Function optimization for Additive Manufacturing

Schorndorf 23.10.2024

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Agenda

1. Overview Siemens
2. Digital Twin for Products
3. Digital Twin for Production
4. Current Trends in the Product Development workflow
5. Conclusion

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Agenda

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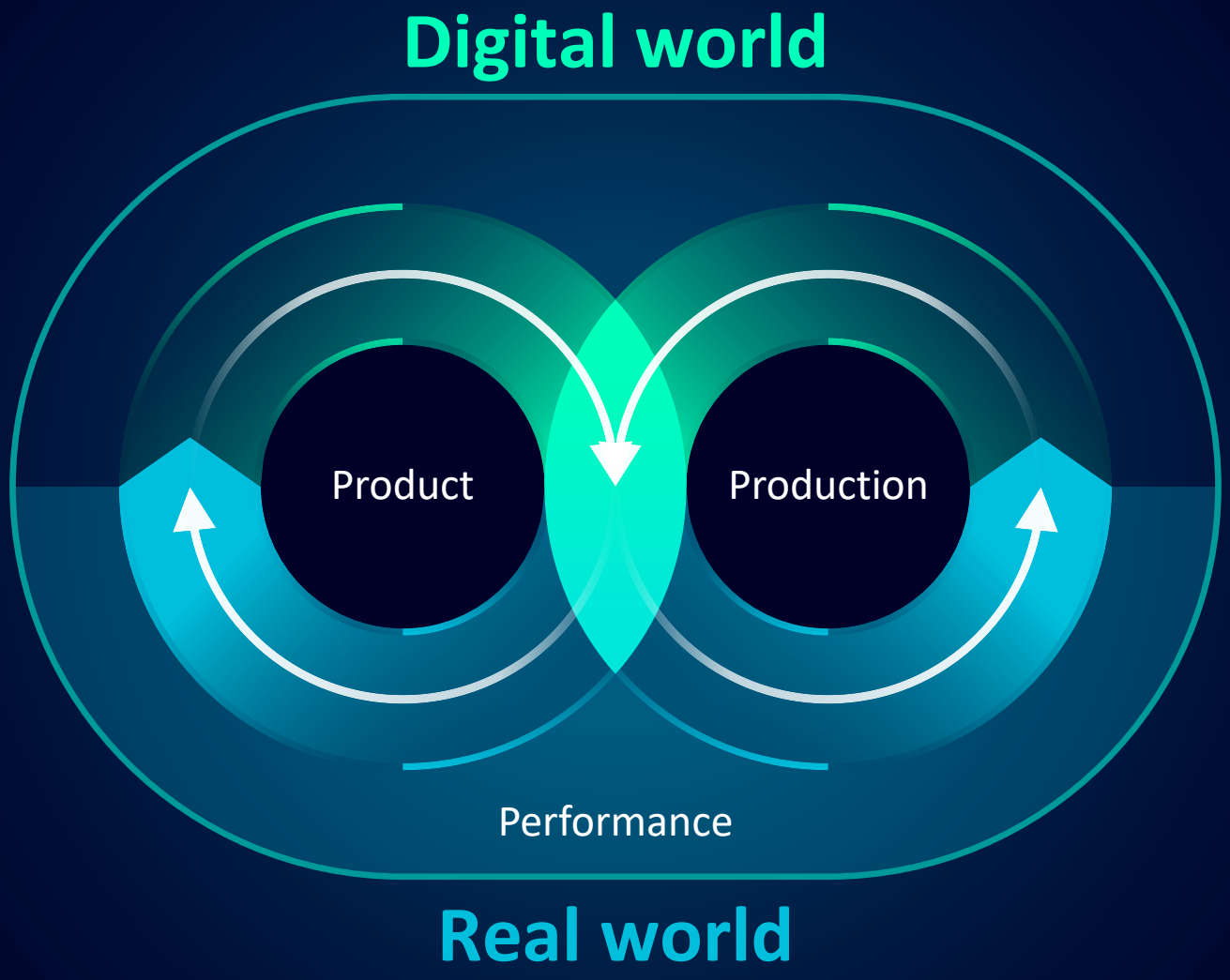

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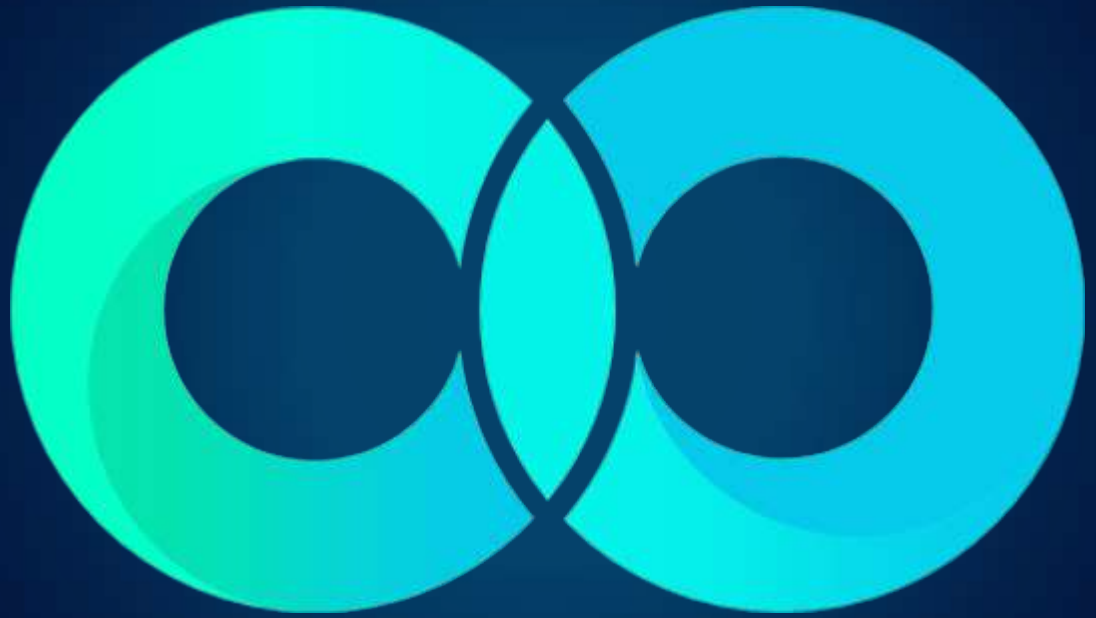

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Digital Enterprise

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Agenda

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3 Digital Twin for Production

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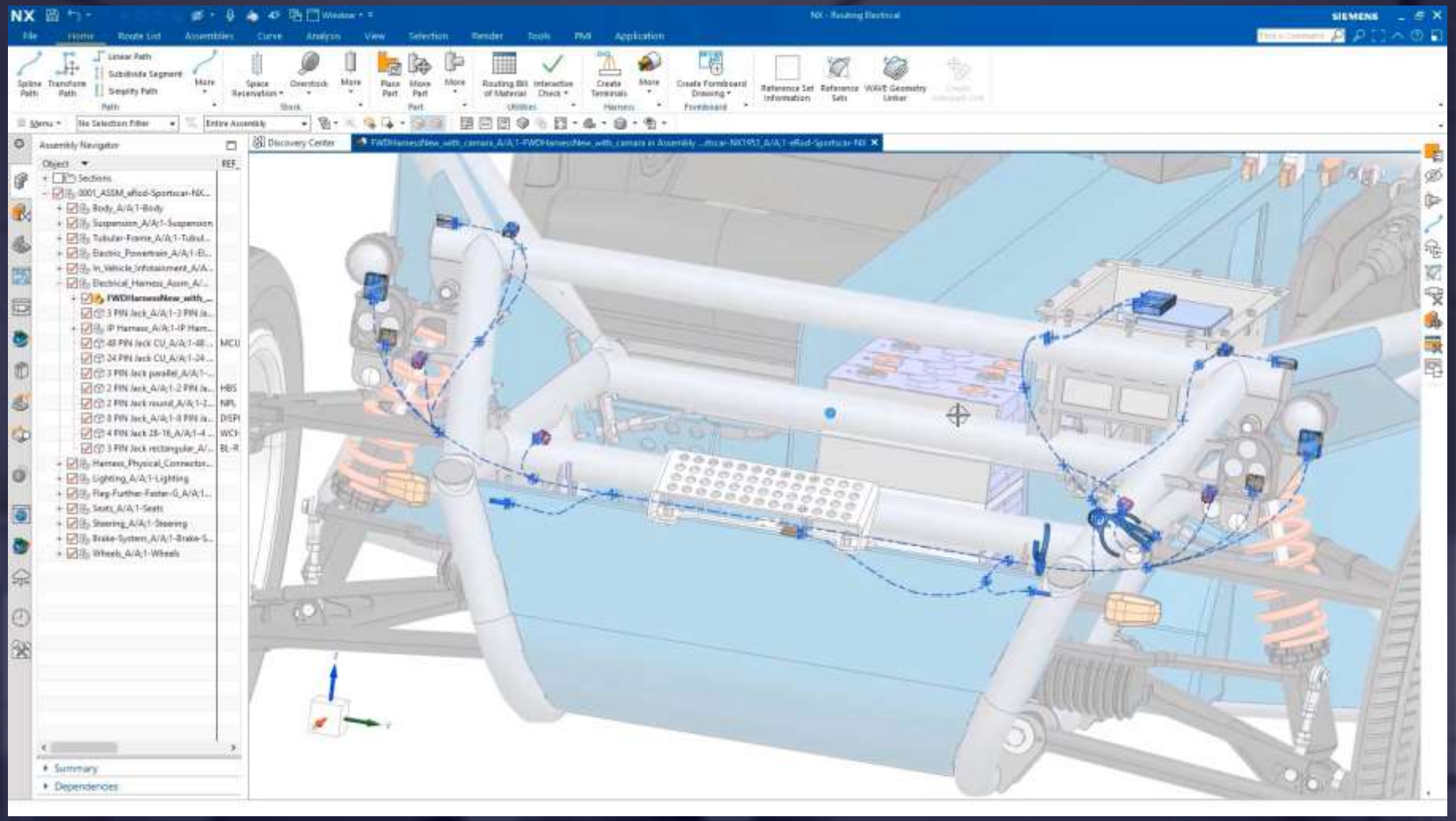

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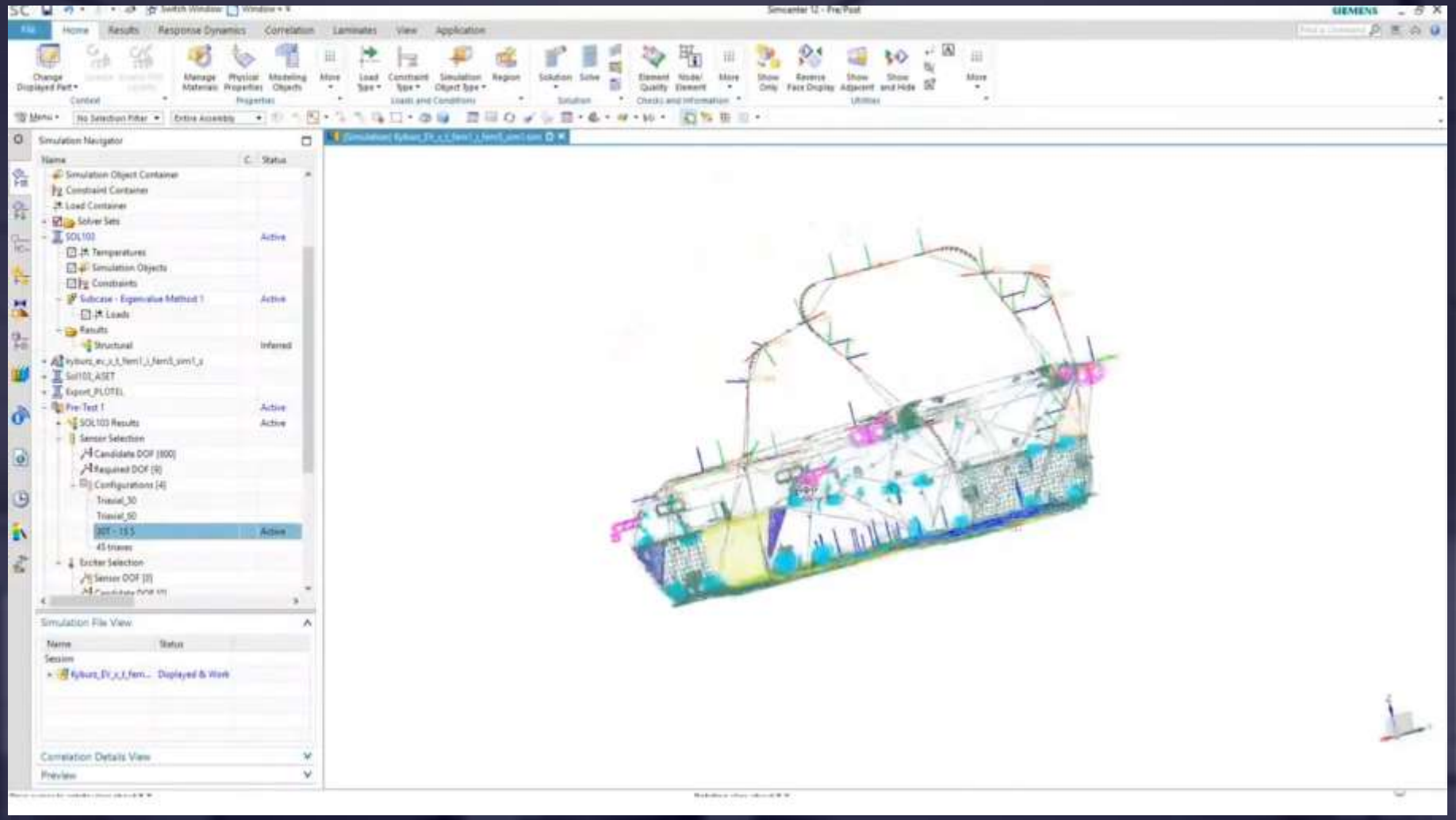

