

# 디지털 트윈 기술을 이용한 풍력발전기 단지의 개발

Younhyuck Chang

Ansys Korea

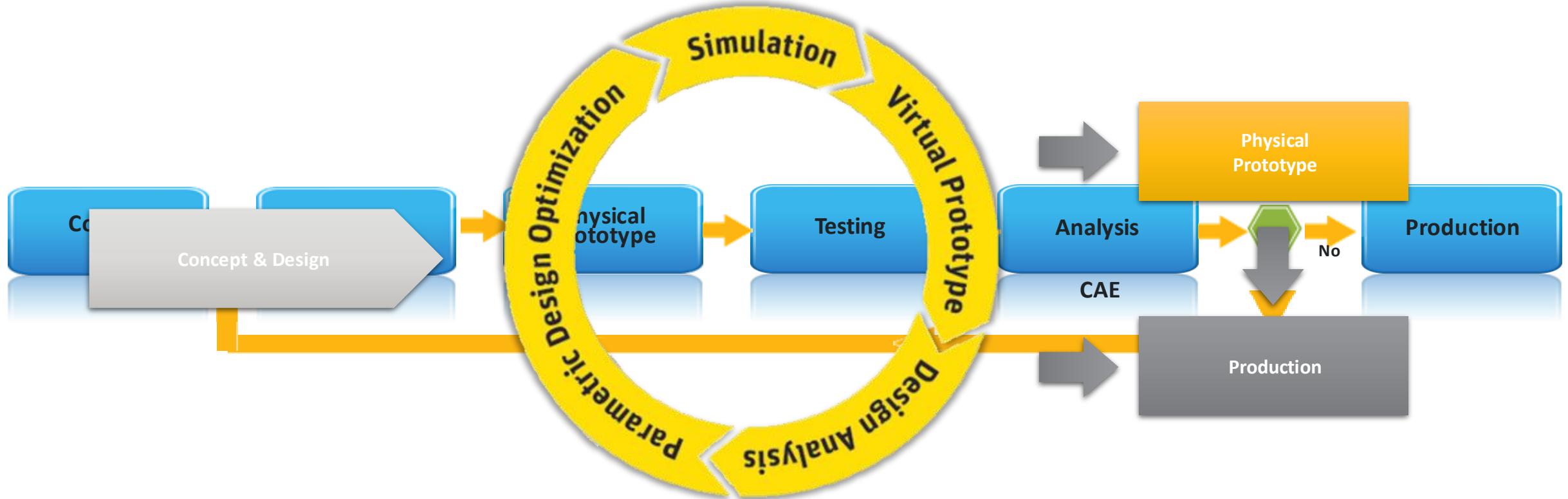


# AGENDA

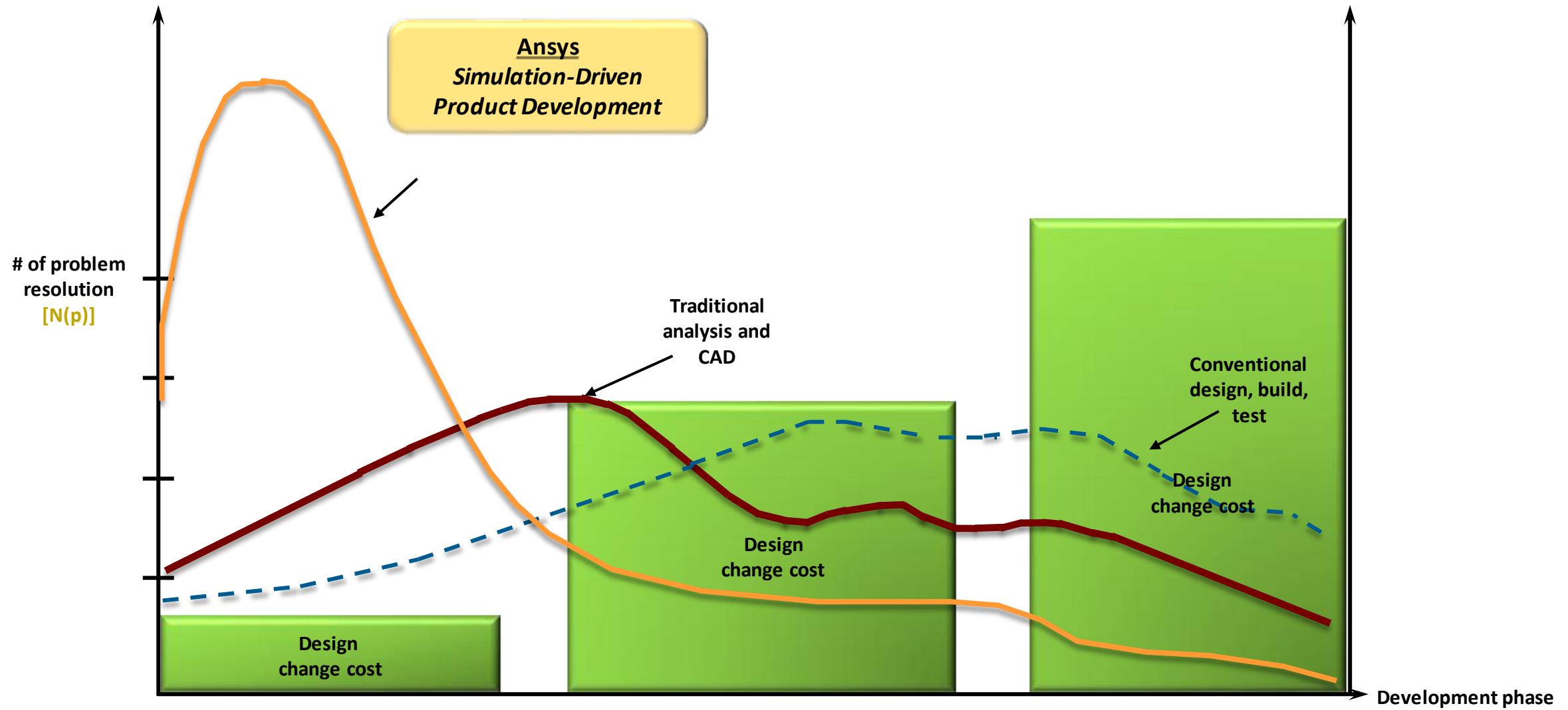
- 설계 패러다임의 변화
- 디지털 트윈 구현을 위한 구성요소
- 통합모델의 성능해석
- 디지털 트윈 구현사례
- Q&A

