ANSYS®

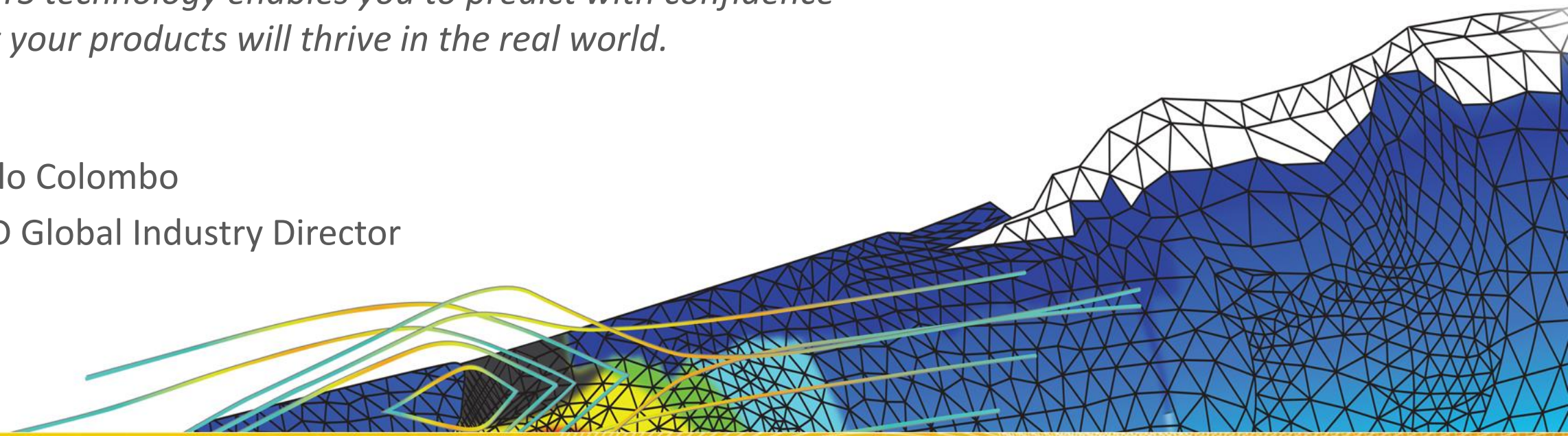
Realize Your Product Promise®

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

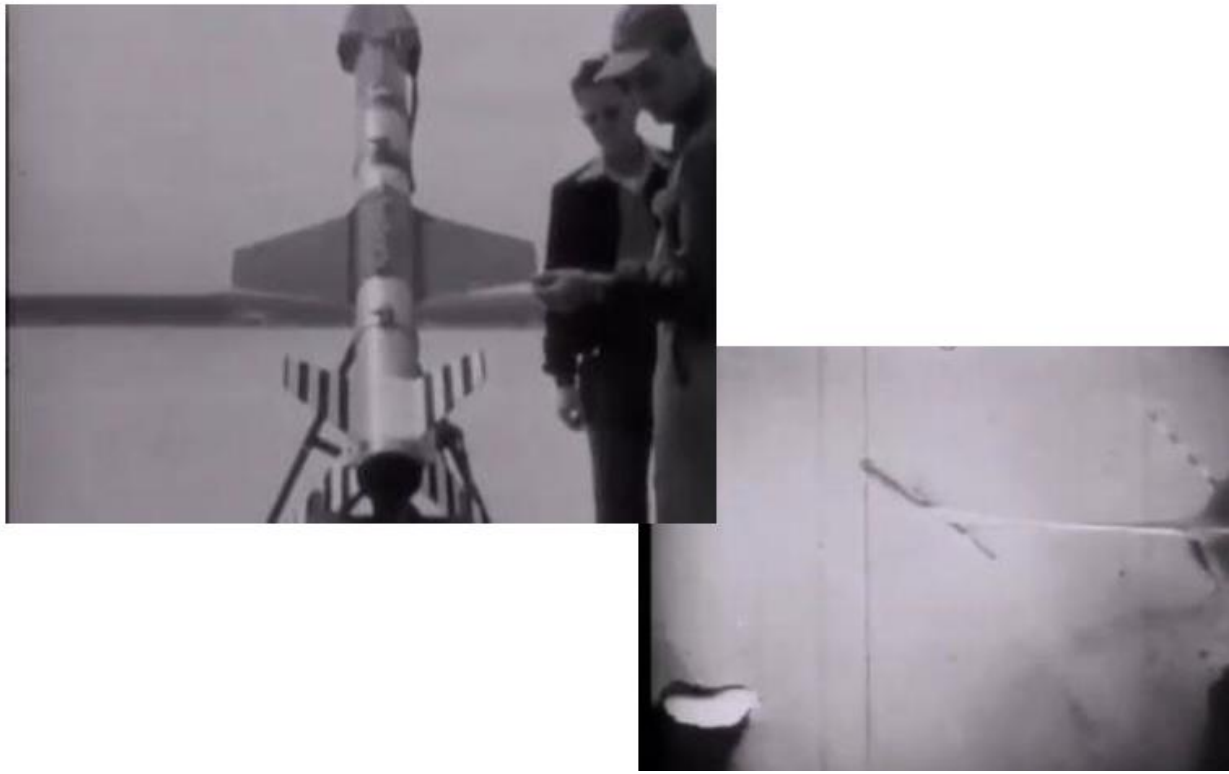
Tech specification:

-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.**

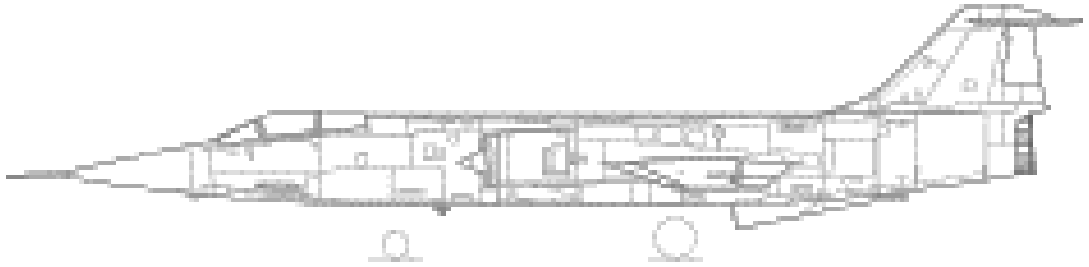


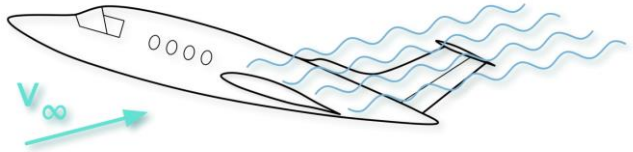
The wing configuration required new tests designed to grasp an understanding beyond a single physic through an integrated testing platform

