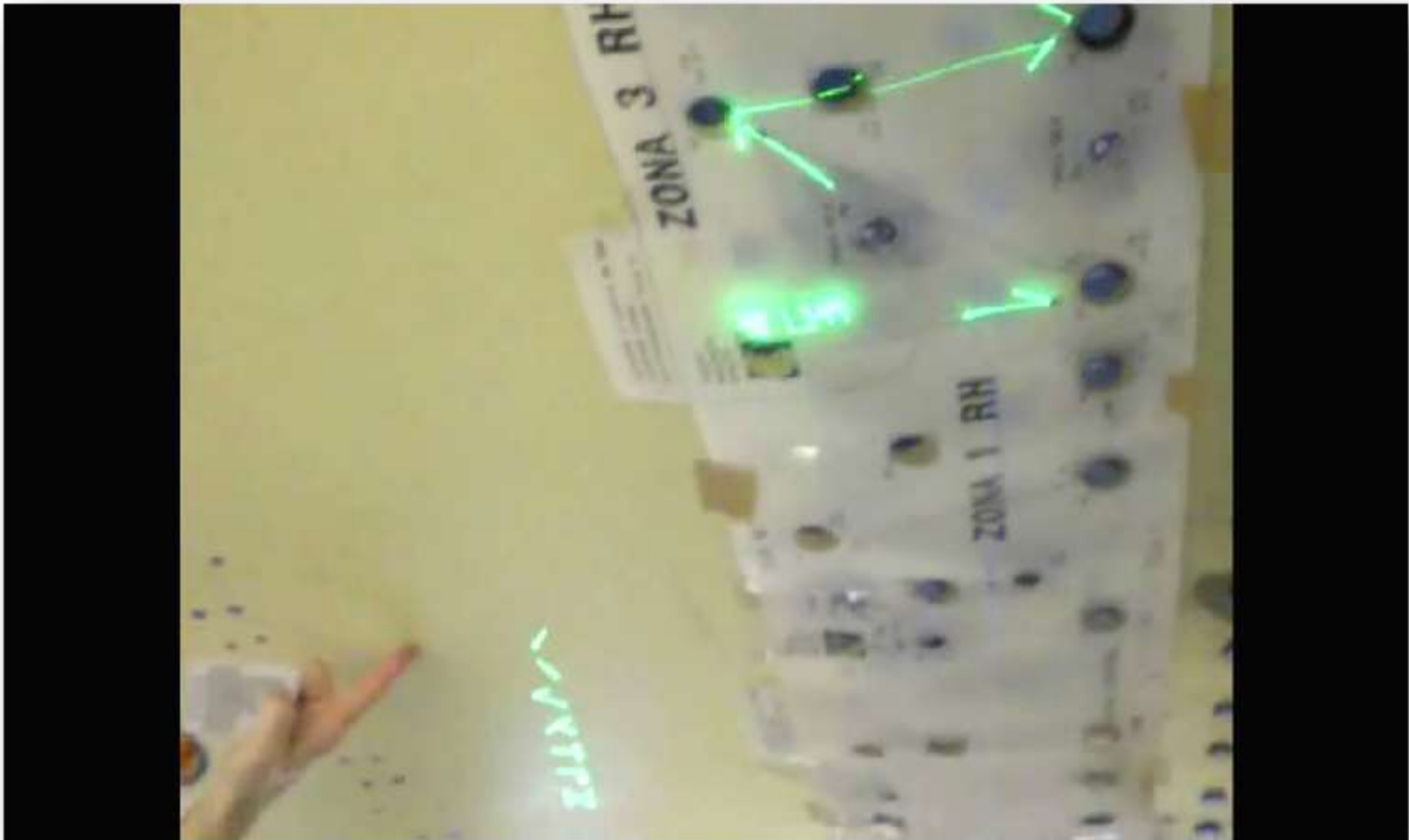
- Documentation not linked to iDMU.
- High generation and update time.
- Low traceability.
- 2D format. Spatial vision needed.

- System linked to iDMU.
- Low generation and specially low update time.
- High traceability.
- No spatial vision needed.

How does augmented reality work?