# 컴퓨터 해석 기반의 설계기법 변화

## 해석 기반의 제품 개발



# 개발 과정의 비교

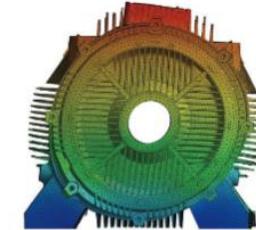
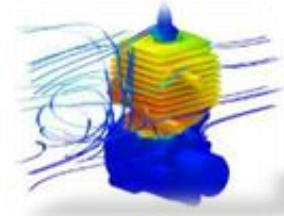


# 해석 기반의 Digital Twin은 무엇인가?

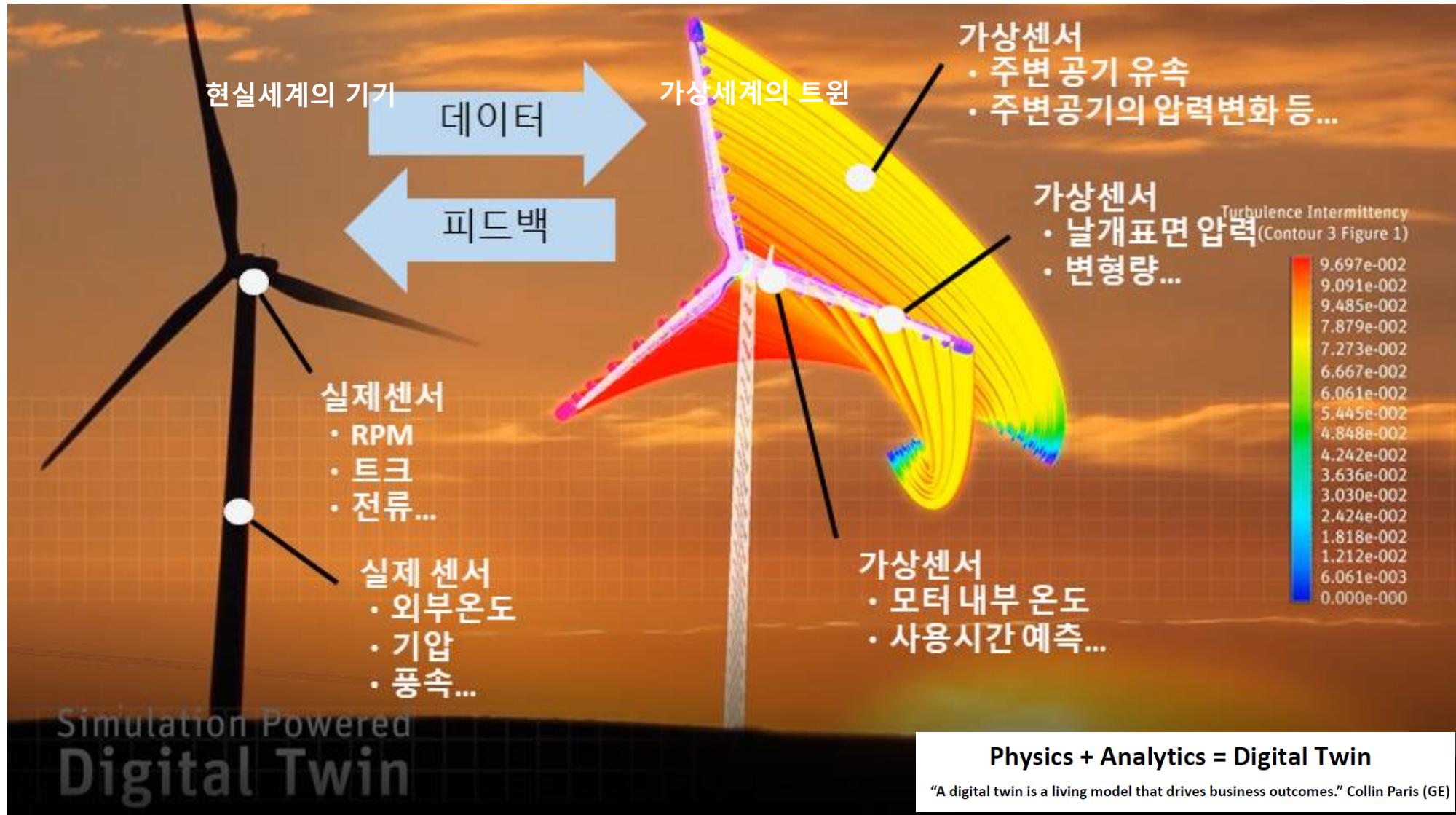
Connected, virtual **replica** of an in-service physical asset, in the form of an integrated multi-domain system simulation, that **mirrors the life and experience of the asset**

Enables **system design and optimization, predictive maintenance** and optimize industrial **asset management**  
자산의 주명 및 경험을 반영하는 통합된 다중 도메인 시스템 해석의 형태로 서비스 중인 물리적 자산과 연결된  
가상의 복제본

