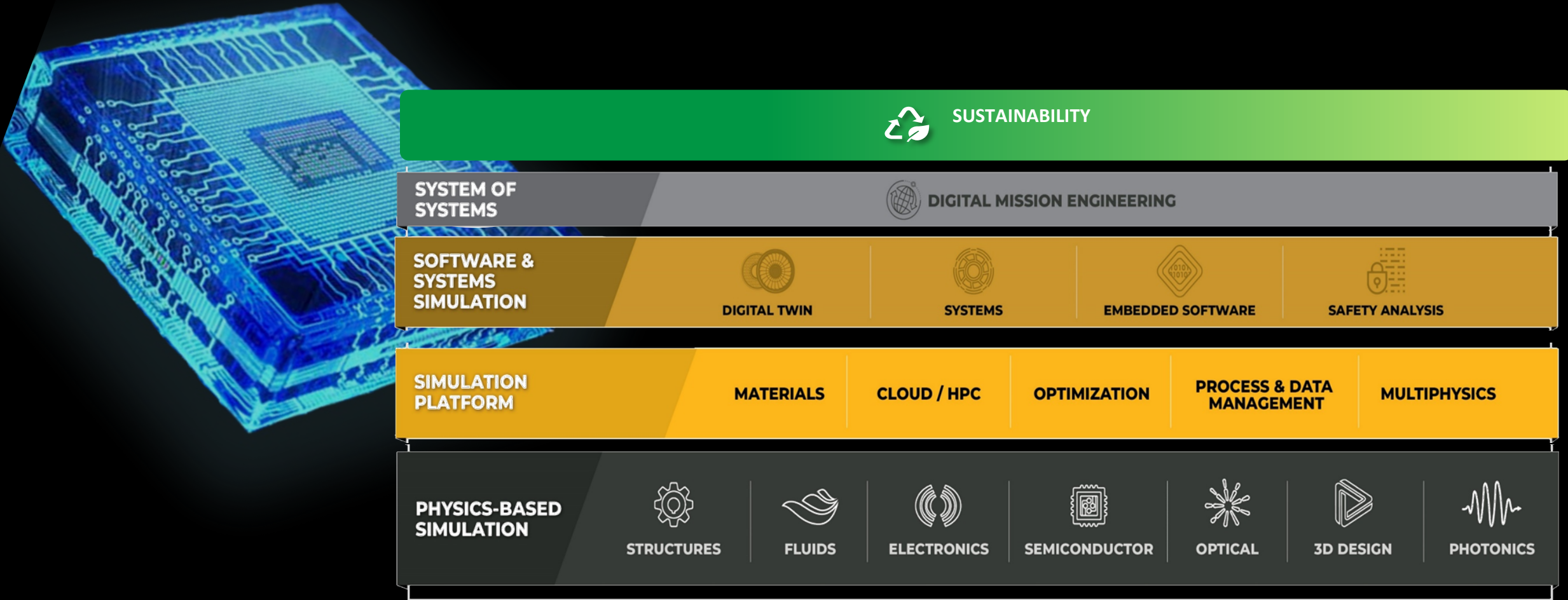Powering Innovation That Drives Human Advancement

Simulate, Innovate, Accelerate: Digital Engineering Unleashed

Will Marsden

Chief Technologist, Ansys

October 16th, 2024

Powering innovation that drives human advancement

Unique design of the Ansys product portfolio, platform, and ecosystem for your development processes

