Enabling Sustainability for Heavy Industry

Dr. Heiko Claussen

May 26, 2020

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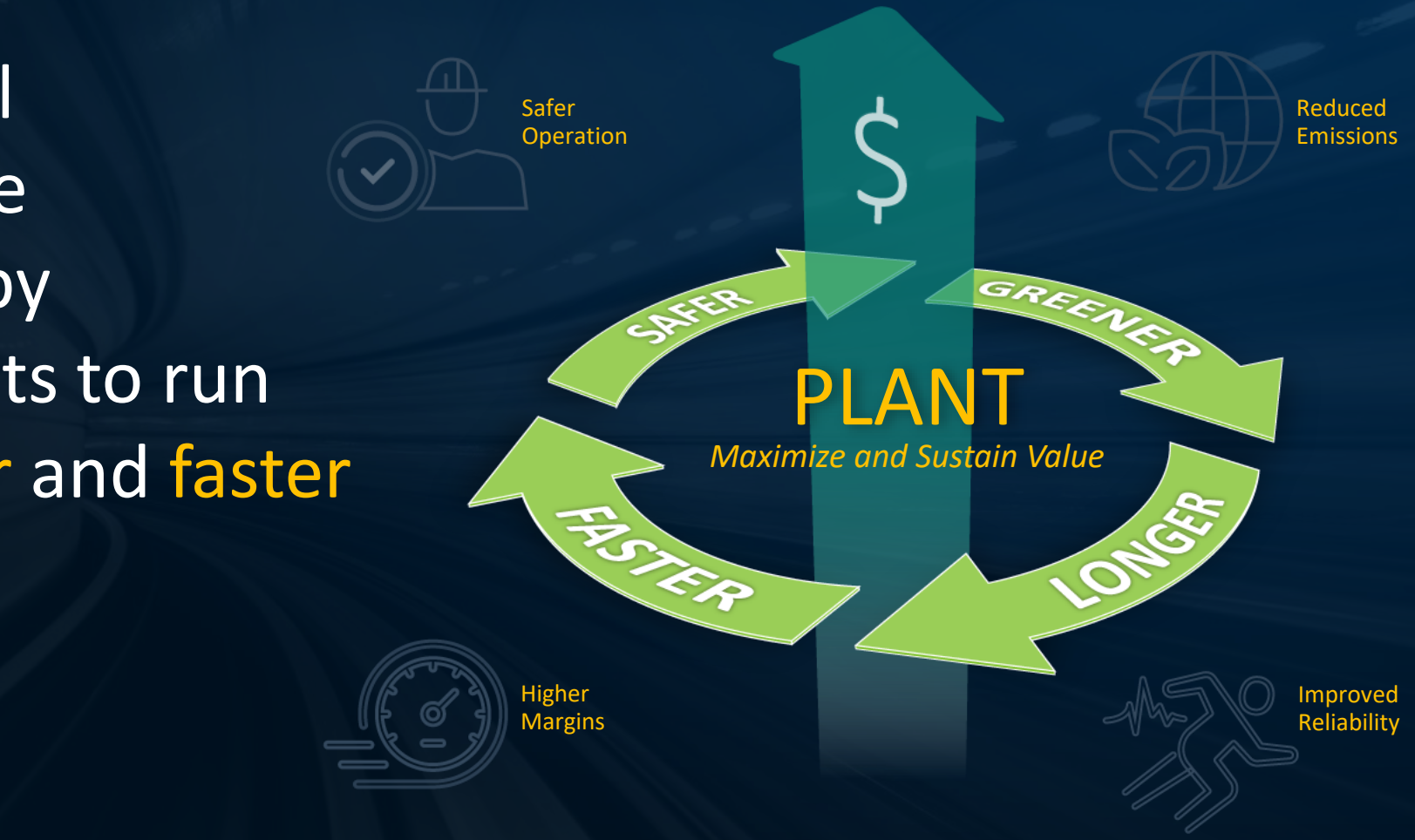
Any such information is for discussion purposes only and does not constitute a commitment by Aspen Technology to do or deliver anything in these product roadmaps or otherwise.

Any such commitment must be explicitly set forth in a written contract between the customer and Aspen Technology, executed by an authorized officer of each company.

AspenTech's Mission

Accelerate the digital transformation of the industries we serve by optimizing their assets to run safer, greener, longer and faster



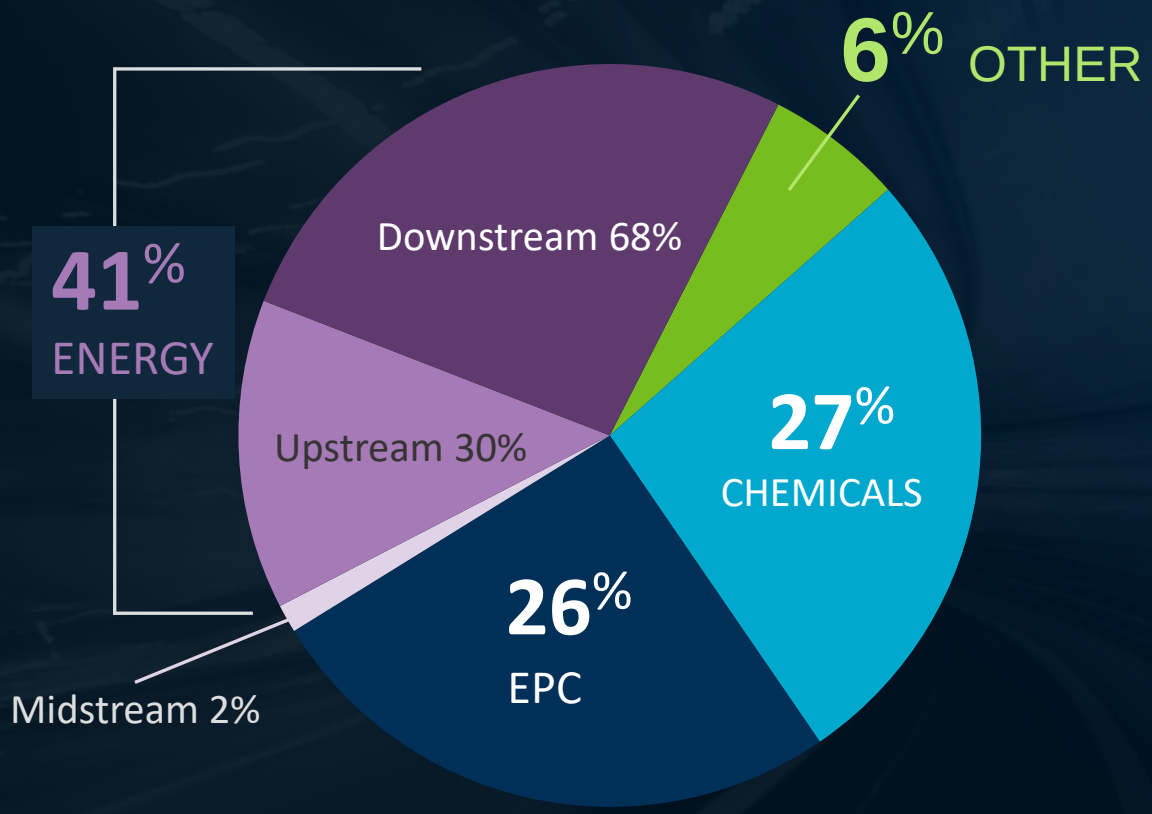
AspenTech By the Numbers

- More than **$50 billion** annually in value created for customers worldwide
- Blue-chip customers, more than **2,300** globally
- **90% revenue** across Energy, Chemicals, Engineering and Construction

- Global presence with **over 60%** of business outside North America
- **1,700** employees worldwide, 50% outside U.S.
- **39 years** of technology leadership and innovation

