



FP7 Support Action - European Exascale Software Initiative
DG Information Society and the unit e-Infrastructures



Addressing the Challenge of Exascale

European Exascale Software Initiative EESI

Towards Exascale roadmap implementation

EESI2 – BLOCK ON “Industrial Vision on EESI and Exascale Applications”

An Airbus Group Contribution...

Pr Eric Duceau
Scientific Director
Airbus Group Innovations

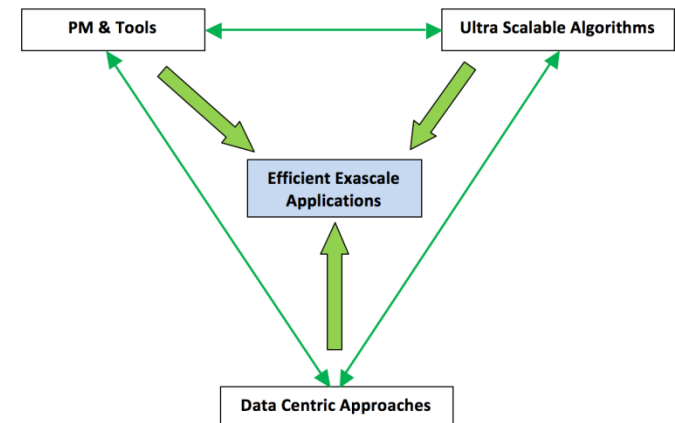


Yes, amazing architecture Exascale Computer will be available soon!

So what for Our Company?

Overview

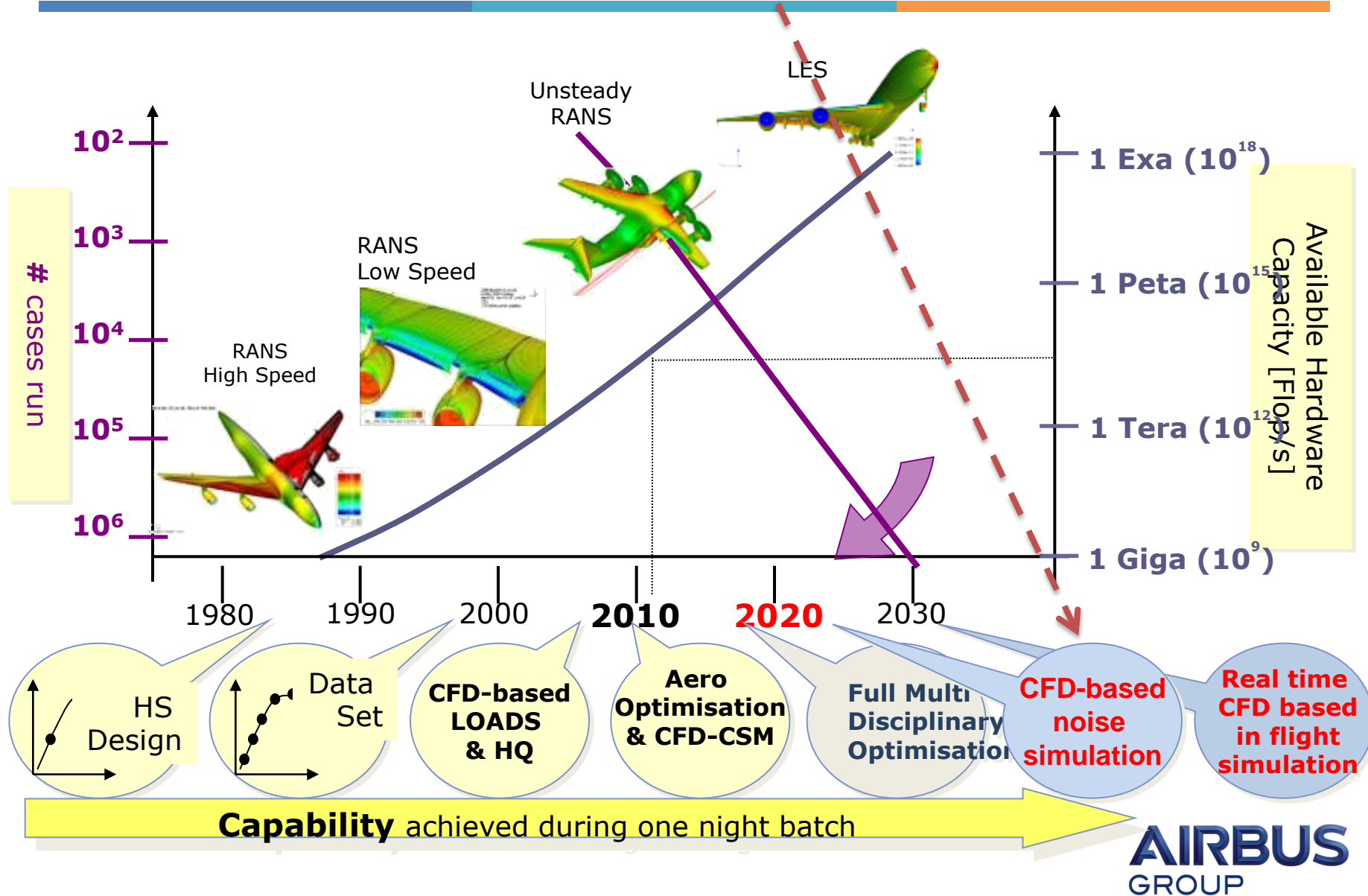
1. Aerodynamics: the in-house legacy hurdle
2. Structure: SW vendor and us!
3. Wave propagation: Linear Algebra
4. Stochastics & couplings: PM is key
5. On top of resilience, security etc