SUSTAINABILITY

SYSTEM OF SYSTEMS	DIGITAL MISSION ENGINEERING			

SOFTWARE & SYSTEMS SIMULATION	DIGITAL TWIN	SYSTEMS	EMBEDDED SOFTWARE	SAFETY ANALYSIS

SIMULATION PLATFORM	MATERIALS	CLOUD / HPC	OPTIMIZATION	PROCESS & DATA MANAGEMENT	MULTIPHYSICS

PHYSICS-BASED SIMULATION	STRUCTURES	FLUIDS	ELECTRONICS	SEMICONDUCTOR	OPTICAL	3D DESIGN	PHOTONICS

Powering Innovation That Drives Human Advancement **Ansys**

Digital Engineering | Ansys Investment Priorities

Core Physics Numerical Methods and Models
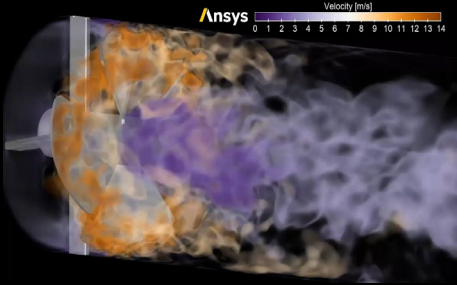
- Solver methods
- Geometry and meshing
- Shape and topology optimization
- Advanced analysis
- Multi-physics
- Multi-scale

High-Performance Computing
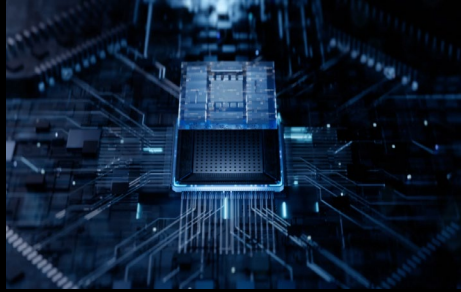
- Shared-memory
- Message-passing
- Fine-grained GPUs
- New architectures: FPGAs & AI hardware
- Quantum computing

Artificial Intelligence and Machine Learning

- Solver acceleration
- Solver settings
- Top-down methods
- Bottom-up methods
- Reduced order models
- Generative AI

Cloud, Platform, and User Experience

- Cloud Enabled
- Cloud Native
- Platform, Collaboration
- Open APIs and developer ecosystem
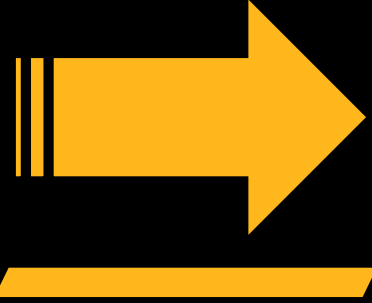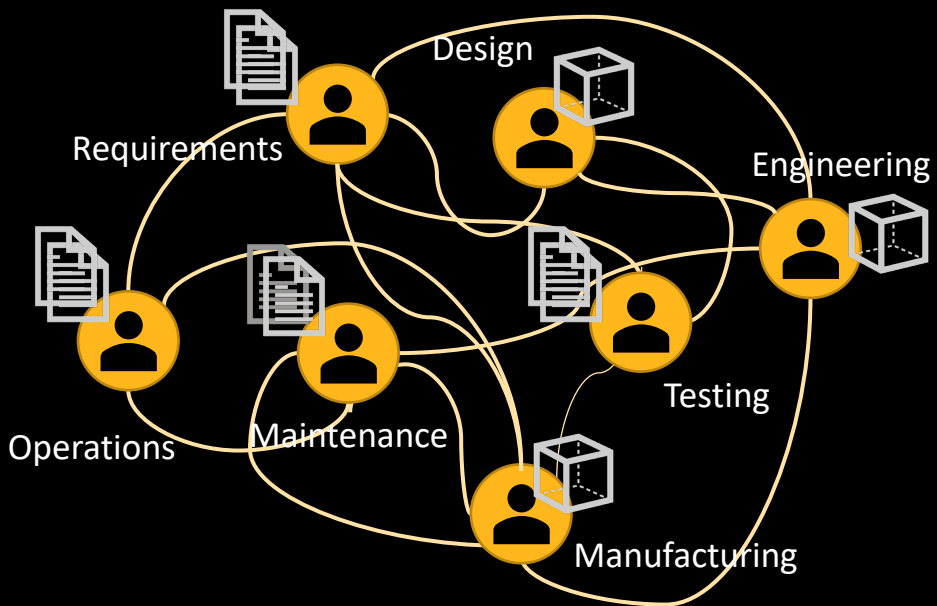- Common user experience