World leader in asset optimization software for capital-intensive industries

Our Customers by Industry



Percentages based on Annual Spend for FY2019 through Q4

20/20
Largest E&C Oil & Gas Companies

JACOBS

ExxonMobil

19/20
Largest Petroleum Companies

20/20
Largest Chemical Companies

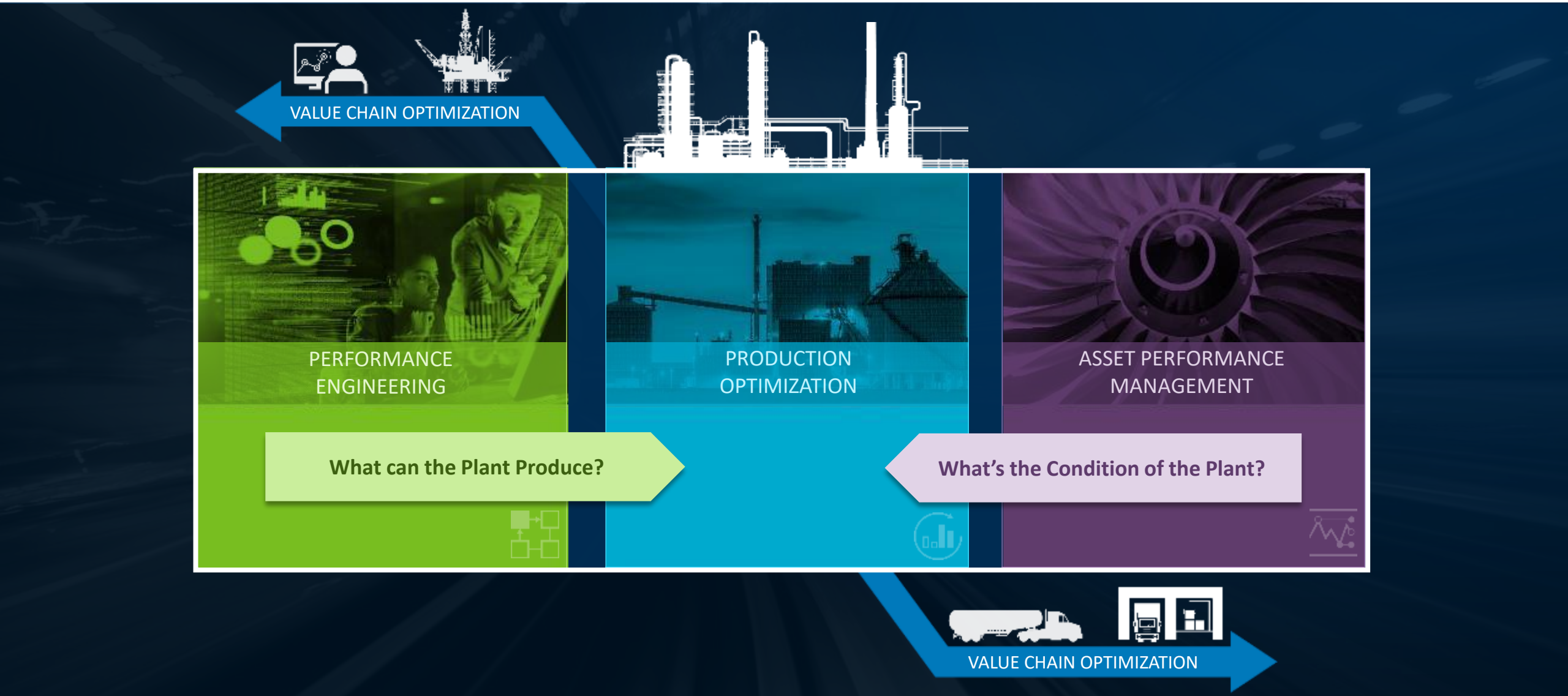
BASF
We create chemistry

DOW

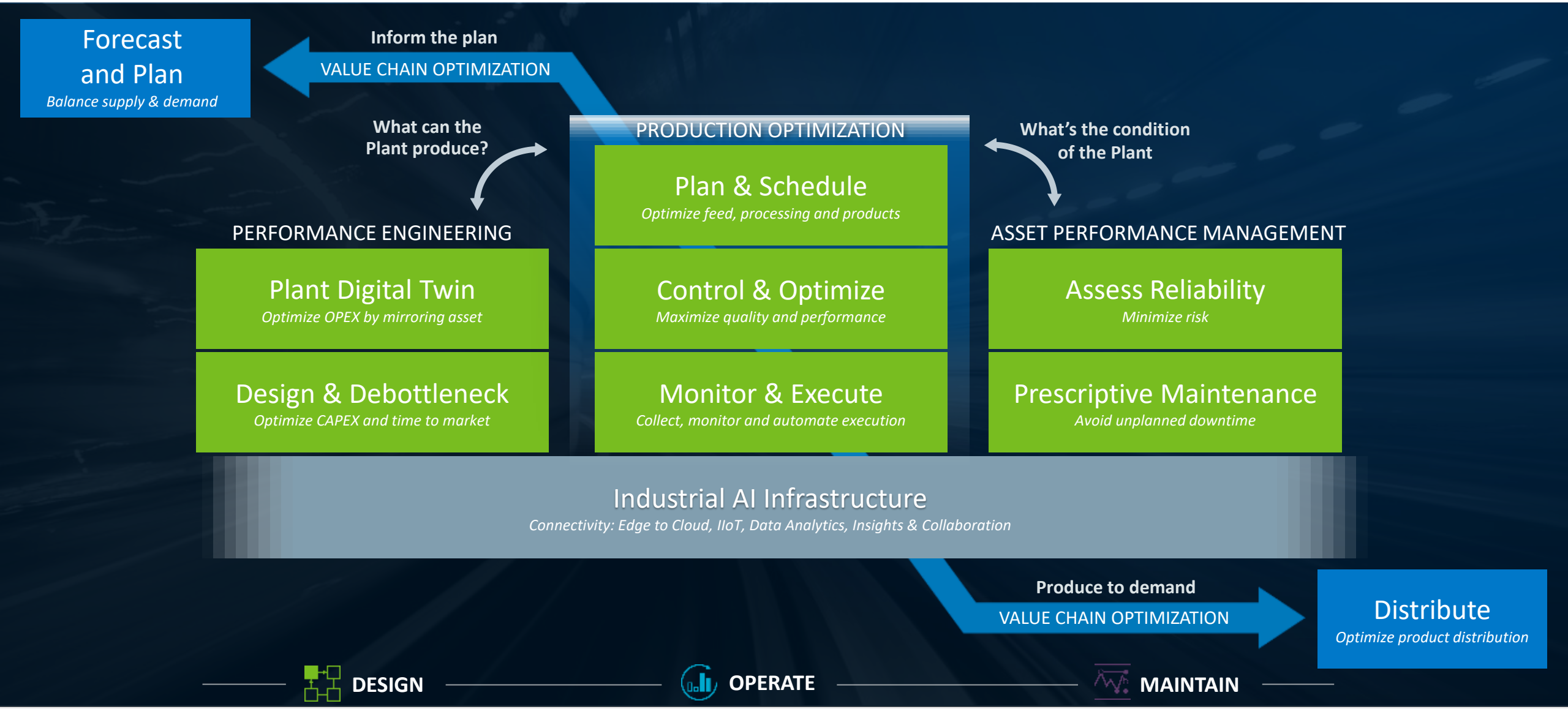
- Pharmaceuticals
- Metals & Mining
- Pulp & Paper
- Food & Beverage
- Power & Utilities
- Industrial Equip Manufacturing