SAMBAlaser - Sistema de Ayuda al Montaje BAso en laser



AQUATIC - Automatic QUALity InspeCtion



High precision and accuracy

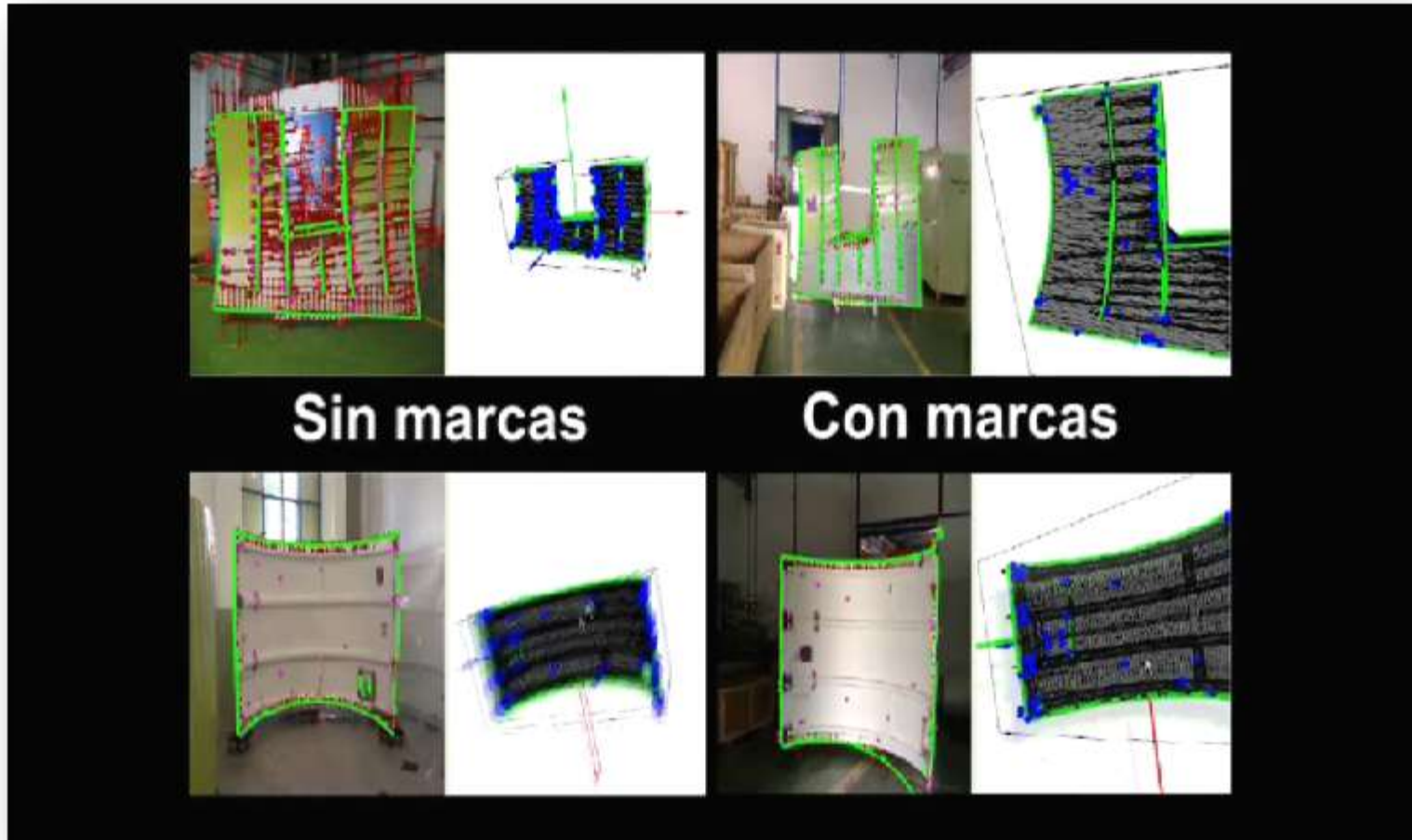
DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