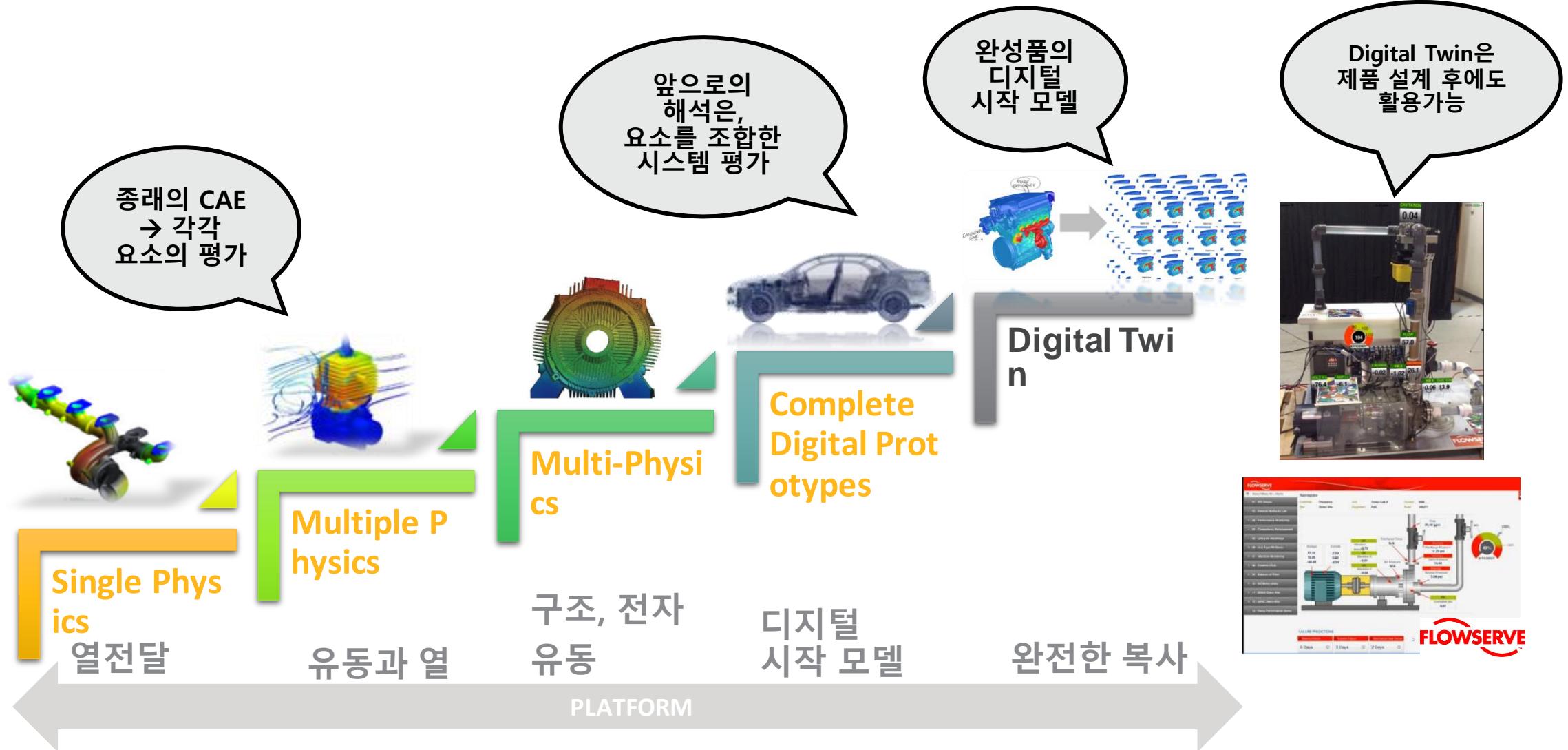
시스템 설계 및 최적화, 예측 유지보수 및 산업 자산 관리 최적화가 가능



# Ansys의 Digital Twin



# 해석 모델의 복잡성



# 디지털 트윈 구현의 중심에 있는 시뮬레이션



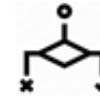
## Simulation-Based & Hybrid Analytics



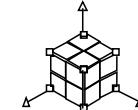
Create virtual sensors to “measure” missing data