Our point is to illustrate which “application scenarios” will likely benefit from Exascale capability and answer following questions:

- What level of efforts from our side is mandatory?
- What kind of show stopper may arise?
- Which synergy can we foresee with other industrial actors?

Example 1: Aerodynamics / Aeroacoustics



Example 1: Aerodynamics / Aeroacoustics



- “In-house” codes
- Differentiating tools
- Huge legacy

Target: be more *realistic*, *build references*

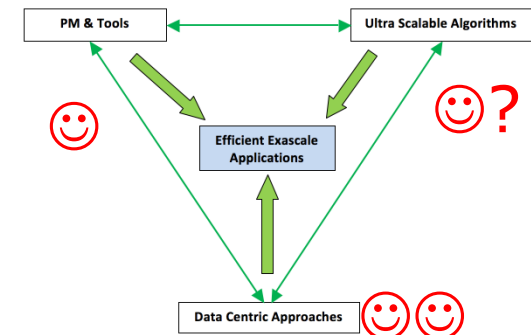
- CFD-based noise simulation → turbulence
- Real time CFD based in flight simulation

*Move to data centric view is ☺☺**

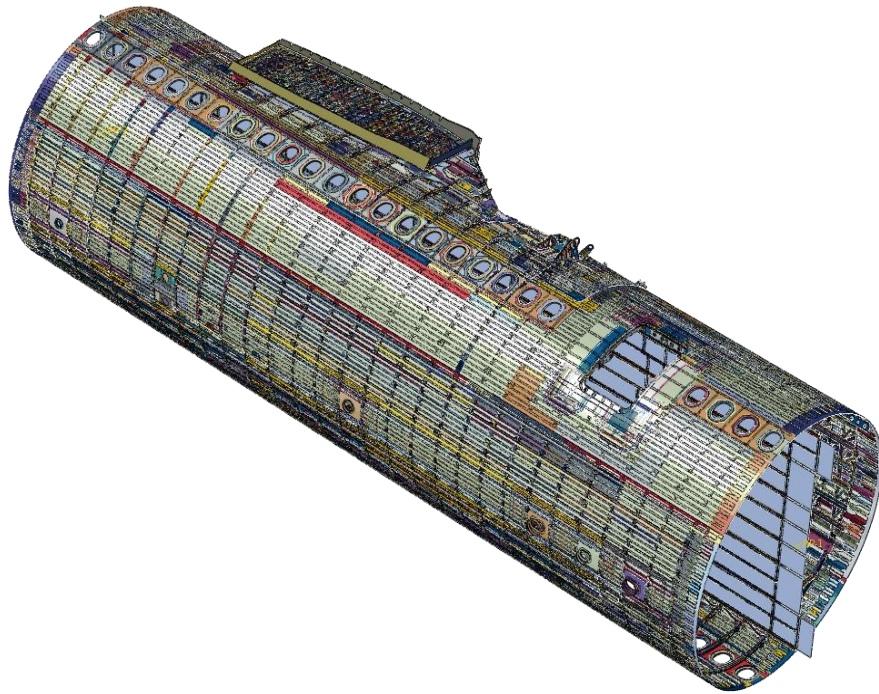
(*digitalization initiative @ Company level)

Bottleneck: Costs to adapt/create new SW?