MOON - asseMbly Oriented authOring augmeNted reality



ELARA - gEneraLization to assembly authoring Aug. ReALity



DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

ORION - low cost laser for AutoRing sf documentatiON



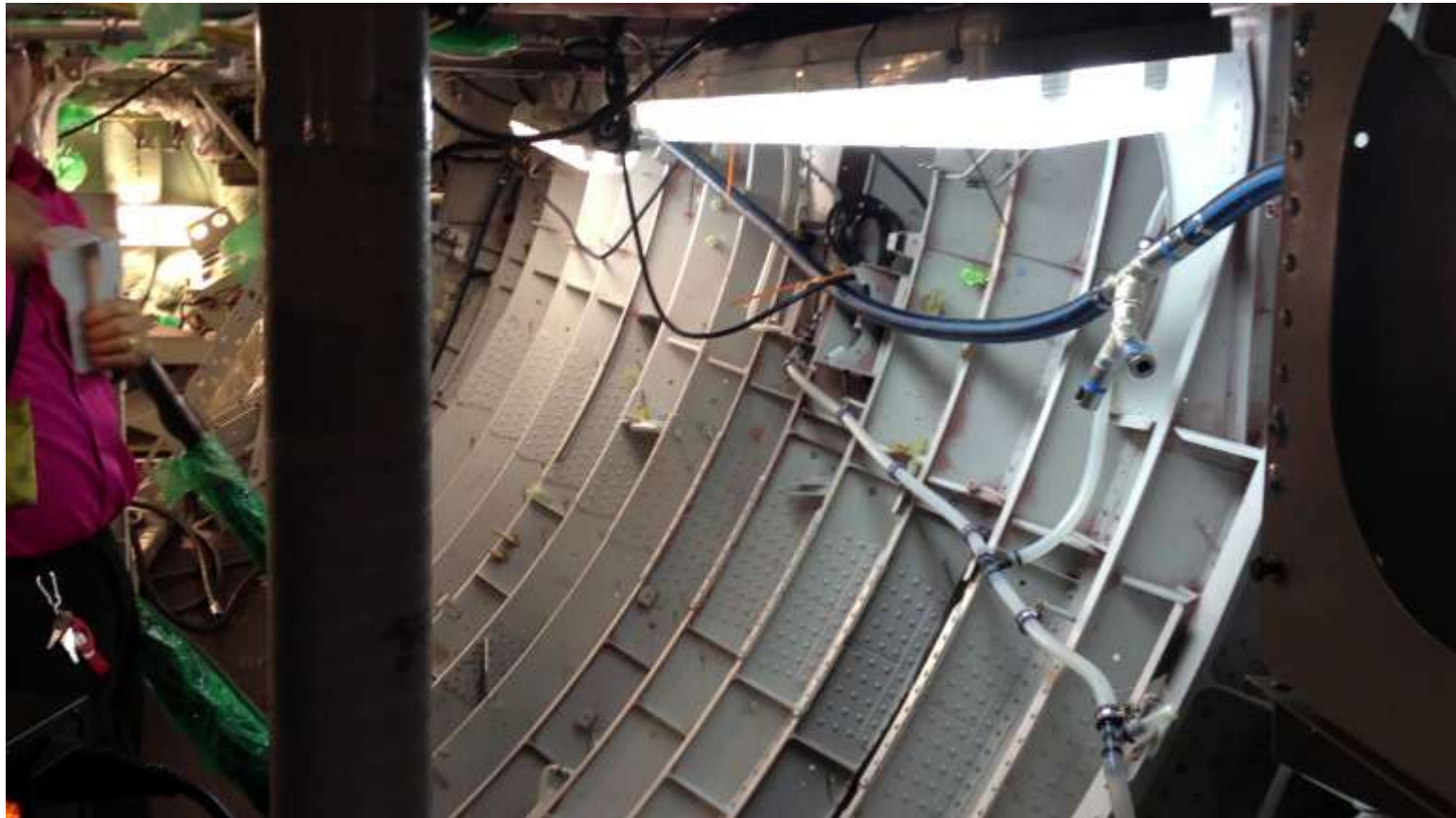
SELENE - Stickers assEmbly by LasEr projection tEchs