Digital Engineering

- Model Based System Eng.
- Requirements & architecture Connections
- Safety, security, & software
- Digital twins
- Simulation process & data management
- Mission engineering

Five Ansys engineering Pillars – compressing timelines and enabling digitally paced global collaboration …

Powering Innovation That Drives Human Advancement

/\nsys

Shift from Traditional Engineering to Digital Engineering

Current State

Requirements
Design
Engineering
Testing
Maintenance
Operations
Manufacturing

- Model-based
- Collaborative
- Agile
- Connected
- Traceable:
  - Right Information
  - Right Time
  - Right Format
- Dev(Sec)Ops

Desired State

Maintenance
Requirements
Operations
Design
Engineering
Manufacturing
Testing

Powering Innovation That Drives Human Advancement

Ansys
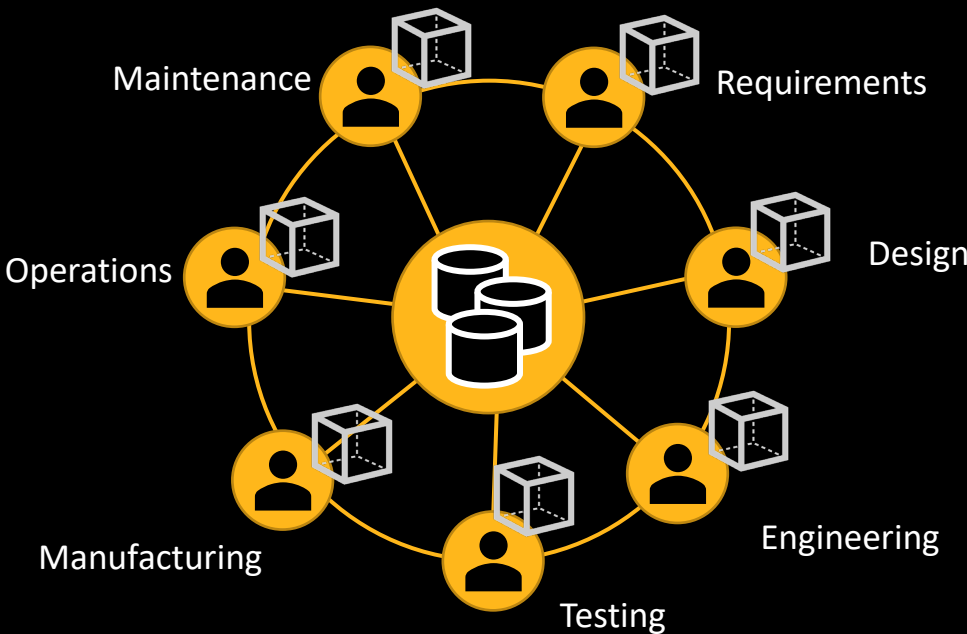
Shift from Traditional to Digital Engineering