Pictures of next pages taken from https://www.youtube.com/watch?v=C-djjebjfOU

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

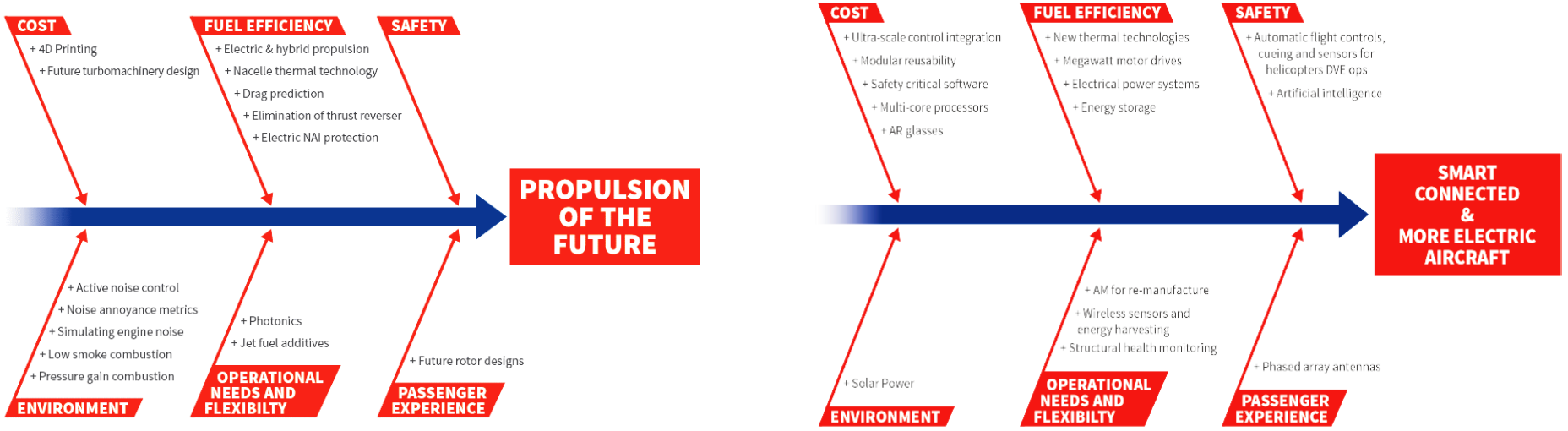
Safer, More Comfortable Passengers

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



Source: ATI Systems Specialist Advisory Groups

Reduce cost of space launchers and microsatellites

Increase safety
Human – Machine Interactions

Increase onboard comfort
More connected aircraft

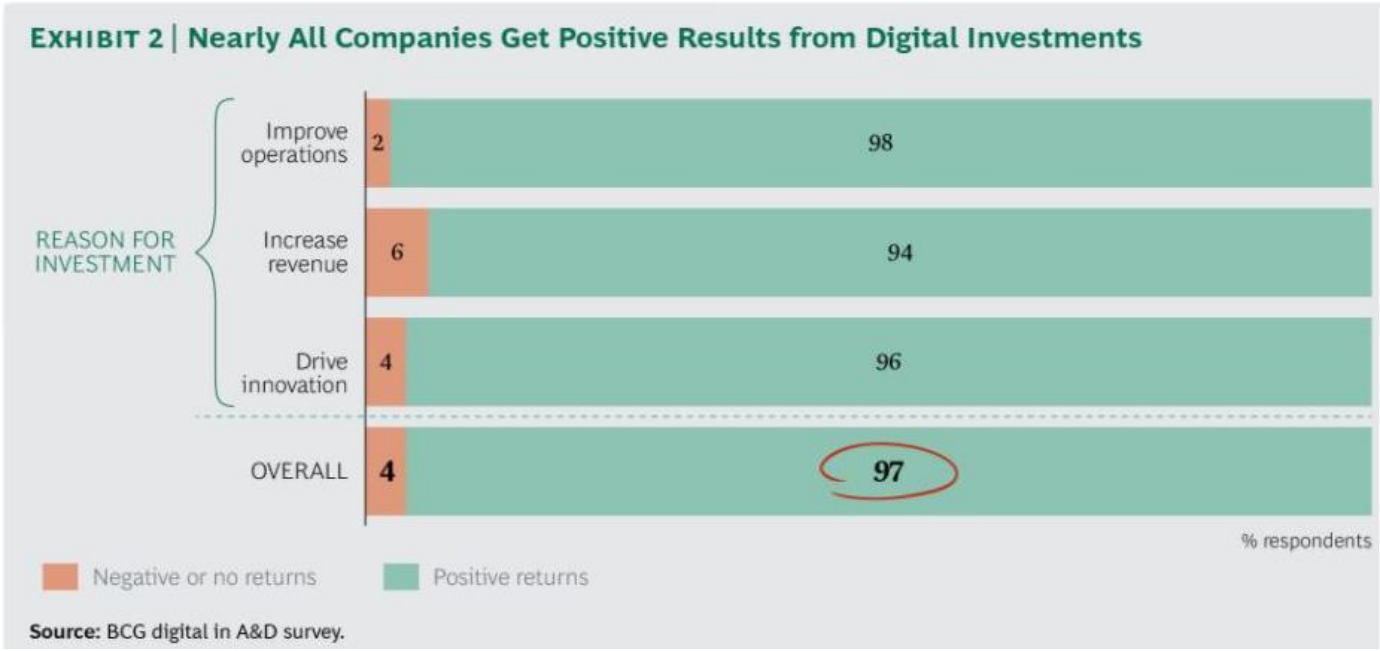
New production methods and materials
Services and maintainance

