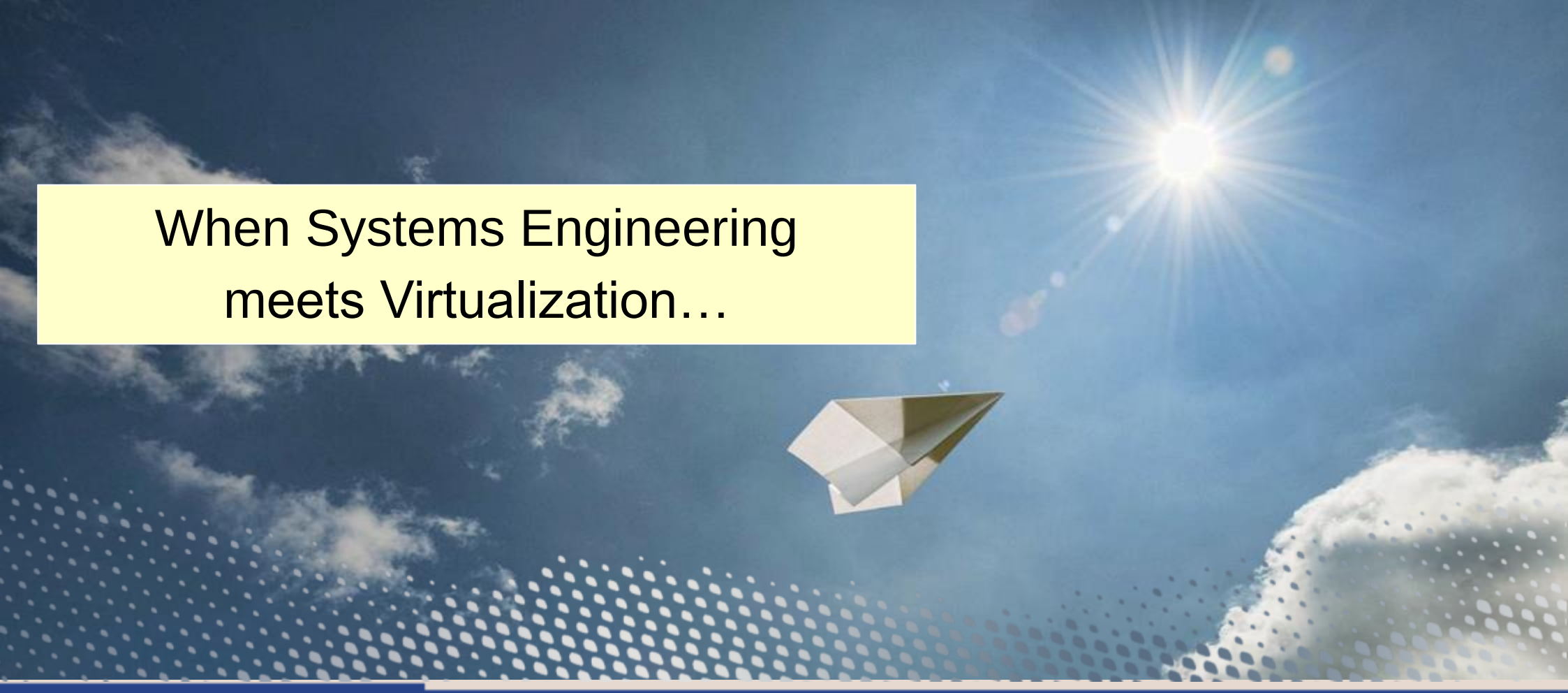

When Systems Engineering meets Virtualization…

Pr E. Duceau

Scientific Director

System Engineering, Applied math & Information Technologies

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When Systems Engineering Meets Virtualization

Outline

→ RoI, Bottlenecks and Constrains

- Where I am from
- High level requirements →*We have a dream…*
- Common Virtual Bird →*Global picture*
- Functional Digital Mock-Up → *yes we could!*
- Risk assessment → *but not alone,*
- Virtual Testing → *and make money* ☺

- Conclusion: Key Challenges

1. **3 Divisions & Corporate targets to align**
2. **Size, time-to-market, competitors**

Airbus Group Management structure

Airbus Group Innovations is part of
Chief Technical Officer Organization

Denis Ranque — *Chairman of the Board of Directors (BoD)*
Tom Enders — *Chief Executive Officer (CEO)*

Chief Financial Officer	Chief Strategy & Marketing Officer	Chief Technical Officer	CEO Airbus Group Inc.	Chief Human Resources Officer
Harald Wilhelm	Marwan Lahoud	Jean J. Botti	Allan McArtor	Thierry Baril

Airbus
Fabrice Brégier (CEO)

Airbus Helicopters
Guillaume Faury (CEO)

Airbus Defence and Space
Bernhard Gerwert (CEO)