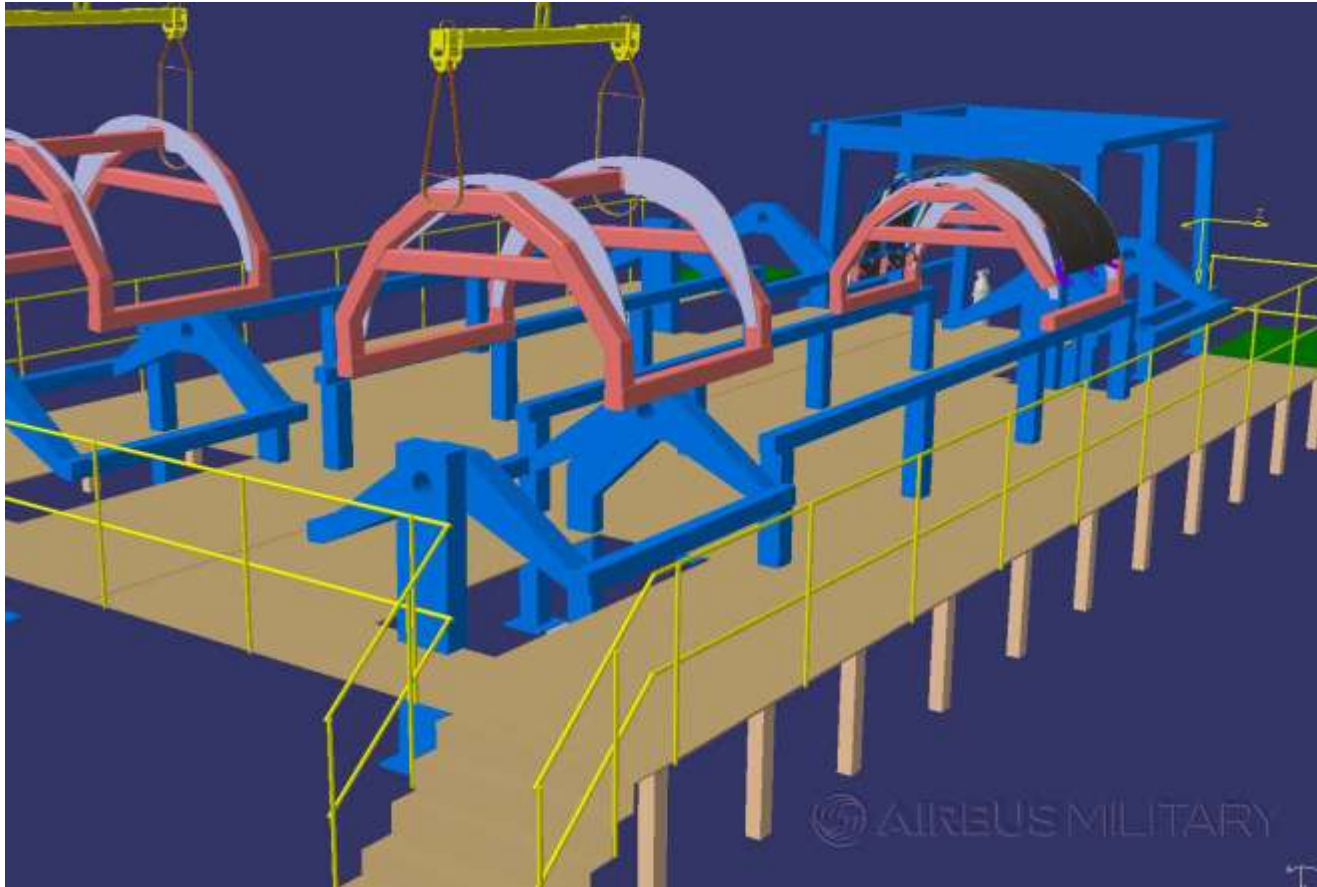
DISCOVERING PLM

GESTIÓN DEL CICLO DE VIDA DEL PRODUCTO

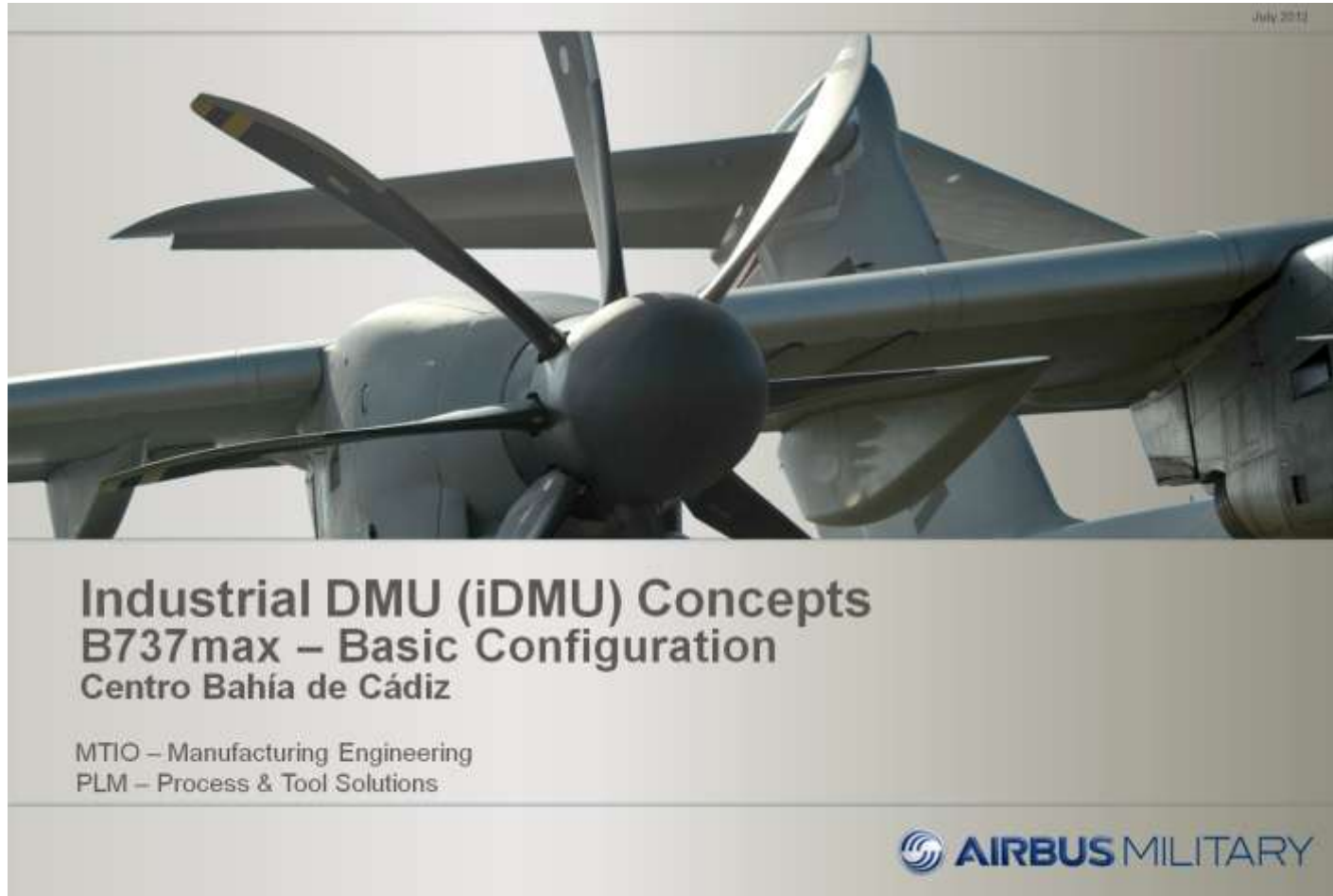
ANDALUS - universAl augmeNteD reAlity assemBly sUpport for bracketS