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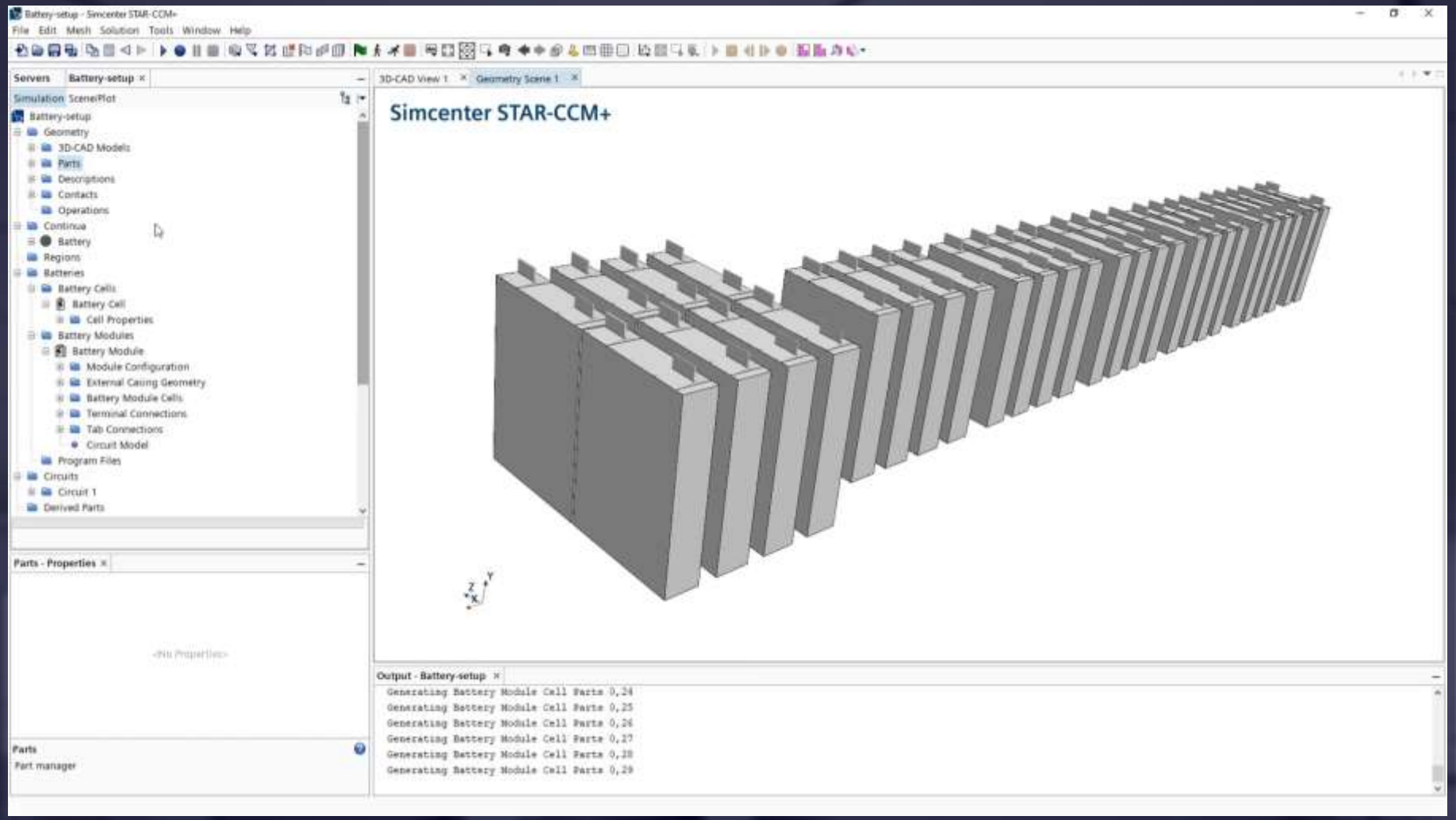

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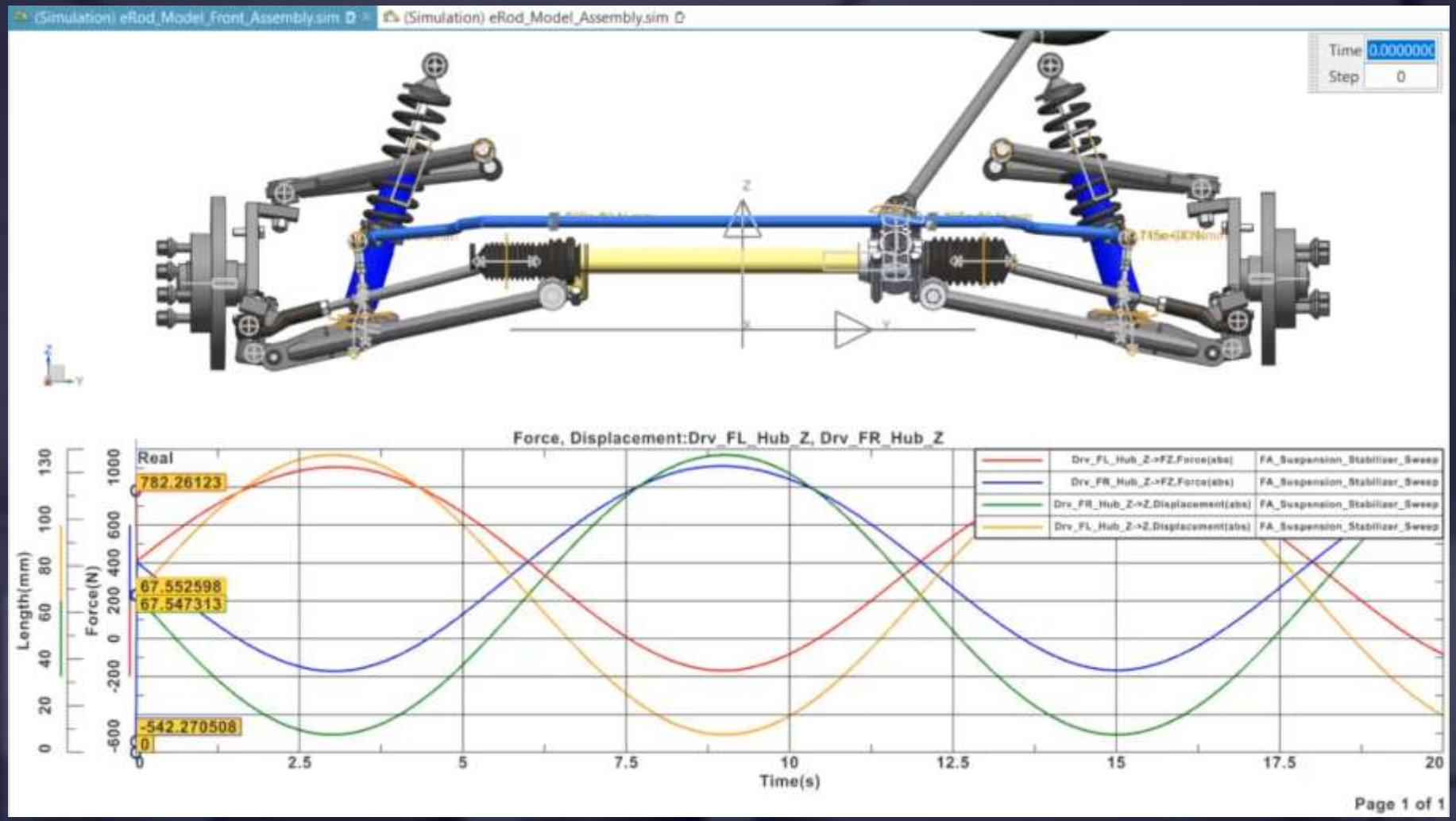

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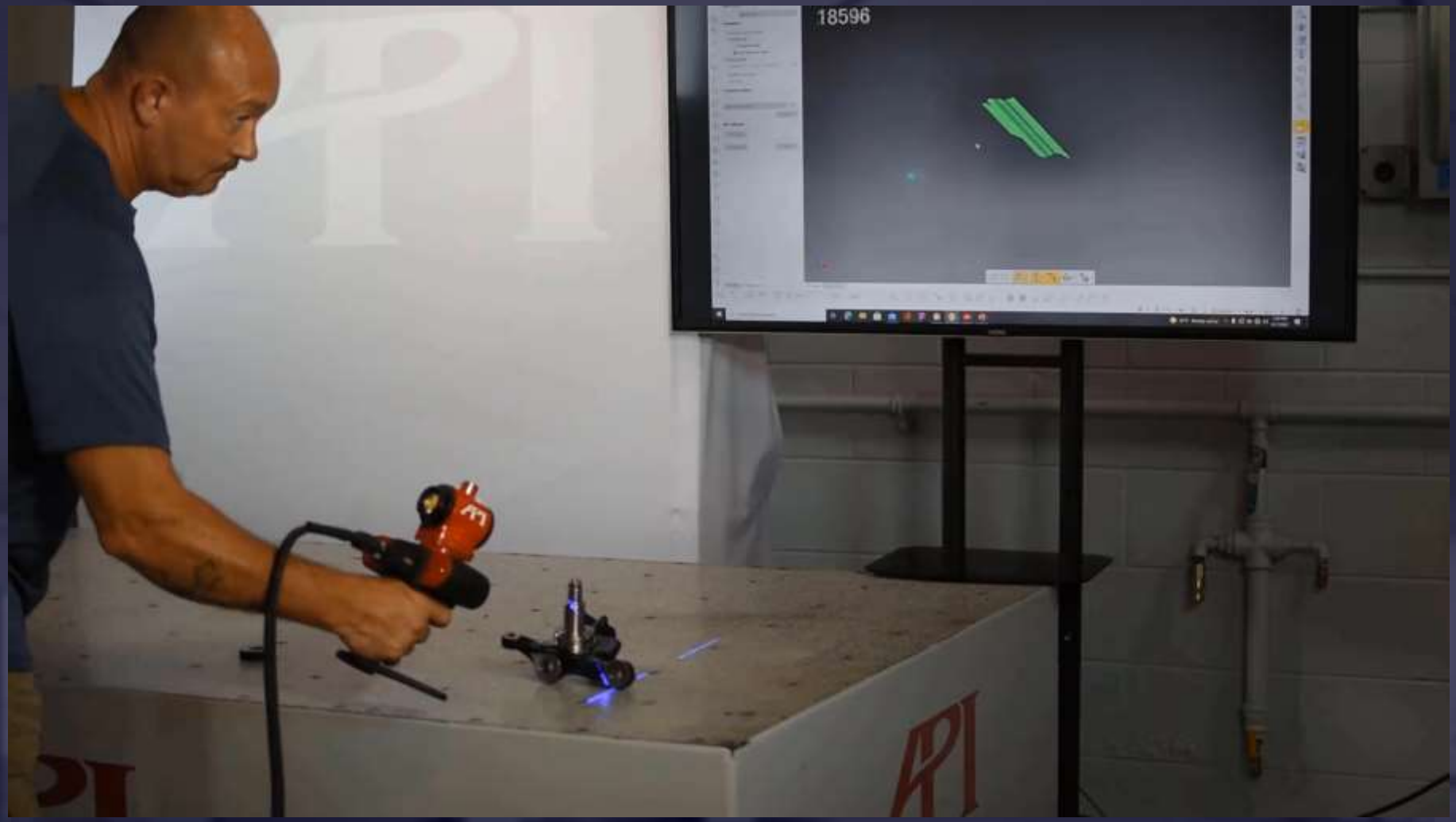

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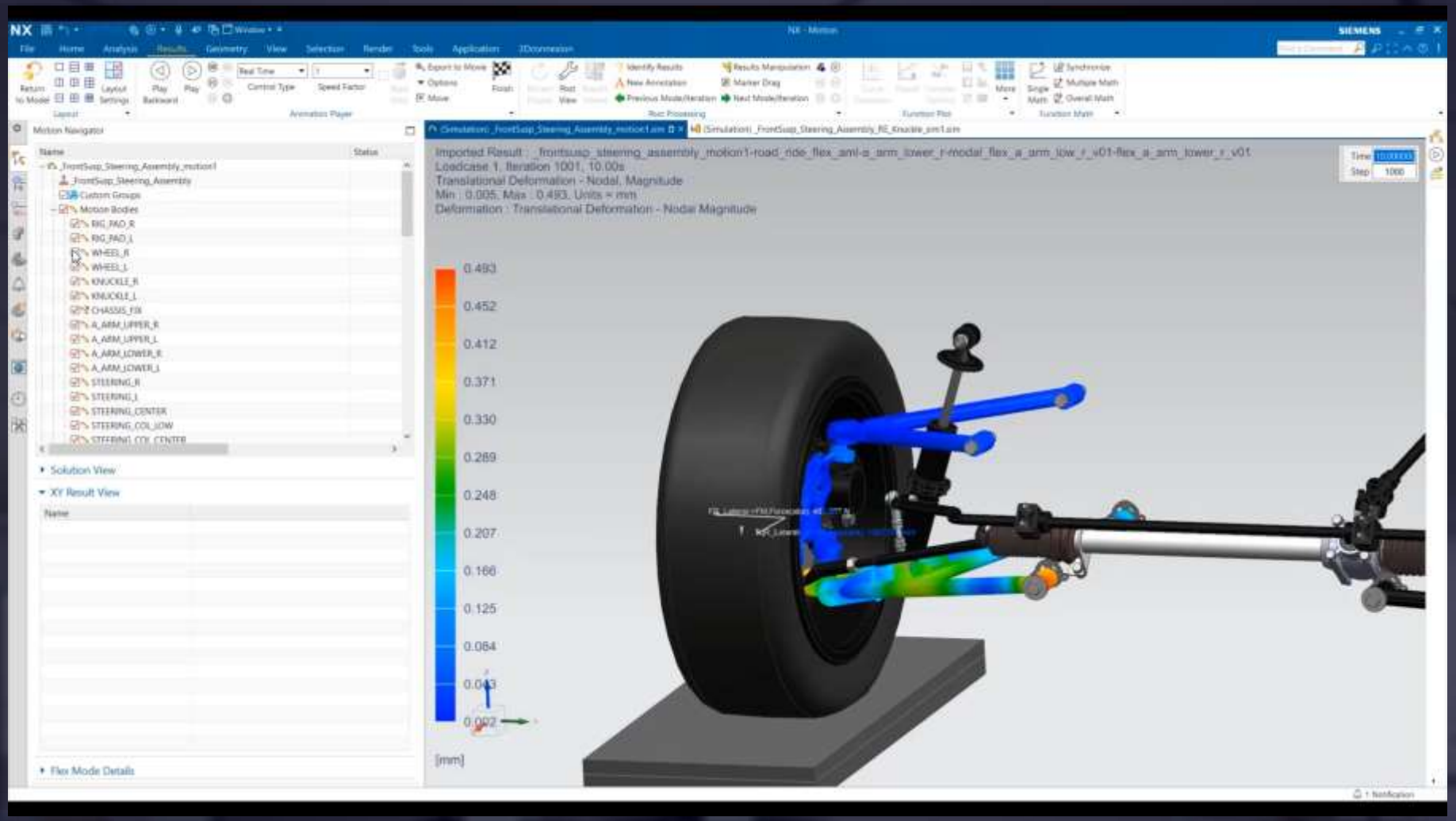