Ranking from ENR, ICIS and Forbes for calendar year 2018

Asset Optimization Solutions



Asset Optimization — Extending the Lifecycle



Delivering Value in Sustainability with Digitalization Activities

SUCCESS STORY

Reliance Industries Limited

Saved **166 tons** of cracked gas from flaring during every start up

Chevron

Ensured pressure relief safety & saved **$30M** in CAPEX

MITSUBISHI CHEMICAL

Reduced time to evaluate investment for new chemicals from **6 mo** to **2 wks**

LOTTE CHEMICAL

Cut CO2 emissions by **30%** using digital twins

صدارة Sadara

Avoided hazardous events by estimating the process safety response time

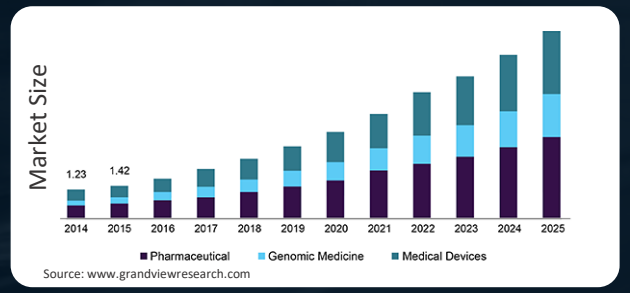
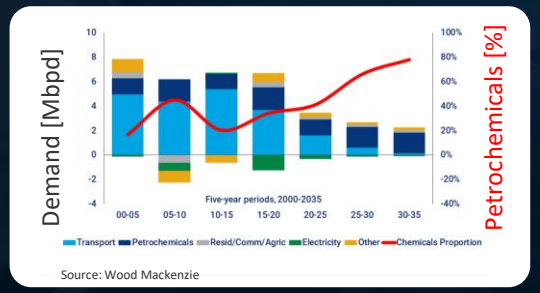
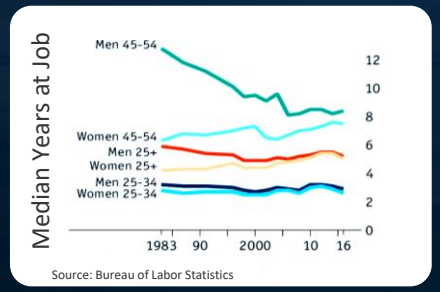
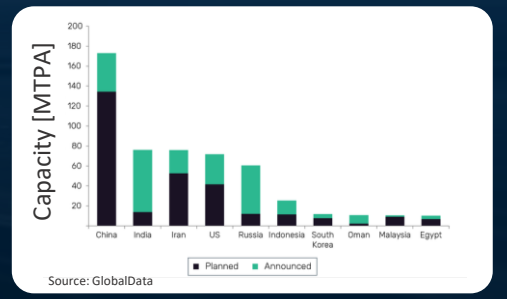
أدنوك ADNOC

Reduced water use **15%** in Abu Dhabi's largest gas field

The World is Changed!

A VUCA Environment

Megatrends – Affected by Technological Breakthroughs

	Urbanization	Climate Change	Demographic Change	Globalization
Driver				
Observation	**Personalized Medicine Market China** 	**Global Crude Oil Demand Shift** 	**Median Job Tenure Trend** 	**Planned & Announced Petrochemical Capacity Additions by 2030** 
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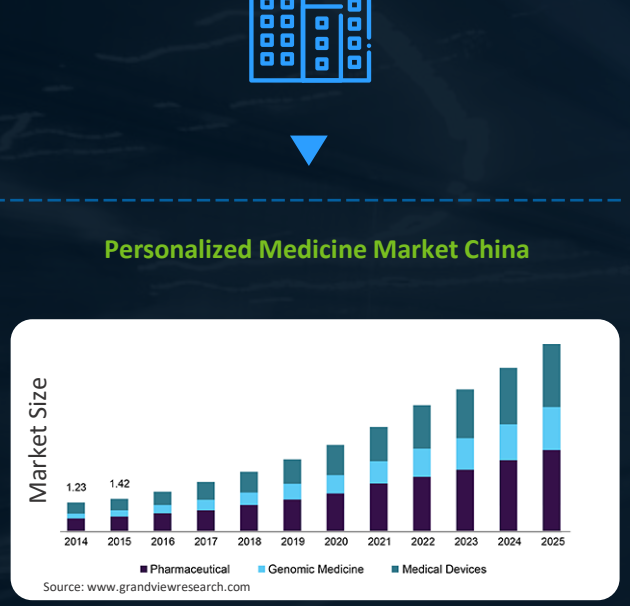
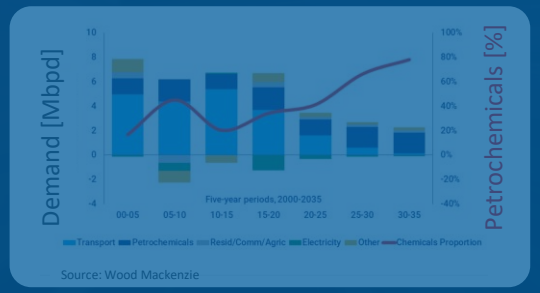
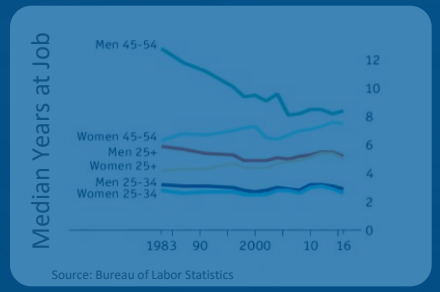
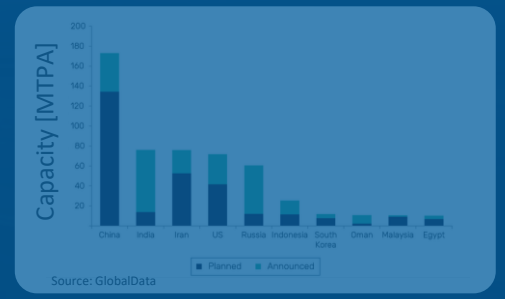


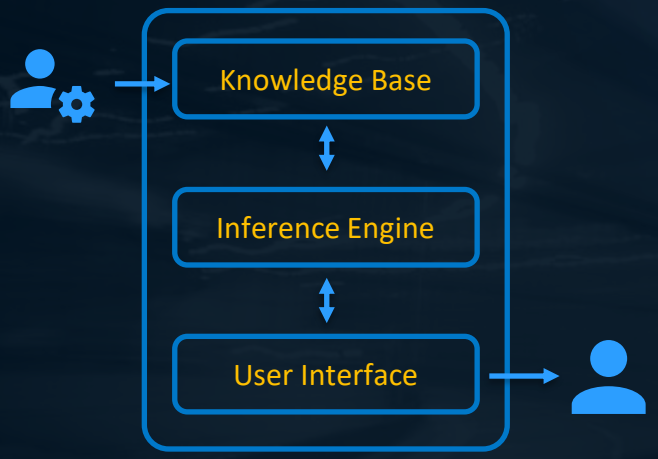






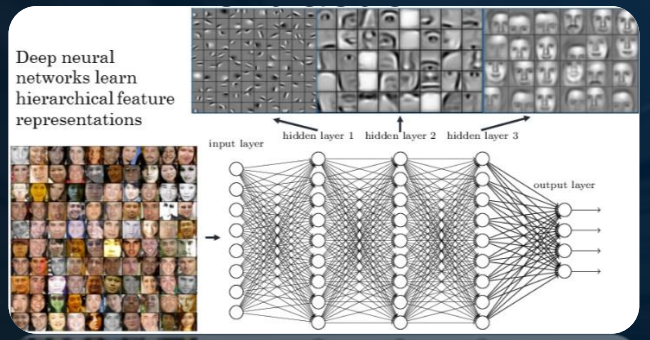
Artificial Intelligence – Algorithm Trends