Analyze accurate and deterministic **predictions** based on physical principles

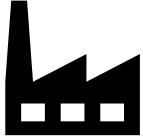


Perform **what-ifs** before applying a solution



Explore **causality and failure modes** using physics

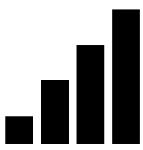
# 디지털 트윈의 대표적인 사용 사례



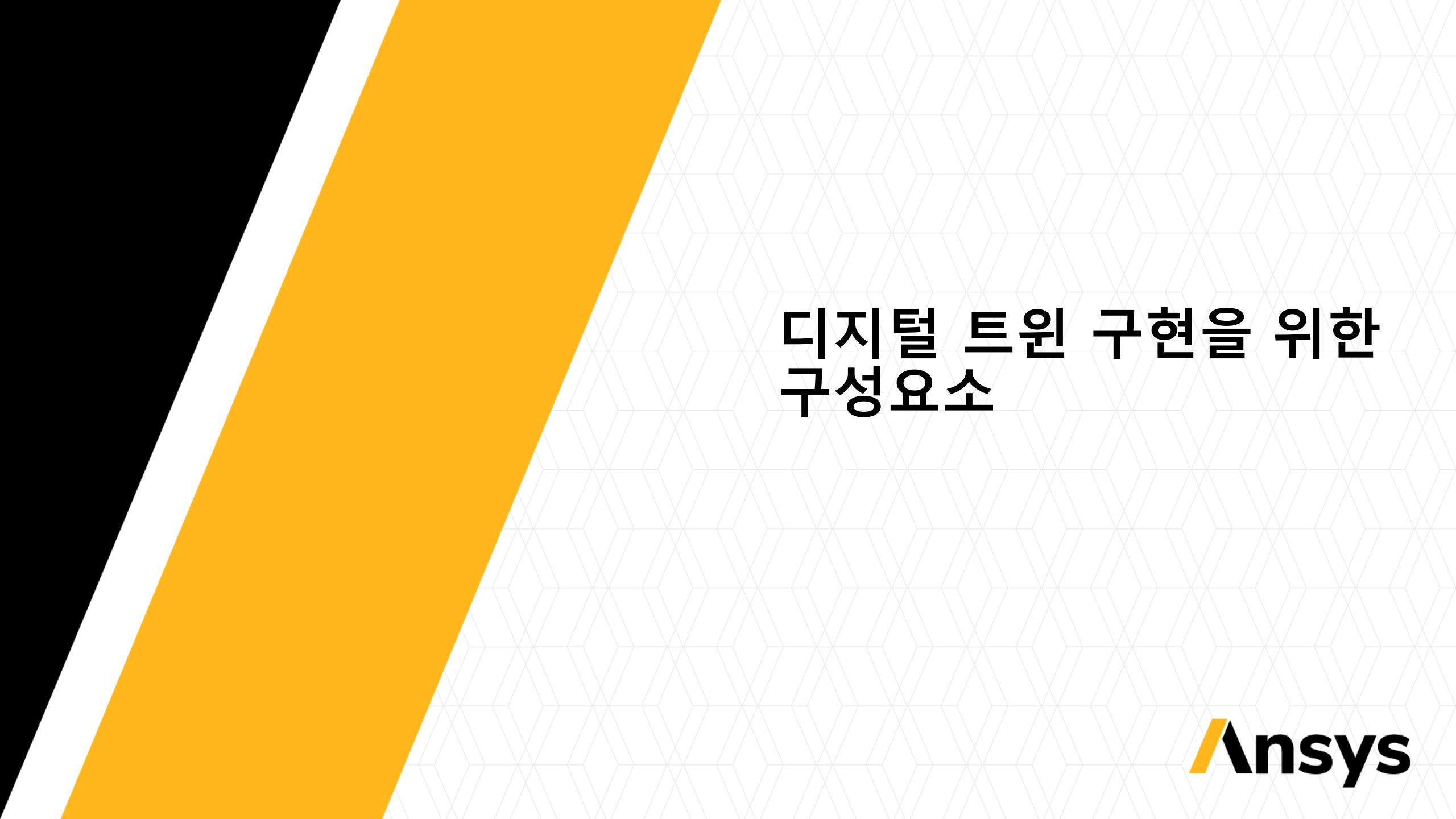
가상 커미셔닝, 문제 해결 및 시스템 구성



예측 및 처방적 유지관리



운영 최적화 및 서비스로서의 수익률



# 디지털 트윈 구현을 위한 구성요소



# Ansys Twin Builder의 주요 기능

Deploy



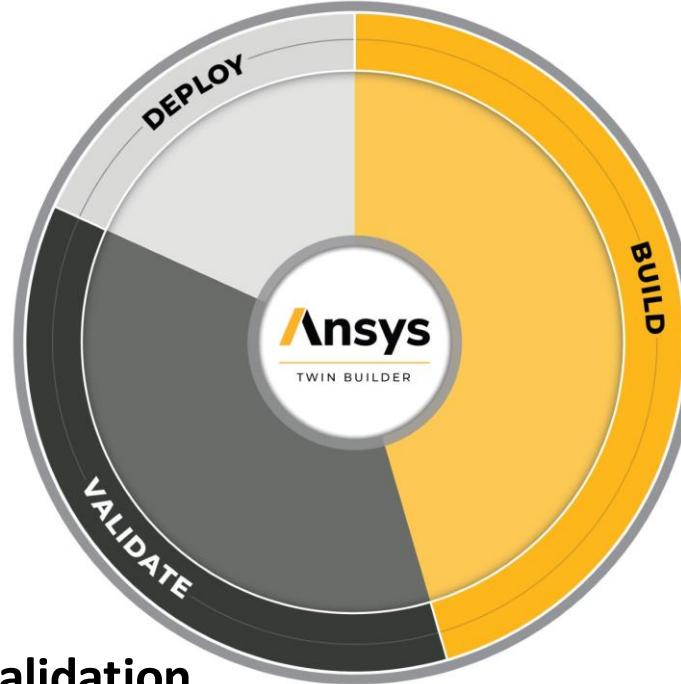
**System  
Predictive  
Maintenance**

Connect the Twins to IIoT  
Platforms and Deploy Run times  