Exascale is a path to meet the target; will be addressed by organizing our “aeronautic” network/community

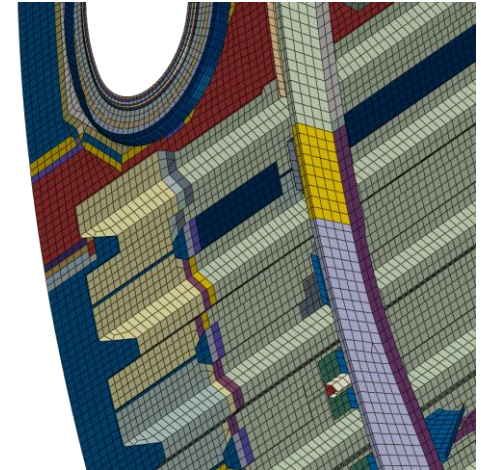


Example 2: Structural Engineering



Fuselage :

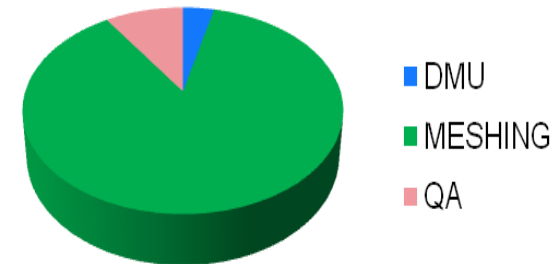
- classical shell elements
- 15-20mm
- no fillet in stringers, clips, frames
- tie conditions



Today effort is put on **AUTOMATION**

- data preparation
 - # of jobs for „analysis“
- Data centric with Machine learning to automate as much as possible

Modeling Work Request (h)



Meshing includes being SW compatible too! (format, physics inside, numerics and computer constrains)

Example 2: Structural Engineering

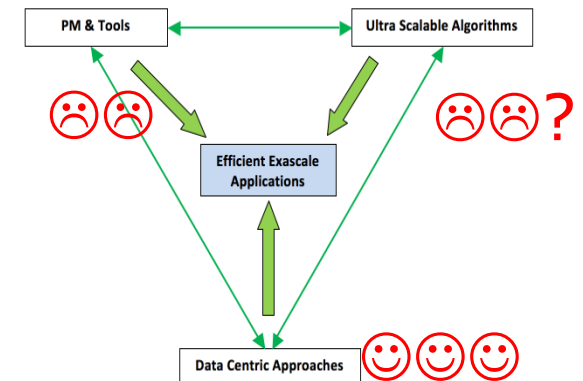
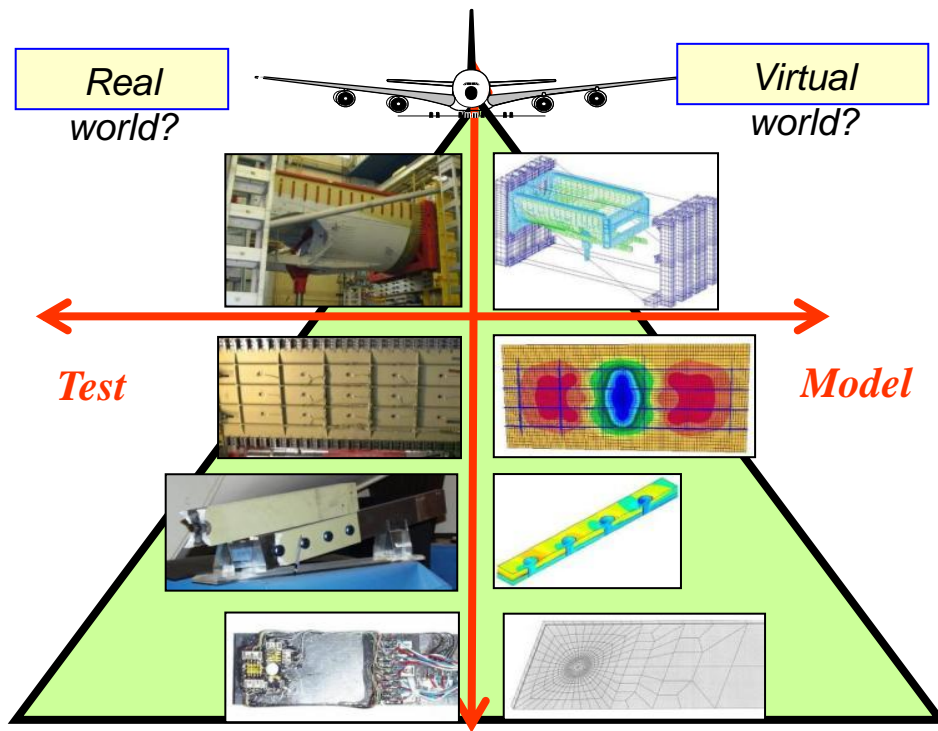
- 80% Commercial SW
- Tools used within certification process
- Huge legacy

Main Valuable **Target:**
Revisiting Margin Policy

- including Uncertainty Quantification
- And Uncertainty Propagation (multiscale aspects...)