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Agenda

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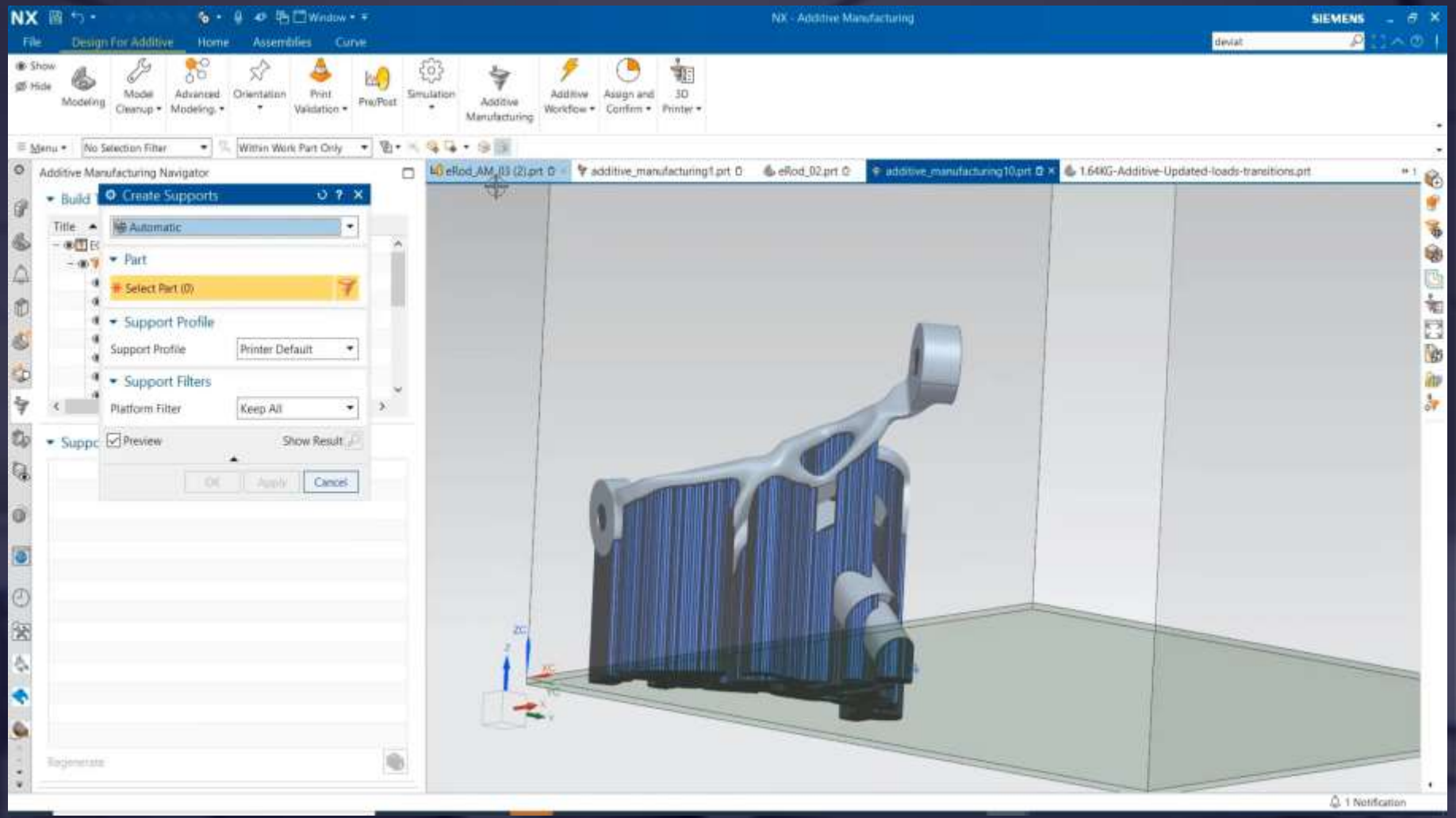

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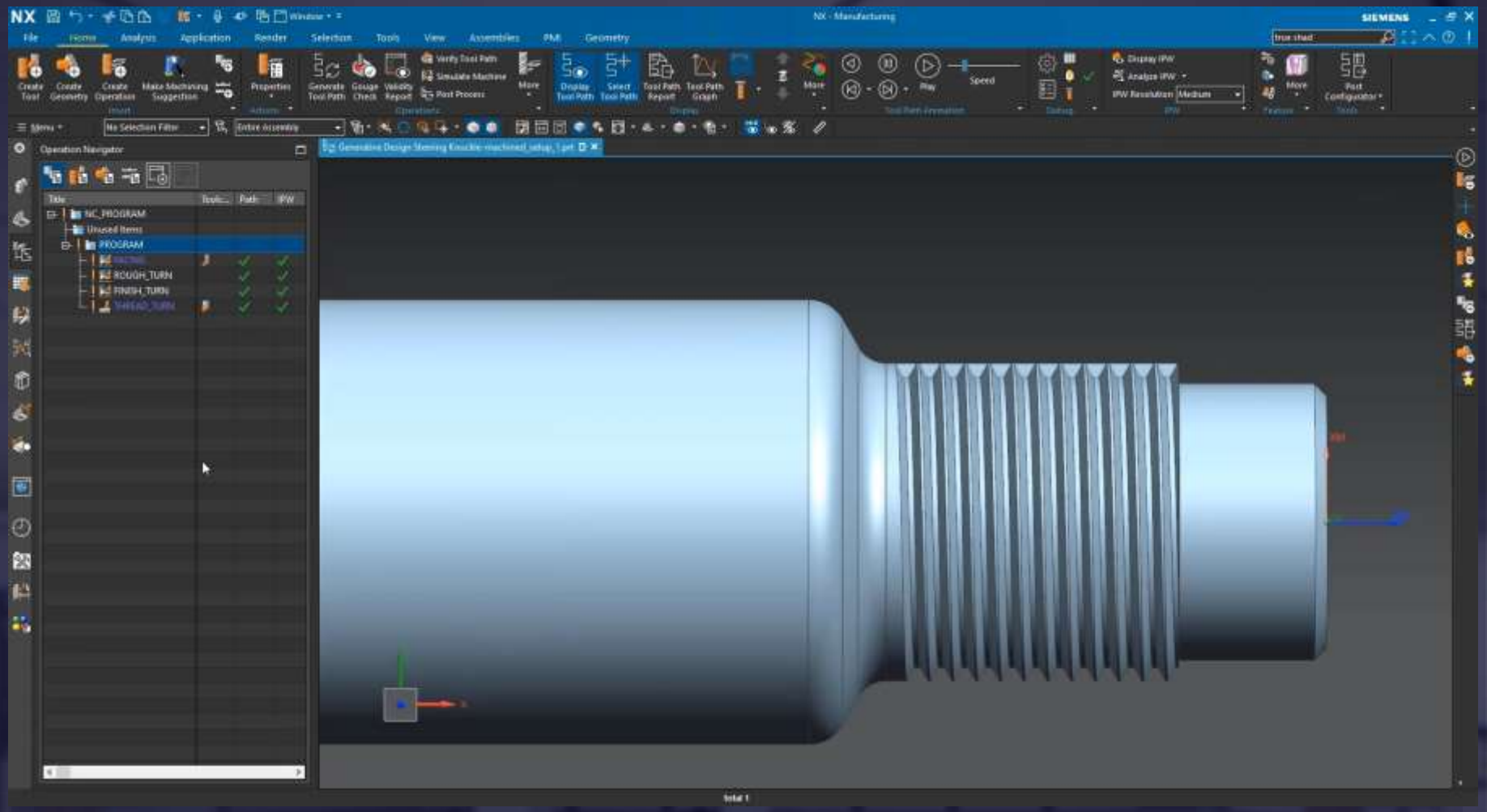

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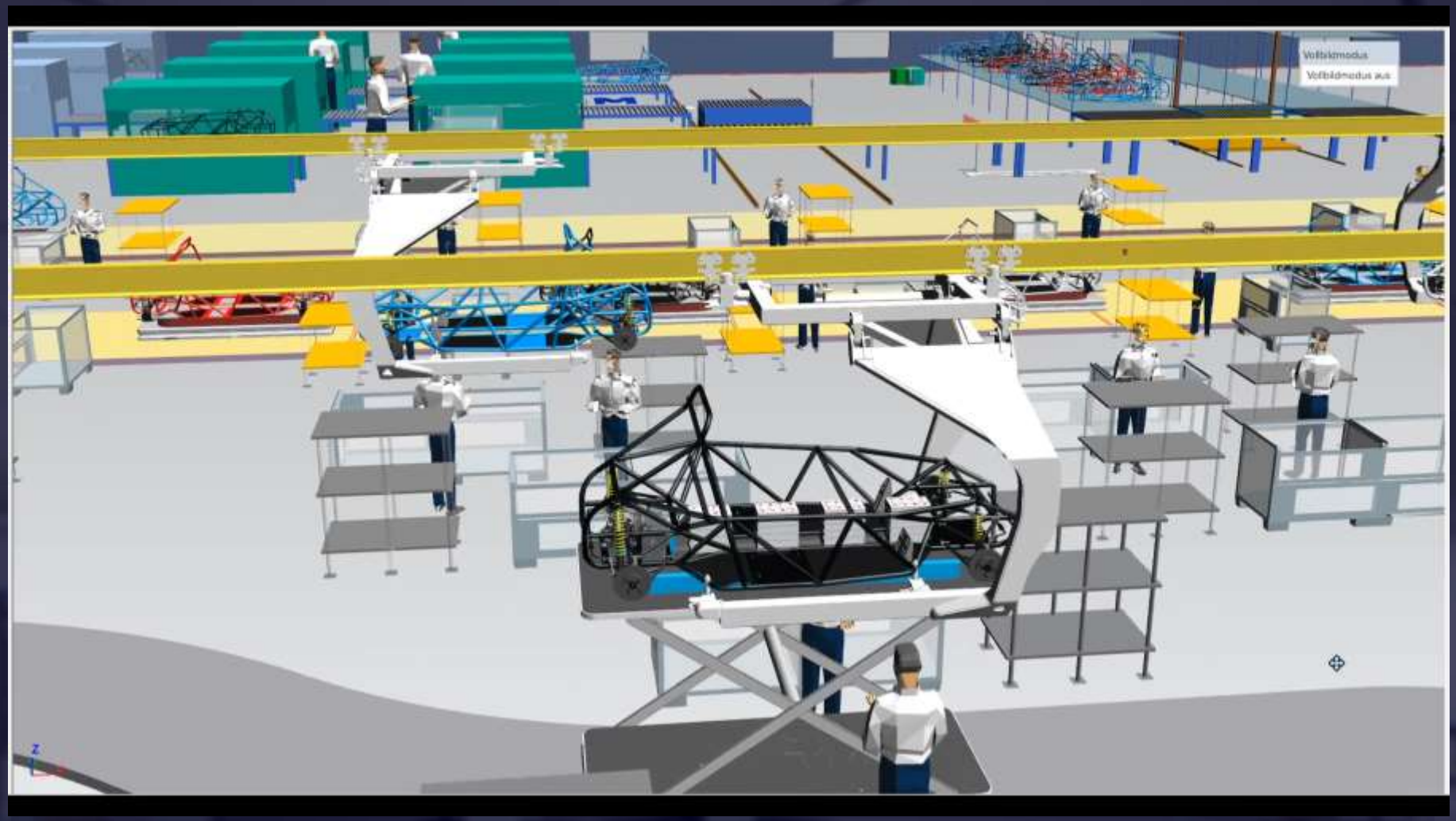

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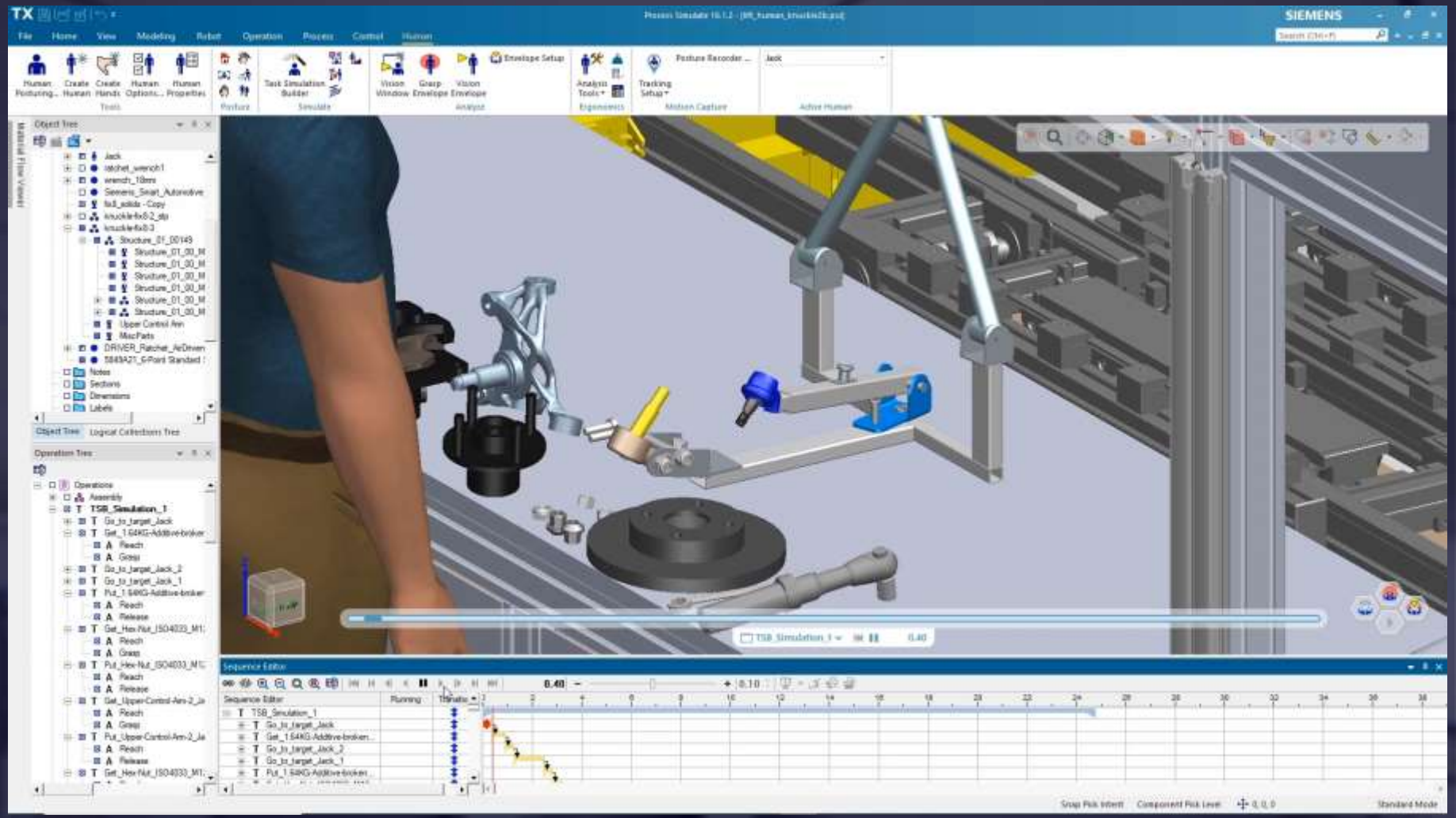