Expert Systems



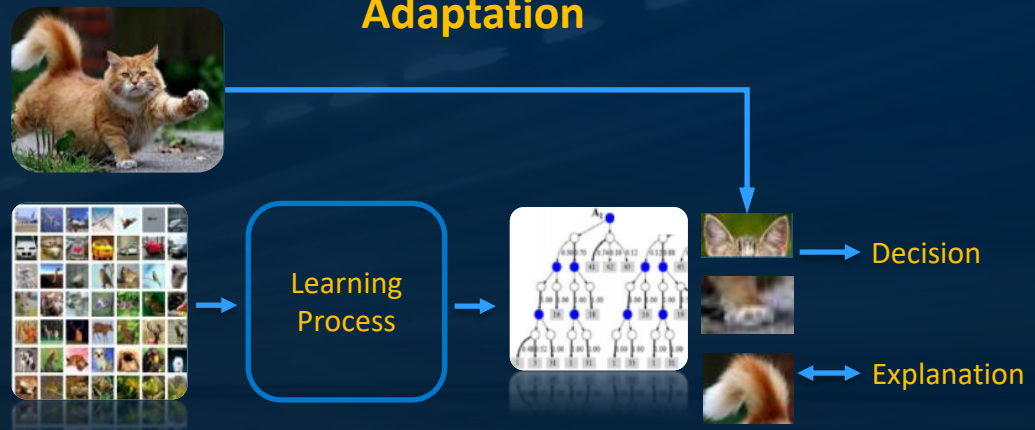
Domain Specific Reasoning
(e.g., Taxes, IT Security…)

Statistical Learning



Classification and Prediction Tasks
(e.g., Speech to Text, Object Tracking…)

Contextual Adaptation



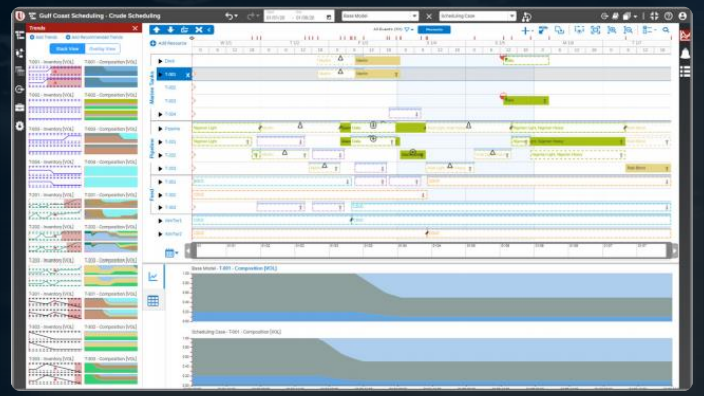
Human Machine Interaction
(e.g., Chabot, Conversational Speech Interaction…)

Artificial Intelligence senses, learns, reasons, acts and adapts to the real world without explicit programming