→ Full Virtual Testing

- Move to data centric view is 😊😊😊
- **Move to scalable algorithms is ☹️☹️?**

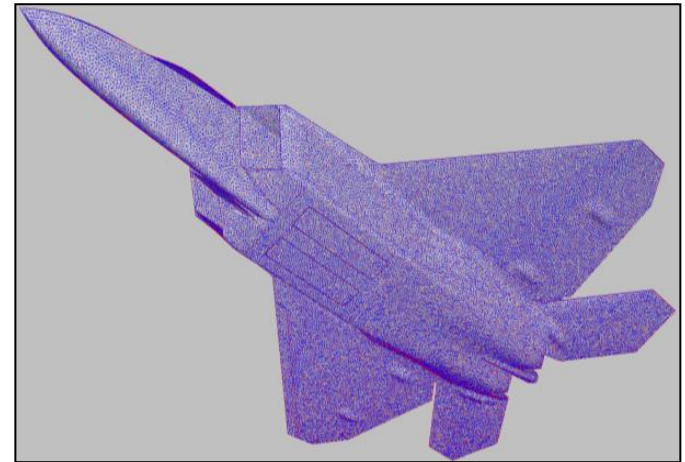
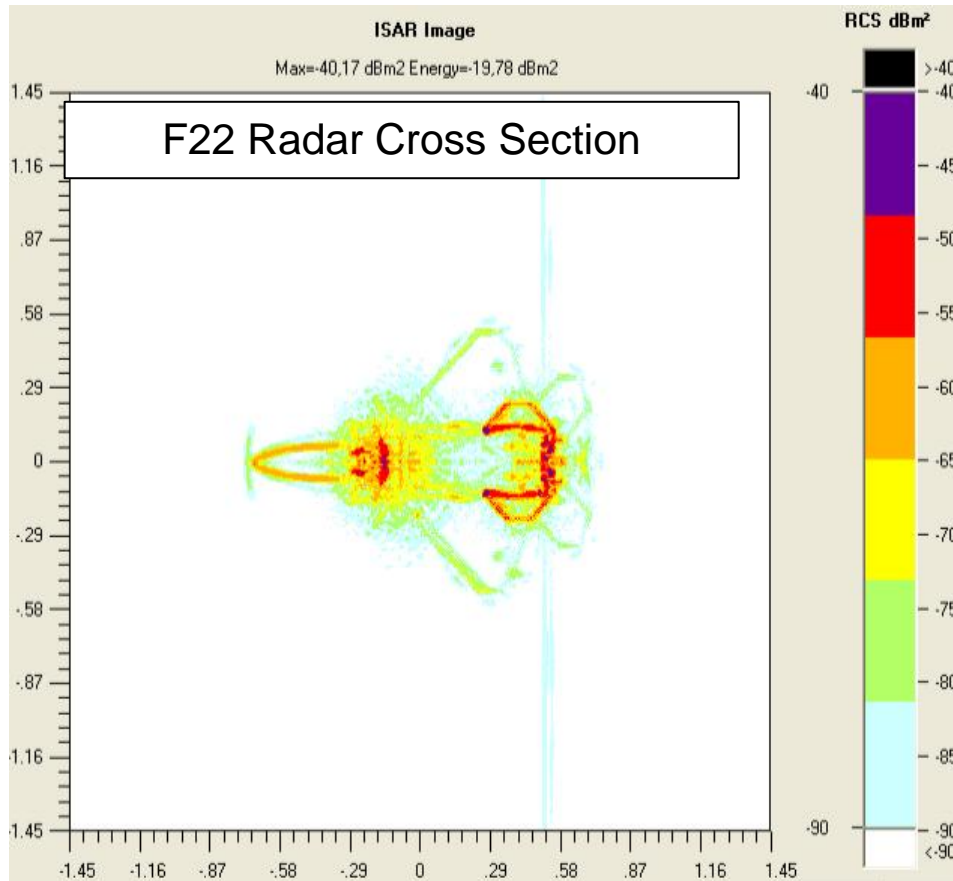