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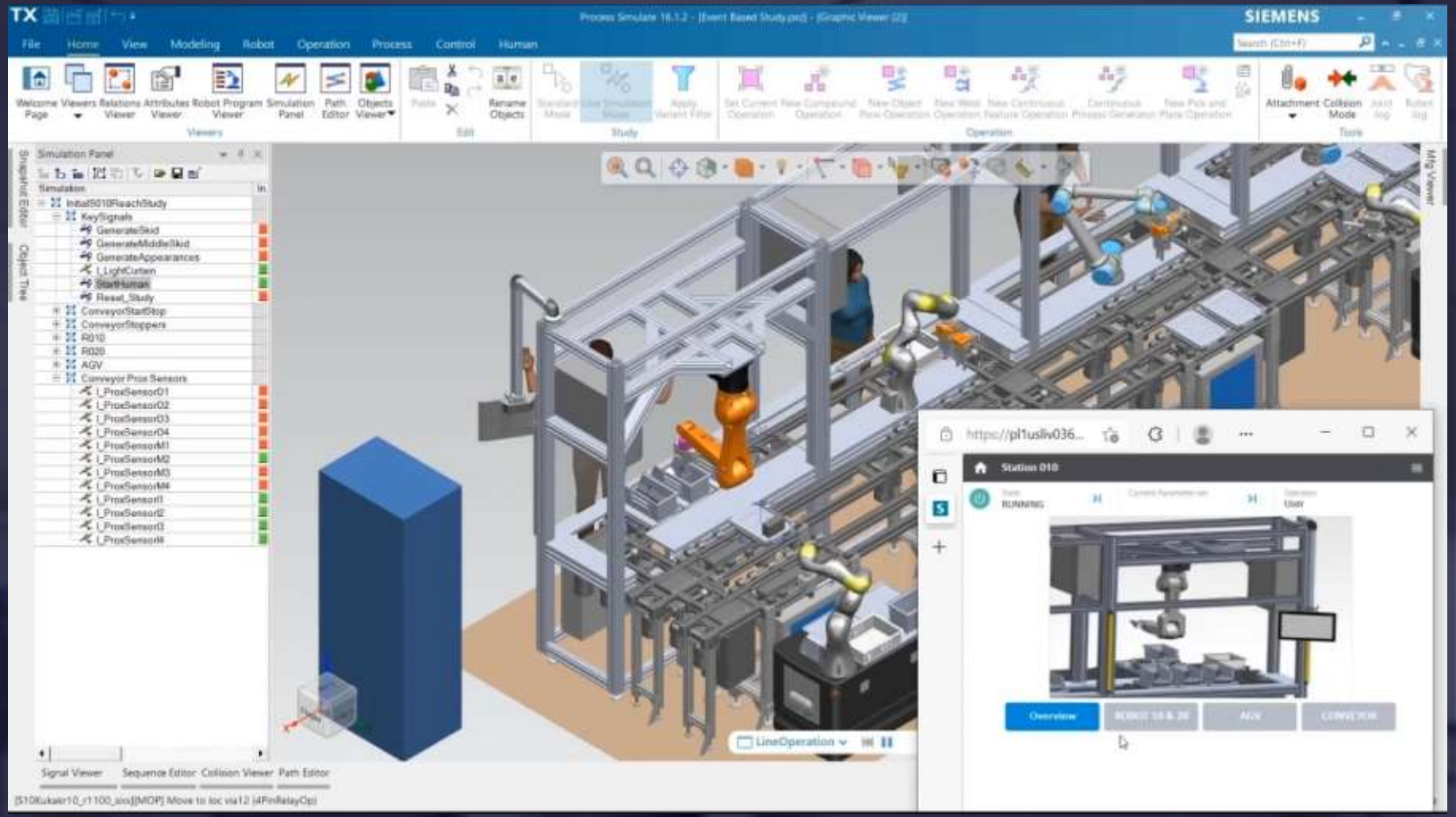

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Agenda

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5 Conclusion

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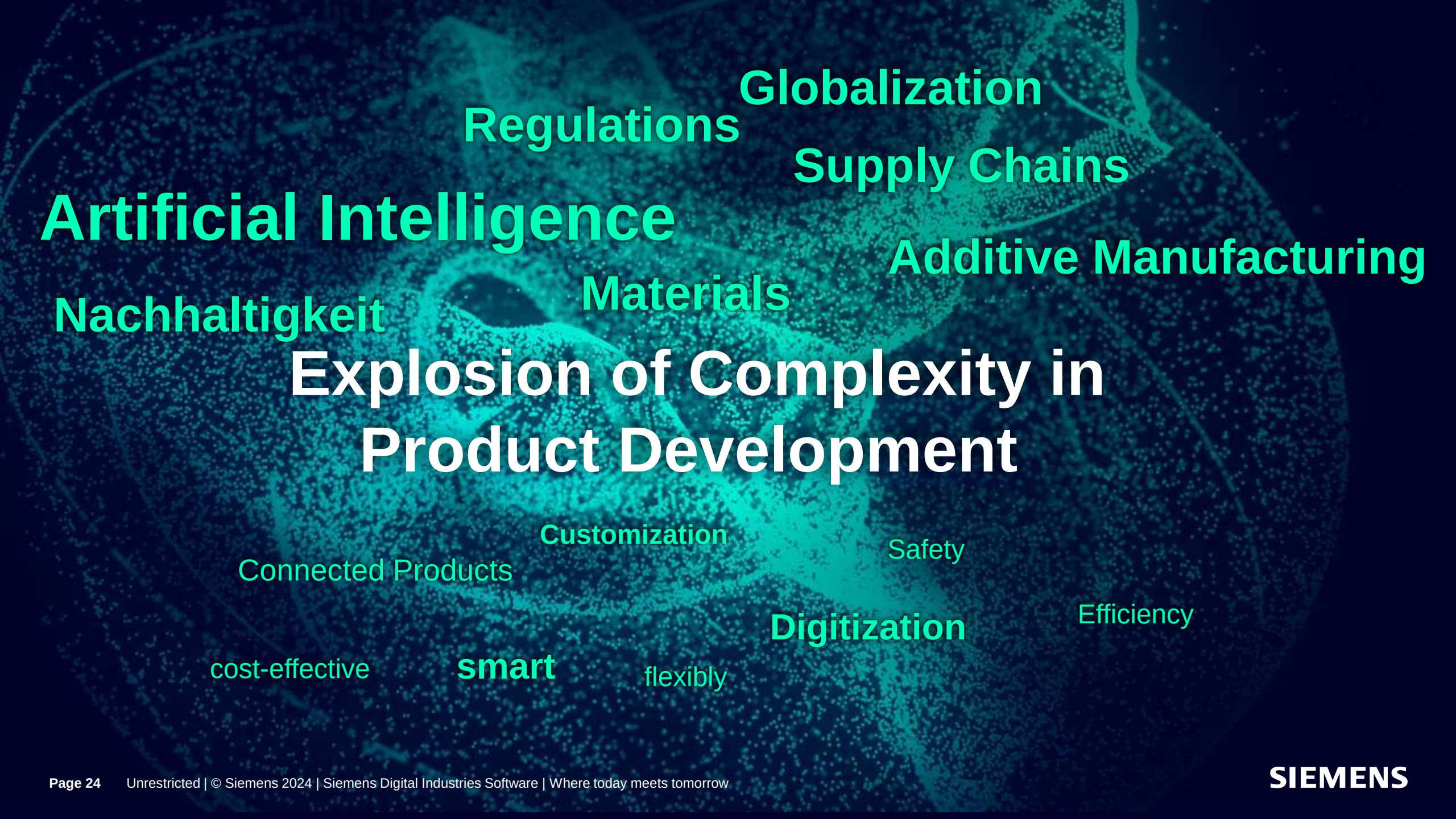

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Manage Complexity with Polarion

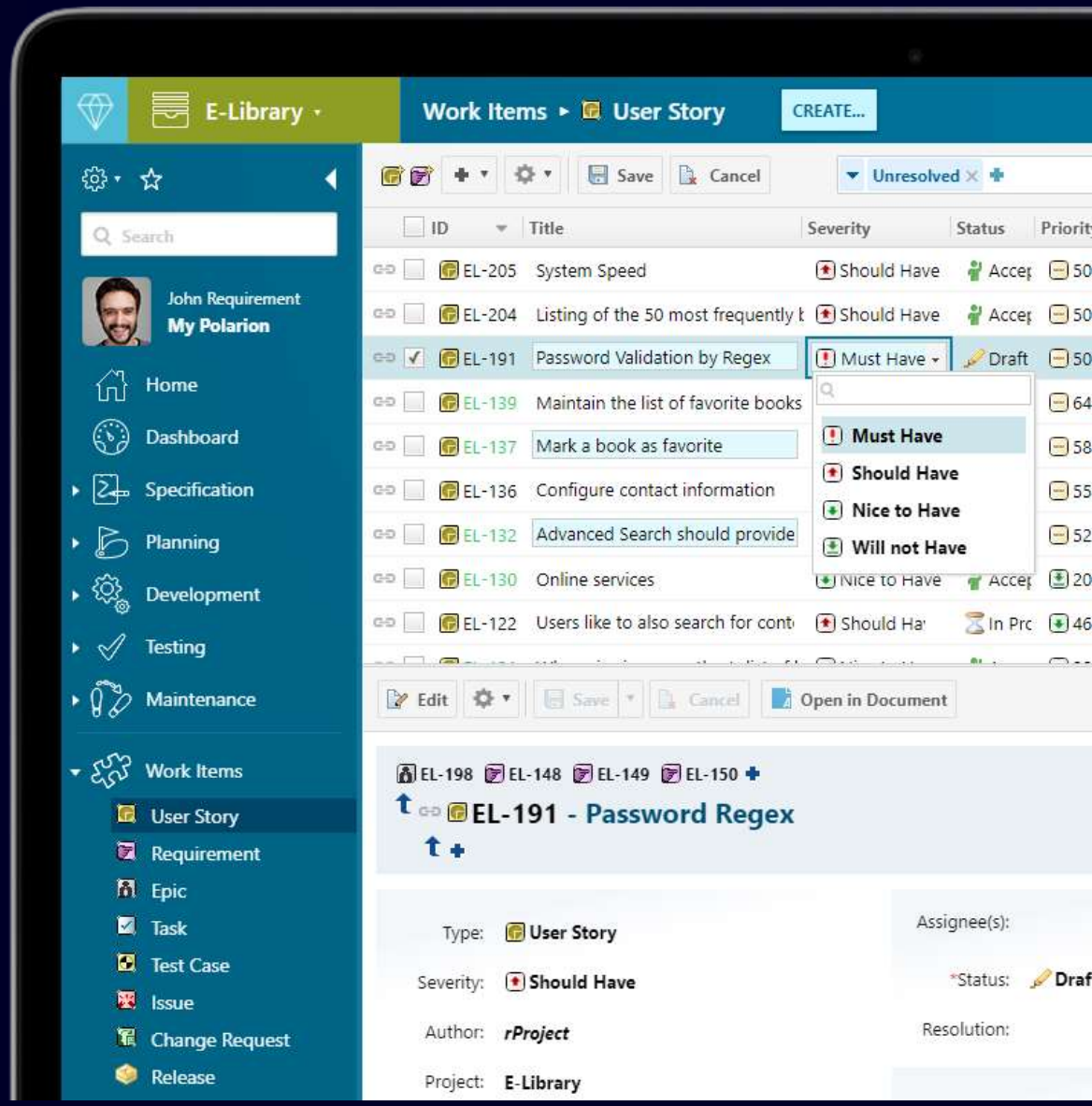
Data X

Instantly start managing your complexity

Grows with you
Data / Users / Scalability

Industry Solutions

Apply AI solutions



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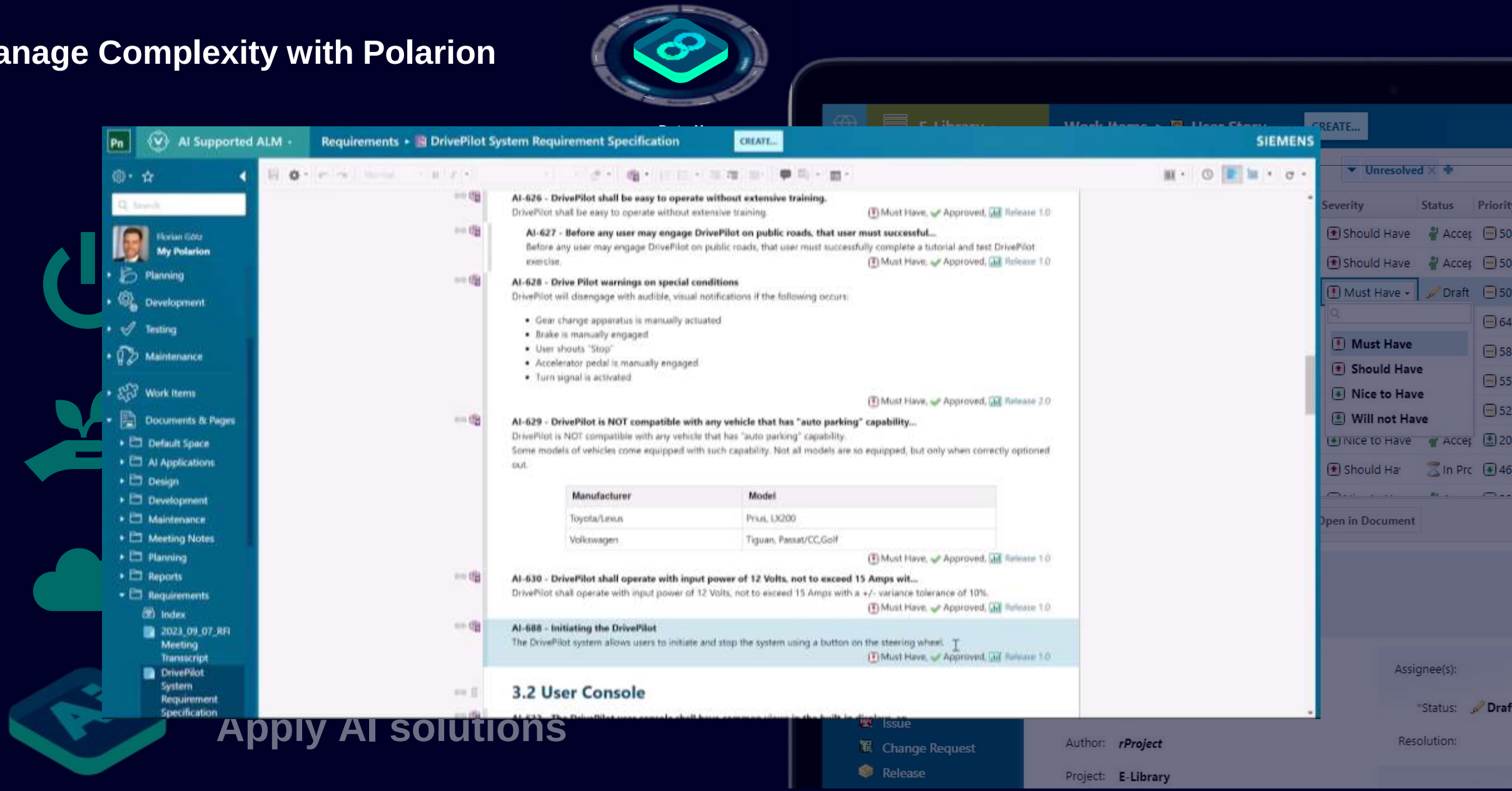
Manage Complexity with Polarion