in operation

**Validate**



Validate and Optimize the Twin



**System Validation  
and Optimization**

**Build**

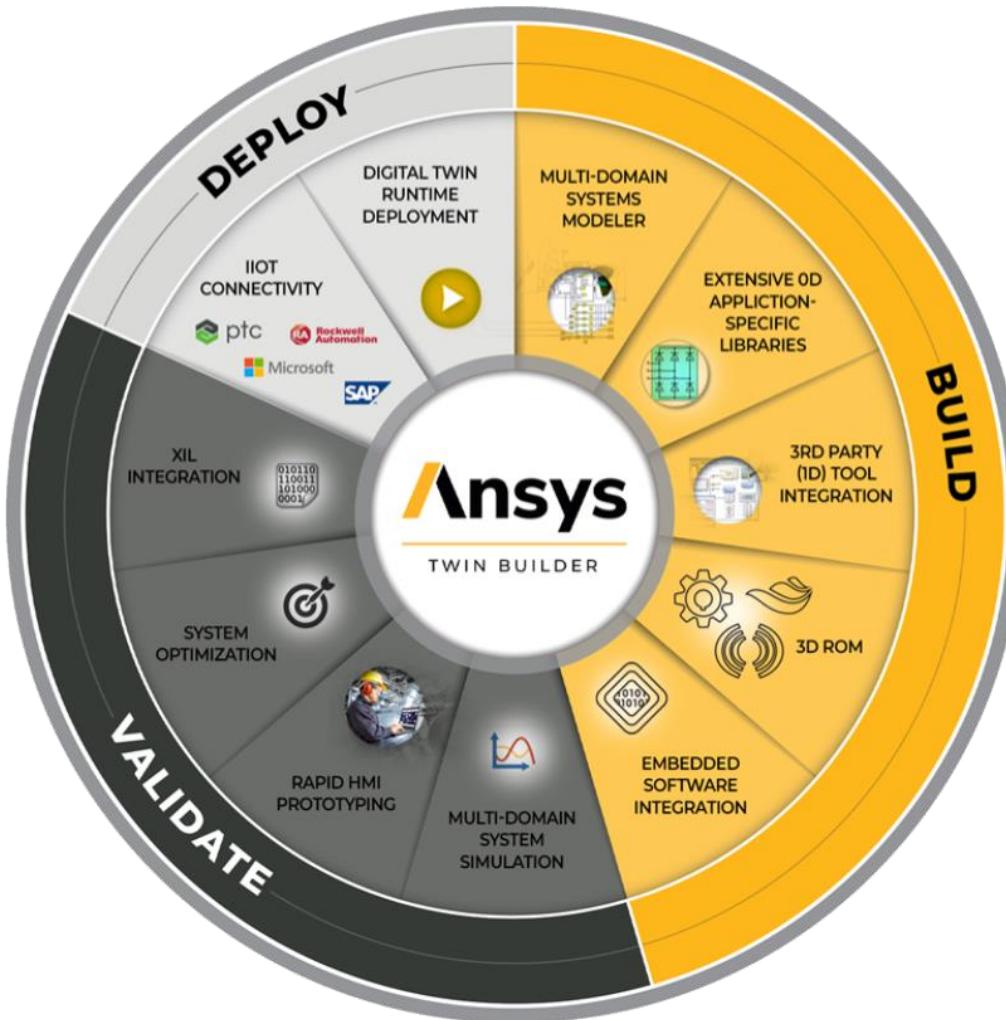


**System  
Simulation**

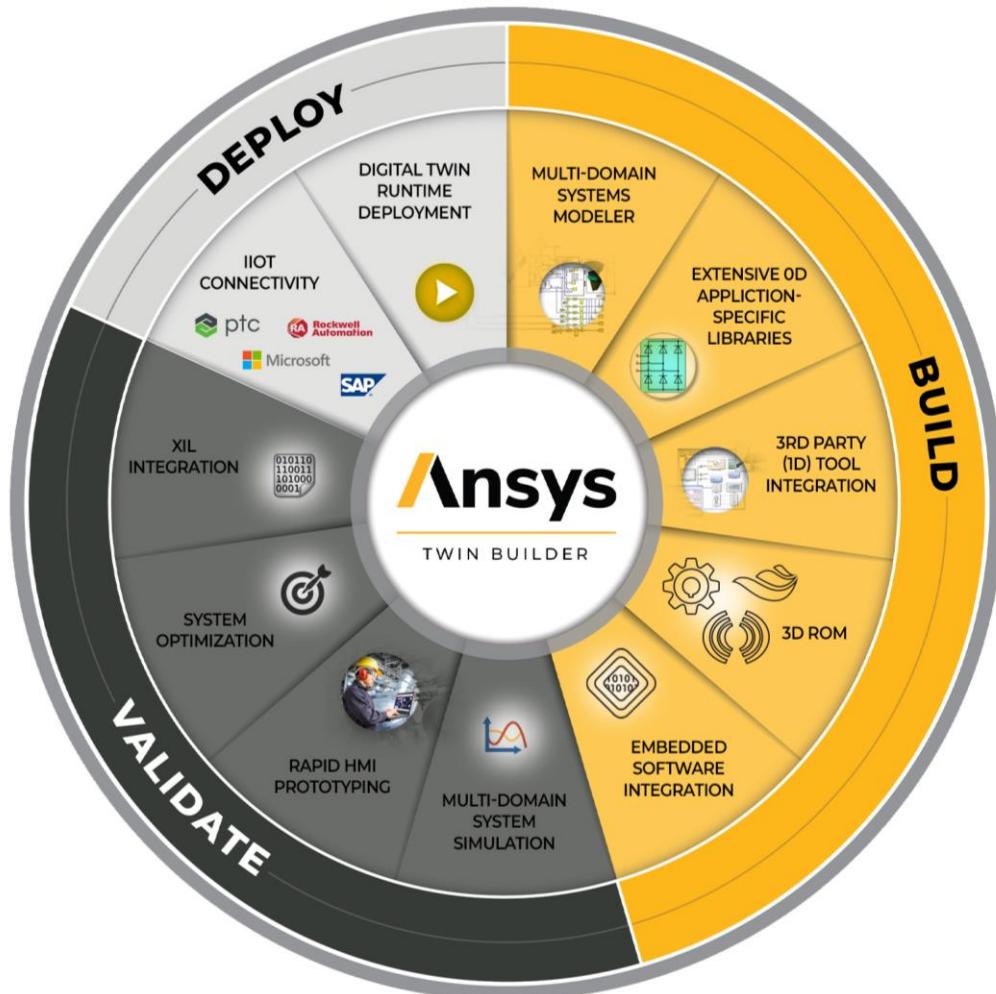
Build an accurate Physics-based  
Digital Twin in record time



# Ansys Twin Builder의 기술 기능 개요

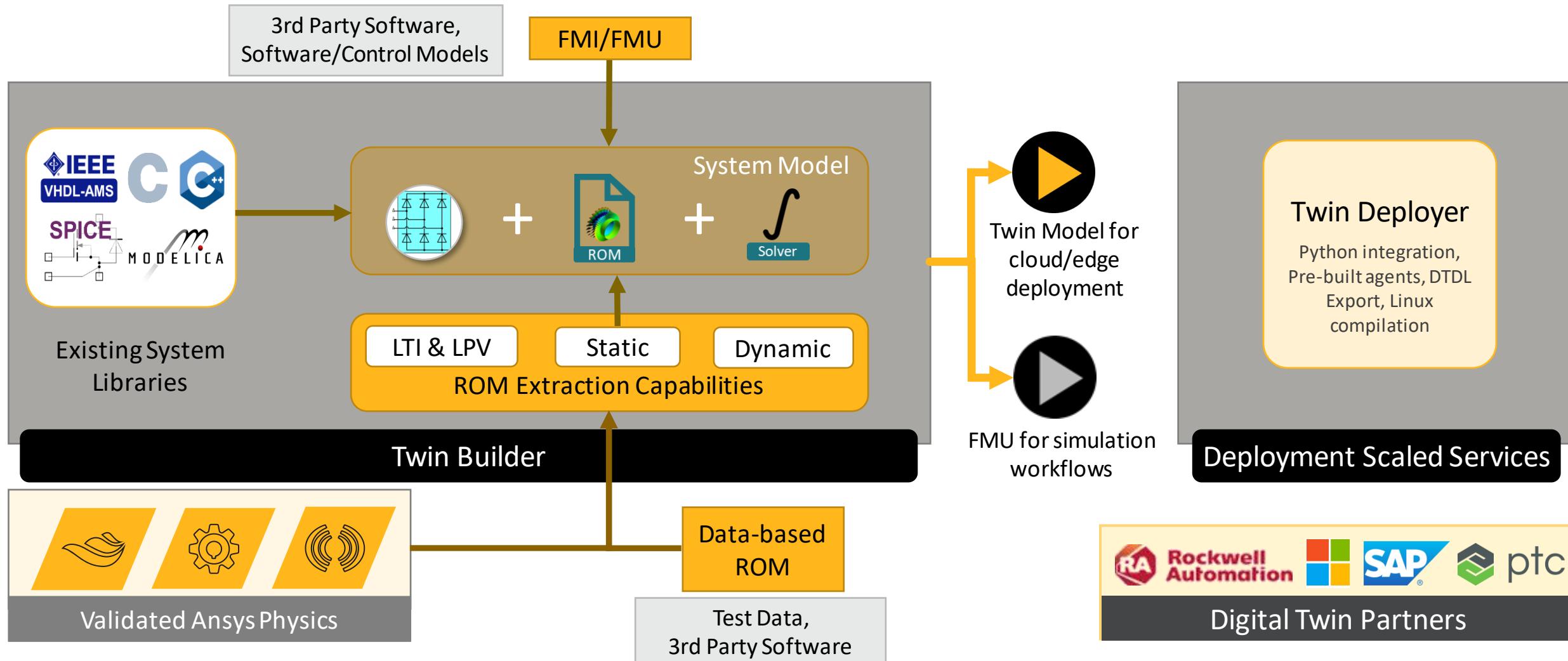


# Ansys Twin Builder: 역량과 장점



- ▶ 멀티 테크놀로지 플랫폼  
Multi-technology platform
- ▶ 축소 차수 모델링  
State-of-the-art reduced order modeling
- ▶ 상호운용성 지원  
Interoperability support
- ▶ Digital Twin의 런타임 구축 기능  
Ability to deploy runtimes for Digital Twin