1

Architectes of
complex systemes
=
The Challenge in
Innovation

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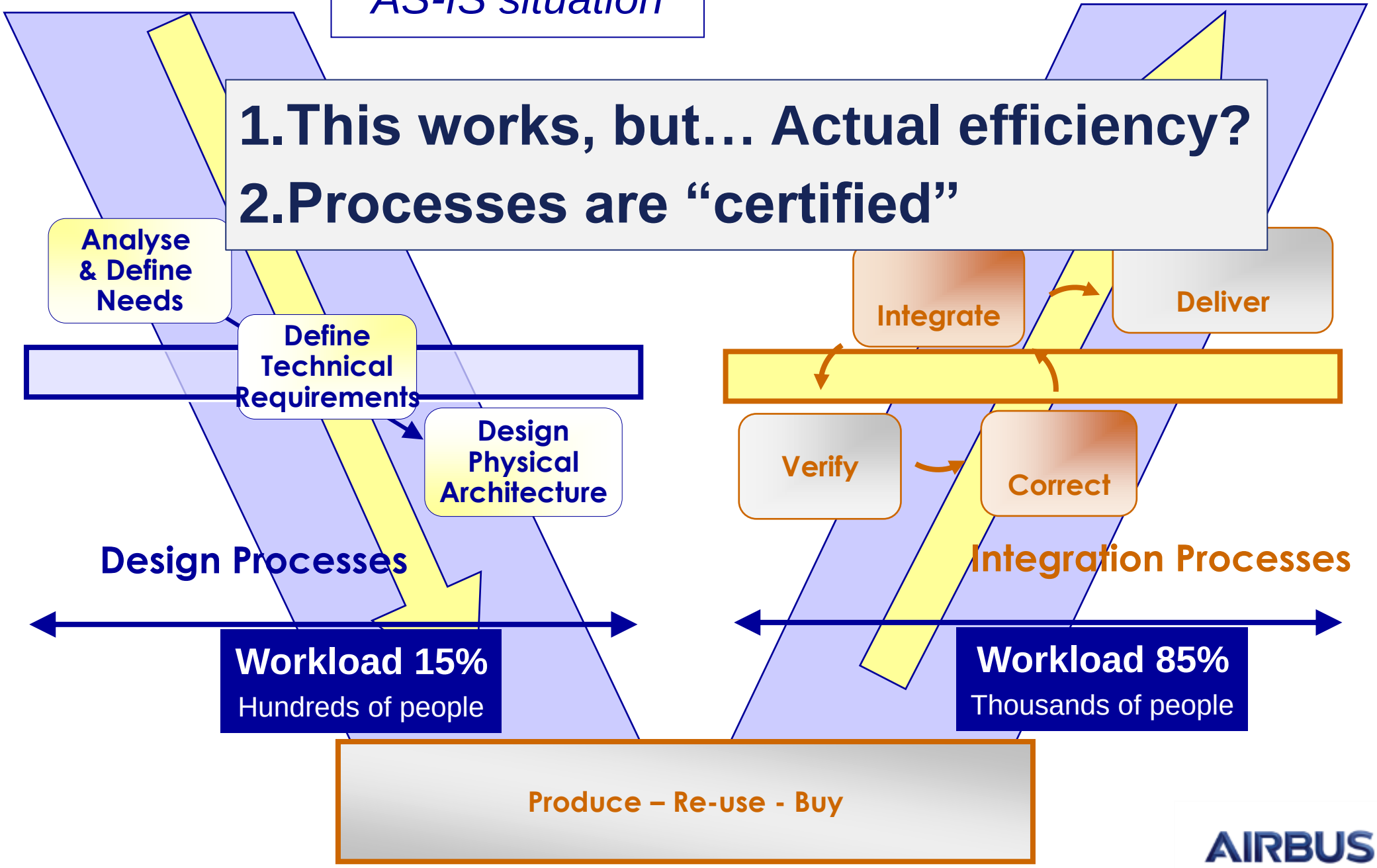
The problem is …

AS-IS situation

1.This works, but… Actual efficiency?

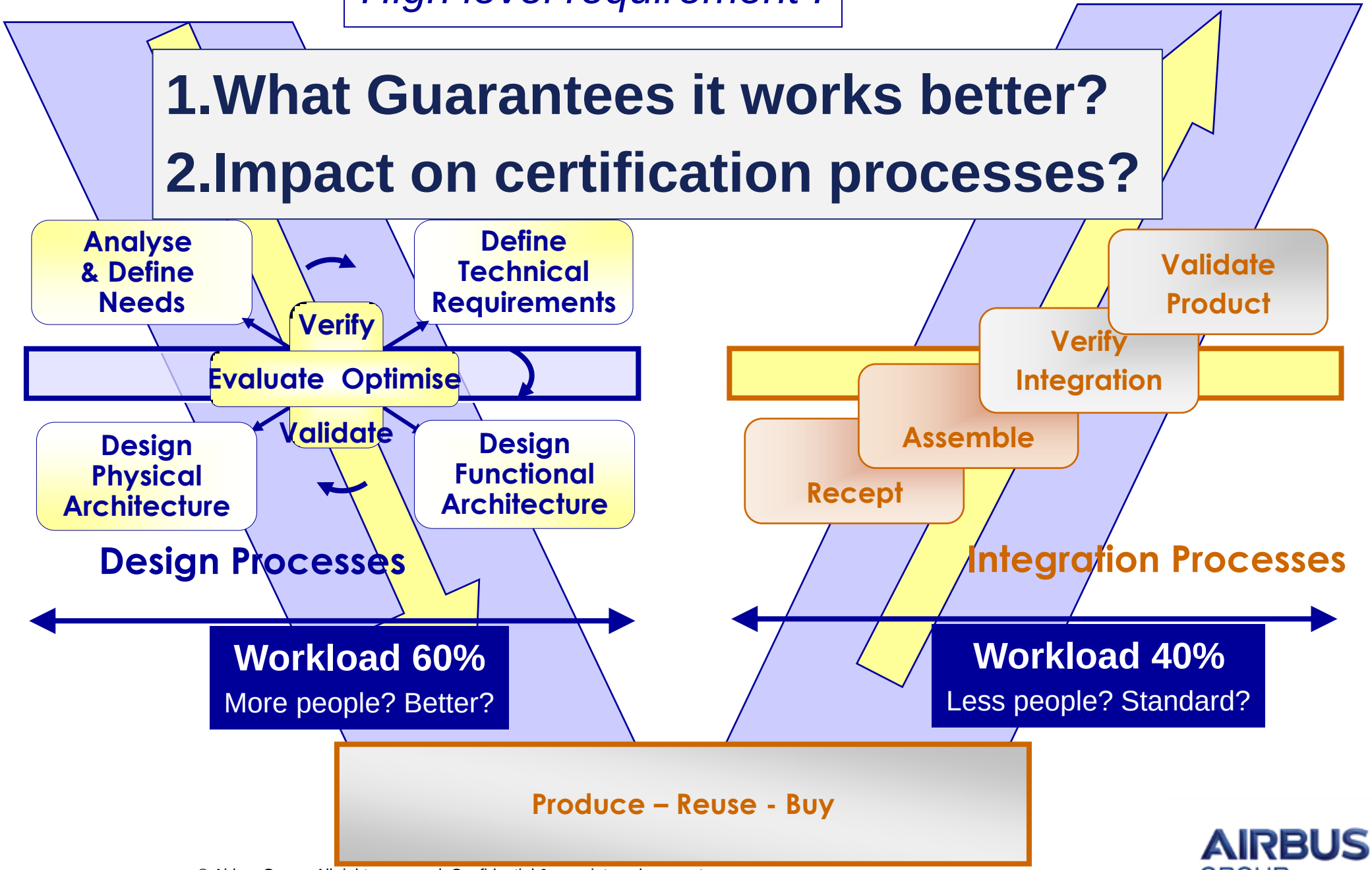
2.Processes are “certified”



The target is …

High level requirement !

1.What Guarantees it works better?
2.Impact on certification processes?