COTS=> Business => enlarge the market

Example 3: Wave Propagation

Electromagnetics : antenna siting, Electromagnetic compatibility, Stealth, Lightning

Acoustics: noise source creation and propagation, acoustic footprint

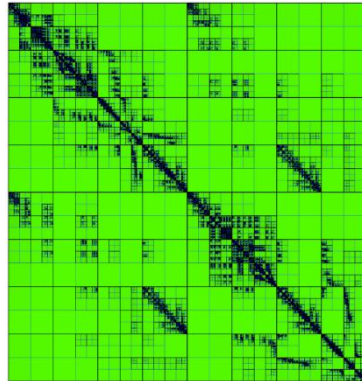


Bottlenecks:

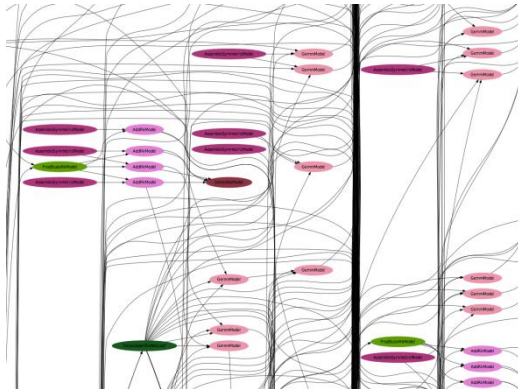
1. Full Dense Complex Matrix (100 Millions)
2. Number of RHS!!! (10^{**5})
3. + Prepare “uncertainty” assessment

Example 3: Wave propagation

- 90% “In-house” codes
- Contribution to open source community is key because of **Linear Algebra**



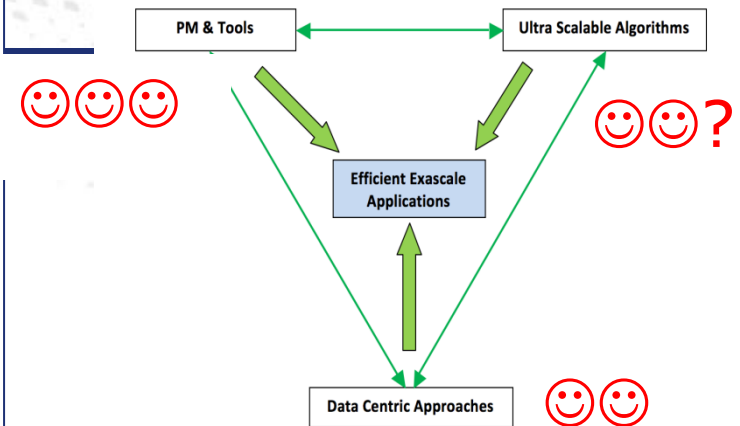
- already based on **graph of tasks**



Target #1= affordability!!!!

- user interface
- post processing
- couplings
- Data sharing

Seems an Internal Airbus Concern but looks very similar to other companies !

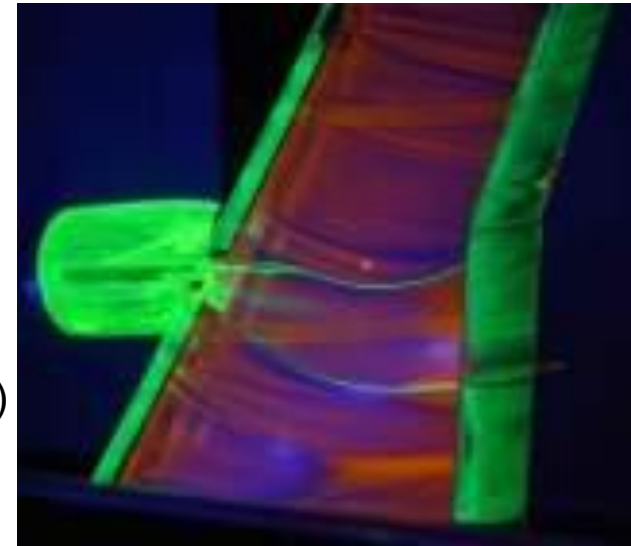


Actually, the new frontier will be: Modeling “**weakly stochastic**” phenomenon in weakly coupled physics