Workstream 2:
Electronic Hardware Development

Workstream 4:
Compliance & Safety

Workstream 1:
Physical Product Development

Workstream 3:
Software Development
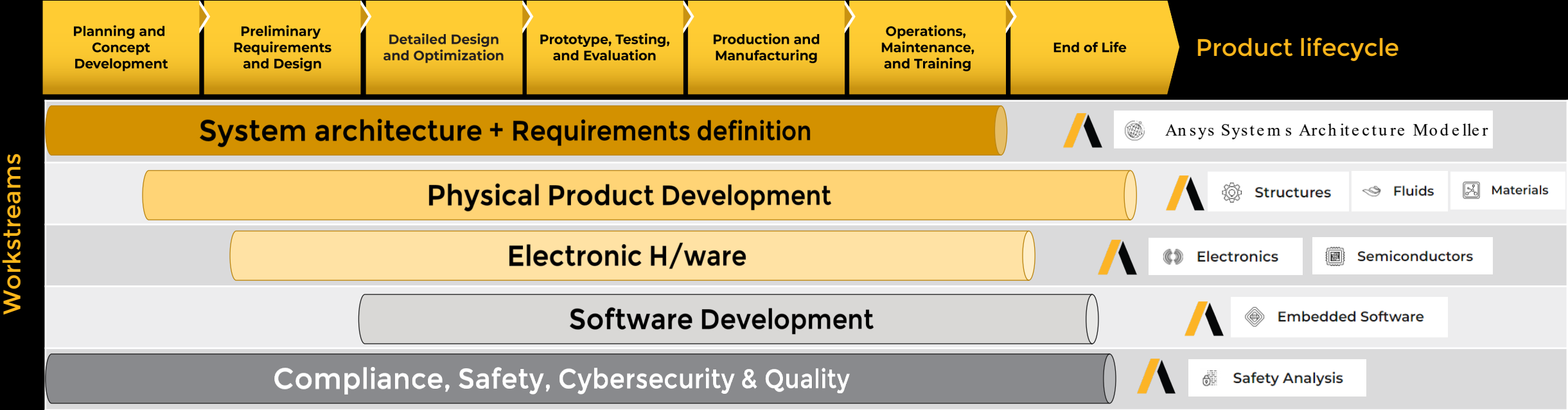
Workstream 5:
Quality

CURRENT STATE:

Each individual engineering workstream is complex and working independently of one another. Manual, inefficiency integration activities MUST happen frequently & repeatedly during the product lifecycle.

The more complex the project, the more scope for error.

Powering Innovation That Drives Human Advancement

Ansys

Shift from Traditional to Digital Engineering

Planning and Concept Development	Preliminary Requirements and Design	Detailed Design and Optimization	Prototype, Testing, and Evaluation	Production and Manufacturing	Operations, Maintenance, and Training	End of Life	Product lifecycle

Workstreams

System architecture + Requirements definition — Ansys Systems Architecture Modeller

Physical Product Development — Structures / Fluids / Materials

Electronic H/ware — Electronics / Semiconductors

Software Development — Embedded Software

Compliance, Safety, Cybersecurity & Quality — Safety Analysis

ANSYS OFFERS

World-class products for each of the individual workstreams.

These products are open, allowing them to be integrated into any legacy or future state engineering tool set-up.

Powering Innovation That Drives Human Advancement

/Ansys

Shift from Traditional to Digital Engineering

Product lifecycle

Planning and Concept Development	Preliminary Requirements and Design	Detailed Design and Optimization	Prototype, Testing, and Evaluation	Production and Manufacturing	Operations, Maintenance, and Training	End of Life

Workstreams

System architecture + Requirements definition — Ansys Systems Architecture Modeller (SAM)

Physical Product Development — Structures · Fluids · Materials

Electronic H/ware — Electronics · Semiconductors

Software Development — Embedded Software

Compliance, Safety, Cybersecurity & Quality — Safety Analysis

- Safety & Quality Support
- Refine requirements and validate system
- Trade studies into physical, H/w and S/w
- Detailed design optimization at system level
- H/w and S/w integration, safety analysis & sign-off
- System requirements V&V

DESIRED STATE:

Connect workstreams to the System Architectural Model through automated, integrated workflows.

These models become the <u>Authoritative Source of Truth</u> + ensure integration tasks are <u>automated, efficient & consistent</u>.

Powering Innovation That Drives Human Advancement

/Ansys

Morgan Brennan
"What's pretty incredible about this highly complicated, highly complex program, but we typically see, unfortunately, is that when programs of this size are go through development, they tend to come over budget. They tend to be delayed. That has not been the case with B21 so far. You're on schedule. How have you been able to pull that off?"

Kathy Warden, Northrop Grumman Chair & CEO
"We've been using digital engineering from the beginning of this program to help us iterate on thousands of designs and then translate those into the platform that the world will see tonight.