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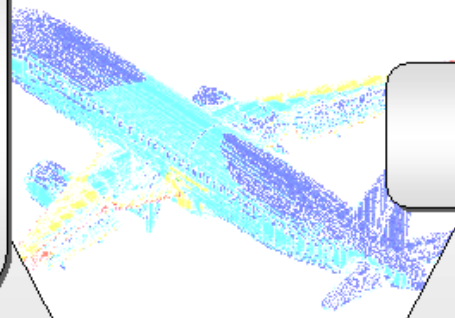
One Enabler is … Virtualization

1.Is Virtualization really managed?
2.Maturity of processes in M&S?

rd

Virtual design
at A/C level
Multidisciplinary design
Fast iterations
Decision making
Weight saving
Architecture maturity and robustness
Time to market reduction



Virtual testing
Time and Cost reduction
Risk reduction

Virtual design
at component level
Right first design
Process improvement
Time reduction
Increased re-use

Design Integration
Process/ communication optimisation with suppliers

irtual

Limit risks in decision making

Impact of change configuration (up to certification)

reduce development cycle

Example: the Common Virtual Bird initiative (Airbus 2004-2010)

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2

Blériot faisait une consommation effrayante de monoplans.
Il en serrait toujours par miracle indemne et recommençait. (Journal, 1913)

Design &
Multidisciplinary Optimization
=
The methodological Challenge

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Common Virtual Bird

Extended enterprise

1.IT is still a bottleneck, even today

2.Organization/size may be a show stopper

Collaborative

Distributed

} work

Data exchanges - Design reviews - Specific visualisations . . .

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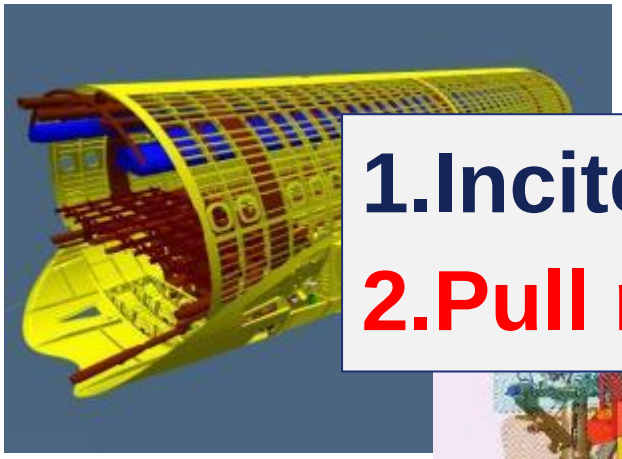
Common Virtual Bird

Modelisation - Simulation - Visualisation

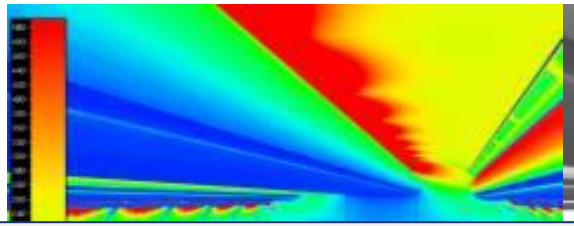
Pieces

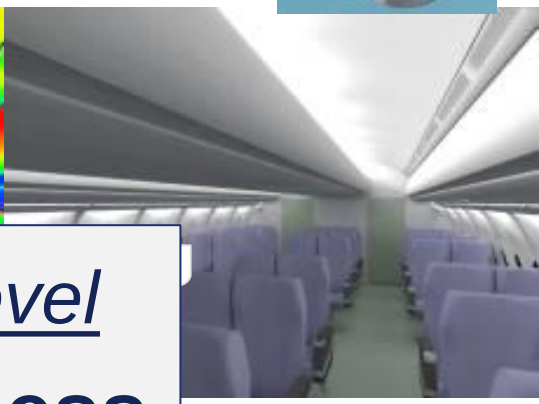
Sub-assemblies



Aircraft

part/function

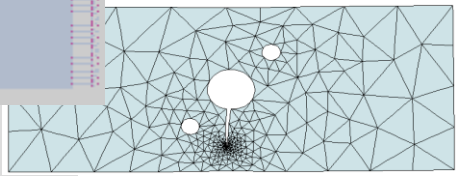




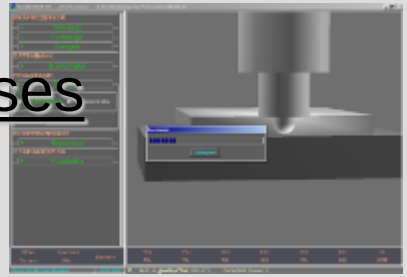
1.Incite all disciplines *up to right level*