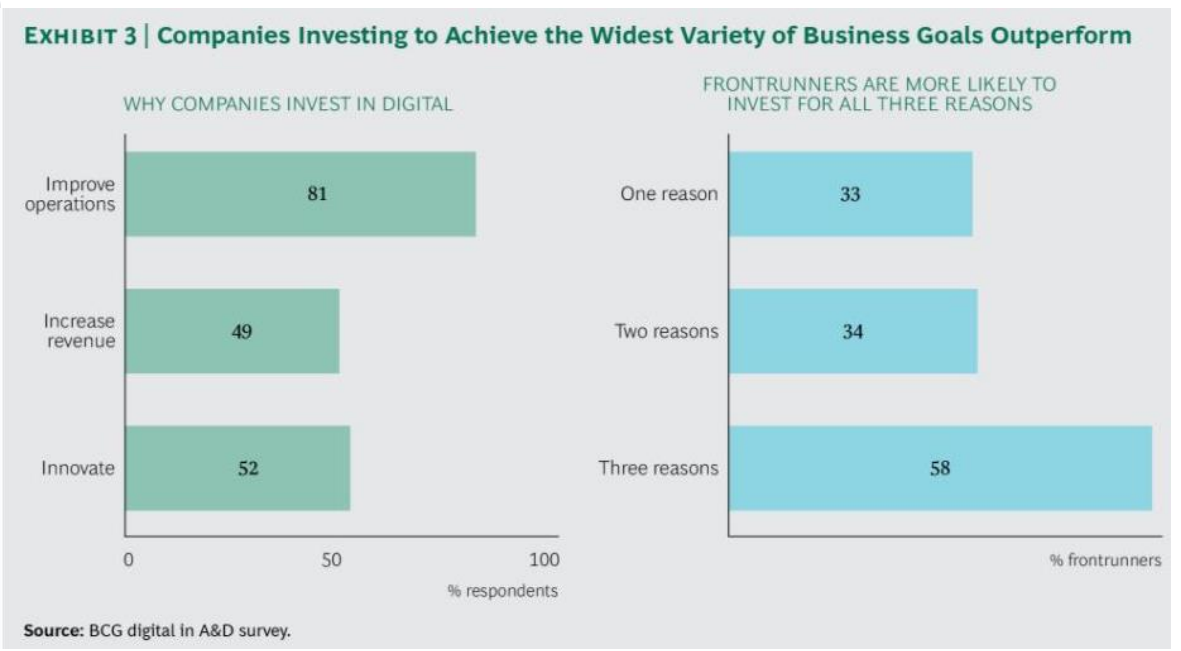
Break-through innovation requires a digital approach

CIMdata
2017 Market Analysis Report Series
Simulation & Analysis Market Analysis Report

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

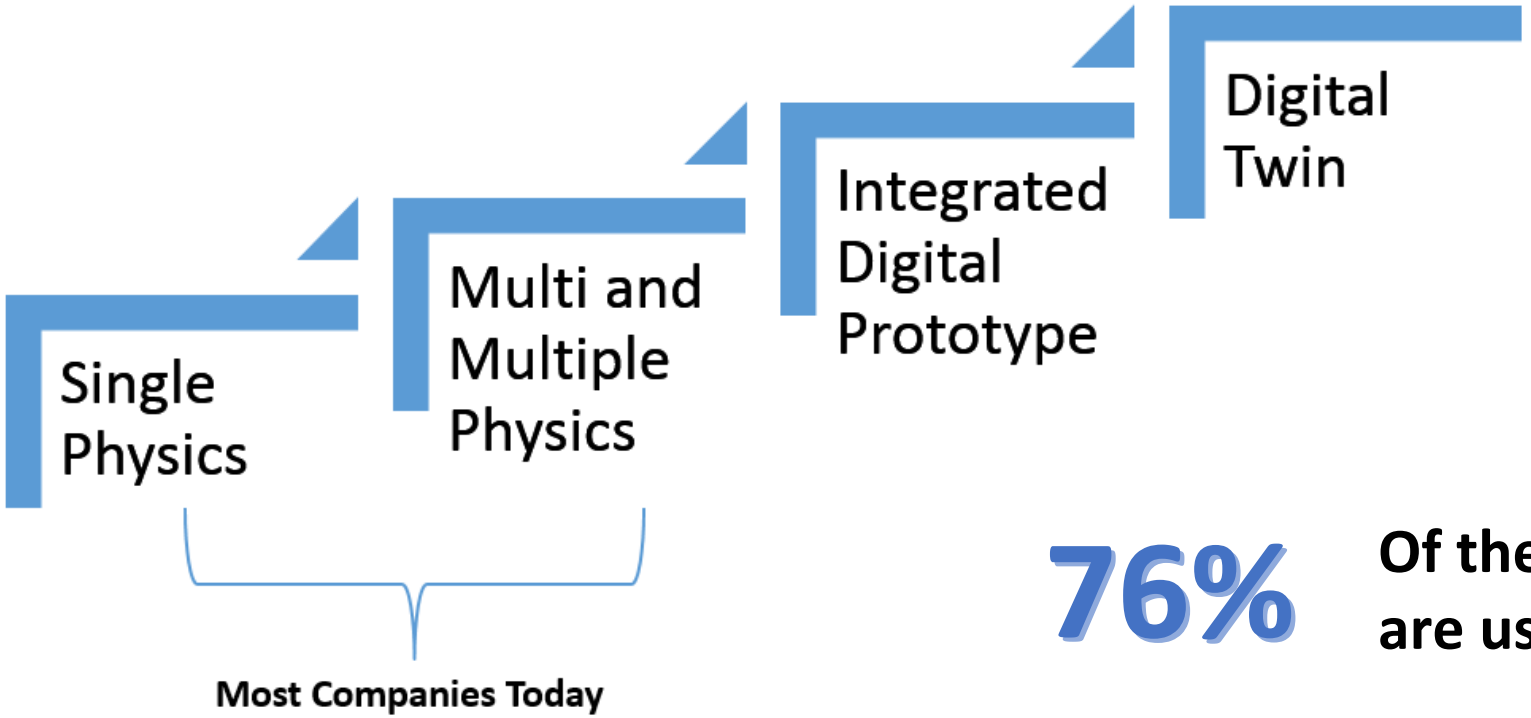




AEROSPACE TECHNOLOGY INSTITUTE

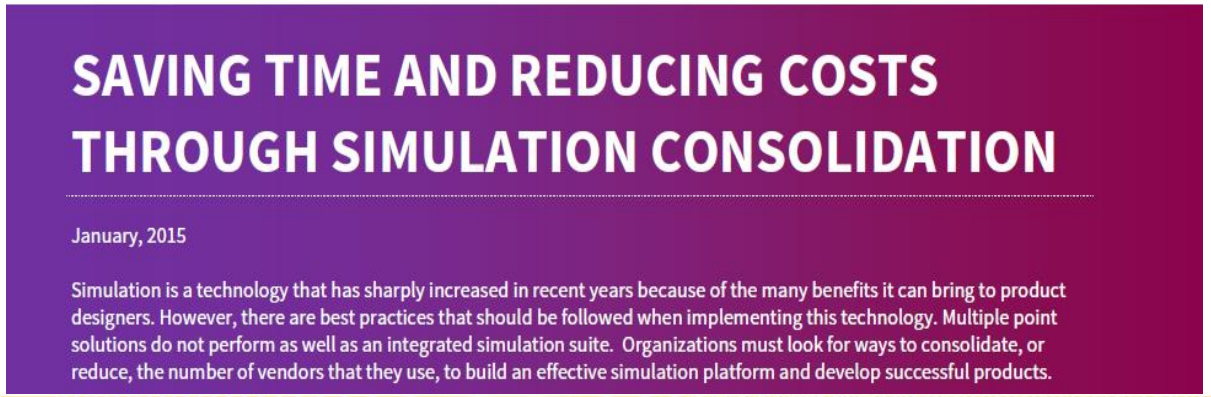
*"Digital can deliver **real value** throughout the supply chain, driving productivity, quality and cost improvements"*