Apply AI solutions

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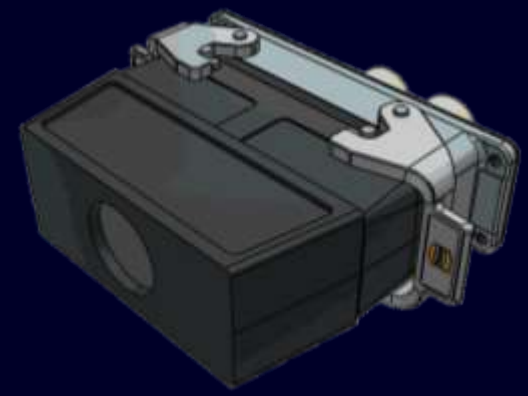
Artificial Intelligence
Generative development with Azure OpenAI and NX

Input in natural language → Extraction of the specifications → Selection/creation of a CAD model

"Hi, I'm Teddy Knurling and I develop power connection cables for the wind power industry. I'm looking for a connector for a project that has two 300 amp contacts at 56 volts and 5 data transmission lines."

```
spec = {
    "polution_degree": 4,
    "housing_material": "metal",
    "ip_rating": "IP55”,
    "contacts": [
        {
            "voltage": 56,
            "current": 300,
            "count": 2
        },
        {
            "voltage": 12,
            "current": 1,
            "count": 5
        },
    ]
}
```



Generative development with Azure OpenAI and NX

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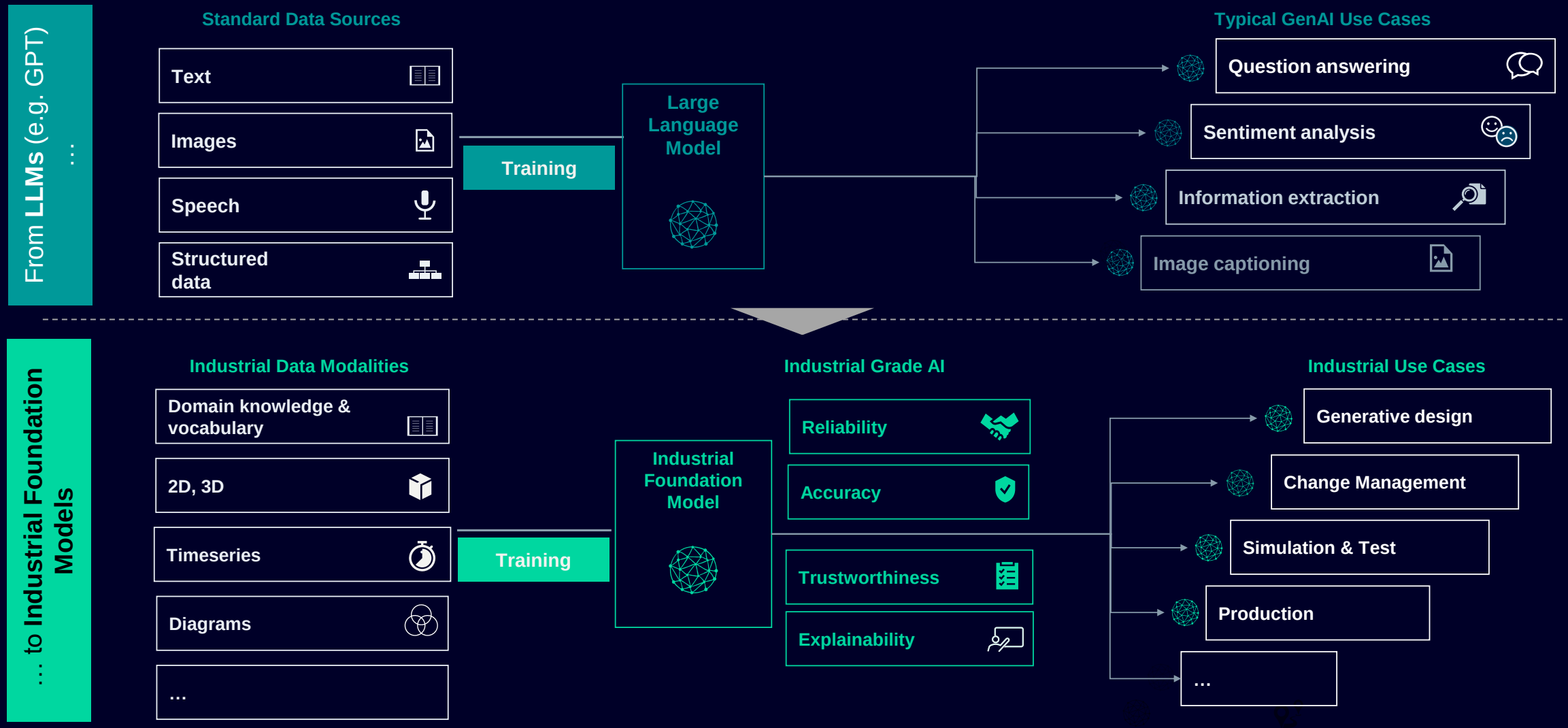
Artificial Intelligence
Large Language Models vs Industrial Foundation Models



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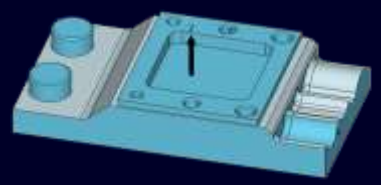
Artificial Intelligence
The CAM development process with AI support



NX

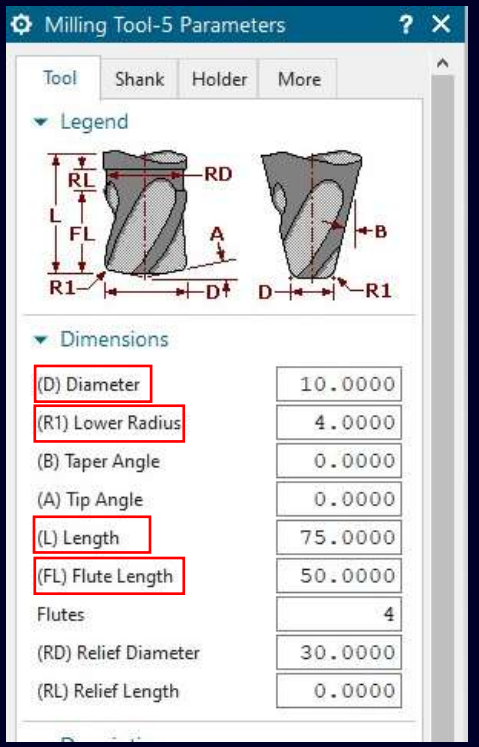
CAM AI assistant

CAM program

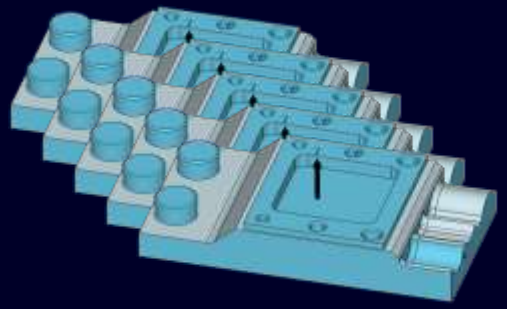
- Features
- Tools
- Operations

CNC code

```
M190   S60
M109   S215
G29
G1     X10 Y-3.0 Z0.5
G92    E0.0
G1     X60.0 E9.0 F10
G1     X100.0 E12.5 F
G92    E0.0
```

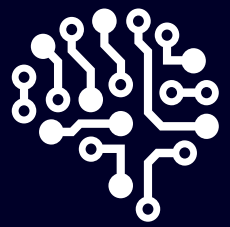


CAD/CAM data



Tuning

Base AI model



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Agenda

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Conclusion

- The Siemens Xcelerator enables the complete digitalization of value chains through interconnected software products
- The NX software provides an entire CAD/CAM/CAE platform
- The products already meet requirements in the field of artificial intelligence
- In bilateral activities, AI models can already be used in software products today

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The Impact

Experience Digital Transformation

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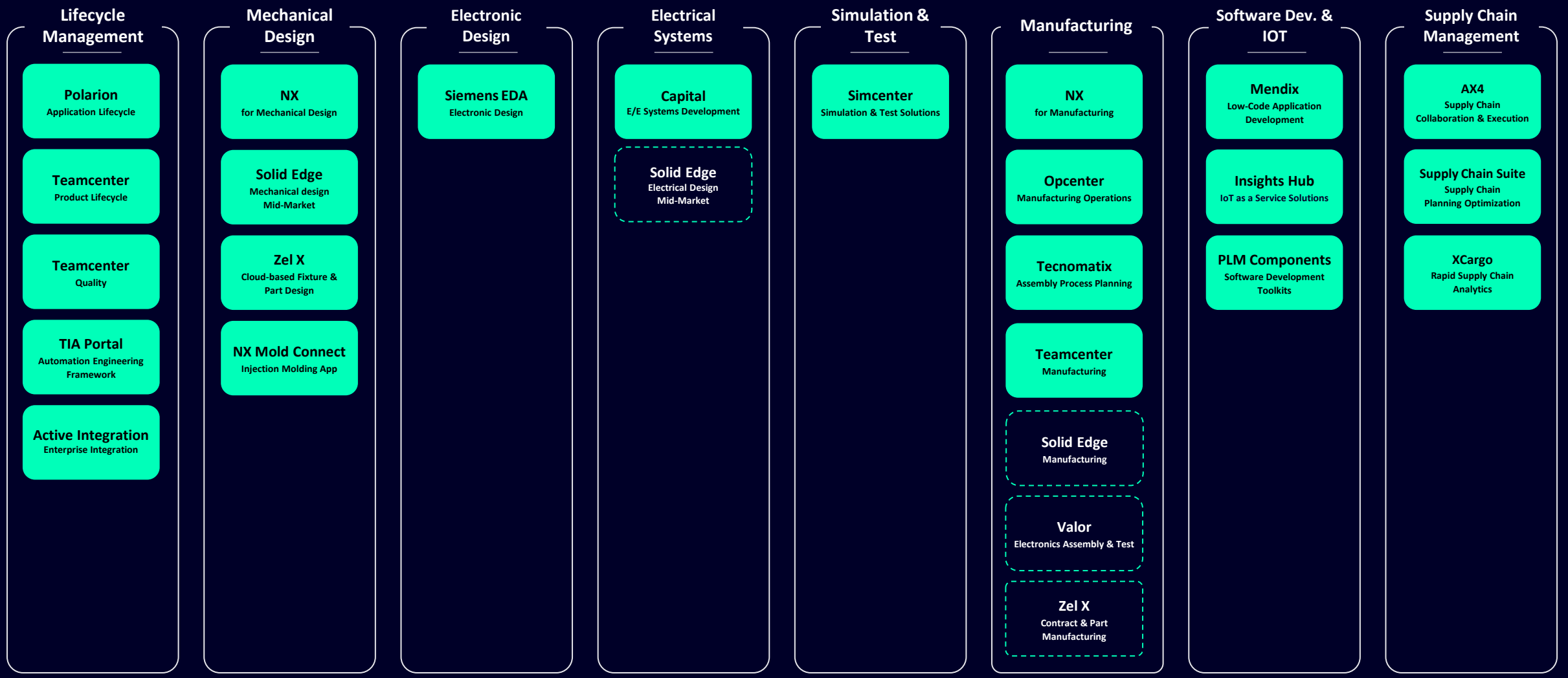
Siemens Xcelerator
Software and products



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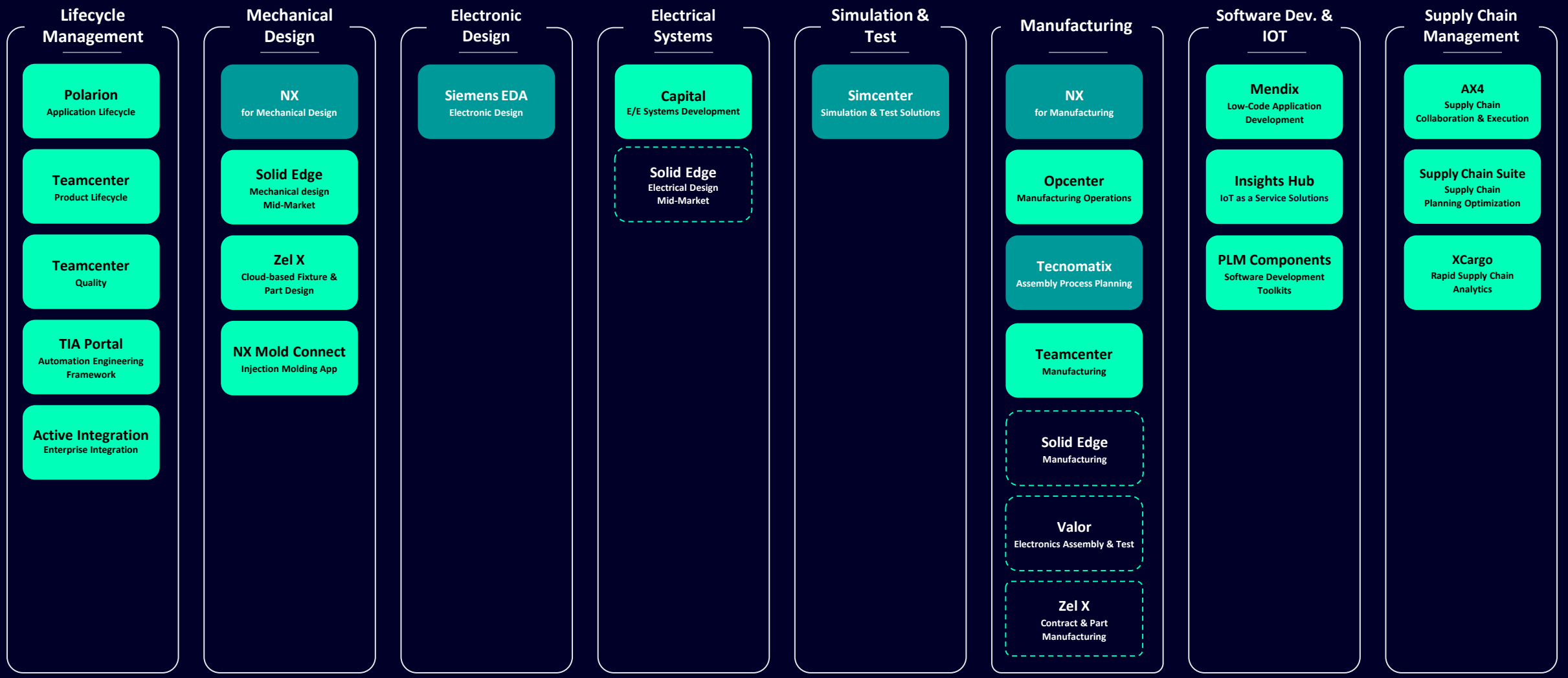
Siemens Xcelerator
Software and products