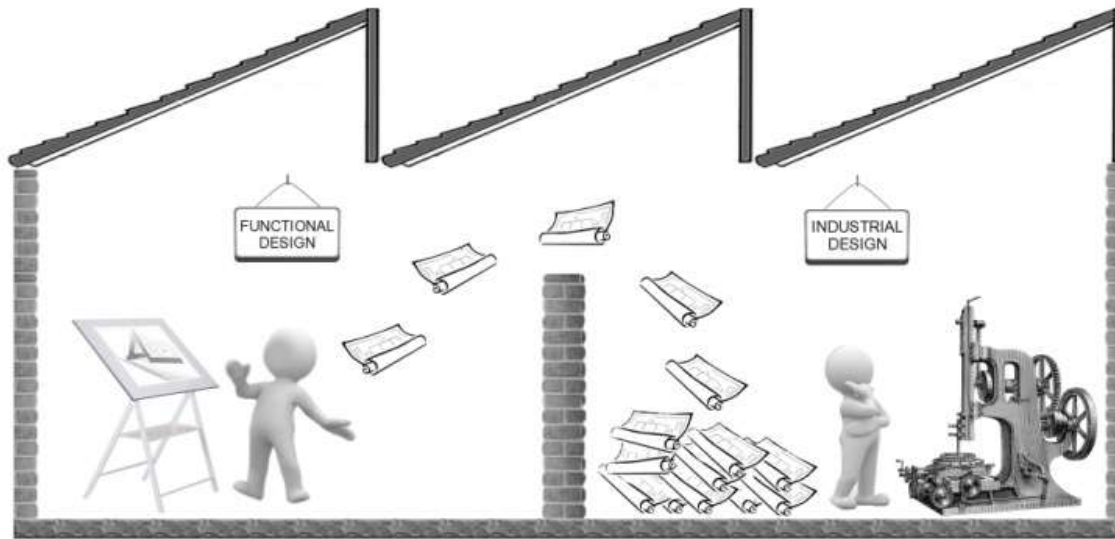
Collaborative Engineering



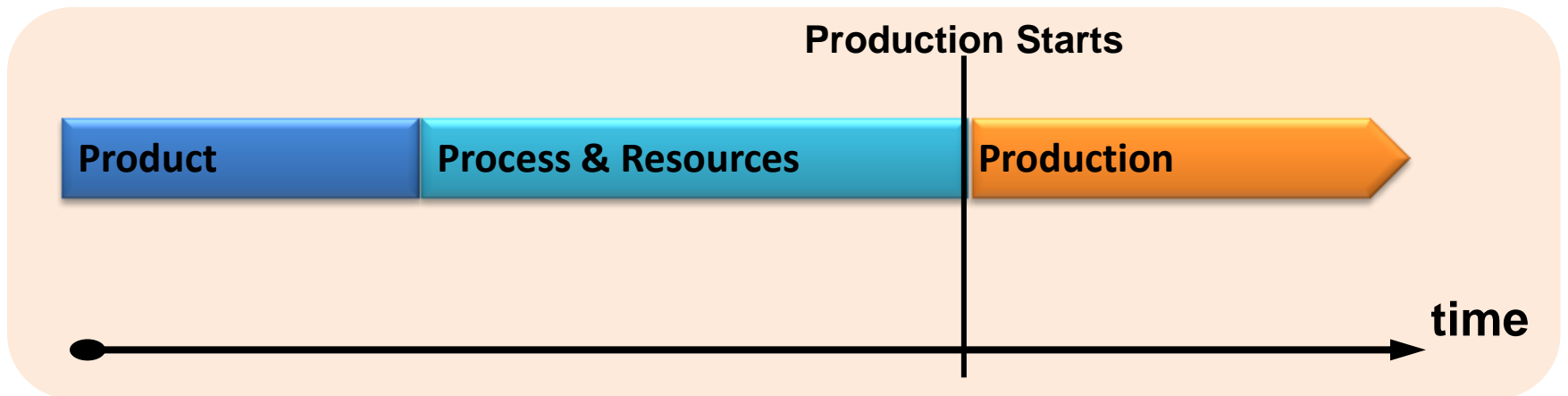
Collaborative Engineering – B737max Assembly line