Simulation Has Been Deployed Very Methodically in A&D



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

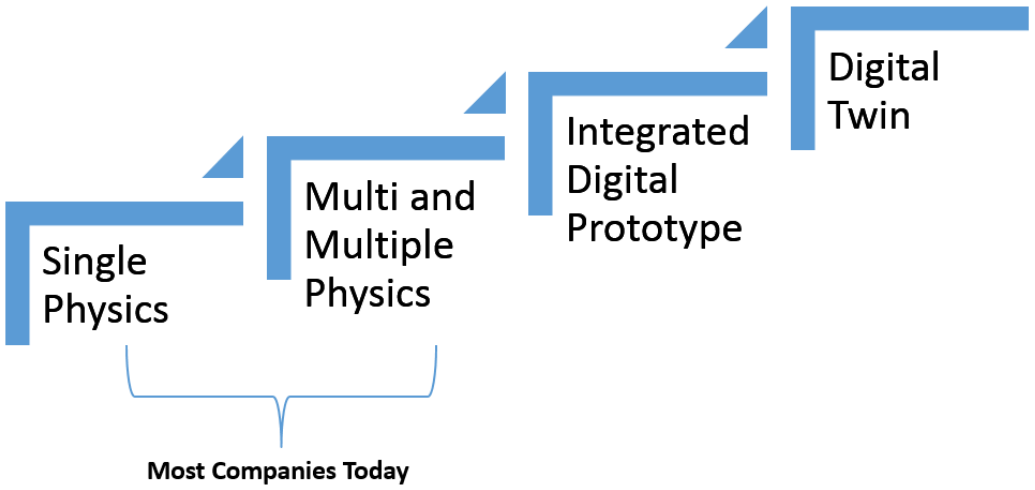
- Faster than physical prototyping
- More cost effectively
- More innovation, More confidence



ABERDEEN GROUP
A Harte Hanks Company

ANSYS

Simulation Has Been Deployed Very Methodically in A&D

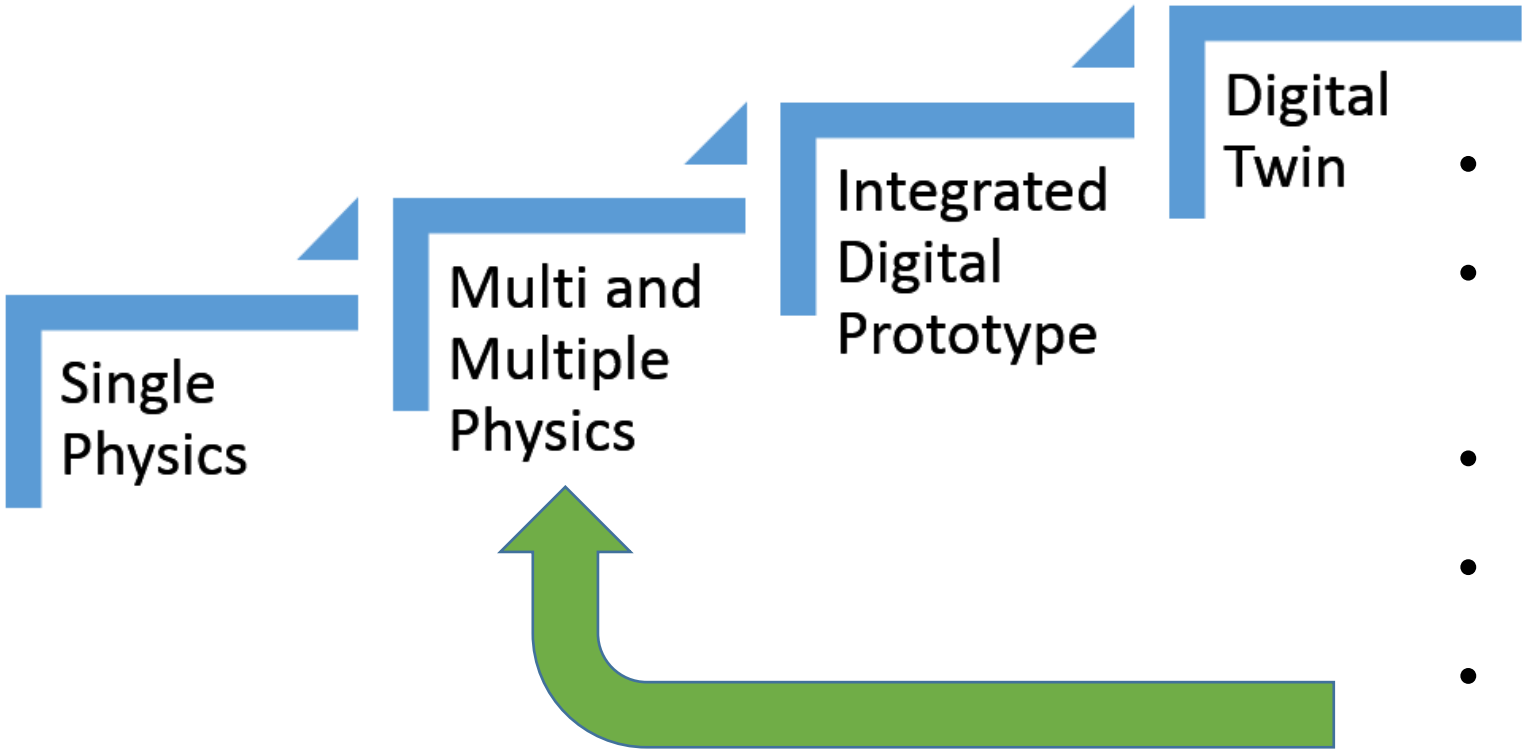


Limiting factors in A&D industry, due to legacy and fear in changing what worked in the past