And we are so proud of what our team working alongside in a very transparent way with the Air Force has been able to do differently in the acquisition program for the B21 Raider."
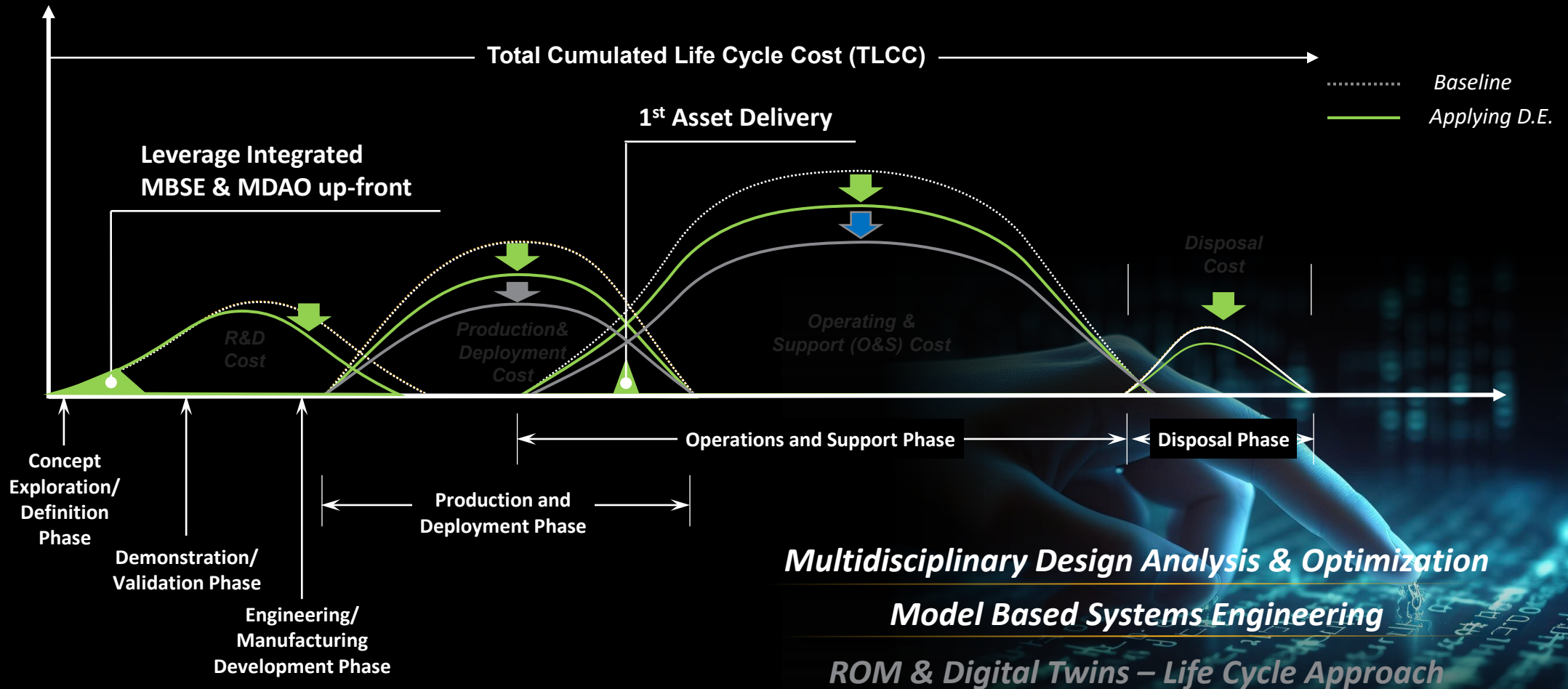
Digital Engineering | Strategic ROI Methodologies - MDAO, MBSE to Digital Twins

*OEMs realize larger **ROI** throughout the product life-cycle | Extended to ROMs for Digital Twins*

Total Cumulated Life Cycle Cost (TLCC)

1st Asset Delivery

Leverage Integrated
MBSE & MDAO up-front

Baseline

Applying D.E.