2.Pull models by top-down process

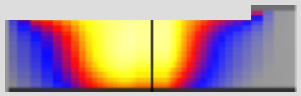
Behavior



Processes

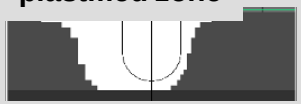


temperature distribution

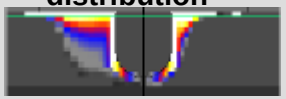


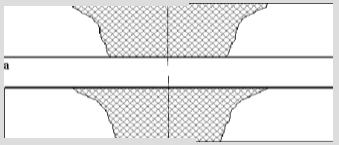
heat generation

plastified zone

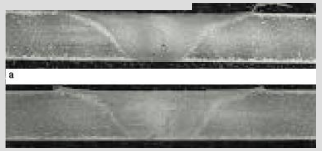


speed distribution





experience



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Common Virtual Bird

Concept

Marketing

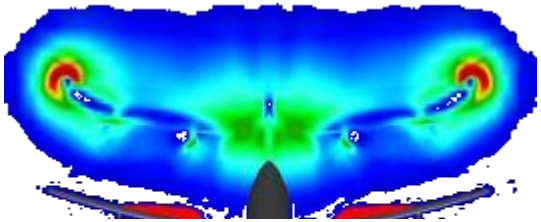
Support

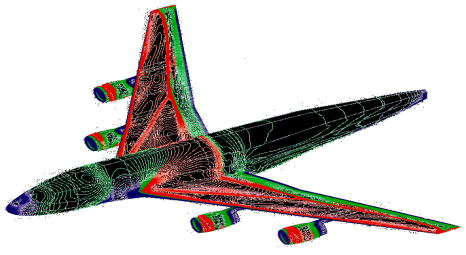
1.Legacy: design, manufacturing, tests…

⟶ ≠

2.Targeted: more services or new demands

Design





Manufacturing

Ground & Flight tests

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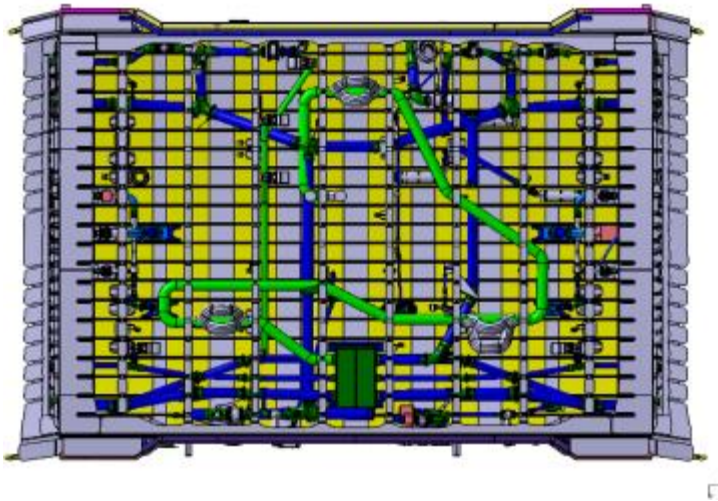
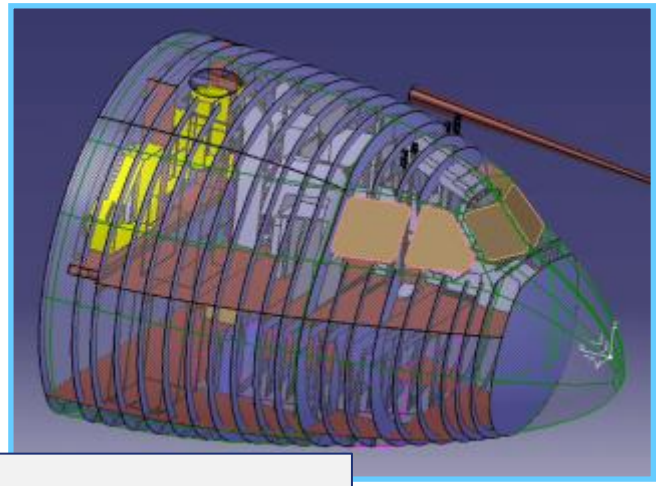
Example: Needs for Architects

Add more and more « Views »

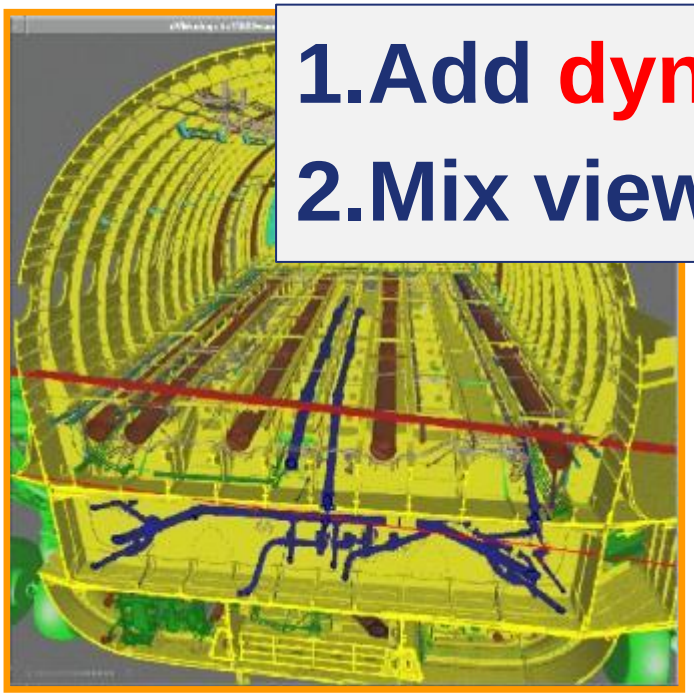


- Manufacturing
- Weight, performances
- Safety, Certification
- Energy, Fuel
- Electricity, hydraulics
- Air conditioning



1.Add dynamically requested *Views*

2.Mix views depending on scenarios



- Cost per function
- ***Maintenance***
- ***Operability***
- Green aspects
- *etc*

