Digitalization of Aerospace & Defense

ANSYS technology enables you to predict with confidence that your products will thrive in the real world.

Paolo Colombo
A&D Global Industry Director
Learning from the F-104 Starfighter

Designed in 1952 – maiden flight in 1954 - In service till 2004

Tech specification:

- Must be ready ASAP
- Very light
- Low cost
- Simple and easy to build and maintain
- Multirole and OW capable
- High performance – best performance ever

Does it sound familiar?
Understand complex phenomena and explore the unknown

- Supersonic flight was a new (unexplored) science
- The F-104 had a wingspan of 6.35 mt.

The wing configuration required new tests designed to grasp an understanding beyond a single physic through an integrated testing platform

Pictures of next pages taken from https://www.youtube.com/watch?v=C-djjebfEOU
Undesired interactions – engineering the system

- The T tail came from design variance exploration.
- In stall condition, it makes the plane unrecoverable.

The limitation in design space exploration and the impossibility to engineer the entire system lead to hard compromises in the final design.
The simple machine that became complex

In order to prevent stalls and to help the pilot with keeping the aircraft within the flying envelope, designers added «safety features» as the stick shaker and kicker were added.

Nowadays embedded software allows aircraft to perform beyond the human limits, even in full autonomy.
Market trends drive investment in A&D initiatives

More Efficient, Environmentally Friendly

Safer, More Comfortable Passengers

Design for Affordability, Managing complexity
Accelerated innovation, Cost reduction

Future aircraft configuration, Autonomy

Accelerated production, MRO and services
These trends drive initiatives that bring more complexity

Reduce cost of space launchers and microsatellites
Increase safety
Human – Machine Interactions
Increase onboard comfort
More connected aircraft
New production methods and materials
Services and maintenance
Break-through technology will be required to secure future competitive advantage, most notably in terms of energy, management of complexity and environmental performance.

Significant global product development trends are making multi-domain, multiphysics, and multiscale systems-level virtual prototyping and performance simulation indispensable to enable a transformation to digital systems development.
A digital approach improves operations, increases revenue, drives productivity, cuts costs while driving innovation.

“Digital can deliver real value throughout the supply chain, driving productivity, quality and cost improvements”
Simulation Has Been Deployed Very Methodically in A&D

Most Companies Today

- Single Physics
- Multi and Multiple Physics
- Integrated Digital Prototype
- Digital Twin

76% Of the company in this survey said they are using multiple physics simulation

SAVING TIME AND REDUCING COSTS THROUGH SIMULATION CONSOLIDATION

January, 2015

Simulation is a technology that has sharply increased in recent years because of the many benefits it can bring to product designers. However, there are best practices that should be followed when implementing this technology. Multiple point solutions do not perform as well as an integrated simulation suite. Organizations must look for ways to consolidate, or reduce, the number of vendors that they use, to build an effective simulation platform and develop successful products.
Simulation Has Been Deployed Very Methodically in A&D

BUT...

• Use of physics based simulation evolved in alignment with organizational structures. Lot of silos without proper communication

• Simpler models of discrete components running on simpler hardware. Still low adoption of high fidelity models and full digital prototypes

• Bolt on tool to traditional design workflow, and big resistance in using new more efficient tools, workflows and automation

• Focus on product features and not on a full simulation platform

Limiting factors in A&D industry, due to legacy and fear in changing what worked in the past
New simulation domains

- Multifunctional materials
- Topological optimization and additive manufacturing
- Process automation
- Bridge silos and foster collaboration
- Knowledge and IP management

Tamas Havar
Manager, Lightweight Design
EADS Innovation Works

“ANSYS Workbench provides accurate results that allow us to **reduce** modeling time by up to 65% compared with traditional methods”
Products’ complexity and cost reduction initiatives are accelerating the adoption of digital approaches.

The simulation platform and model based enterprise is maturing. Space 2.0 Companies are leapfrogging with no “history”

Andy Sadhwani
Senior Propulsion Engineer
Space Exploration Technologies

“Coupling simulations has enabled SpaceX to optimize the weight of the vehicle by 10-15%”

“System simulation reduced board development time from 6 months to 3 months”

https://www.ansys-blog.com/startups-new-players-space-2-0/
Digital prototype of an entire system: ice building analysis and de-icing Systems

Aerodynamics
Aircraft Icing, Single Phase, Non-Reacting Flow, Free Surface Flows, Particle Flows