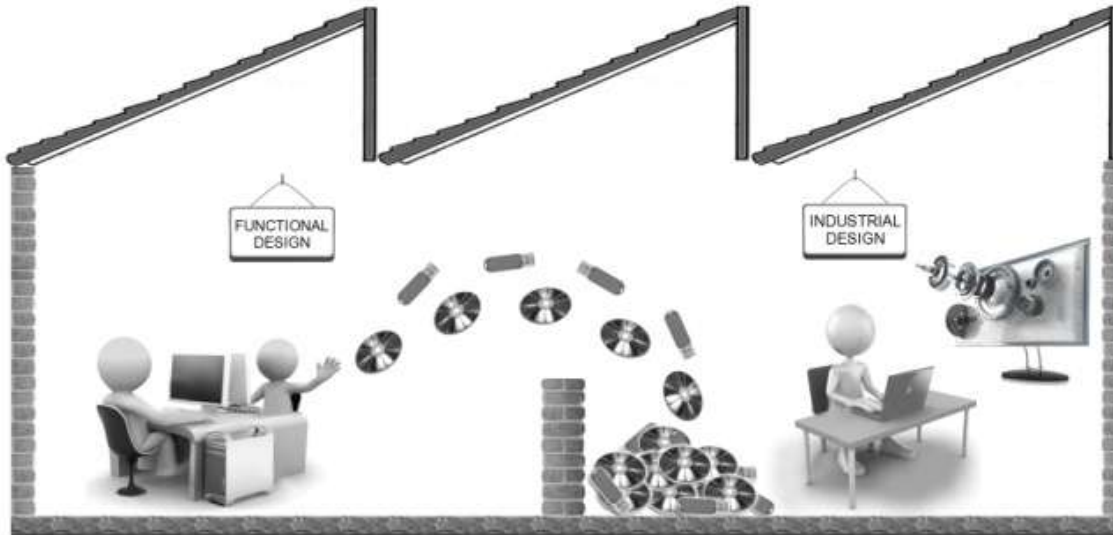
A Transformation Process (i)



Classical
view

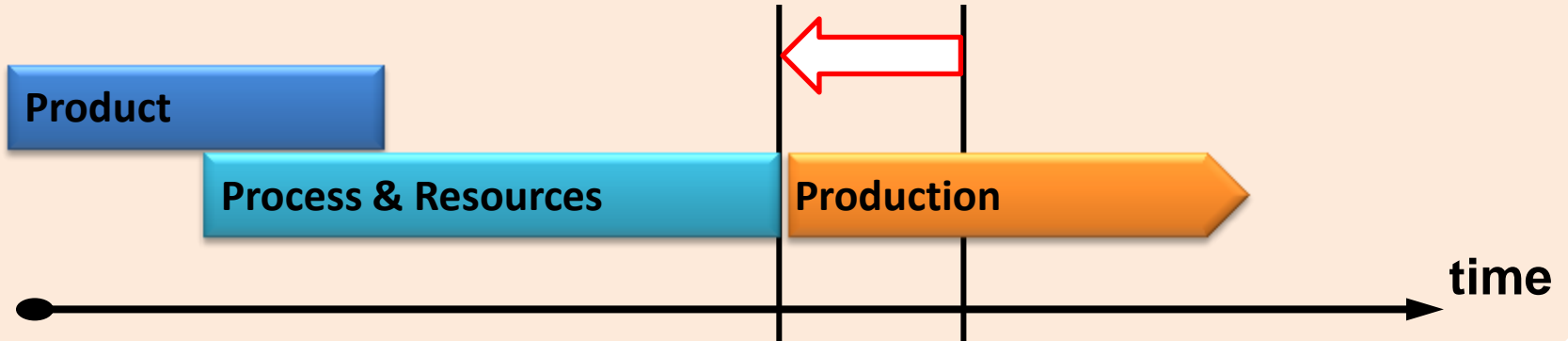


A Transformation Process (ii)