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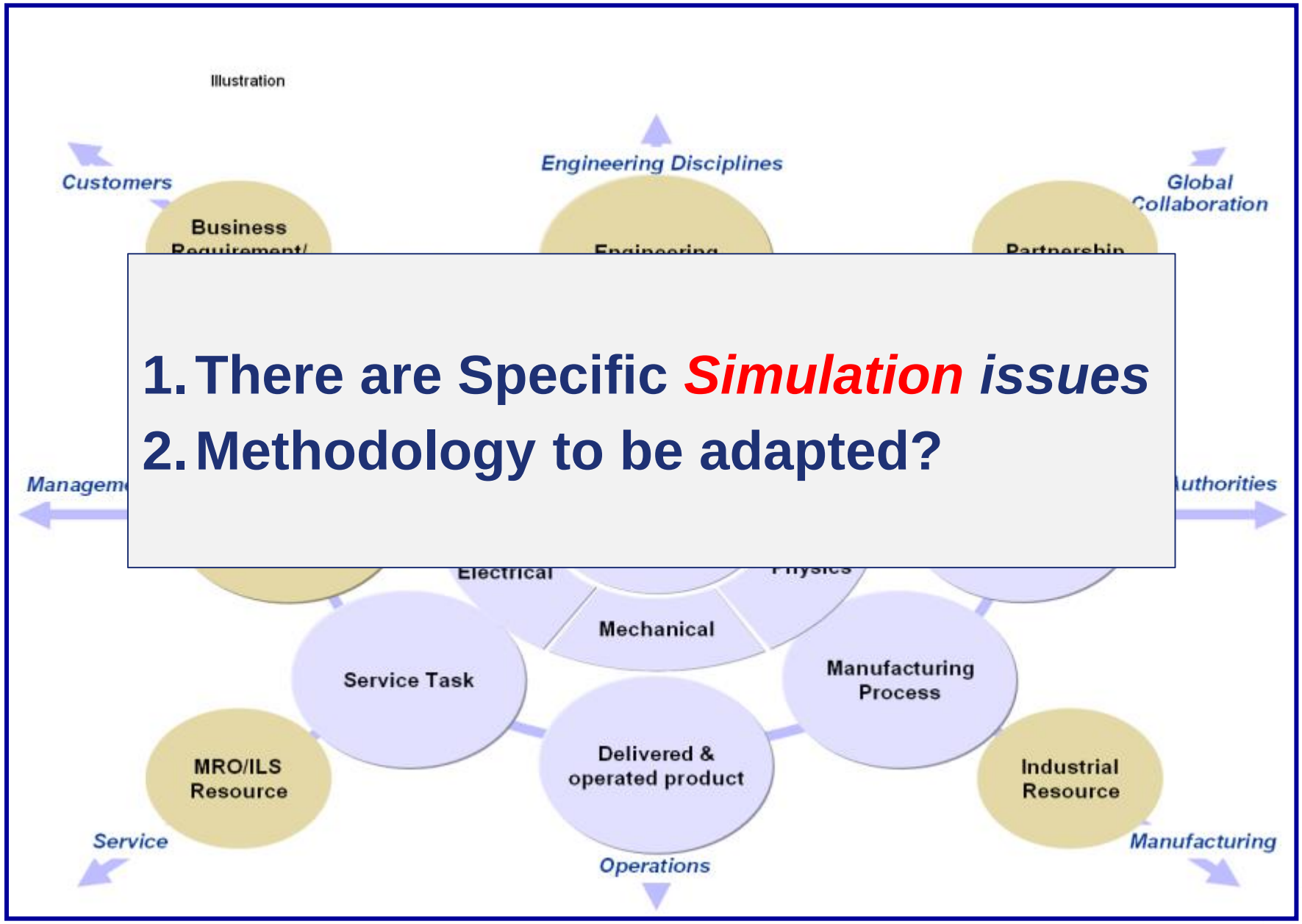
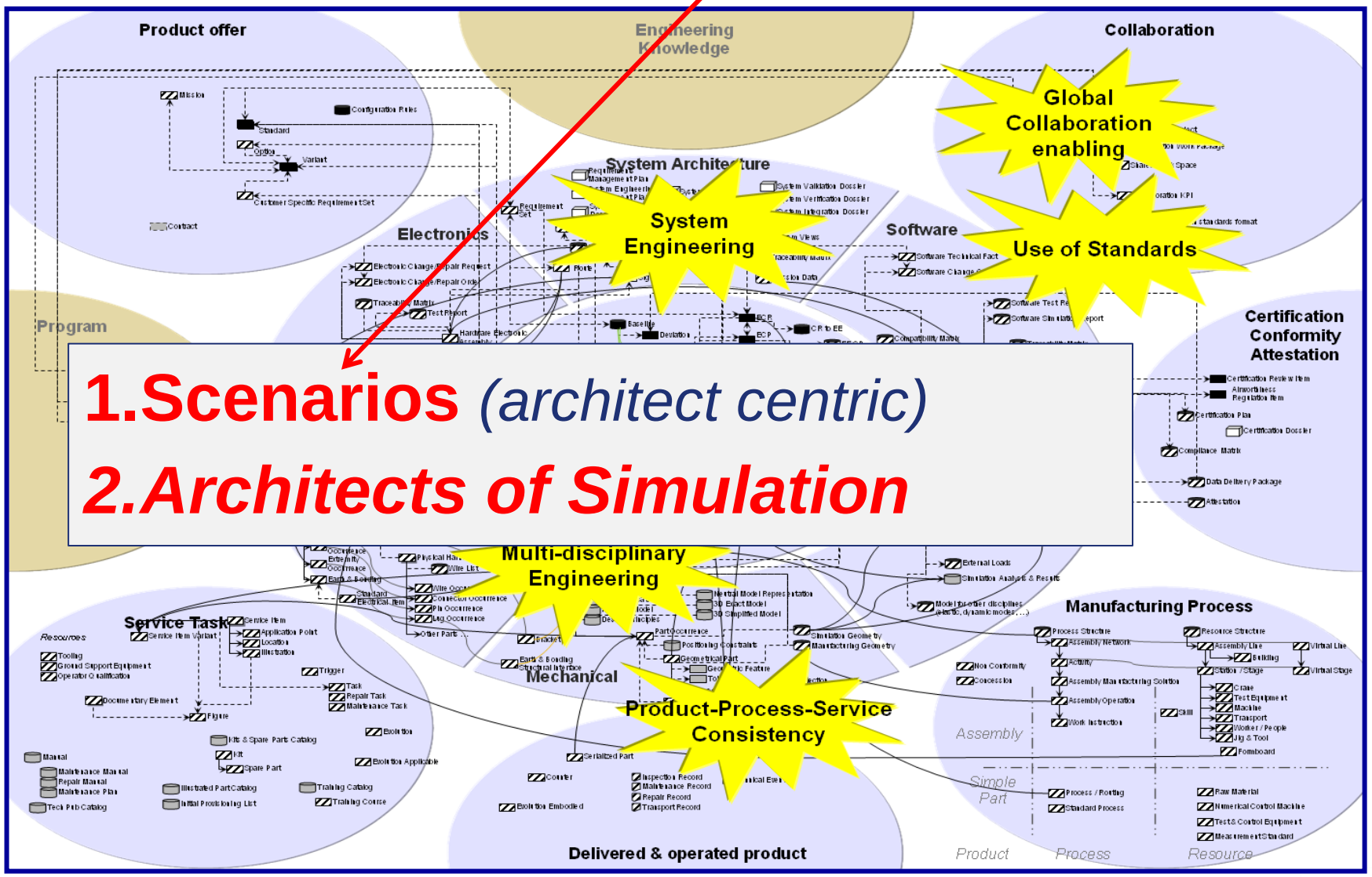
Starting point: Basic System Engineering view



1. There are Specific ***Simulation*** ***issues***
2. Methodology to be adapted?

Dependencies, couplings, impacts.. Yes but not with the same importance ; *Dynamically*