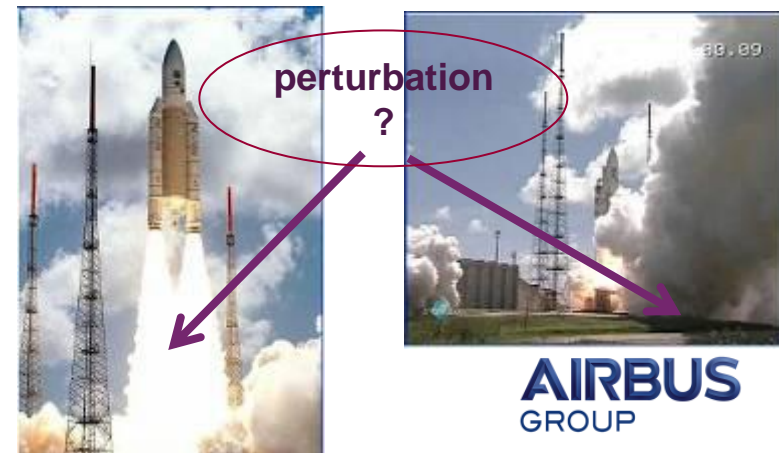
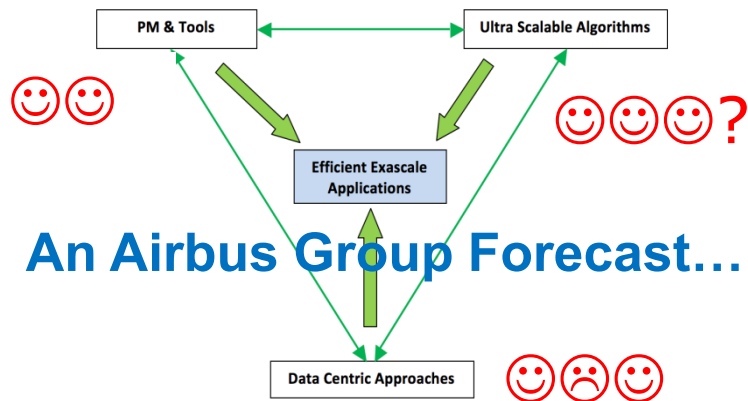
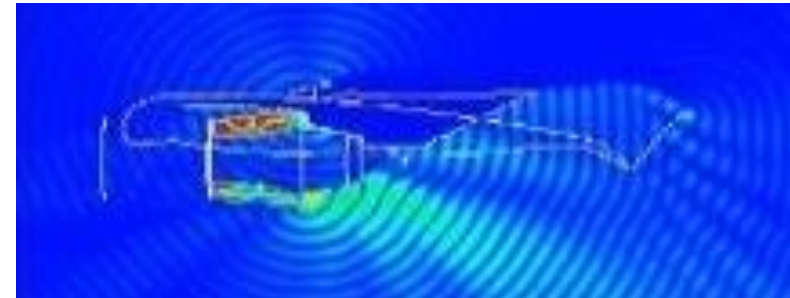
Acoustic propagation or **Thermal** in a “**weakly turbulent**” flow

Perturbation being of a **random nature** on top of deterministic (stochastic parameters of correlation or copulas in space and time)

Optimisation under **uncertain constrains** (eg, robust design)



Exascale Capabilities (and not only Architecture!) are mandatory to tackle this challenge



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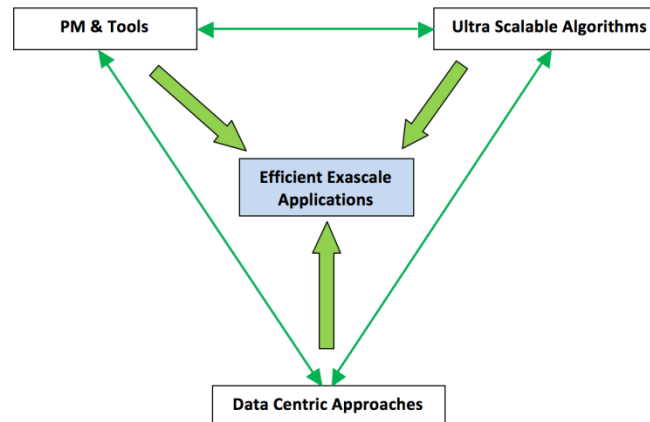
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An Airbus Group Conclusion...

Legacy as a
constraint
(*business!*) New SW
paradigms are
compulsory

Extended
Entreprise



Sharing costs
and validation!
open source on
dedicated Research
Communities

Fully open to
External world

Our *internal* problem
= cost + training
→ Digitalization