# 디지털 트윈 솔루션 아키텍처

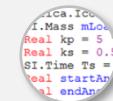


# 기술 기능 개요: Twin Builder를 사용하여 디지털 트윈을 신속하게 구축

## Build Phase Benefits and Capabilities

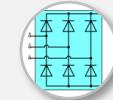
Easily assemble virtual replica from a variety of sources

Multi-domain, multi-fidelity, multi-language



### Support for multiple modeling domains and languages

- Support for Modelica, VHDL-AMS, C/C++, SPICE and more



### Extensive 0D Application Specific Libraries

- Electrical, Electronics, Std. Modelica Lib., Fluid Power, Thermal etc.



### 3rd Party Tool (incl. 1D) Integration

- Support for FMI/FMU, Ansys 3D solvers and co-simulation



### 3D Reduced Order Model Creation and Integration

- Simplify 3D physics by use of ROM (Dynamic, Static and DX)



### Embedded Software Integration

- SCADE Suite, SCADE Display and more

# 기술 기능 개요: 디지털 트윈 검증 및 최적화

Validate Phase Benefits and Capabilities

Ensure Product Reliability and Robustness

Optimize System Performance with built in Optimizers

Easily Integrate and validate with Test data



## Multi-Domain Simulation with Integrated Post Processing

- Analyze and optimize the interactions among the multi-domain components in a system.



## Rapid HMI Prototyping

- Enhances the simulation experience with powerful, easy-to-design, and interactive graphical panels. etc.



## System Validation and Optimization

- Support for DoE, Parameter Sweep and Scripting (VBA/Iron Python)



## XIL Integration

- Support for co-simulation for Model-in-the-Loop (MiL) and Software-in-the-Loop (SiL) validation workflow

# 기술 기능 개요: 선도적인 IIoT 플랫폼에 디지털 트윈 구축

## Deploy Phase Benefits and Capabilities

Optimize Operations

Deploy for Preventive Maintenance



### Quickly Connect to supported IoT Platforms

- Configure connector to connect to IIoT platform and send and receive operational data
- SAP Predictive Engineering Insights enabled by Ansys
- Partnership with Rockwell Automation and Azure Digital Twins

### Export and Deploy Generated Models

- Export from Twin Builder to generate portable, cloud deployable Twin

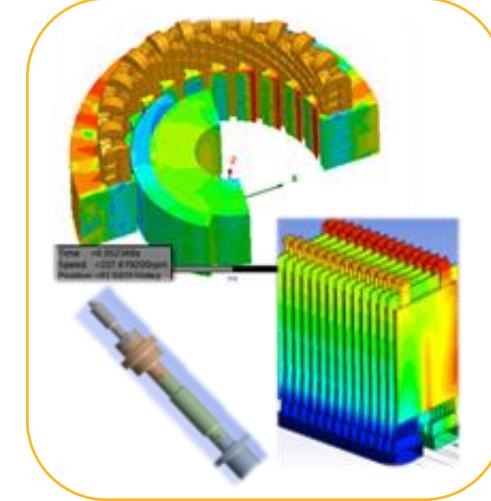
### Easily Deploy Digital Twins with Ansys Twin Deployer

- Significantly reduce deployment time by performing validation and verification on Twins

# 3D Reduced-Order Modeling Interfaces

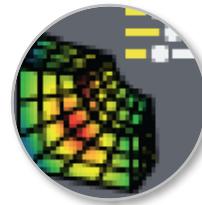
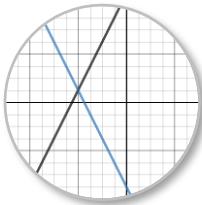
## Transforms 3D simulation results into system-level models

- Use Reduced-Order Modeling (ROM) interfaces to generate accurate, compact models from detailed 2D and 3D physics simulations.
- Simulates in a fraction of the time required by 3D Techniques for all Ansys physics
- Link to a variety of Ansys tools to create high performing models.