To really make a breakthrough thanks to simulation

The Big Issue is…

1. **Physics is real world** *(PDE)*
2. **Systems is engineers world** *(ODE)*

Expectations and Value Models

Customers expectations

Concepts definition

Preliminary design

Detailed definition

Functional Design + Physical Design

MATLAB/Simulink

SCADE

Components development

Operational support + services

Verification & Certification

Assembly & Systems Validation & Verification

Integration & assembly

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3

Risk Management &
Margin Reduction
=
The Industrial Challenge

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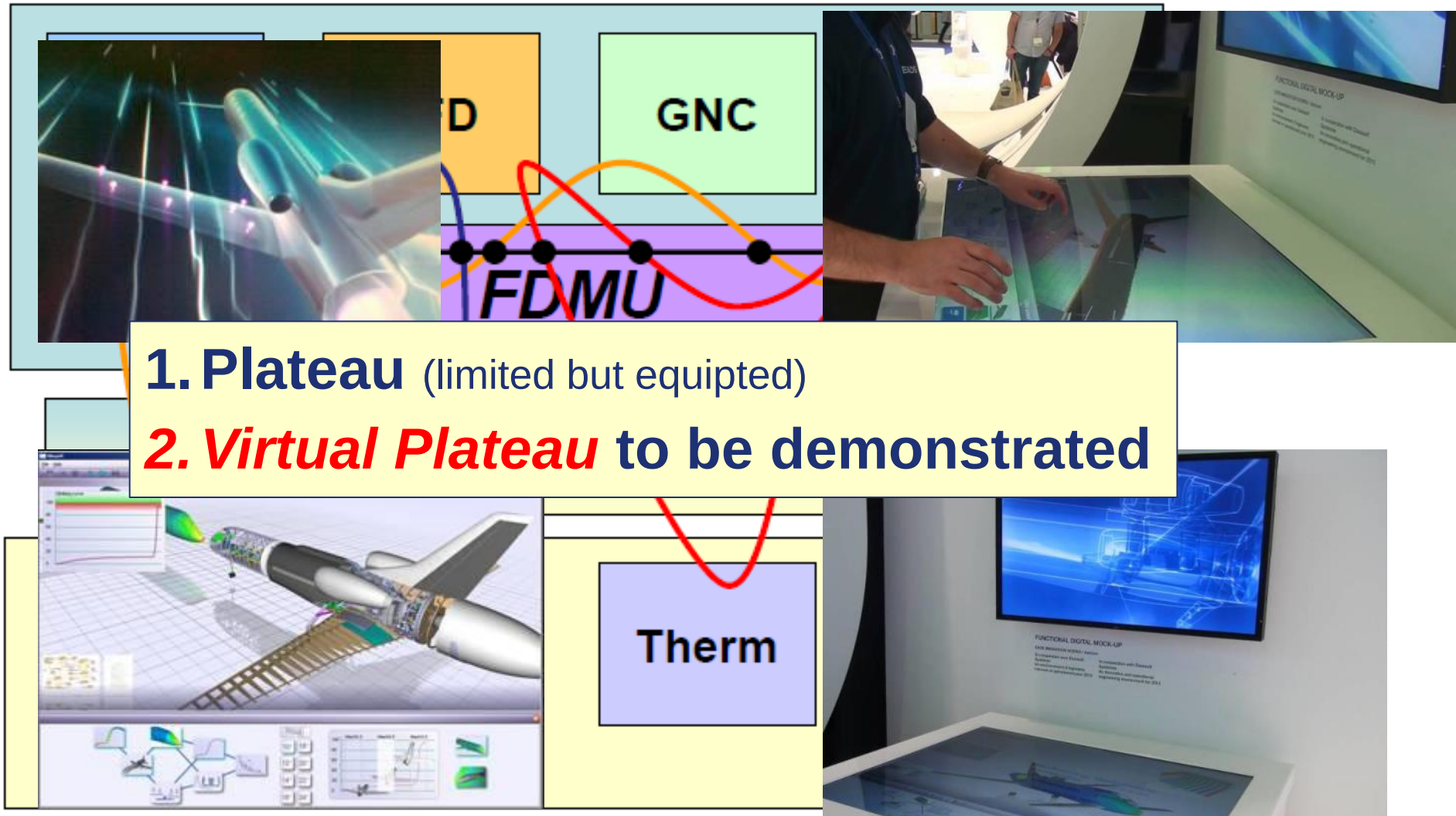
Today we do invest on
FDMU concept(s) Functional Digital Mock-up

http://www.youtube.com/watch?v=Z1k8KqHq7Bk

Le Bourget 2011



1. Plateau (limited but equipted)

2. Virtual Plateau **to be demonstrated**

Example: Digital Spacecraft
(Airbus Defense & Space

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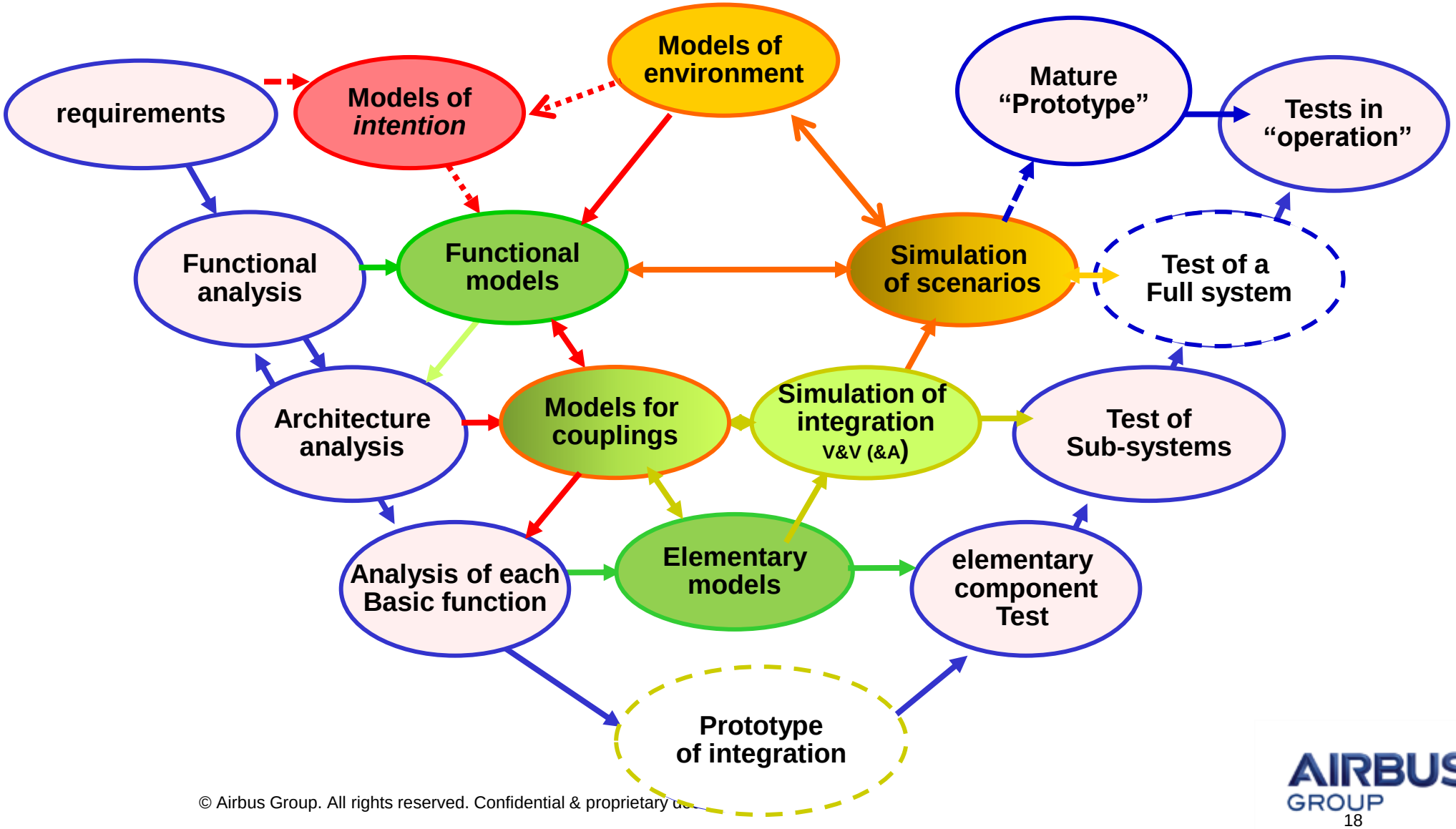
Our innovation capacity depends on our modeling capabilities