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**

New simulation domains



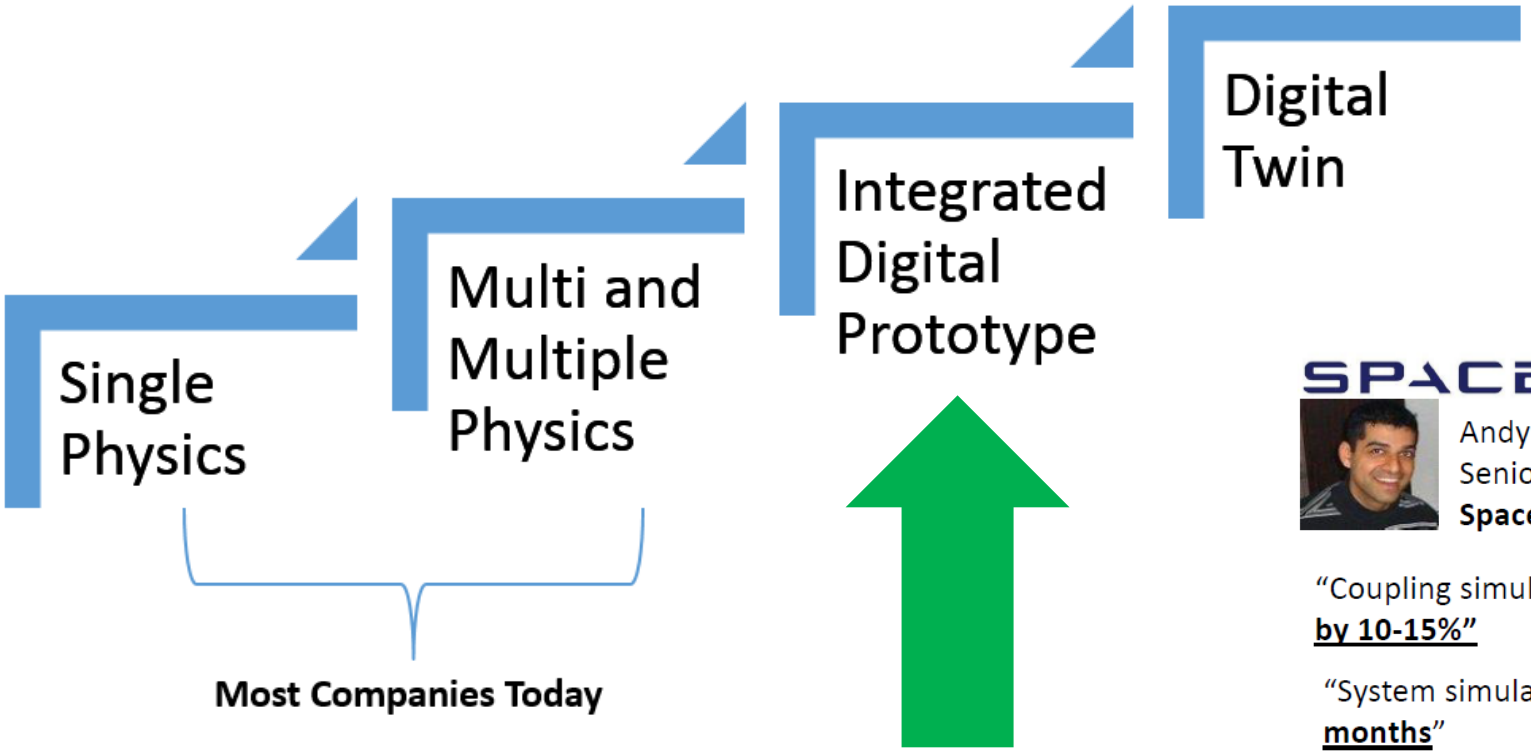
- **Multifunctional materials**
- **Topological optimization and additive manufacturing**
- **Process automation**
- **Bridge silos and foster collaboration**
- **Knowledge and IP management**

AIRBUS

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"

SPACEX

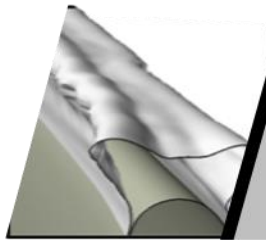
Andy Sadhwani
Senior Propulsion Engineer
Space Exploration Technologies

"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**"

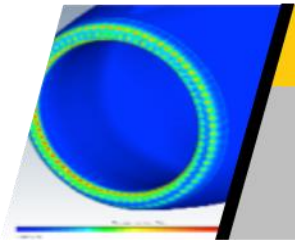
https://www.ansys-blog.com/startups-new-players-space-2-0/

Digital prototype of an entire system: ice building analysis and de-icing Systems



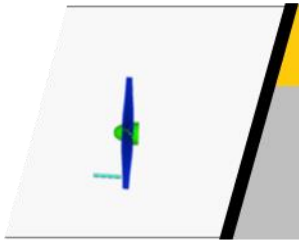
Aerodynamics

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



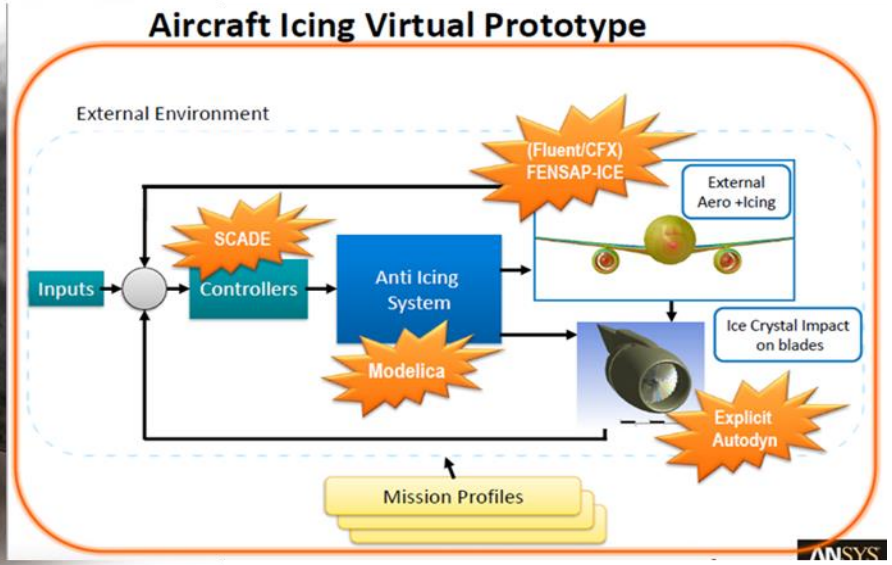
Aero-thermal

Heat Transfer, Thermal FSI



Aerostructures

Impact, Thermal Analysis, Strength Analysis



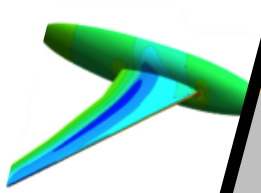
From a $10M test:

To: Estimate 50-100x cost reduction

Daher-Socata

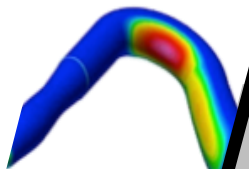
"Comparisons with icing tunnel test data deliver increased confidence in this 3D method for reliable use in future aircraft development"

Digital prototype of sub-systems



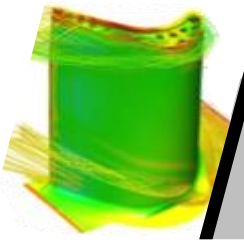
External Aerodynamics

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



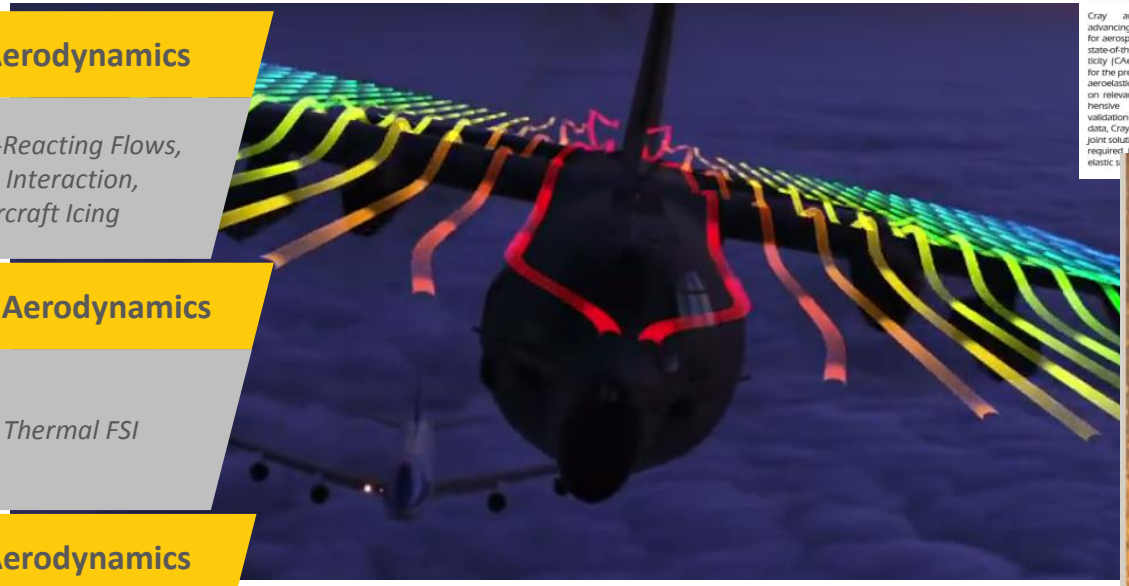
Integration Aerodynamics

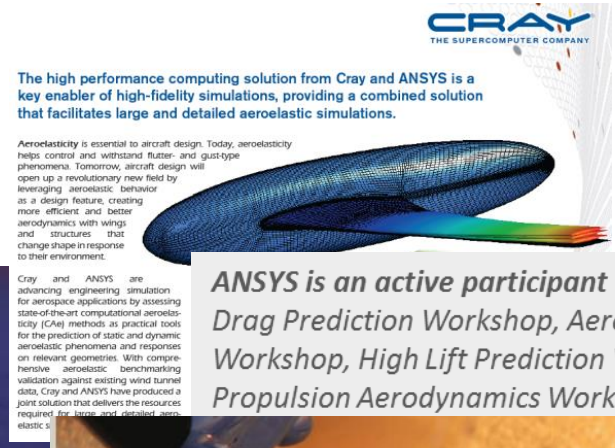
Heat Transfer, Thermal FSI



Propulsion Aerodynamics

Turbomachinery, Heat Transfer, Single Phase, Non-Reacting Flows, Reacting Flows & Combustion, Thermal FSI, Rigid Body Dynamics





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

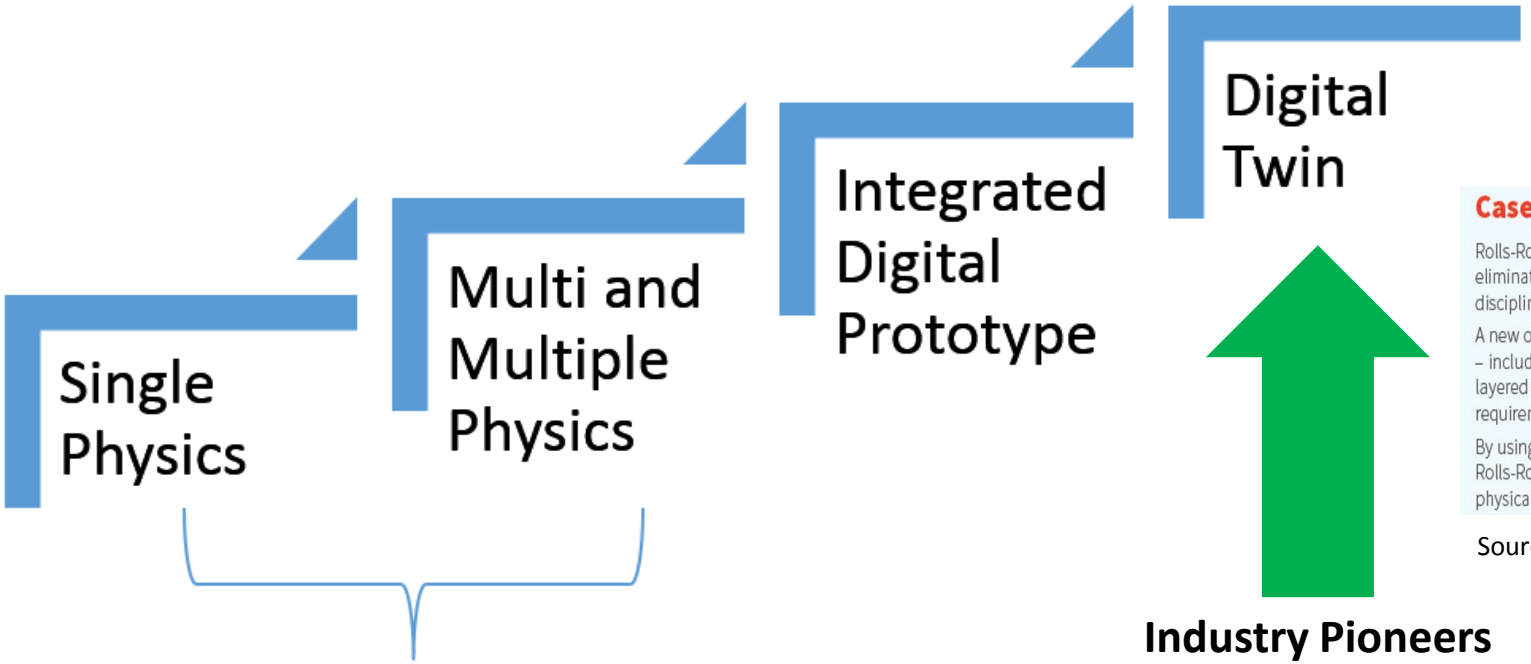
Cray

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

Working on the next thing... That is already here



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-VINCI, 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 to 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/