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Siemens

your partner to drive digitalization

A strong, long lasting Partner

Siemens AG

- Digital Industries
- Smart Infrastructure
- Software
- Motion Control
- Process Automation
- Factory Automation
- Customer Services

Siemens DIGITAL INDUSTRIES Software

>30,000 employees worldwide

End-to-End solutions between the digital and real worlds to Digitalize Product Development & Realization

Leader in Industrial Digitalization

#1 industrial software

> €10Bn in revenue

> €11Bn M&A investment in 11 Years

#2 software company in Europe

The broadest Portfolio – Xcelerator for the Digital Enterprise

COLLABORATION PLATFORM
PLM, low code apps & enterprise integration

MECHANICAL DESIGN
CAD, specialized engineering and Formulation

ELECTRONIC DESIGN AUTOMATION
systems, electrical, IC and embedded

SIMULATION AND TEST
predictive engineering and test

APPLICATION LIFECYCE MANAGEMENT
plan, build, test, release and control

PERFORMANCE ANALYTICS
collect and analyze data for optimization

MAINTENANCE, REPAIR & OVERHAUL
service instructions, planning, execution & documentation

MANUFACTURING & LOGISTICS PLANNING & OPERATIONS
process & factory design simulation, NC programming, automation programming, MES, APS, Quality, Supply Chain Management

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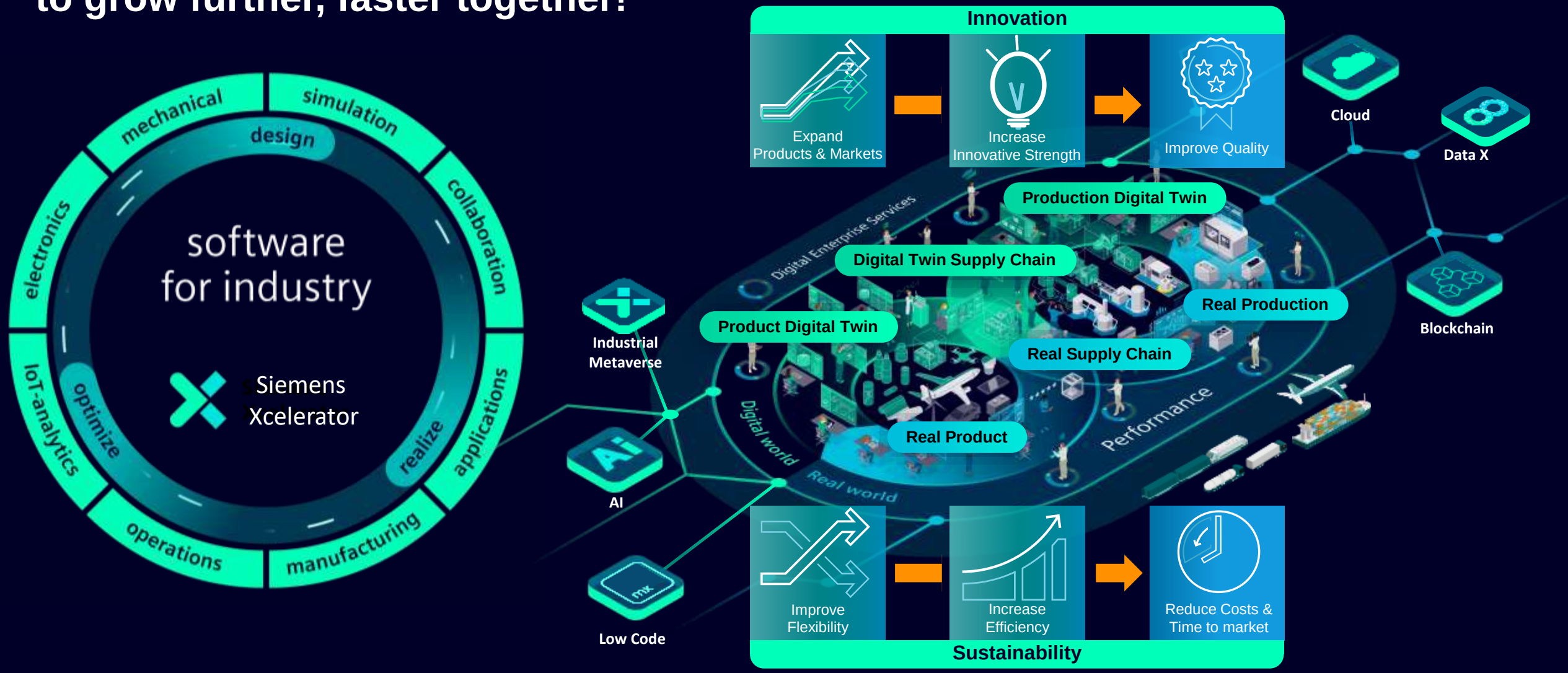
Siemens Xcelerator platform empowers the Digital Enterprise accelerating Innovation, Sustainability & Access to New Technologies to grow further, faster together!



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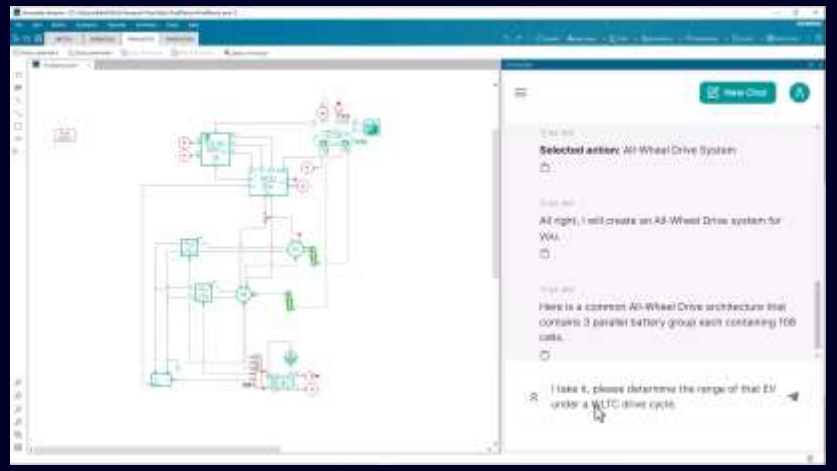
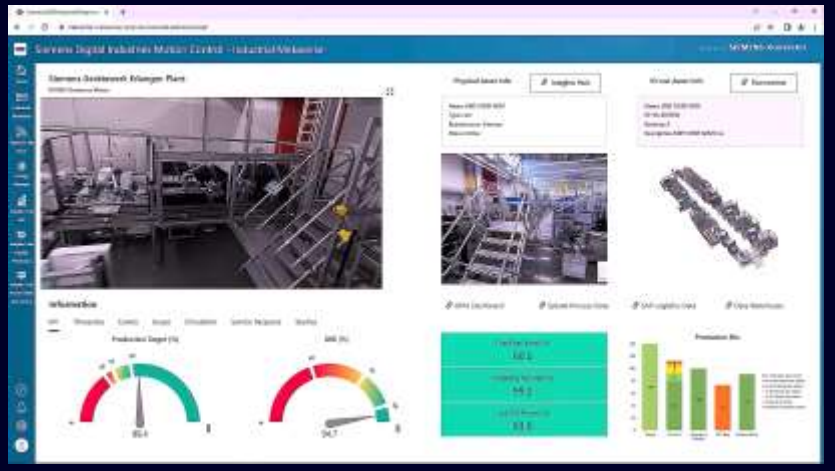
Unleash the Power of New Technologies





Data X

Seamless Collaboration

AI

Employ AI

Industrial Metaverse

See it. Try it. Feel it.

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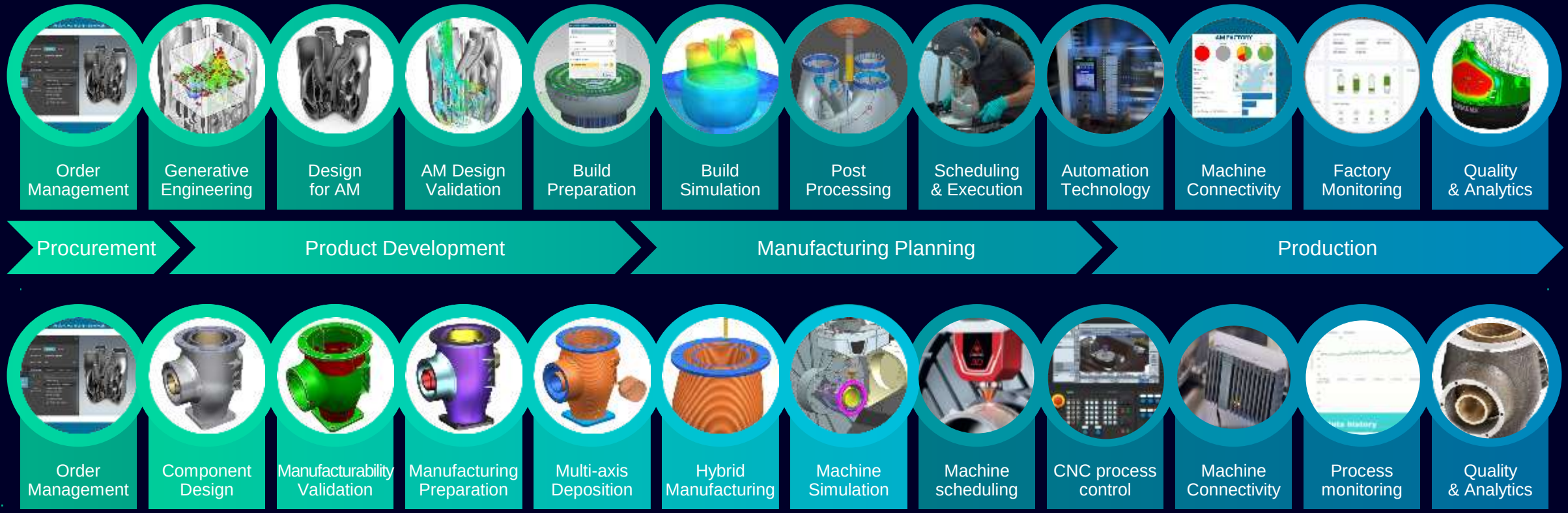
End-to-end Additive Manufacturing Workflow



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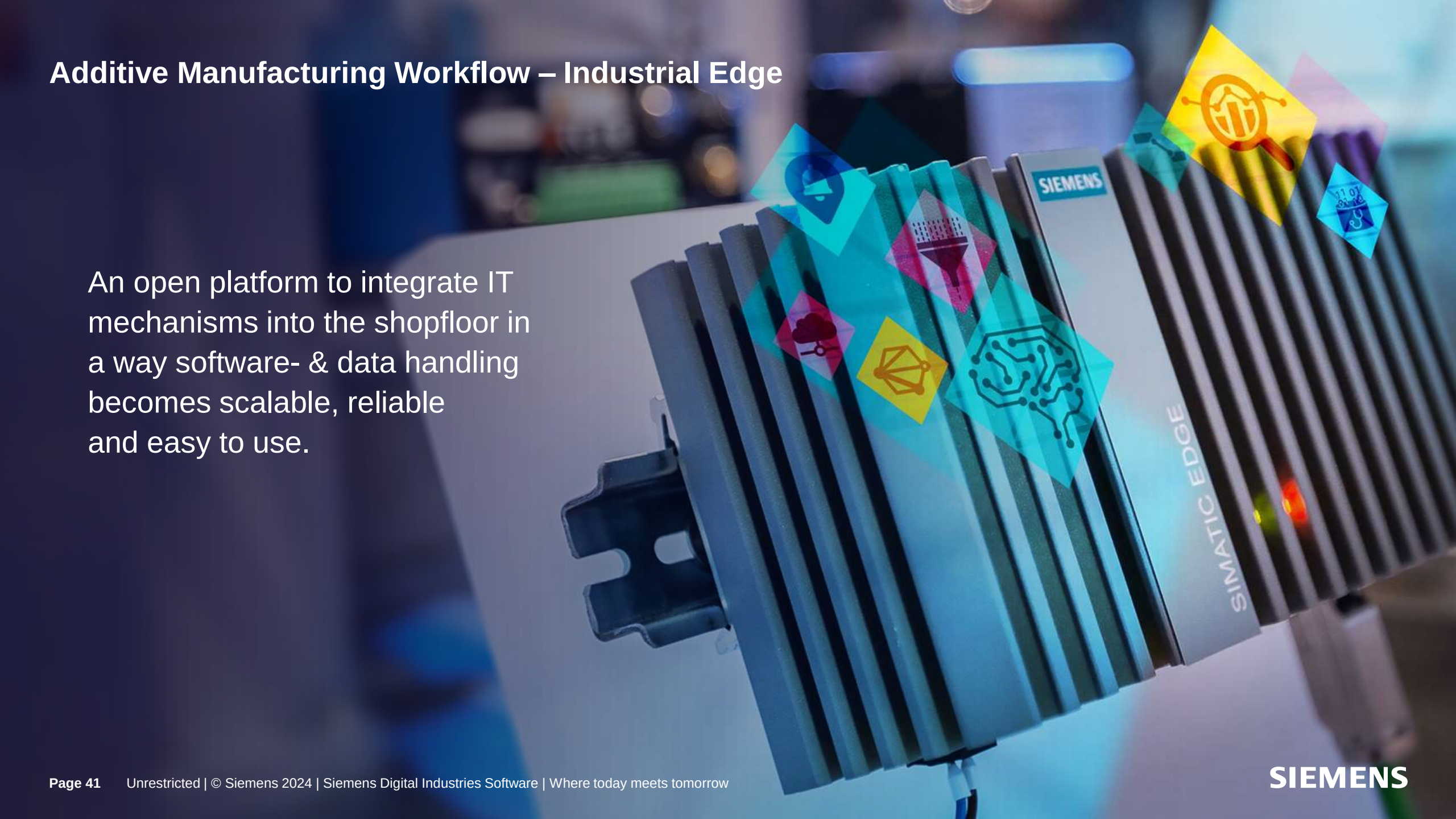
Additive Manufacturing Workflow – Industrial Edge



An open platform to integrate IT mechanisms into the shopfloor in a way software- & data handling becomes scalable, reliable and easy to use.