**Connections with  
3D Physics**

# Twin Builder에서 사용되는 세 가지 종류의 ROM

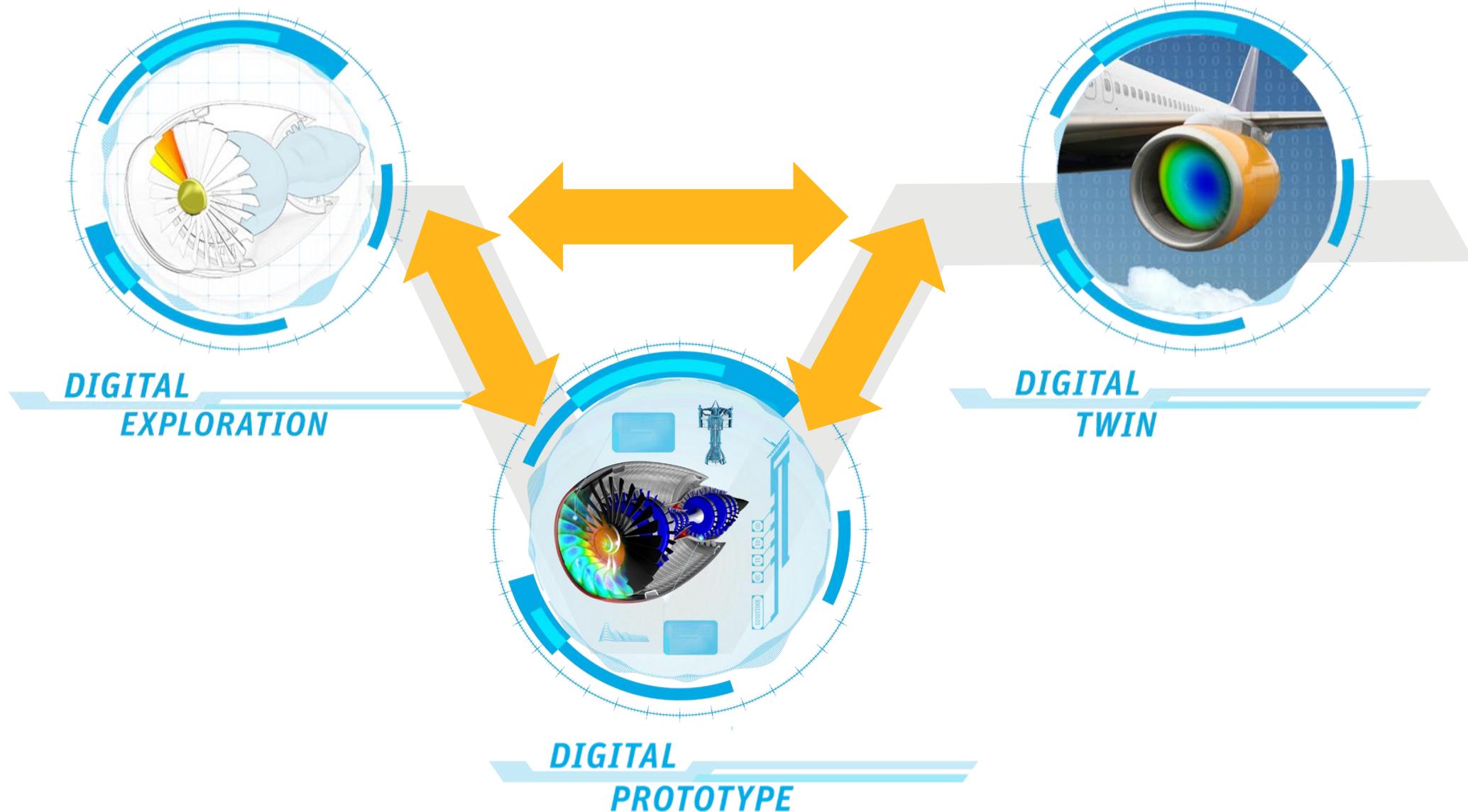


	Linear ROMs	Non-linear, Static	Non-linear, Dynamic
Techniques	State-Space/LTI Modal S-Parameter	<b>Twin Builder Static ROM Builder</b> Response Surface ROM OptiSLang	<b>Twin Builder Dynamic ROM Builder</b> Maxwell ECE
Supported Tools	Fluent, Mechanical, Icepak, Q3D, Maxwell, HFSS, SIwave	<b>Twin Builder Static ROM Builder:</b> All	<b>Dynamic ROM Builder:</b> All Maxwell ECE: Maxwell
Limitation	Linear system only Specific limitation for each tool Support enabled by tools	Static only Extending support for new tools requires effort	For Scalar only Limited input and outputs