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

PITTSBURGH, November, 16, 2016 - ANSYS (NASDAQ: ANSS) announced today that it will collaborate with GE to create model-based digital twin technolog

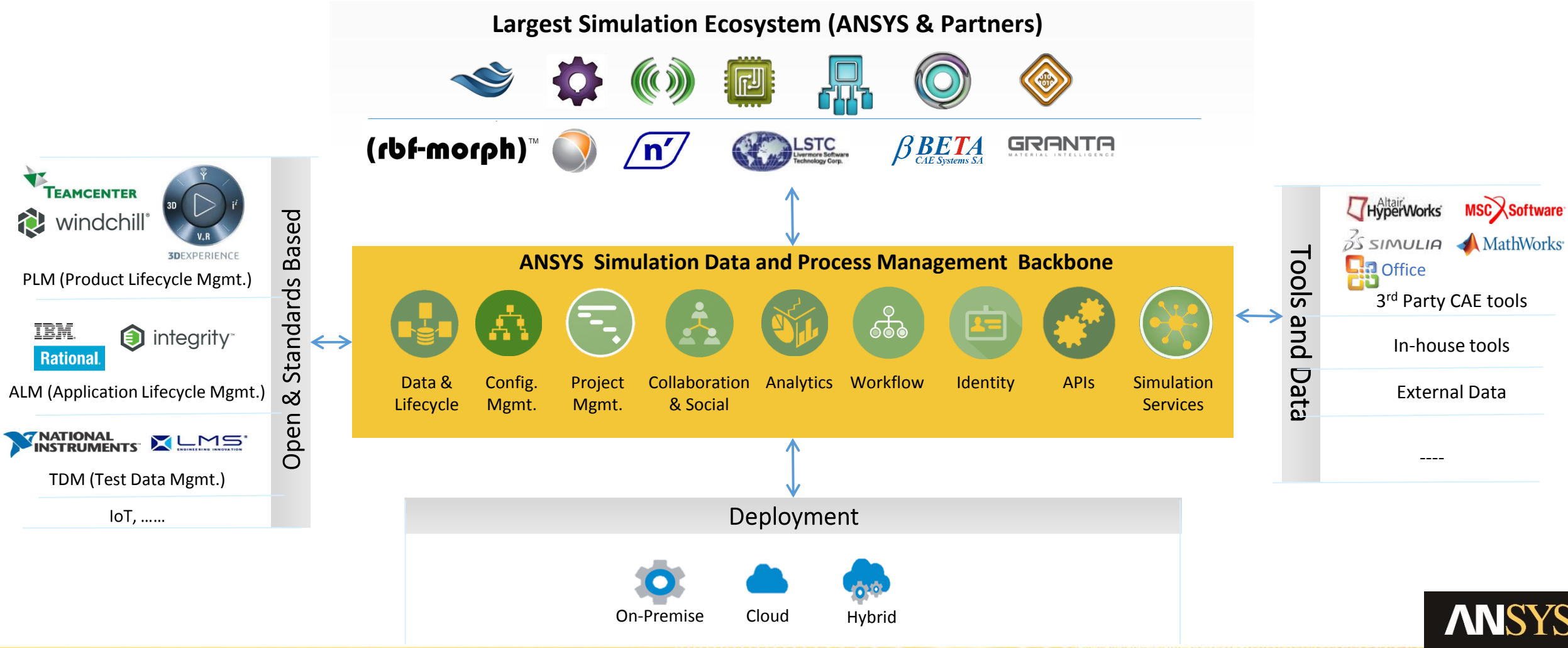
PTC and ANSYS to Develop Platform Solution Enabling Digital Simulation for the Industrial Internet of Things

Released : 05/17/2017

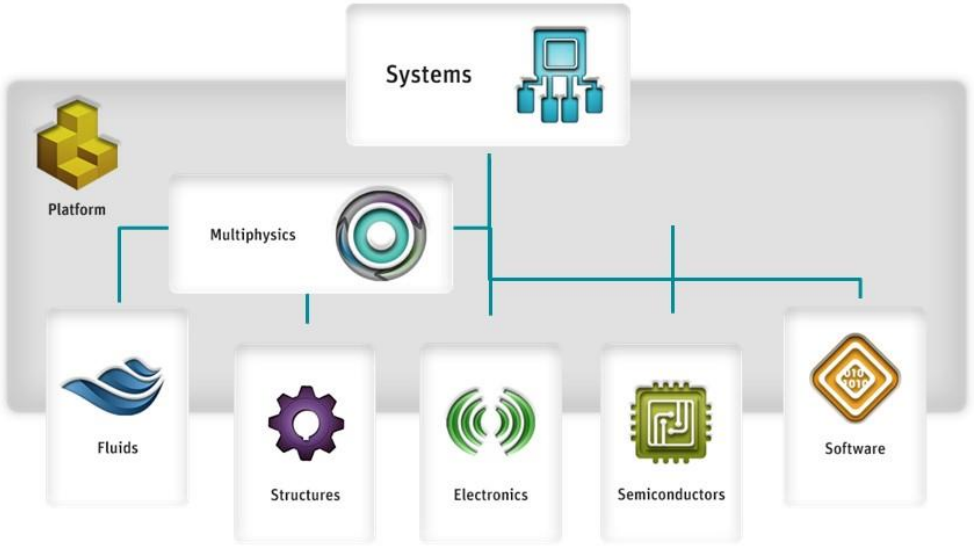
http://www.ansys.com/products/release-highlights/digital-twin