Disposal Cost

R&D Cost

Production & Deployment Cost

Operating & Support (O&S) Cost

Operations and Support Phase

Disposal Phase

Concept Exploration/ Definition Phase

Demonstration/ Validation Phase

Engineering/ Manufacturing Development Phase

Production and Deployment Phase

Multidisciplinary Design Analysis & Optimization

Model Based Systems Engineering

ROM & Digital Twins – Life Cycle Approach

Applying digital engineering methodologies will deliver higher ROIs throughout the entire product's lifes cycle …

Powering Innovation That Drives Human Advancement

Ansys

Ansys' Digital Engineering Vision

Support our customers' **digital engineering transition** for **cyber-physical systems** with an integrated **suite of tools** that **connect** the **parallel engineering workstreams** for systems architecture & requirements; safety & cyber-security; physical engineering, software & controls, **across the product lifecycle.**
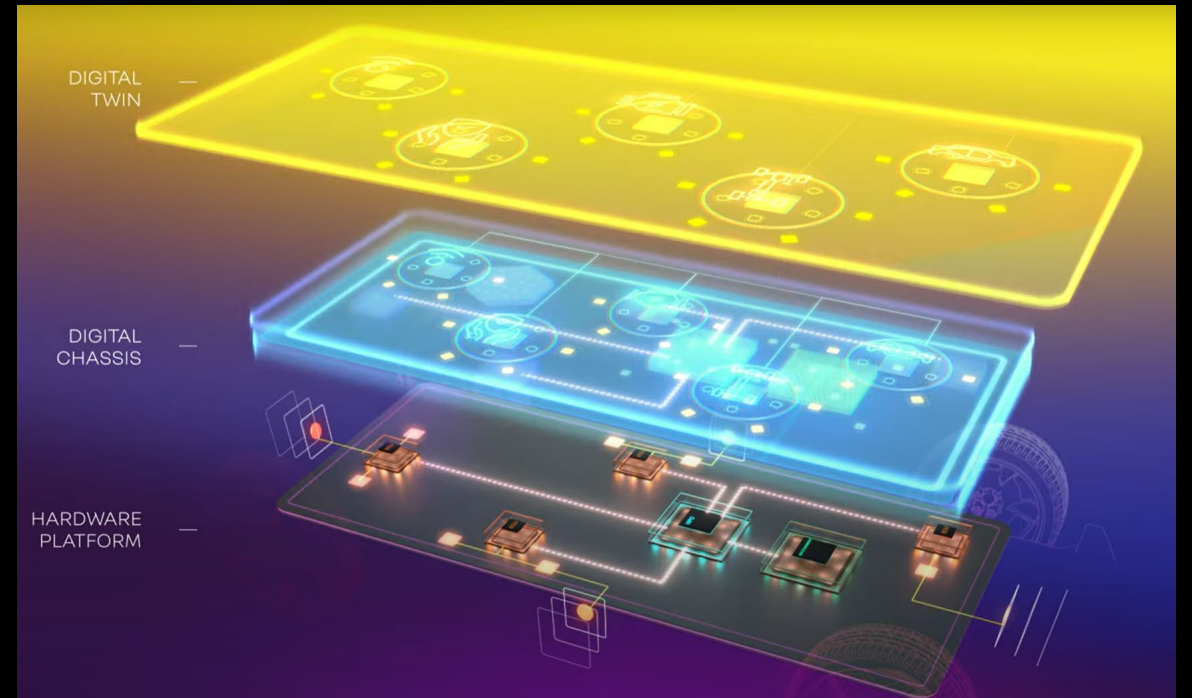
Renault Group & Software Defined Vehicle technology
https://youtu.be/cWnsCMtX9f8?si=2eqhuiCOd6rMblSK

Powering Innovation That Drives Human Advancement

\Ansys