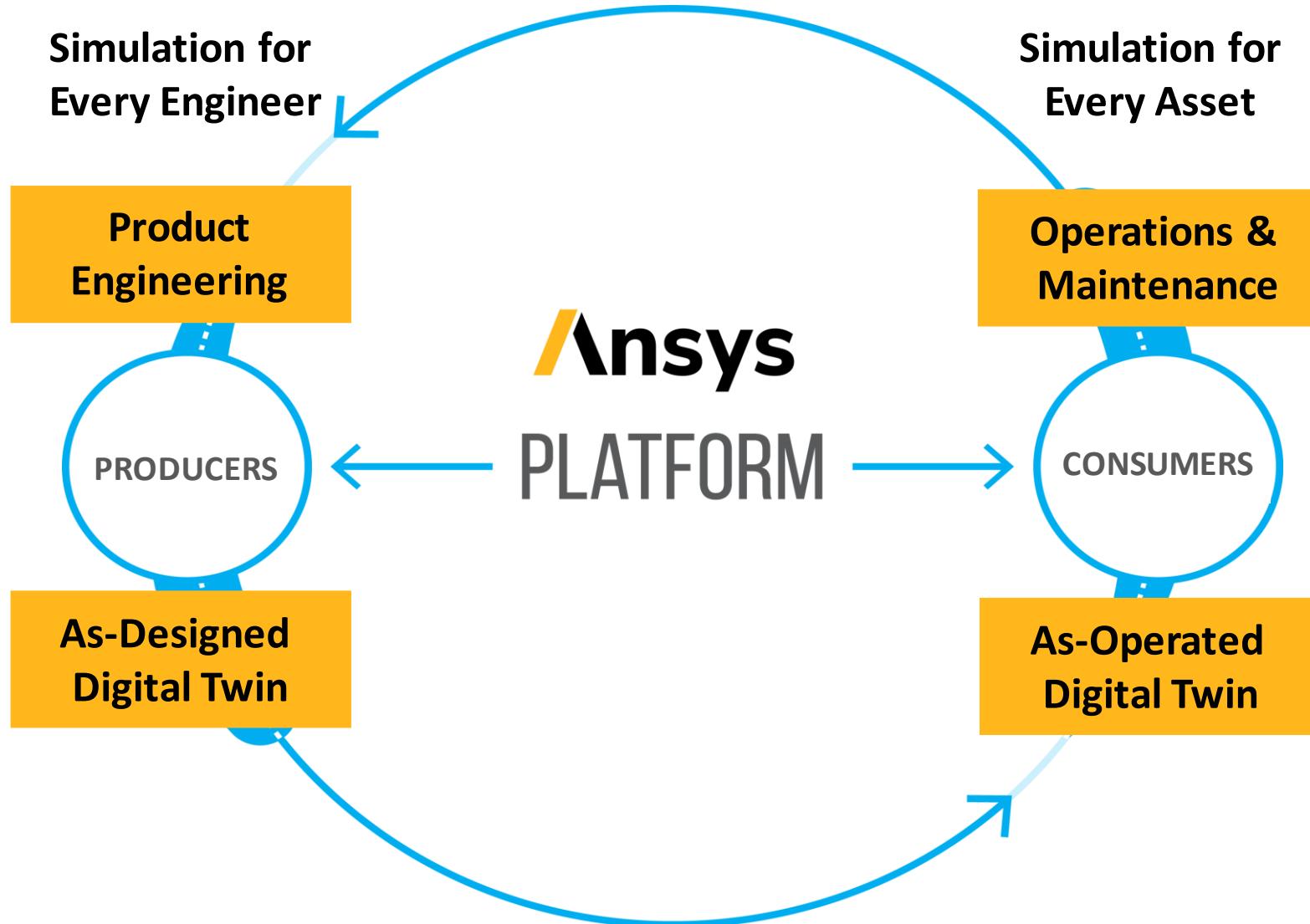
# 통합모델의 성능해석

Ansys

# Ansys를 이용한 퍼베이시브(Pervasive) 엔지니어링 시뮬레이션

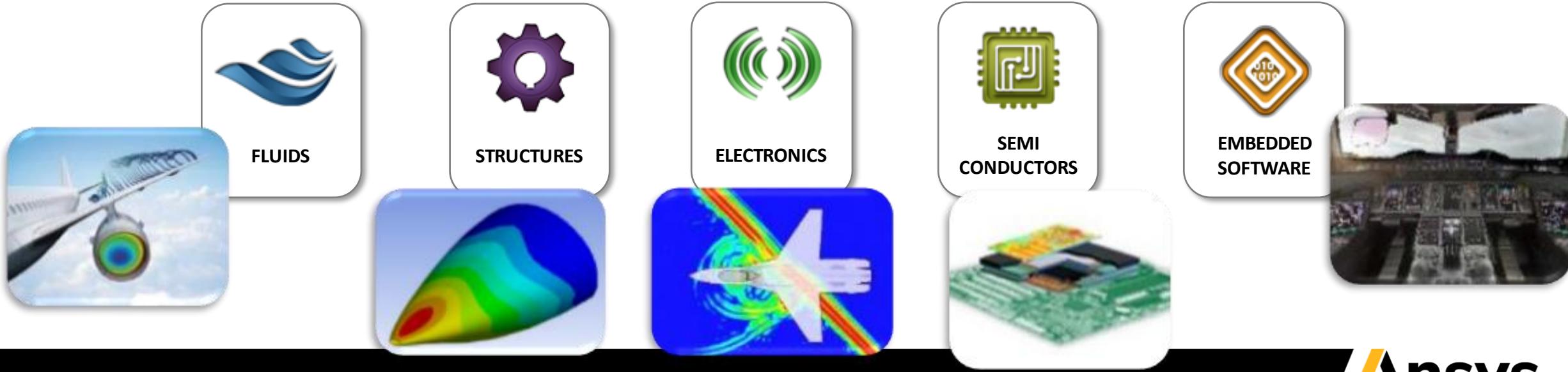


# 제품 설계 및 운영을 위한 공통의 Ansys 시뮬레이션 플랫폼



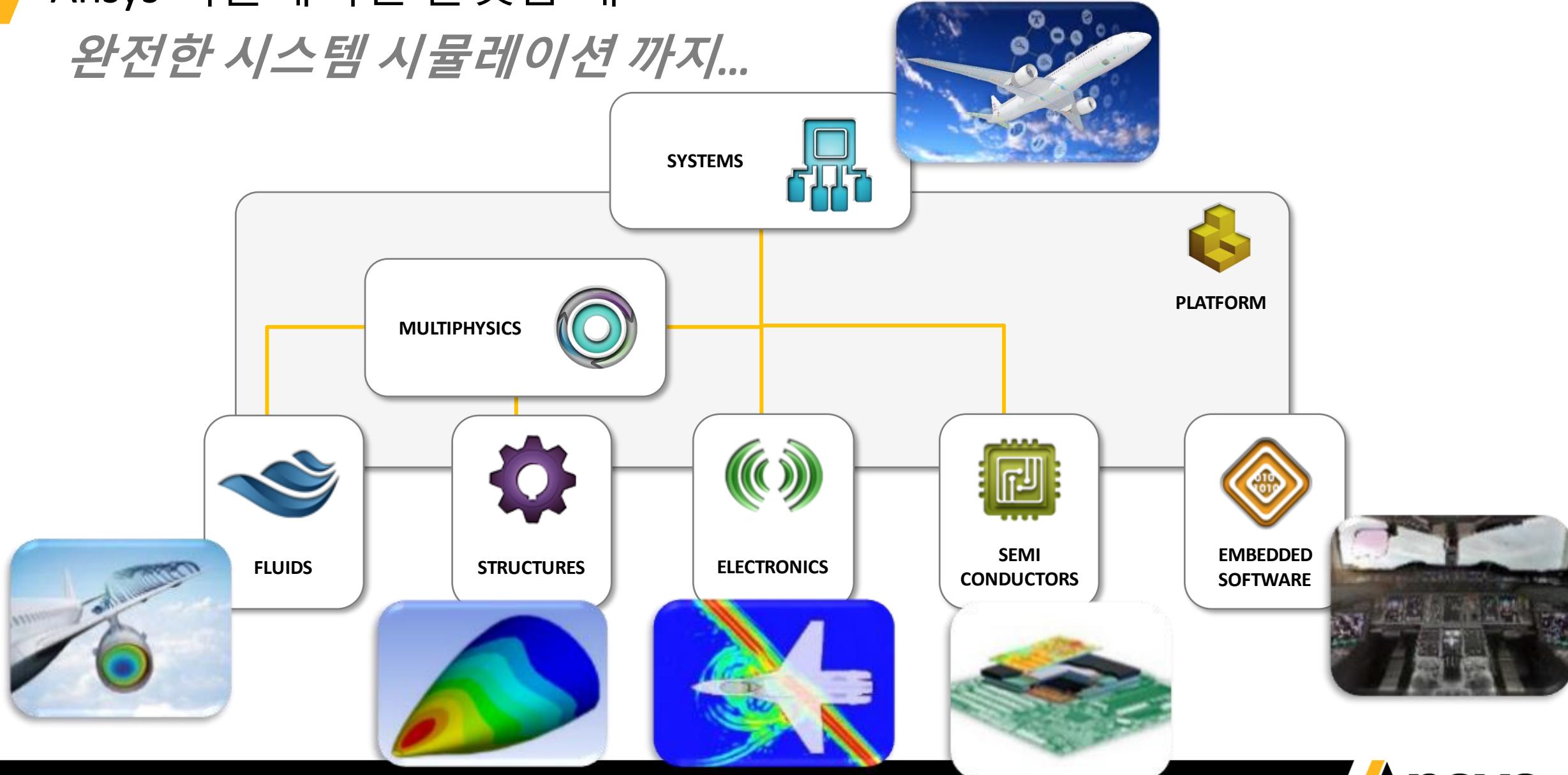
# Ansys 시뮬레이션 플랫폼 개요

포괄적인 구성요소 수준 설계 및 시뮬레이션에서...



# Ansys 시뮬레이션 플랫폼 개요

완전한 시스템 시뮬레이션 까지...





**Thank you!**