Aero-thermal
Heat Transfer, Thermal FSI

Aerostructures
Impact, Thermal Analysis, Strength Analysis

Daher-Socata
“Comparisons with icing tunnel test data deliver increased confidence in this 3D method for reliable use in future aircraft development”

From a $10M test:
To: Estimate 50-100x cost reduction
Digital prototype of sub-systems

External Aerodynamics
- Single Phase, Non-Reacting Flows, Fluid Structure Interaction, Acoustics, Aircraft Icing

Integration Aerodynamics
- Heat Transfer, Thermal FSI

Propulsion Aerodynamics

Cray
World record HPC scaling for ANSYS CFD software

Piaggio Aero
The morphing operation can be executed in a matter of seconds even on very large meshes. The design optimization took less than 1/10 of the time required using conventional methods.

ANSYS is an active participant in:
- Drag Prediction Workshop, Aeroelasticity Prediction Workshop, High Lift Prediction Workshop, Propulsion Aerodynamics Workshop

By Marco Evangelisti, Researcher, and Ludovica Ceccarelli, Research Partner, University of Rome Tor Vergata, Rome, Italy

Google Translate, FID Roland, and Michele Ranzelli, Aerodynamics Engineer, Piaggio Aero Industries, Genoa, Italy
Working on the next thing... That is already here

ANSYS Collaborates with GE to Drive Digital Twin Value and Deliver the Promise of the Industrial Internet of Things

Collaboration to scale the development and deployment of the model-based digital twin

Case Study: Rolls-Royce

Rolls-Royce is working to coordinate all aspects of design, manufacture and through-life service data sets. It is doing this to proactively eliminate data silos, generate a more structured approach to data management, and improve communication between the many disciplines, tool sets and technology required to deliver state-of-the-art engine technology development.

A new overarching programme, DA-WINCI, links existing design and development programmes into a well-structured approach to data – including a digital twin for all the multi-disciplinary aspects involved in the digital representation of a specific physical engine. This layered approach allows the team to understand the intricacies associated with each responsibility, where there are overlaps in data requirements and where there are gaps that may affect future design decisions.

By using a digital twin that matches the physical (as manufactured) attributes of an assembly or component in a virtual environment, Rolls-Royce is moving closer to simulating the behaviour of the model in different scenarios, establish the model's accuracy relative to physical testing, and move toward the ability to virtually certify future platforms.

Source: http://www.ati.org.uk/

Industry Pioneers continue to lead the way

ANYS platform vision

Open, Flexible, Scalable Simulation Platform that adapts to engineering needs and IT strategies

Largest Simulation Ecosystem (ANYS & Partners)

Tools and Data

3rd Party CAE tools

In-house tools

External Data

Deployment

On-Premise

Cloud

Hybrid
An open and complete simulation platform enables digital prototypes

From pre design exploration tools to accurate physics
Interconnected physics, embedded software, HMI
From components to systems
Simulation data management

https://www.youtube.com/watch?v=H1jySucPHWk
http://www.ansys.com/products/3d-design/ansys-discovery-live
The importance of universities

Free student software and training resources
Student teams support (competitions, experimental projects)
Dedicated academic licenses for teaching and research
Collaboration on software development
Partnership in international projects and technology demonstrators

http://www.ansys.com/academic

Florida International University Adopts ANSYS Engineering Simulation Solutions Campus-Wide

Released: 14 Apr 2015

PITTSBURGH, Aug. 28, 2017 — ANSYS (NASDAQ: ANSS) and the Indian Institute of Technology Bombay (IIT Bombay) will fund research projects that fuel groundbreaking innovations across industries. With IIT Bombay, a worldwide leader in engineering education, ANSYS will accelerate research and development to improve the safety, performance and security of autonomous vehicles, next-generation products and smart devices.

Free Student Software
ANSYS is committed to putting free simulation engineering software in the hands of students at all levels.

Download Now

Student Support Resources
Are you a student using ANSYS and looking for assistance?

Get Help

Tools for Educators
Find out about our Academic products, embedding simulation in your curriculum and more.

Learn More
And Startups

ANSYS has a dedicated program to support startups in the first years of their life, and incubators to offer digital prototyping solutions. More than ¼ of the startups in our program are in the Aerospace Industry. Key subjects: electric aircraft, autonomous flying, race to space, new materials, new aircraft concepts. http://www.ansys.com/about-ansys/startup-program
Connect with me to know more

ANSYS _ PAOLO COLOMBO

Google Search  I'm Feeling Lucky

http://it.linkedin.com/in/colombop
@Paoloinnova
paolo.colombo@ansys.com

THANK YOU!