ANSYS platform vision

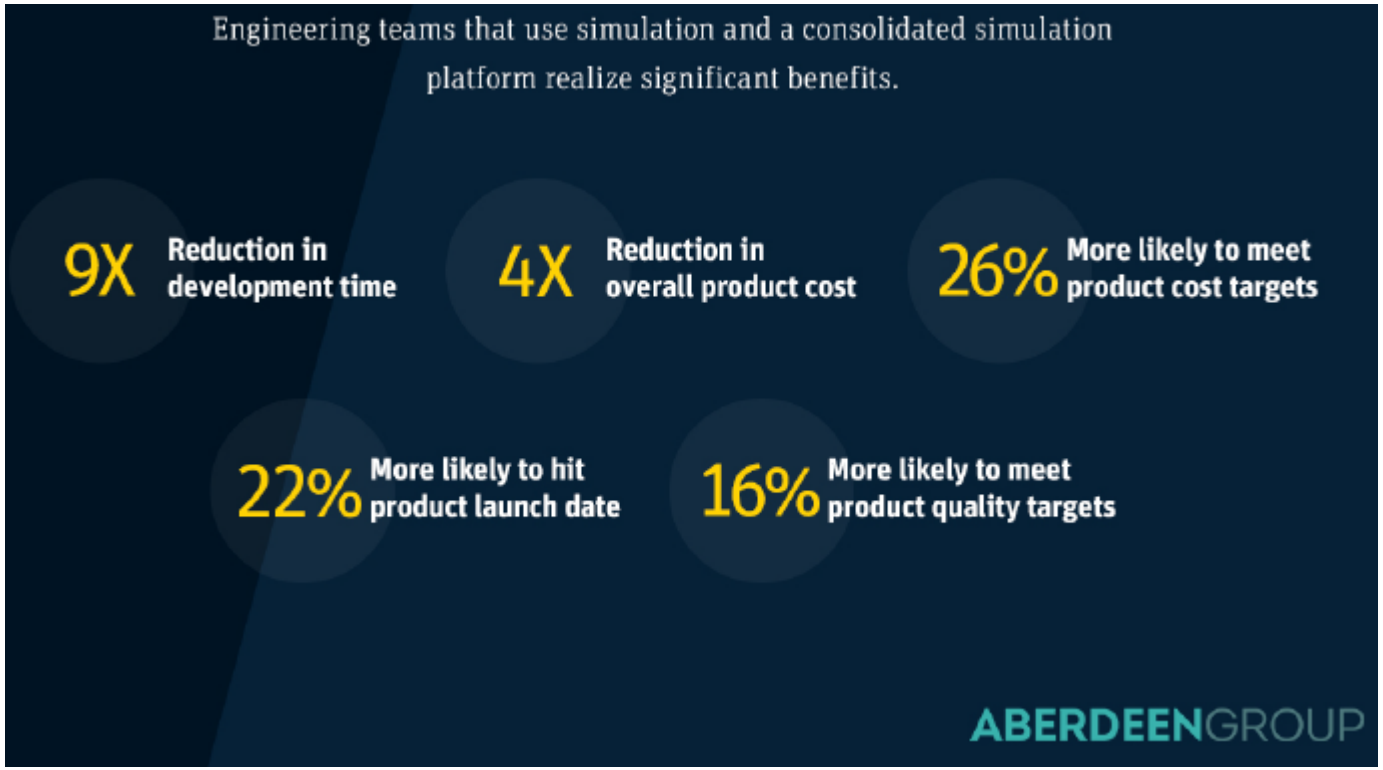
Open, Flexible, Scalable Simulation Platform that adapts to engineering needs and IT strategies



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

ANSYS and Carnegie Mellon University

Carnegie Mellon University

EurekAlert!, June 2016

Future Carnegie Mellon University engineers will design new innovative products more efficiently and effectively, thanks in part to a collaboration with ANSYS. The partnership brings together two world leaders in engineering, computer science and simulation technologies to impact the future of engineering education and research. ANSYS and Carnegie Mellon want to boost engineers' use of simulation to enable unp
development process.

Home » IT & Networking » Al Politecnico di Milano didattica e ricerca si fanno con Ansys

Al Politecnico di Milano didattica e ricerca si fanno con Ansys

Virna Bottarelli - 13 novembre 2013

Software di simulazione

Da diversi anni alcuni dipartimenti del Politecnico di Milano si sono dotati dei software di simulazione numerica Ansys, tra i codici di analisi più diffusi a livello industriale nel mondo caratterizzato da una completezza di strumenti unica e un continuo aggiornamento tecnologico.
Viste le crescenti richieste da parte dei dipartimenti di poter accedere al software, l'Area Servizi Ict di

ANSYS和卡內基梅隆大學攜手推動下一次工

2016年6月2日，匹茲堡訊——得益於ANSYS（NASDAQ:ANSS）和卡內基梅隆
此次的合作代表著工程、電腦科學與模擬技術領域的兩大巨擘強強聯合，致力
與虛擬產品的數位革命相類似，製造業和產品創新領域正在經歷一場加火如荼
發流程之初就能探索更多材料和設計，從而開啟前所未有的創新機遇。觀看視

Florida International University Adopts ANSYS Engineering Simulation Solutions Campus-Wide

Released : 14 Apr 2015

PITTSBURGH, April 14, 2015 /PRNewswire/ -- Students at Florida International University (FIU) now have access to the full suite of ANSYS (NASDAQ: ANSS) multiphysics solutions – enabling them to be better prepared for engineering careers by using the same software used by professionals around the world. University faculty will also be able to conduct research using the campus-wide license.

ANSYS and the Indian Institute of Technology

ANSYS invests in next generation of engineers to drive safety, performance and securi

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

ANSYS

Master's degree in Numerical Simulation in Engineering with ANSYS

Technical University of Madrid

And Startups

ANSYS has a dedicated program to support startups in the first years of their life, and incubators to 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

https://www.youtube.com/watch?v=krWQ85OdKns

Los Angeles Cleantech Incubator (LACI) and ANSYS

Los Angeles Cleantech Incubator (LACI), is built to commercialize clean technologies and provide technical resources for startups. LACI's partnership with the ANSYS Startup Program gives their startups huge value by providing access to ANSYS simulation tools onsite. This allows their startups to save time, reduce risks around making changes, and accelerate their product development process while saving them money.

Edisun

Edisun, a business startup, leveraged software accessible through the ANSYS Startup Program to design and test their first product, PV Booster. PV Booster is the only dual-axis rooftop tracker for the commercial and industrial market providing 20% better economics on your installation by making more efficient use of solar panels. ANSYS software allowed Edisun to speed through design cycles, shorten their time to marked, and work very efficiently.

Connect with me to know more

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paolo.colombo@ansys.com

T H A N K Y O U !