1. **Pull** mode for models
2. ***Simulation Factory***

Adapt our methodology



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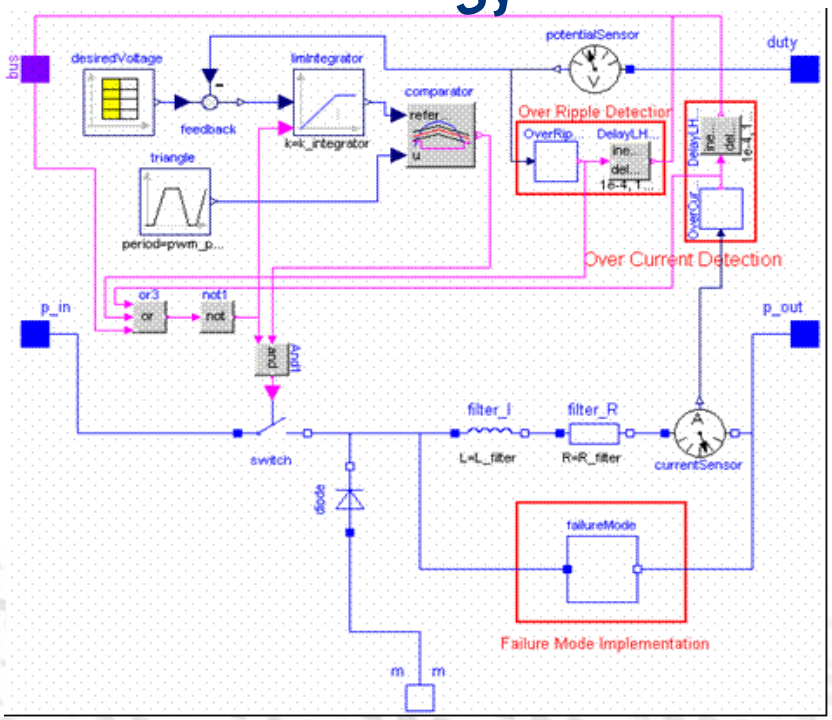
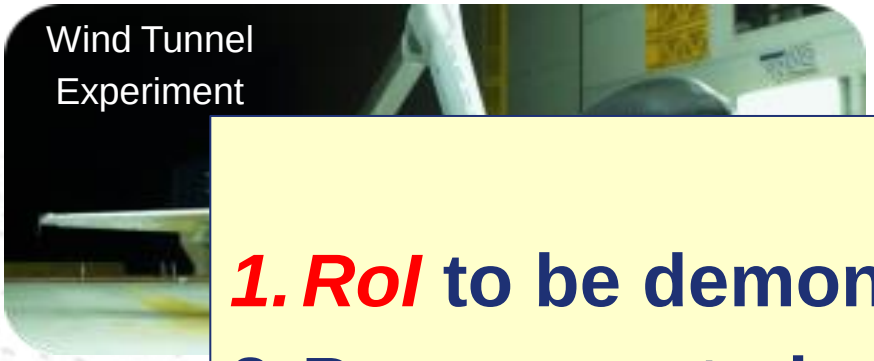
Probabilities, margins, failure analysis everywhere in the process

Challenge behind is « *Virtual Testing* »

Systems



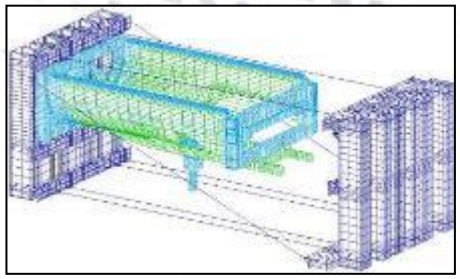


1. ***RoI*** **to be demonstrated**
2. **Processes to be updated**

Com

Any real test "shall" have been prepared by simulation! →Right at first time

Physics



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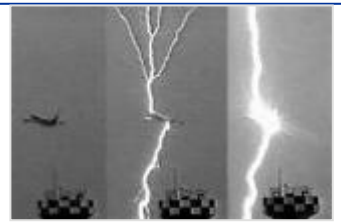
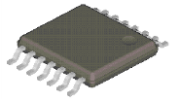
A generic scheme applied to ElectroMagnetic environment of electronics



Harness

Equipment

EU = Electronic Unit



Integrated Circuit

How to “run” a scenario to:

-move from *worse case analysis* to a *probability of failure*

-help the requirement analysis and supplier ordering

-support decision in architectures (syst, Equipt, Harness)

- Provide architects with impact analysis on other domains

1. *Savings is for the integrator*
2. *IPR in early design phase tbc*

scenarios to be investigated: Lightning protection, Energy (power electronics), Wireless, retrofit and optimization for Antenna, etc