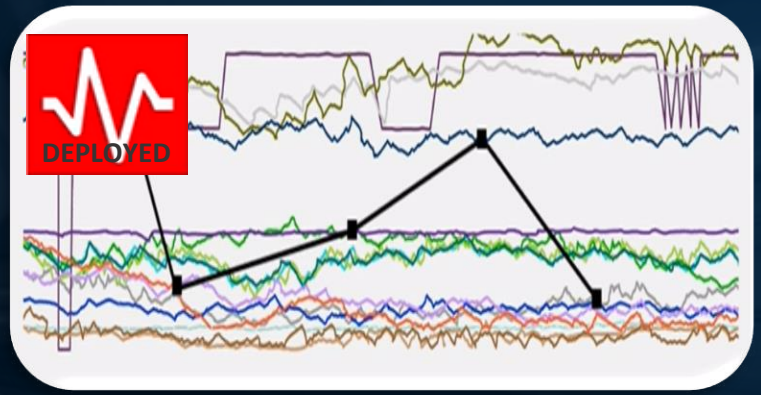
Autonomy by Synergy

VISION

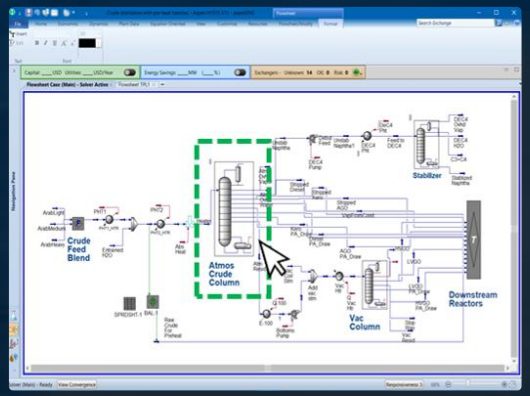
Aspen Unified
Production Scheduling



Aspen Mtell
Anomality Detection Agent

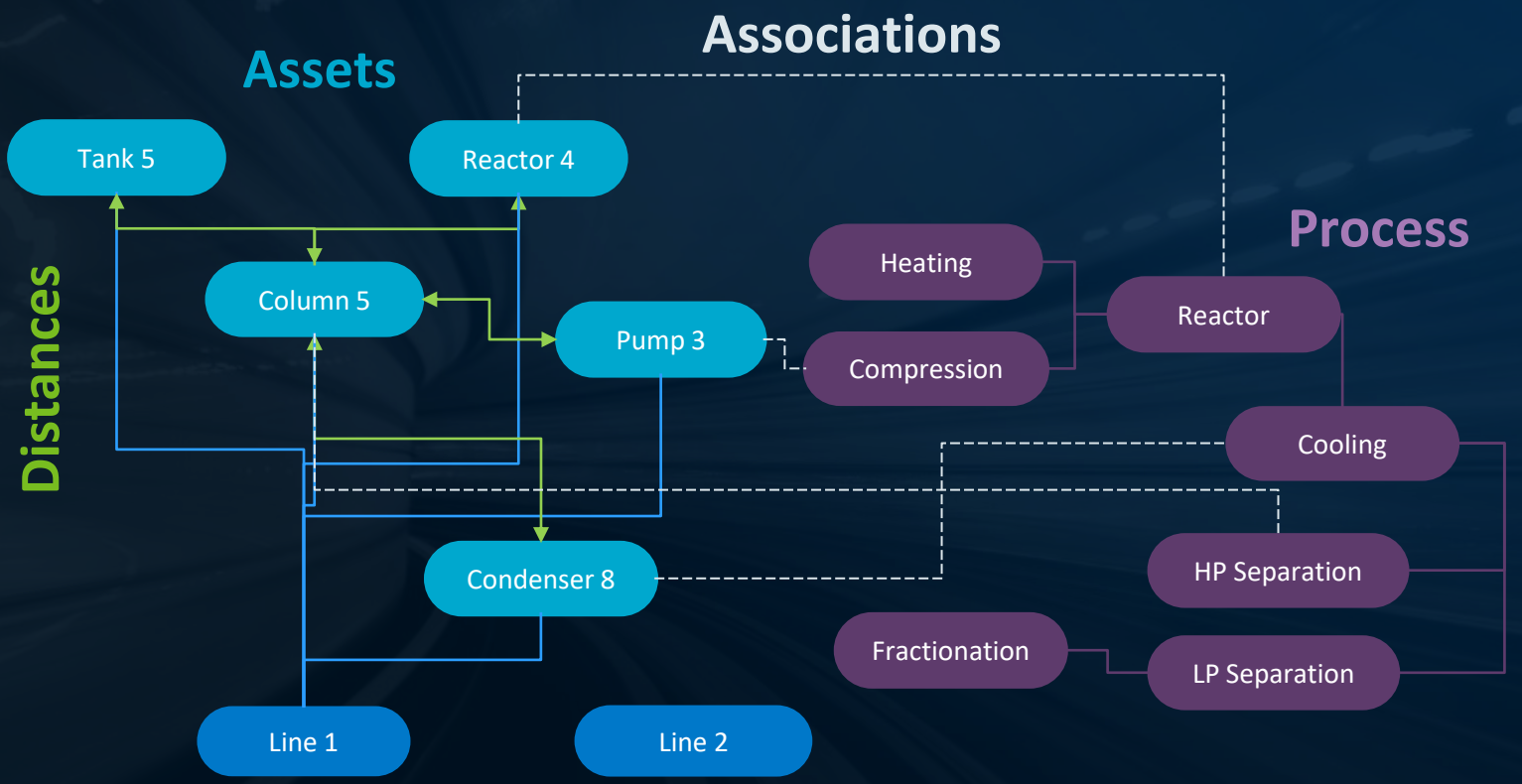


Aspen HYSYS
Hydrocarbon Process



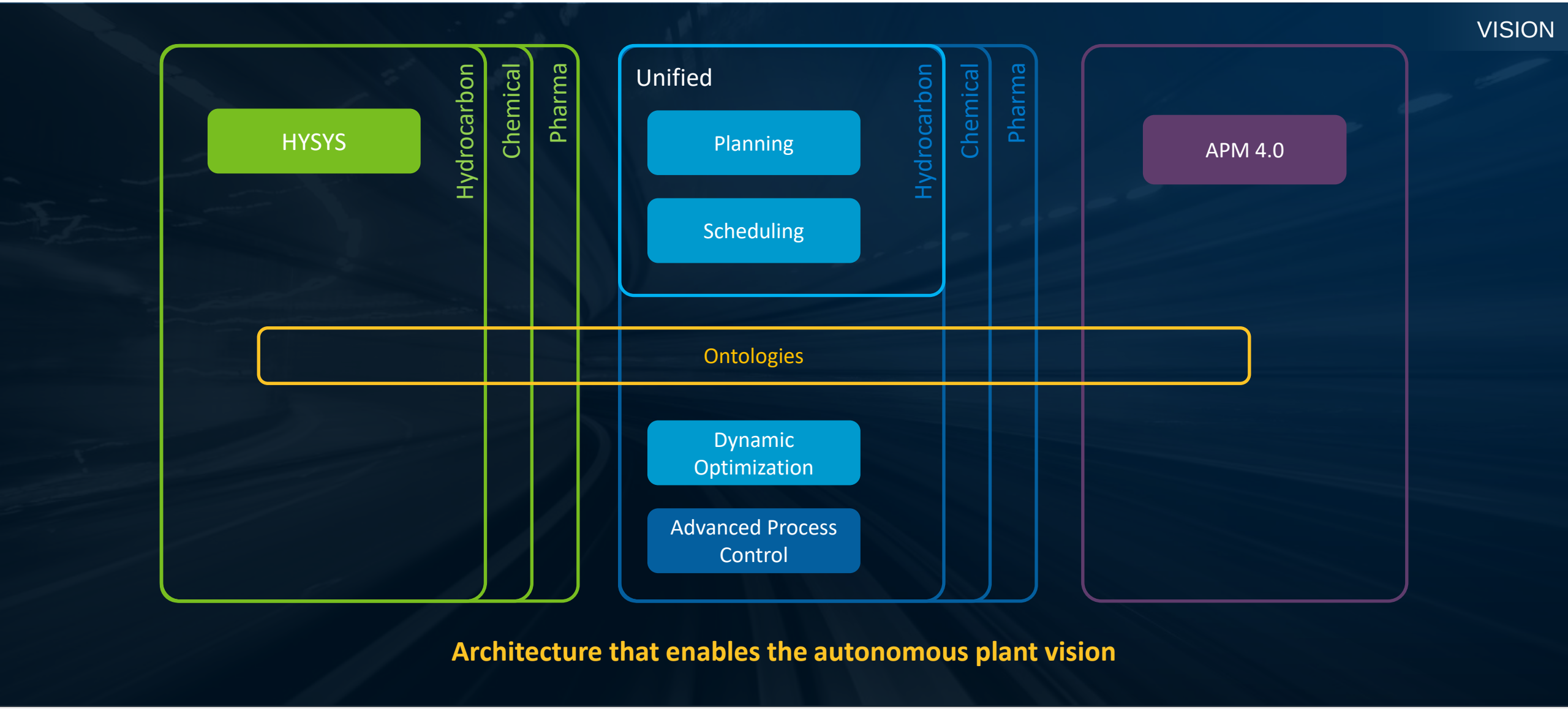
- ✓ **Ontology associates fault prediction with capital risk**
- ✓ **Ontology enables risk mitigating design changes**

Contextual Adaptation – Ontologies



Asset-Process association helps infer capital risk of delaying repair, root causes and preventive actions

Self Optimizing Plant



Architecture that enables the autonomous plant vision

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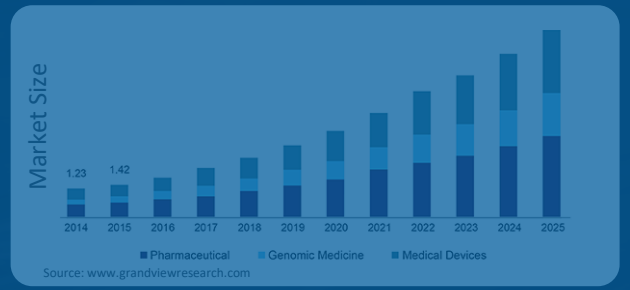
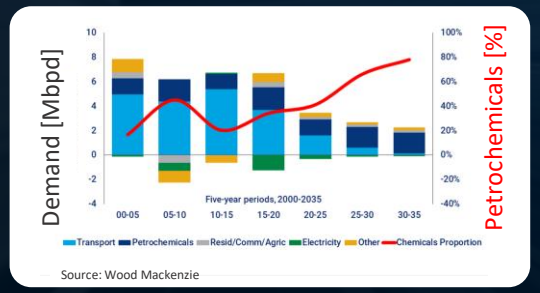
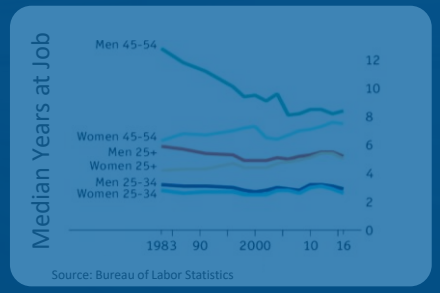
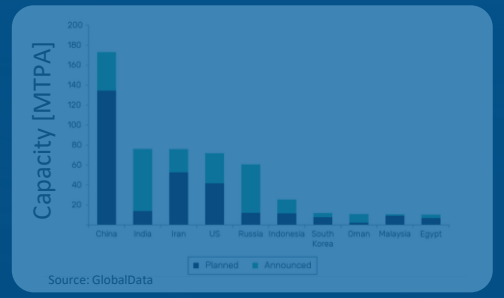