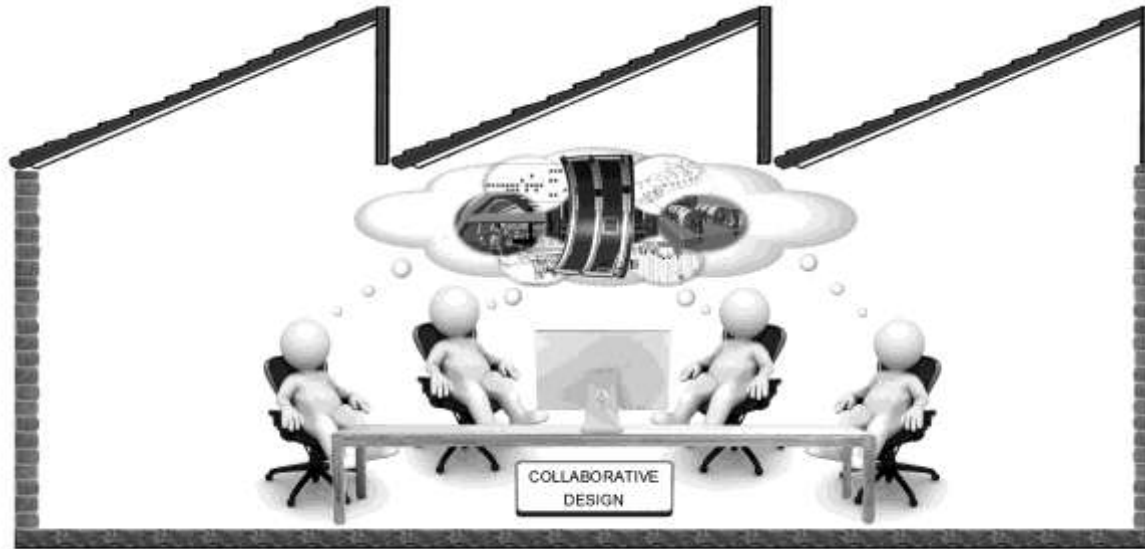


Concurrent
view

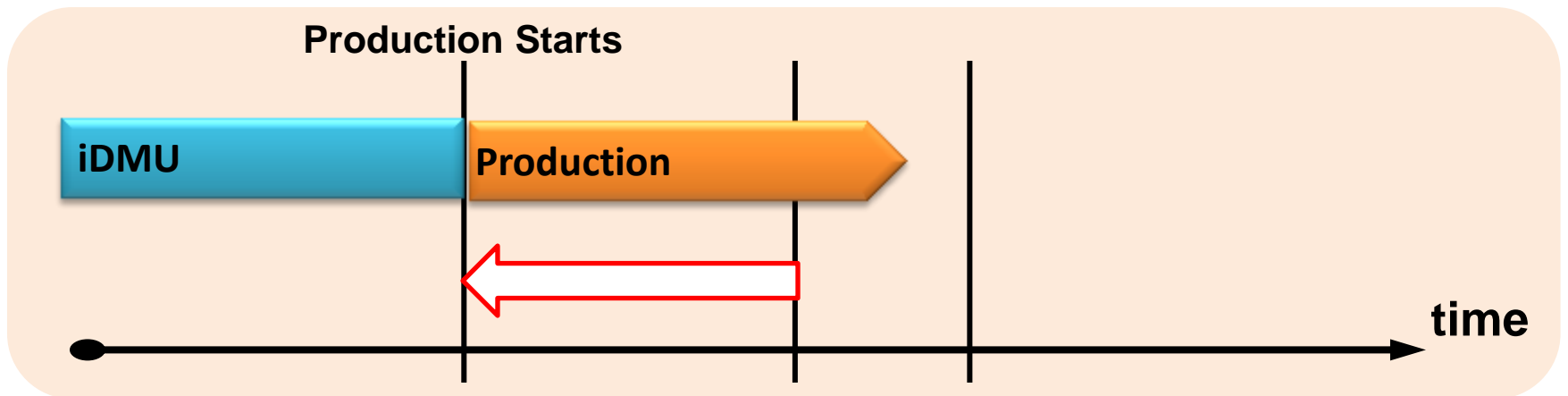
Production Starts



A Transformation Process (iii)