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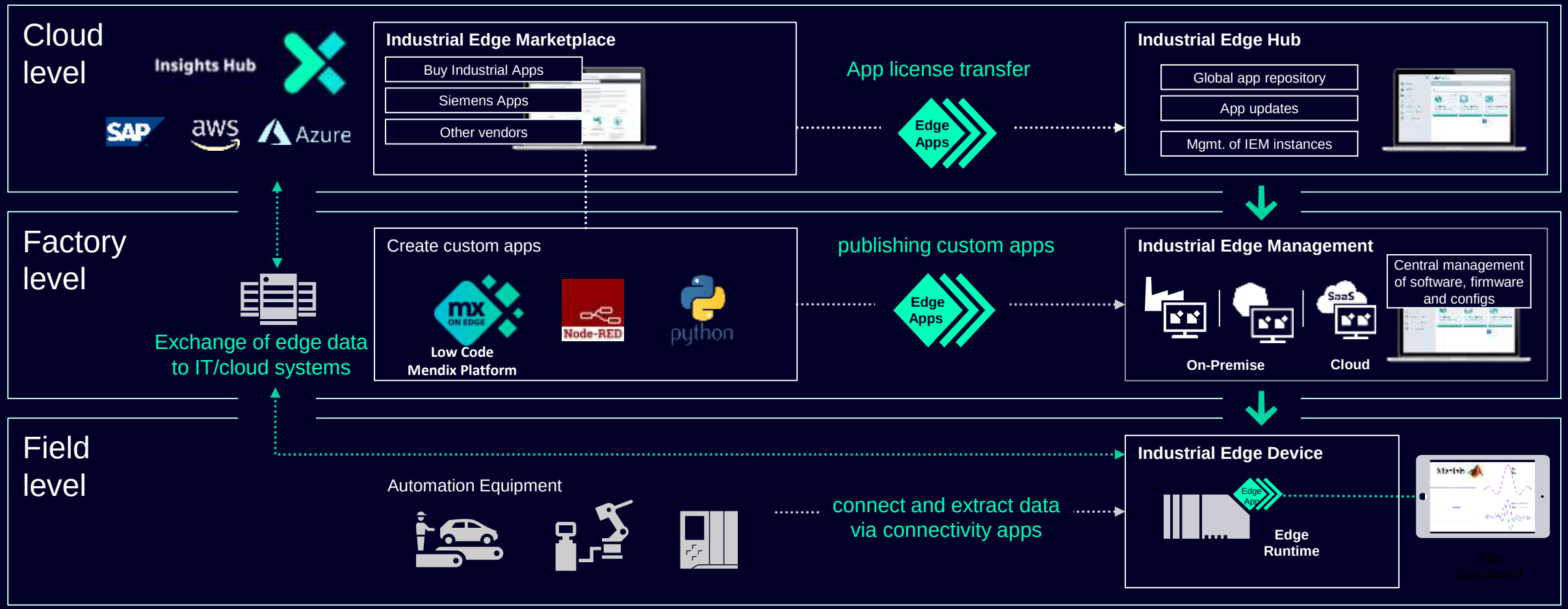
Industrial Edge Blueprint Architecture



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Siemens Xcelerator
Software and products

NX
Mechanical design for product development

Solid Edge
Engineering software for mainstream

Simcenter
Multidisciplinary simulation and testing

Insights Hub
IoT as a Service solutions

Mendix
Low-code application development

Capital
E/E systems development

Opcenter, Tecnomatix, NX CAM
Manufacturing operations management

Xcelerator Data Hub & BI
Data Integration & BI

Teamcenter, Polarion
Product & Application lifecycle management

Supplyframe
Sourcing Intelligence & Procurement

Supply Chain Suite, AX4
Supply Chain Management / Logistics

Valor, HyperLynx
Electronics systems verification

Xpedition, PADs
Electronic systems design

Calibre, Aprisa, Catapult, Tanner
Integrated circuit design

Tessent, Questa, Veloce, Analog FastSPICE, Symphony, mPower, Power Pro
Integrated circuit verification

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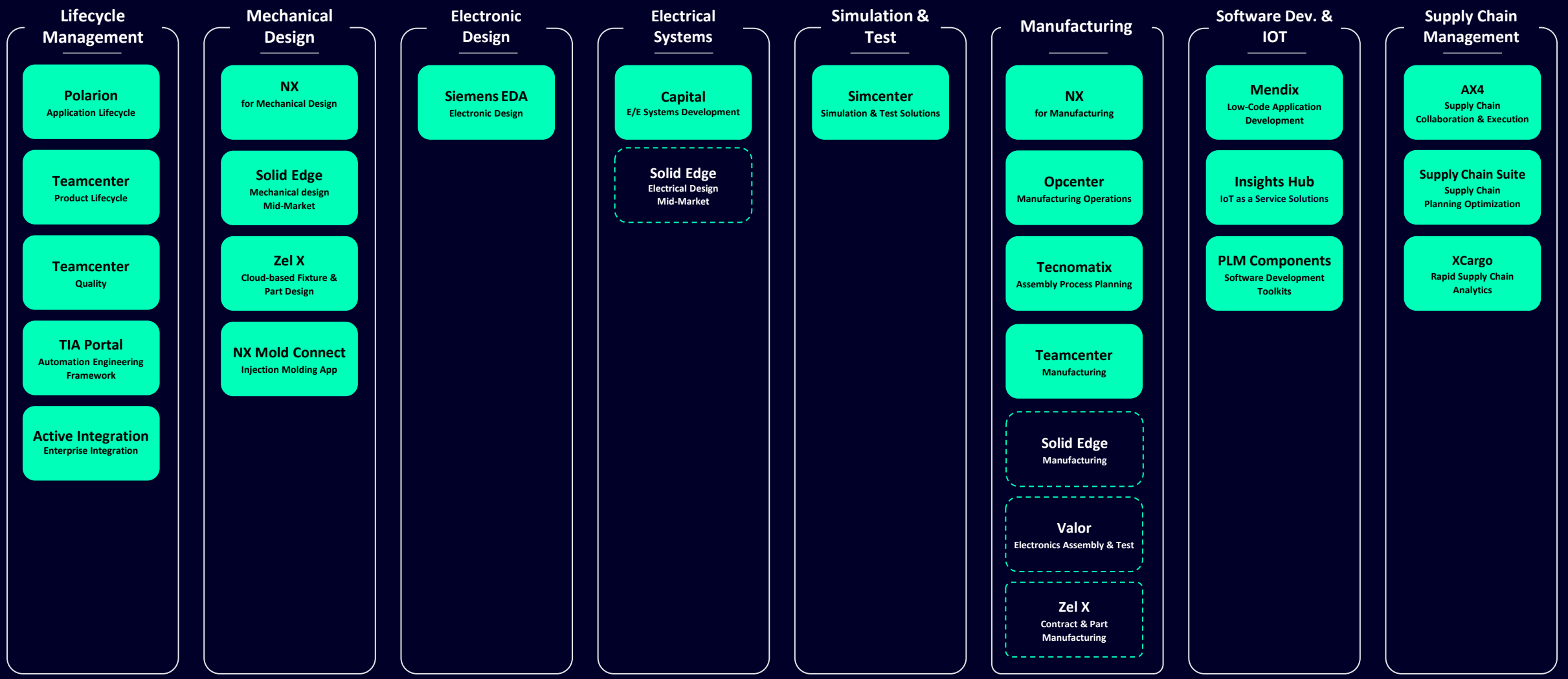
Siemens Xcelerator
Software and products



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Siemens Xcelerator
Software and products

Lifecycle Management
- **Polarion** — Application Lifecycle
- **Teamcenter** — Product Lifecycle
- **Teamcenter** — Quality
- **TIA Portal** — Automation Engineering Framework
- **Active Integration** — Enterprise Integration

Mechanical Design
- **NX** — for Mechanical Design
- **Solid Edge** — Mechanical design Mid-Market
- **Zel X** — Cloud-based Fixture & Part Design
- **NX Mold Connect** — Injection Molding App

Electronic Design
- **Siemens EDA** — Electronic Design

Electrical Systems
- **Capital** — E/E Systems Development
- **Solid Edge** — Electrical Design Mid-Market

Simulation & Test
- **Simcenter** — Simulation & Test Solutions

Manufacturing
- **NX** — for Manufacturing
- **Opcenter** — Manufacturing Operations
- **Tecnomatix** — Assembly Process Planning
- **Teamcenter** — Manufacturing
- **Solid Edge** — Manufacturing
- **Valor** — Electronics Assembly & Test
- **Zel X** — Contract & Part Manufacturing

Software Dev. & IOT
- **Mendix** — Low-Code Application Development
- **Insights Hub** — IoT as a Service Solutions
- **PLM Components** — Software Development Toolkits

Supply Chain Management
- **AX4** — Supply Chain Collaboration & Execution
- **Supply Chain Suite** — Supply Chain Planning Optimization
- **XCargo** — Rapid Supply Chain Analytics

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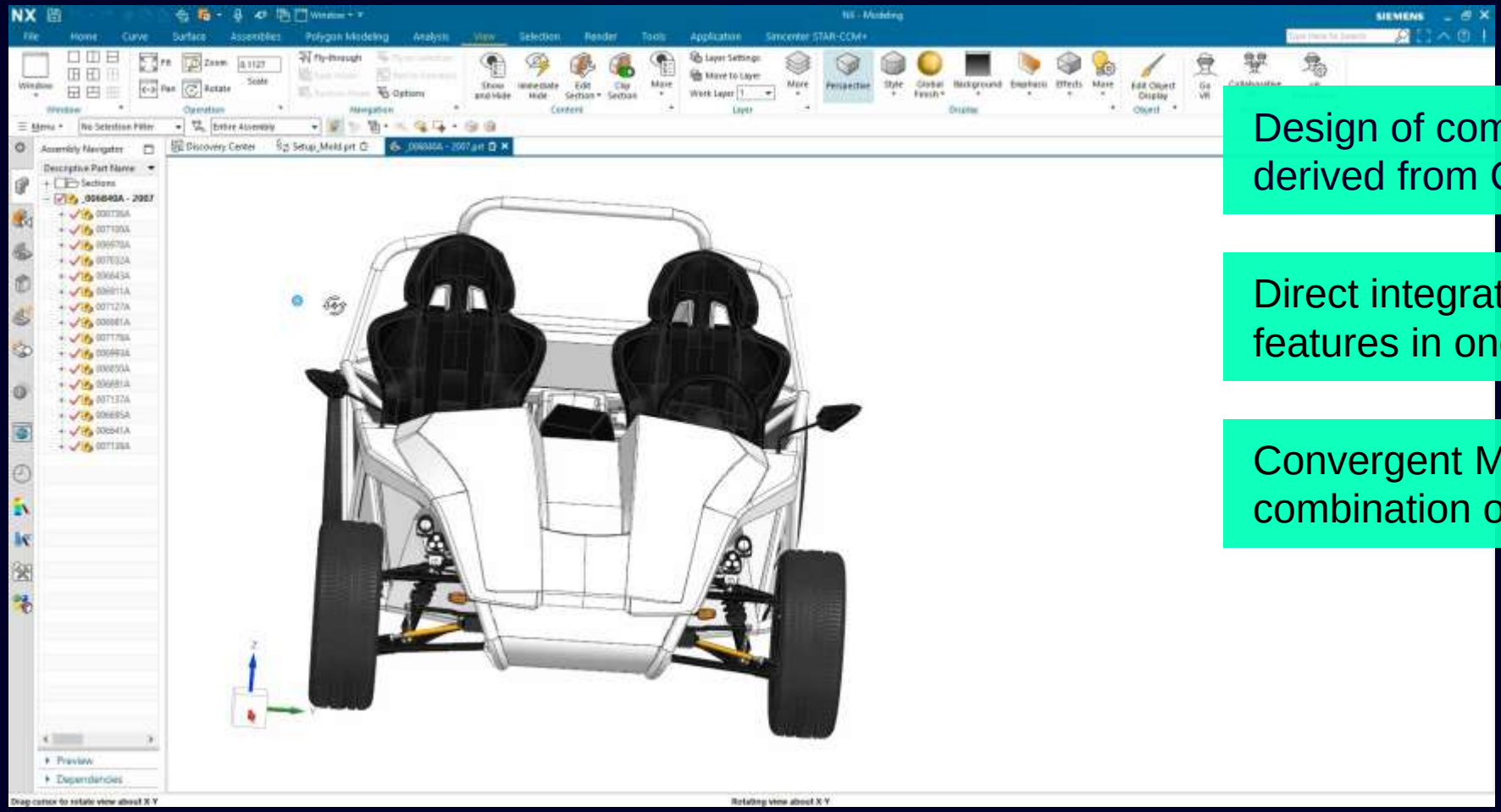
Derive Design of Composite Mold from CAD Geometry in Siemens NX