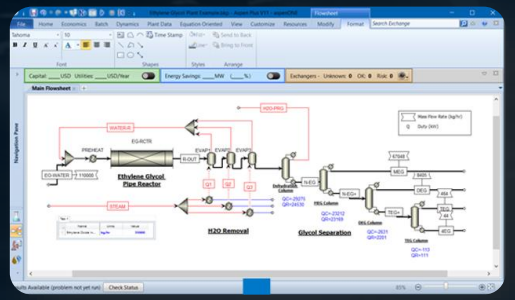




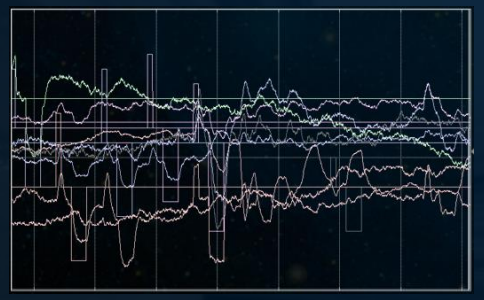


Petrochemical Optimization

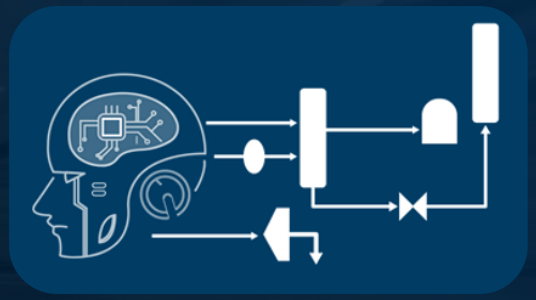
Aspen Plus
Chemical Process



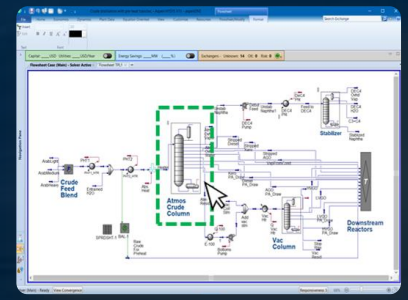
Plant Data
Chemical Process



Hybrid Model
Chemical Process



Aspen HYSYS
Joint Optimization

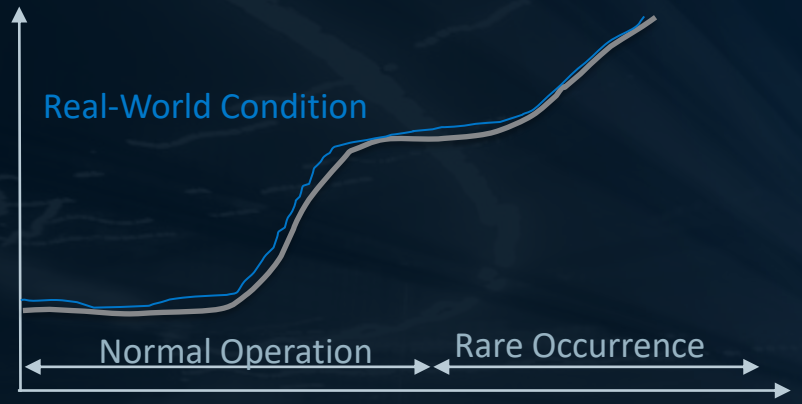


✓ **Hybrid Models better fits real-world data**

✓ **Hybrid Models connect domain specific tools**

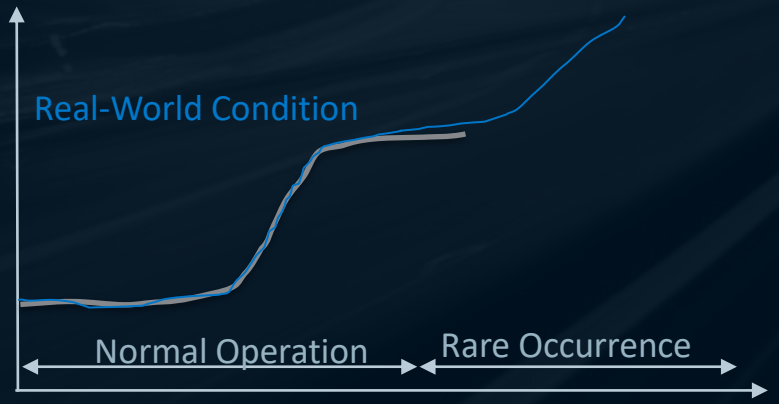
Contextual Adaptation – Hybrid Models

1st Principles Model



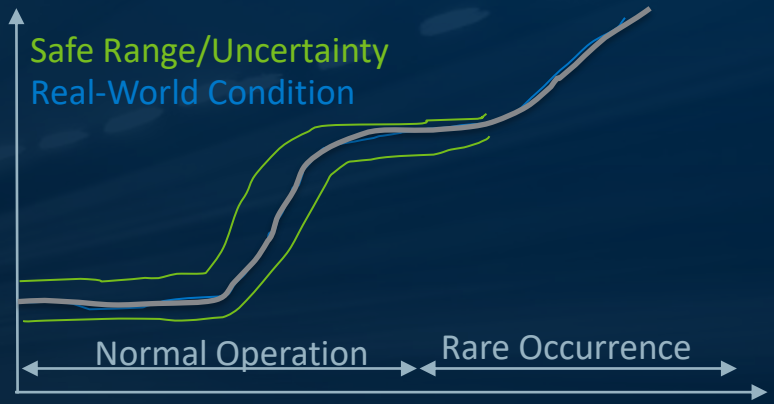
- Model Extrapolation
- Physical Constraints
- Complex to Create
- Doesn't Model Everything
- Computationally Expensive

Data Driven Model



- Represents Measurement
- Continuous Refinement
- High Execution Speed
- No Guarantees/Constraints
- No Extrapolation

Hybrid Model



- Model Extrapolation
- Physical Constraints
- Represents Measurement*
- Continuous Refinement*
- High Execution Speed*

*Where Plant Data is Present

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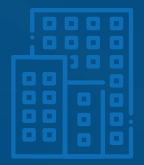
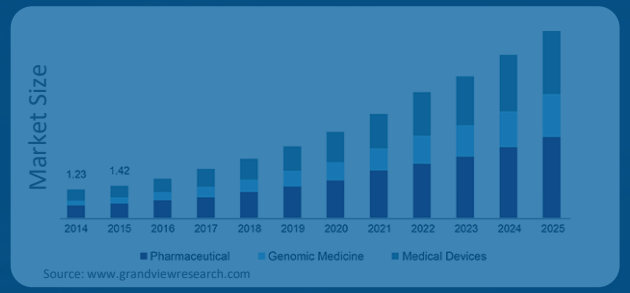
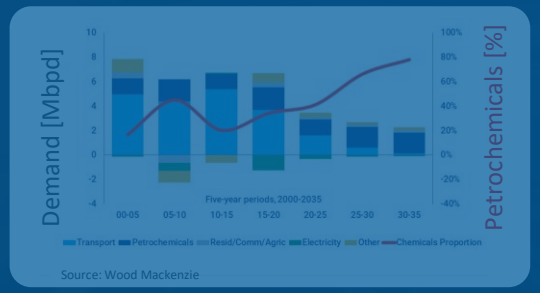
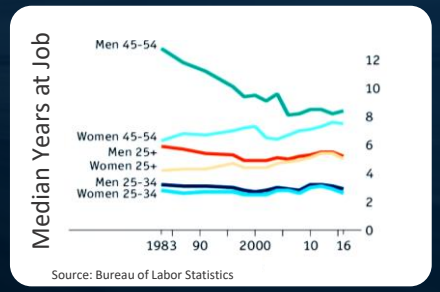
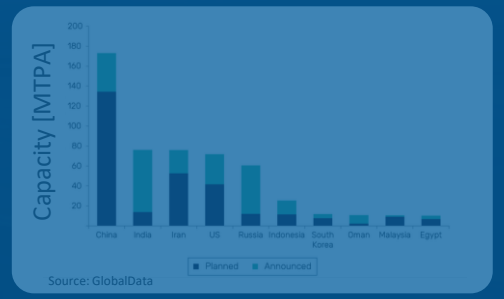
Driver				
Observation	Personalized Medicine Market China 	Global Crude Oil Demand Shift 	Median Job Tenure Trend 	Planned & Announced Petrochemical Capacity Additions by 2030 
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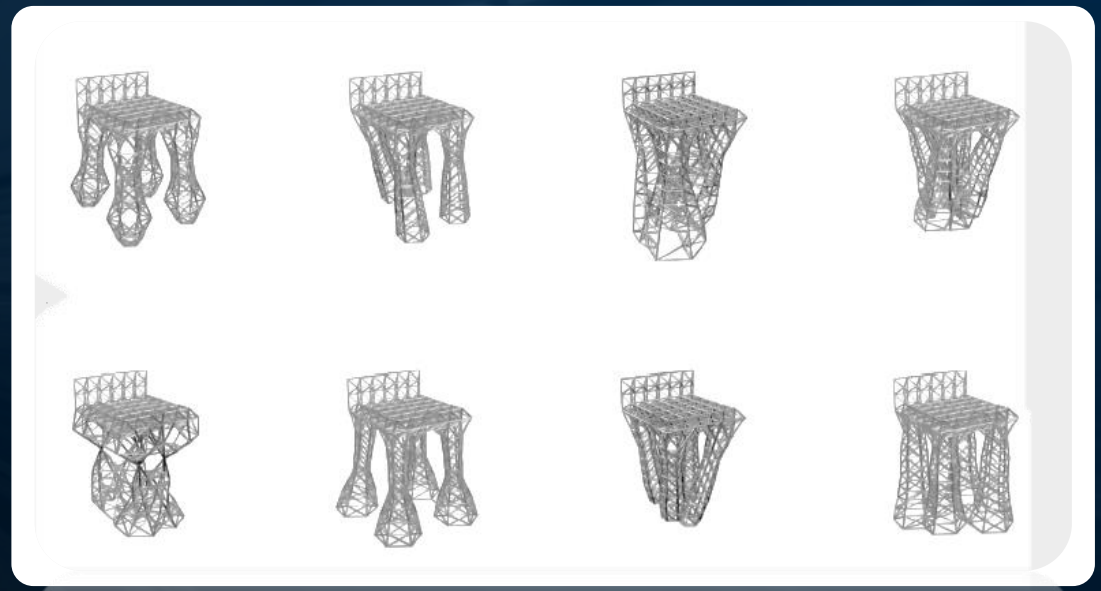
Tool Usability – Additive Manufacturing

Customers need:

Flexible production e.g., short changeover delay, maximum throughput, minimal variance etc.