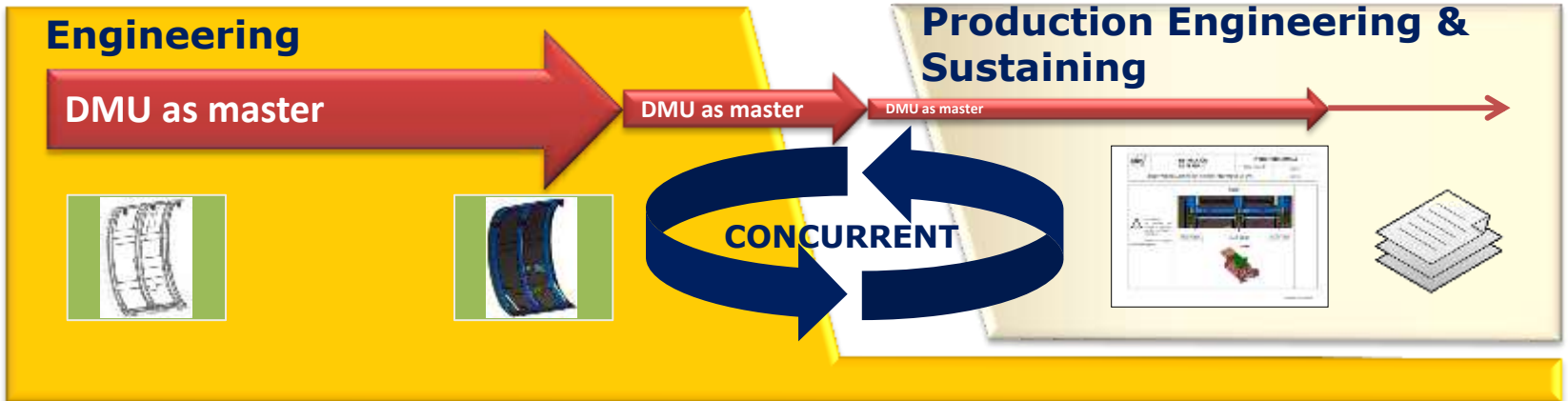
Collaborative
view



Global Scenario



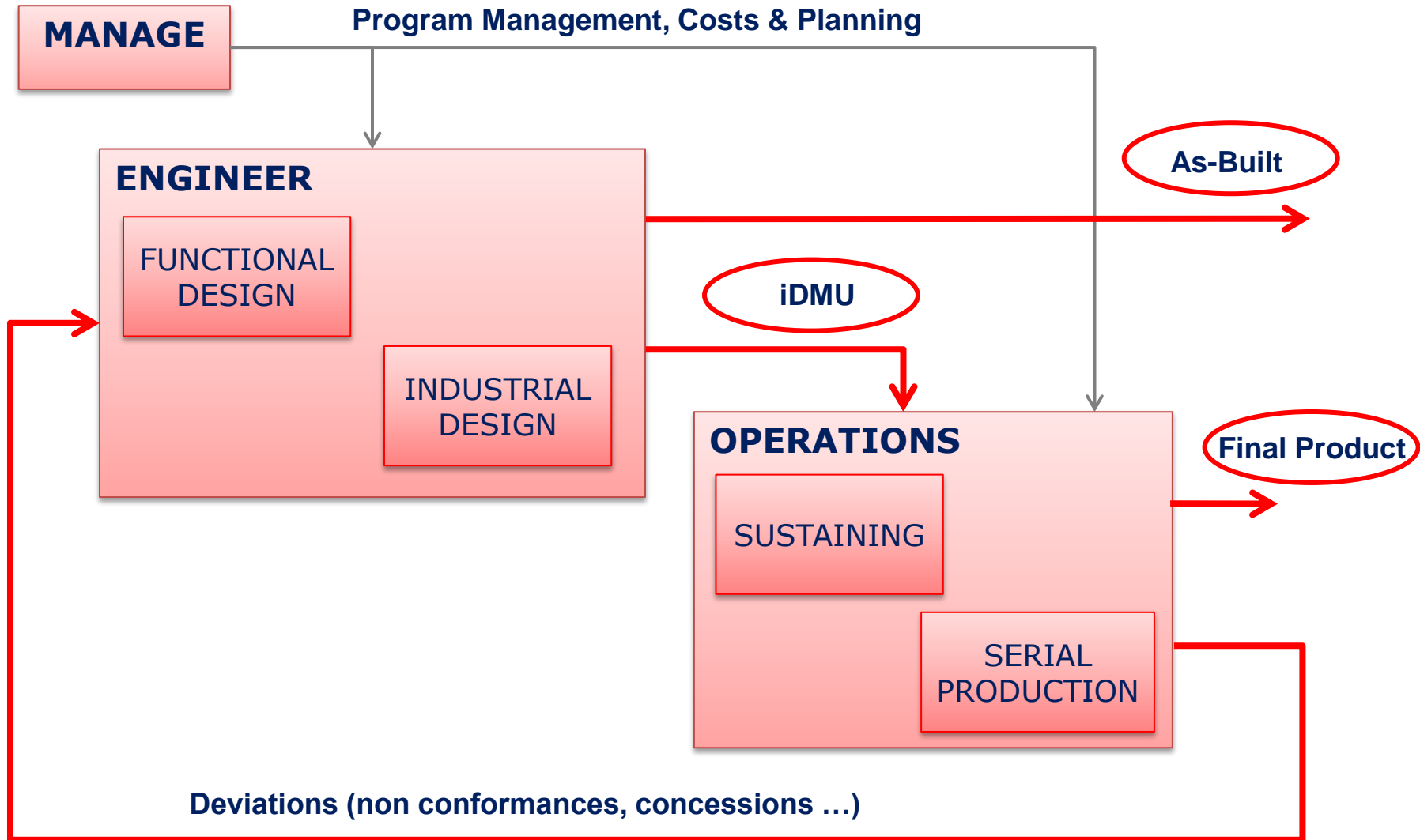
AS - IS



TO - BE



Collaborative Functional Model



**Thank You
Vielen Dank
Merci Beaucoup
Duō Xiè
Muchas Gracias**