One *unique* model of the *equipment* CANNOT cover all scenarios of interest

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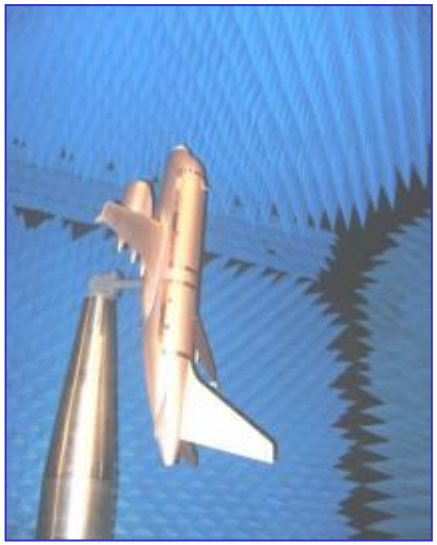
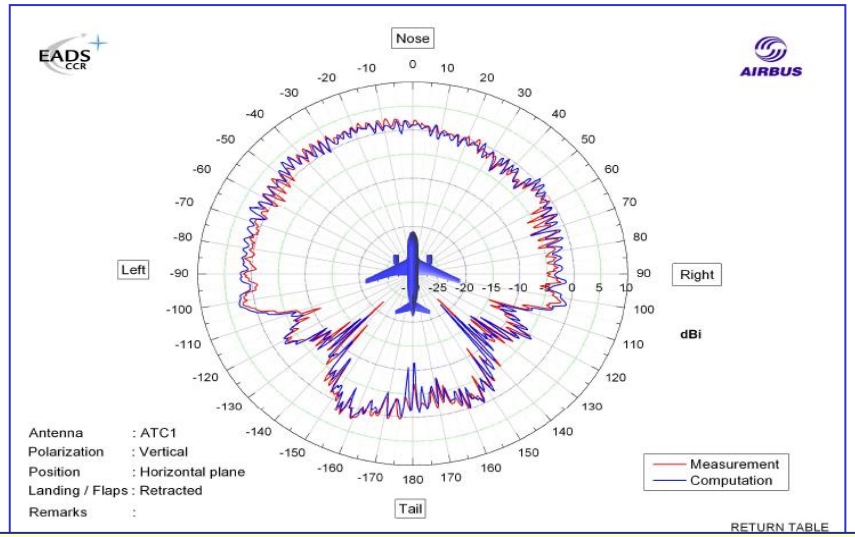
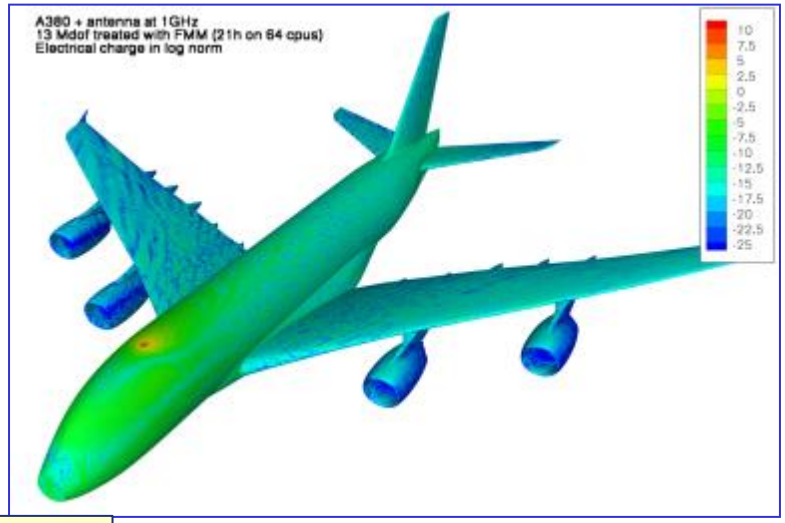
“Virtual Certification”: a milestone in 2006

For **Antenna Sitting: Green light by DGAC authorities**

- **To <u>make Airworthiness Bodies comfortable with Virtual certification</u>: more <u>than 10 years</u> of validation & comparisons, demonstration with Airbus and suppliers …**







Dedicated measu… …compulsory to get confidence

1. Acceptance ≠ science!!!

2. Conservative behavior

SAVINGS = time cycle

- To <u>optimize</u> antennas sitting at low cost by simulation
- To <u>facilitate</u> and prepare the retrofit or the installation of specific antennas by simulations
- To support suppliers with better requirements to limit risks during integration process (later in the cycle)

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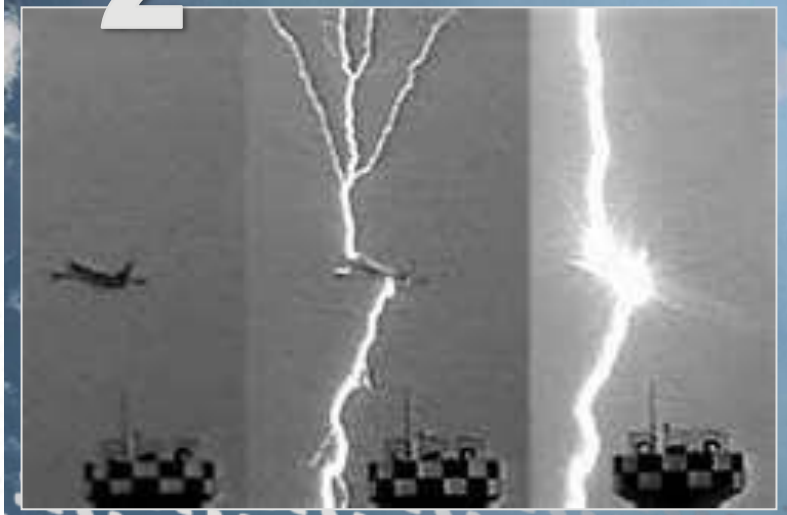
Conclusion

1

2



3

innovation & margin management, acceptance, maturity & RoI…

1. Need for Long Term Investment

2. Value is not where we forecast!

€

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Challenges to be discussed together ☺

- **3 main challenges actually depend on us, only**
  - Architecture of tools chains (Engineering competencies to set-up → innovation)
  - Simulate *for the other(s)* (collaborative spirit in pull mode)
  - Return over investment (where? when? Benefit to be demonstrated)

- **3 challenges depend on other stakeholders** (on top of *us*)
  - Capacity to provide libraries of models (maturity; Knowledge inside)
  - Acceptance (certification process, decision process, integration process)
  - Standardization (affordability)

- **3 typical challenges in "ramp up" phase up to entire company level**
  - Manage the development of virtualization (process to include TRL)
  - (A)symmetry of "games" with suppliers & eco-system (collaborative)
  - Manage the impact on the organization @ company level

- **HR challenge: management of Competencies** (experts, legacy, new profiles)

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Preliminary comments:

- 3 sets of challenges aim at taking advantage of new numerical technologies
- 3 criteria: innovation, maturity, affordability
- 3 hurdles: 2 first sets are mastered and viewed as "evolution" of current activities
- The last one presents a risk but also possible breakthrough

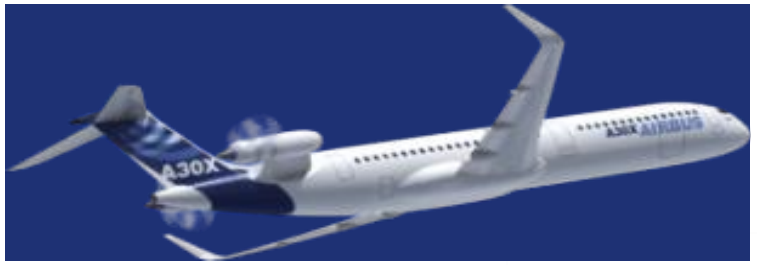
•3 main challenges actually depend on us
- •Architecture of tools chains
- •Simulate *for the other*
- •Return over investment

•3 challenges depend on other stakeholders
- •Capacity to provide libraries of models
- •Acceptance
- •Standardization

•3 ramp up challenges, entire company
- •Manage the development of virtualization
- •A-symmetry of "games" with suppliers & eco-system
- •Impact the organization @ company level

•+1 big challenge: management of people/competencies

Who will be the first to really benefit from these virtualization capabilities?
- Companies with huge legacy?
- New comers in business?



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Thank You

- For the invitation
- For your attention
- For your questions ☺

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