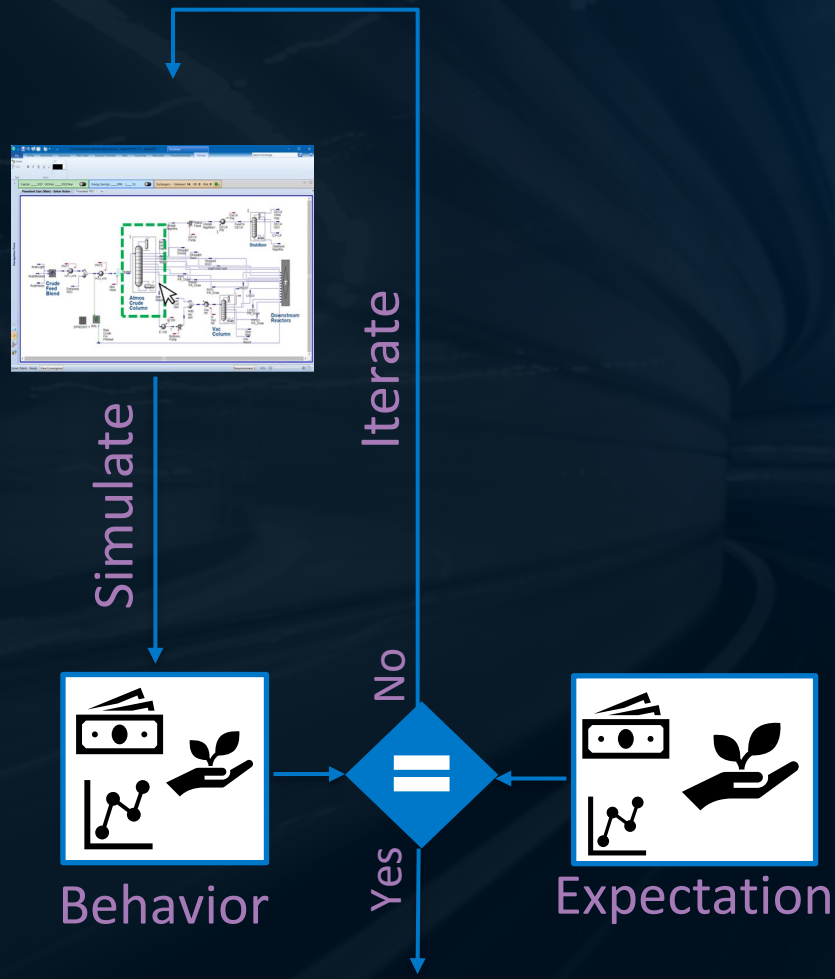
www.autodesk.com



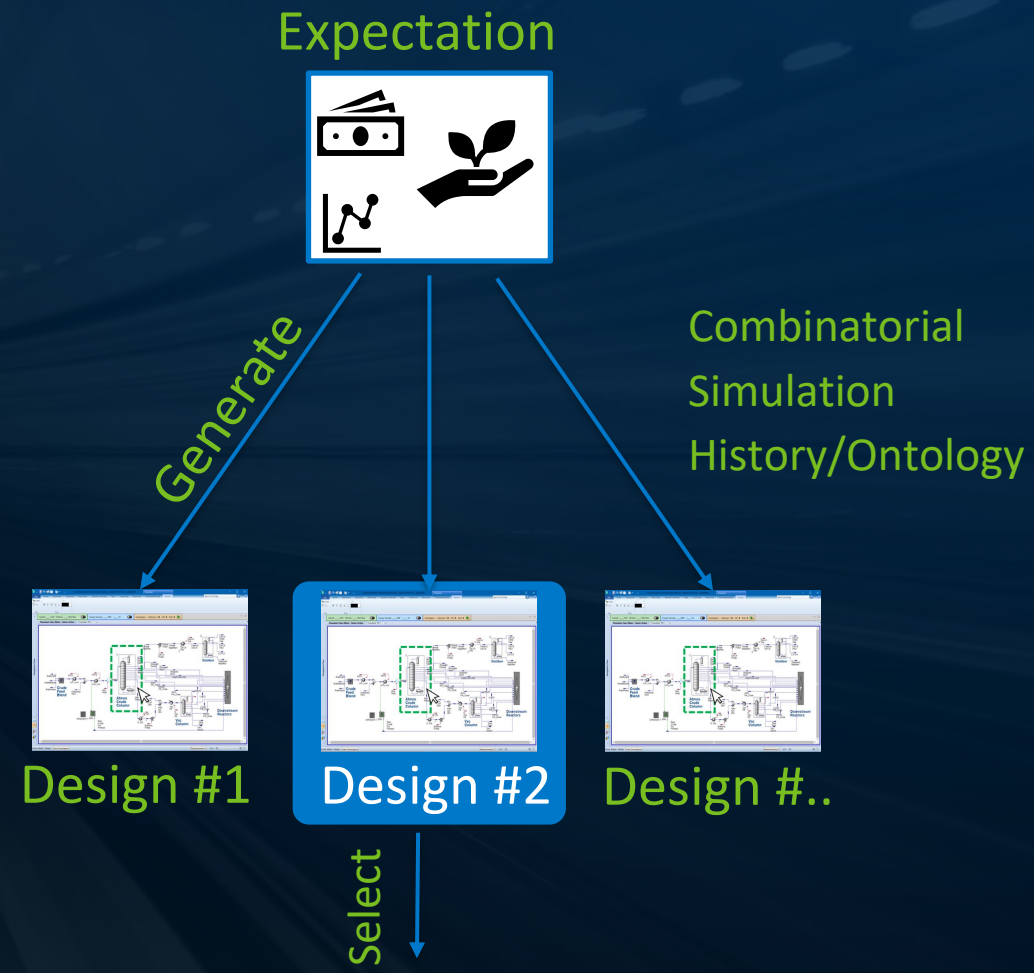
Generative Design defines design process as constraint optimization problem

Comparison of Design Processes

Traditional Design Process



Generative Design Process



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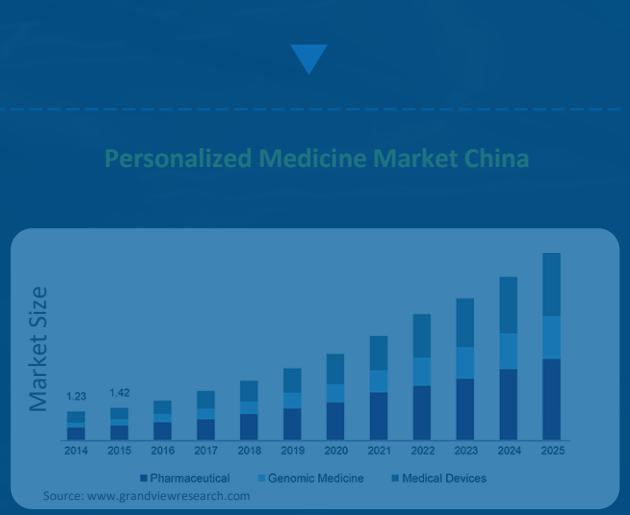
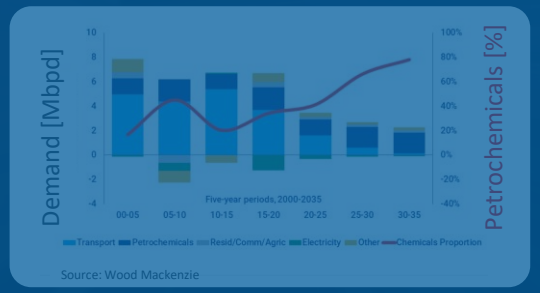
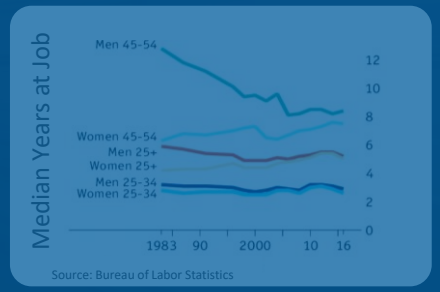
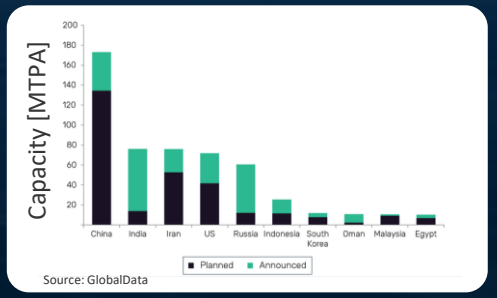