Design of composite mold can be easily derived from CAD Data of SimRod

Direct integration of CAD and CAM features in one NX

Convergent Modeling enables combination of facet data and B-Rep

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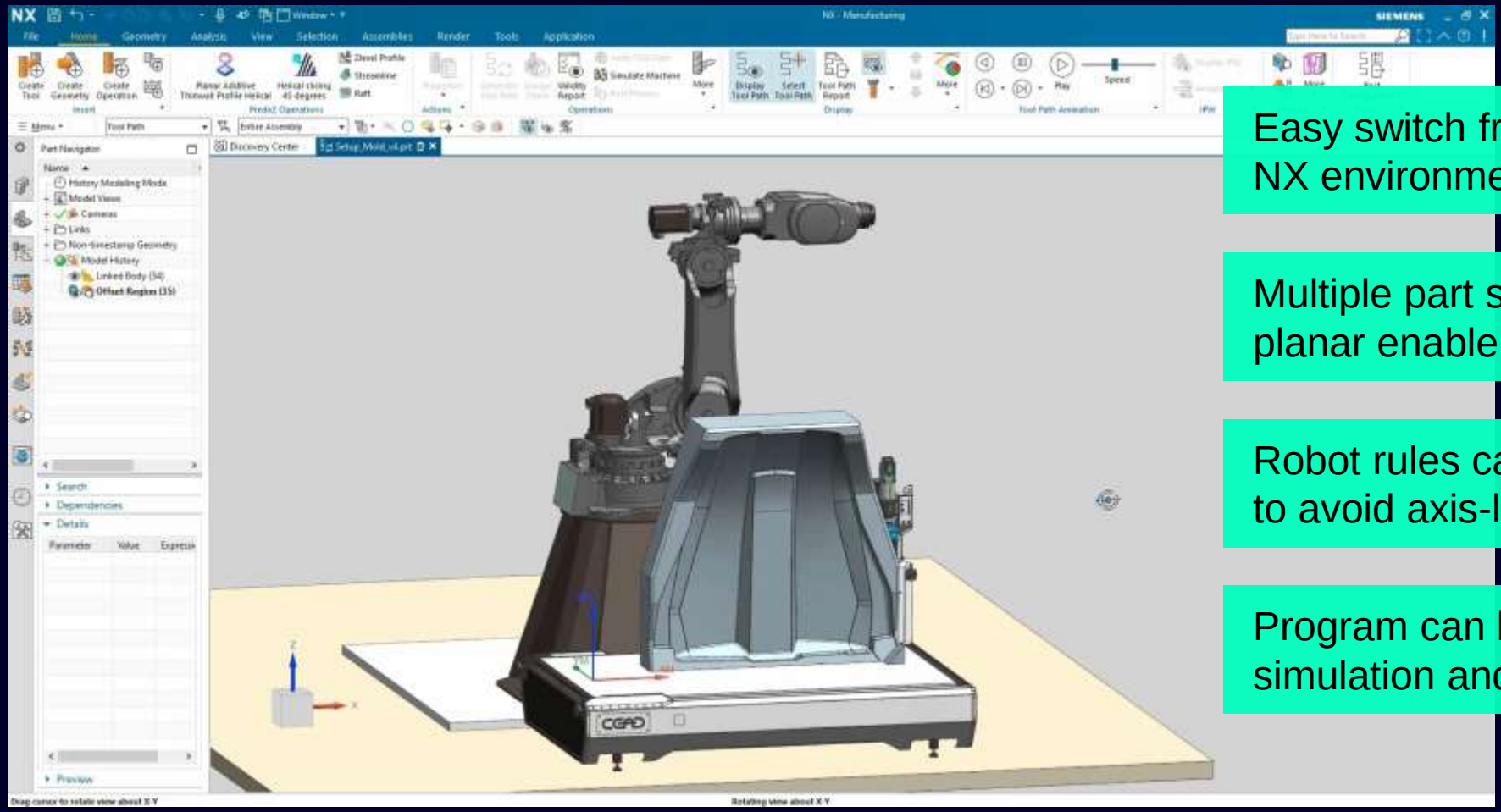
Preparation for Additive Manufacturing of Composite Mold in NX CAM Multi Axis Deposition



- Easy switch from CAD to CAM in same NX environment
- Multiple part slicing strategies e.g. non-planar enable full flexibility
- Robot rules can be applied and verified to avoid axis-limits or singularities
- Program can be verified using machine simulation and IPW*

*IPW = in process workpiece simulation

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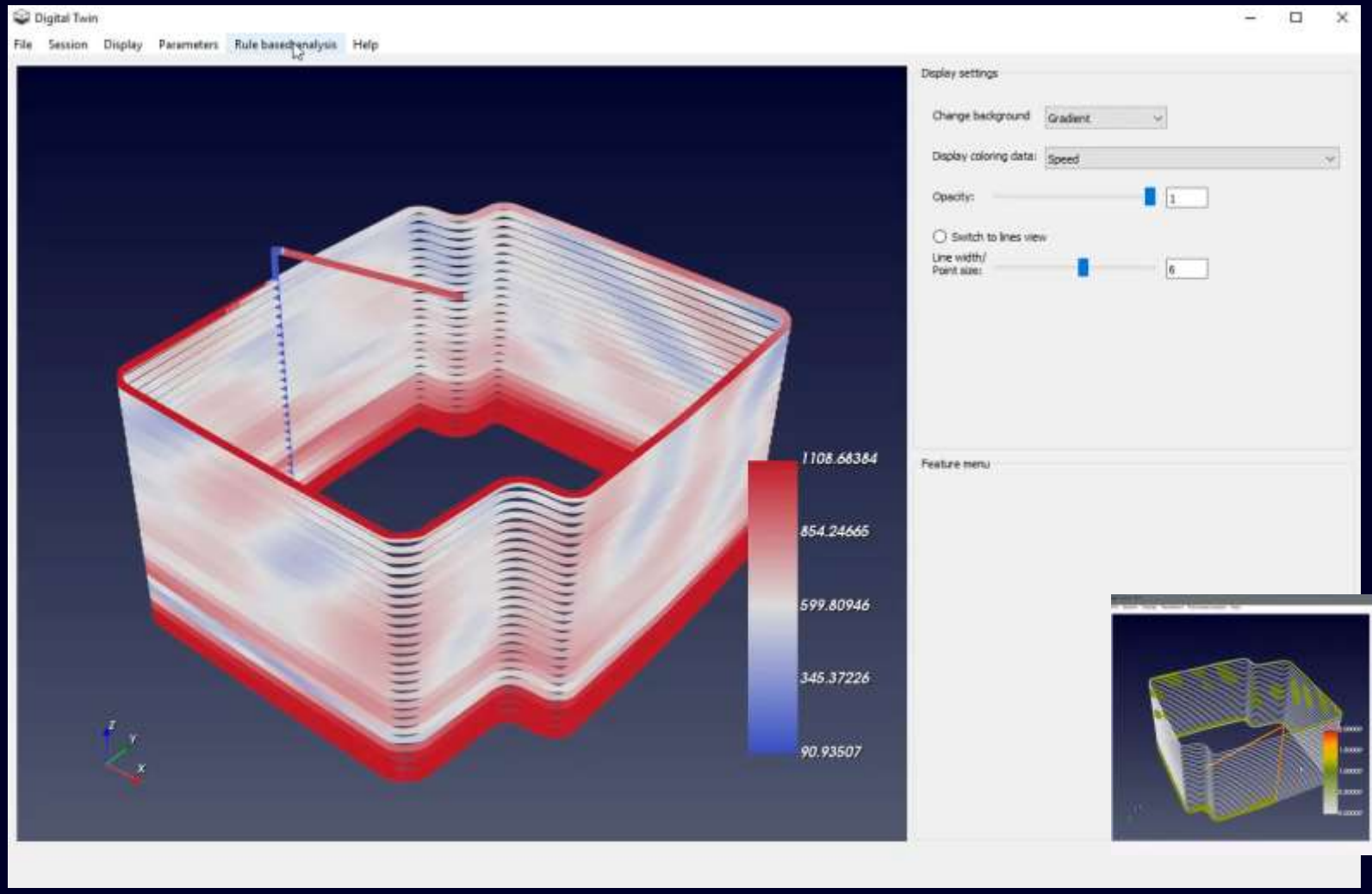
“Geo Mapping” on base of Sinumerik Integrate Tools



Interactive definition of rules for impacting parameters

- Parameter limits, e.g. layer height during LMD process
- Definition of display style

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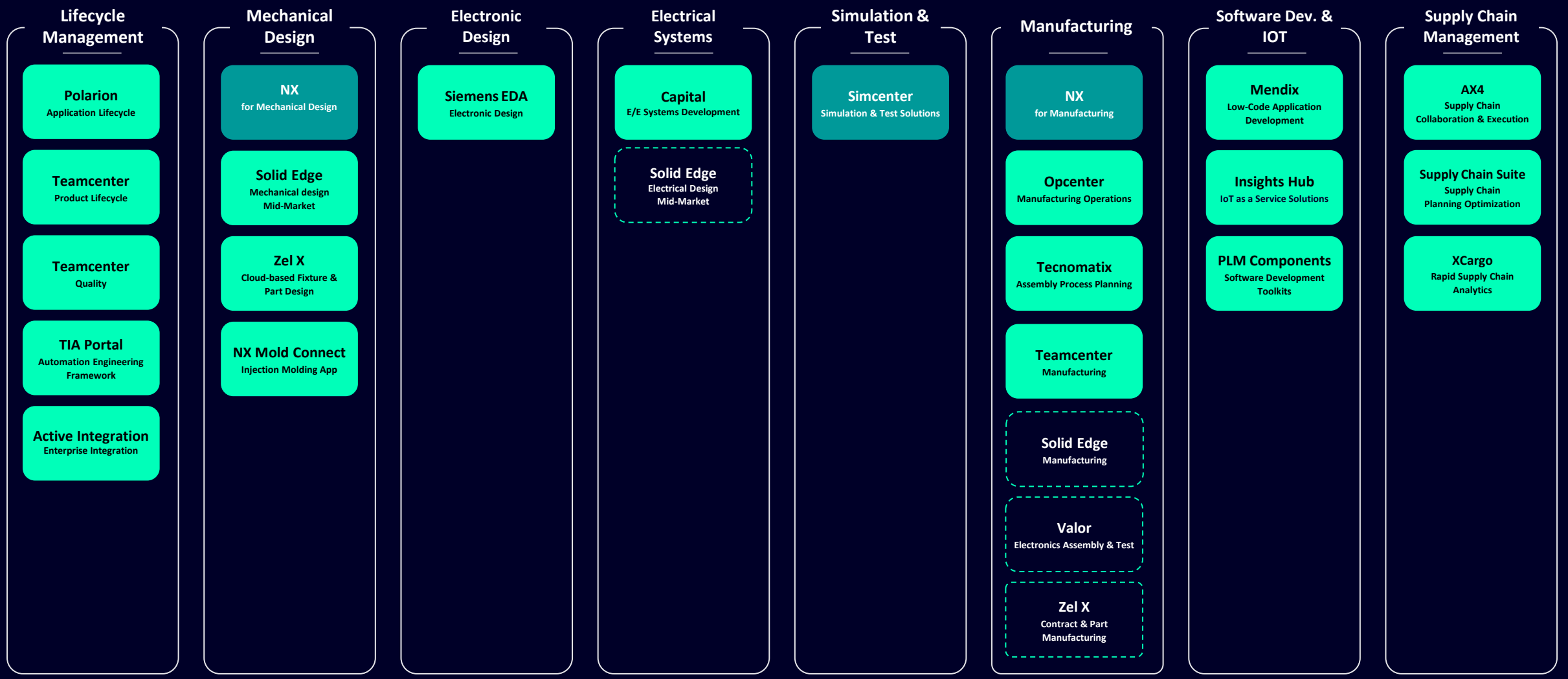

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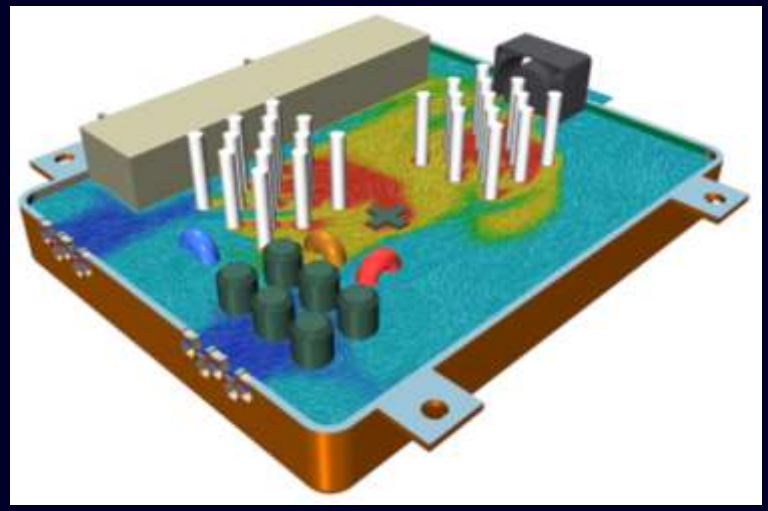
Multidisciplinary Usage
Design optimizations

- Product optimizations are complex
- Combination of at least CAD and CAE necessary

→ Design Space Explorer including optimization methods



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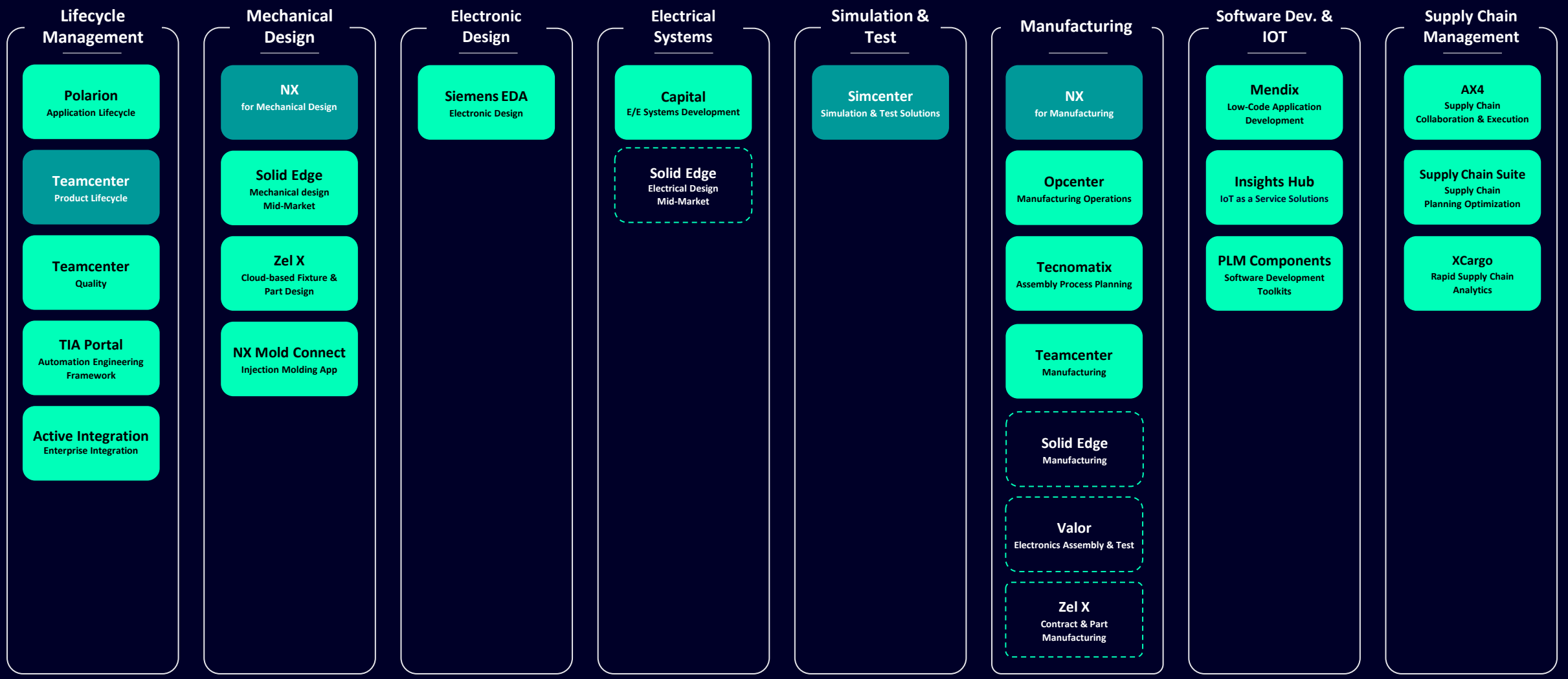

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