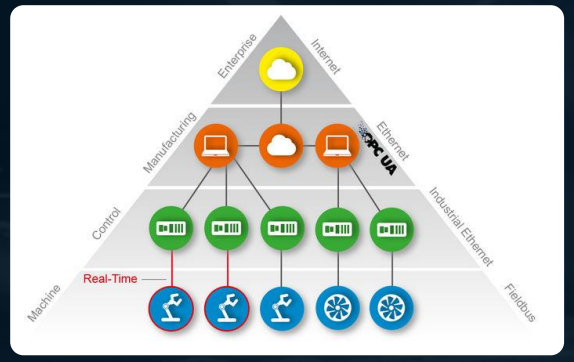


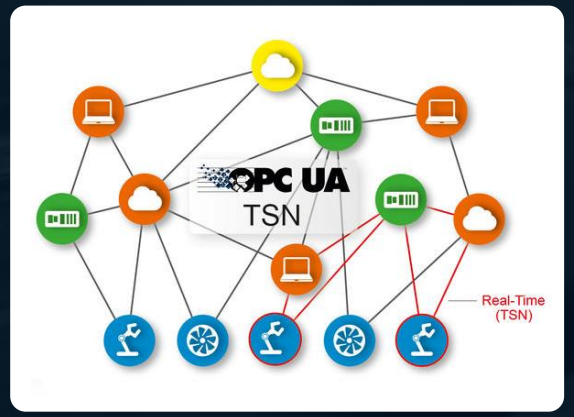




Emerging Markets and Deployment – Trends

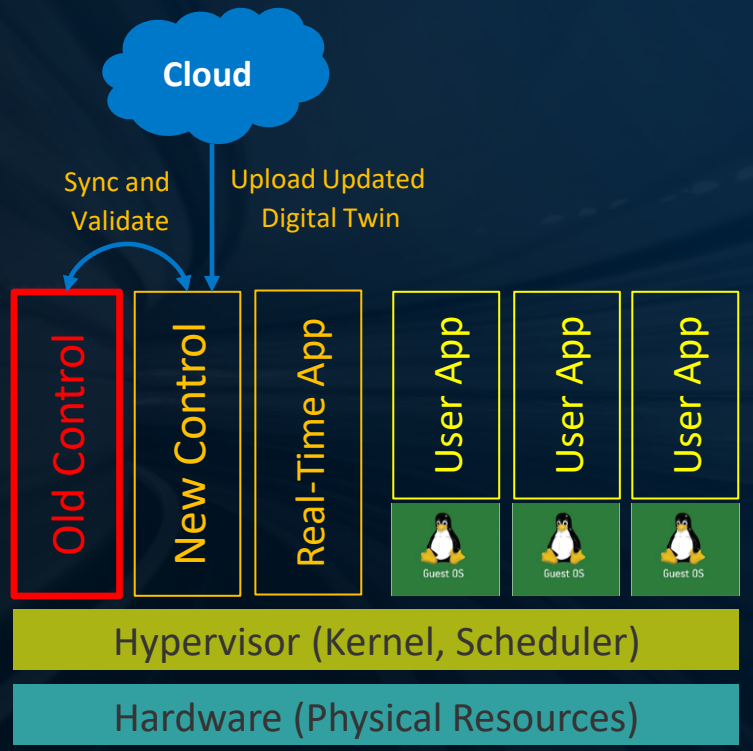
Dissolving of Automation Pyramid



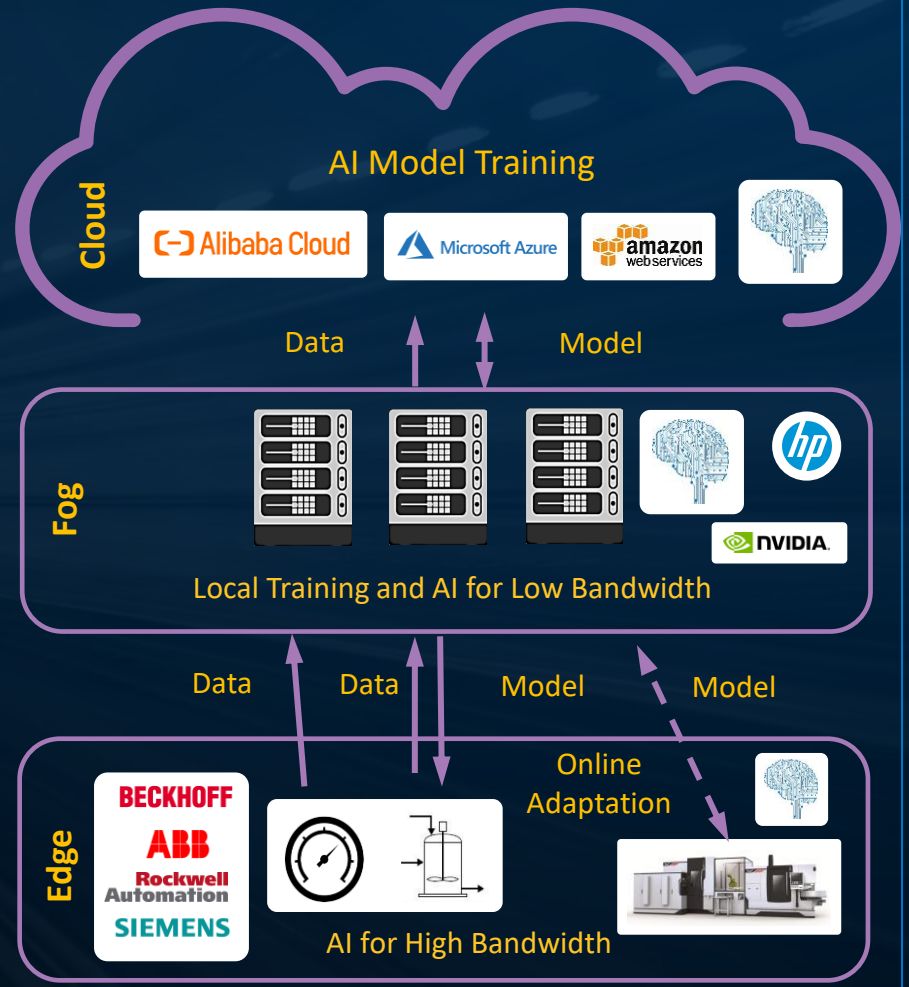


www.industry-of-things.de

Microservice on all Compute Layers



AI on all Compute Layers



Achieving Our Mission

Flexible
Architecture
User Experience

Organizational
Talent

Customer Success

Central to
Mission and Purpose

Industrial AI

Transform the
Industries We
Serve

Thank you for your attention!

Dr. Heiko Claussen
SVP, Artificial Intelligence Technology | Aspen Technology, Inc.
Email: Heiko.Claussen@aspentech.com