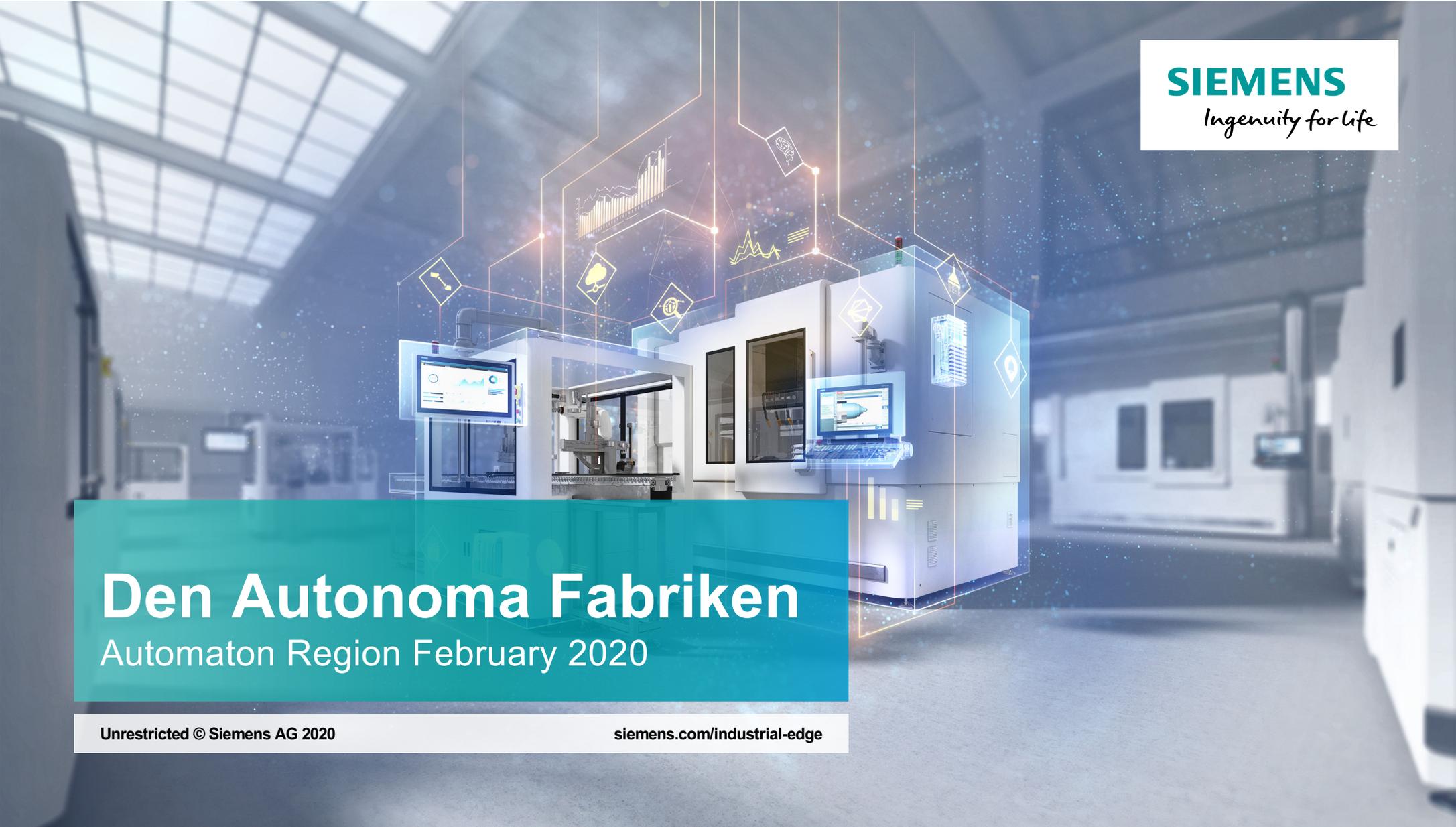




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# Den Autonoma Fabriken

Automaton Region February 2020

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[siemens.com/industrial-edge](https://www.siemens.com/industrial-edge)

# The Autonomous Factory



## Why do we want an Autonomous Factory?

- Maintenance Optimization 
- Increased Production 
- Sustainability 
- Reduced costs 

**I can do it myself!**



# The Autonomous Factory



# Data Enrichment



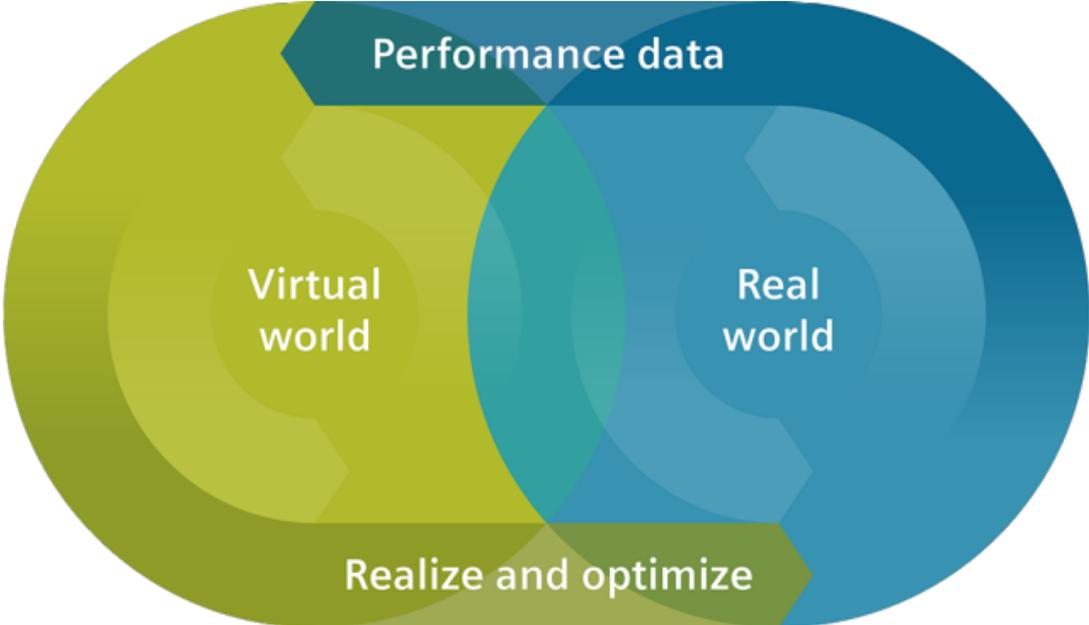
Describe

Diagnose

Predict

Prescribe

# Close the Loop



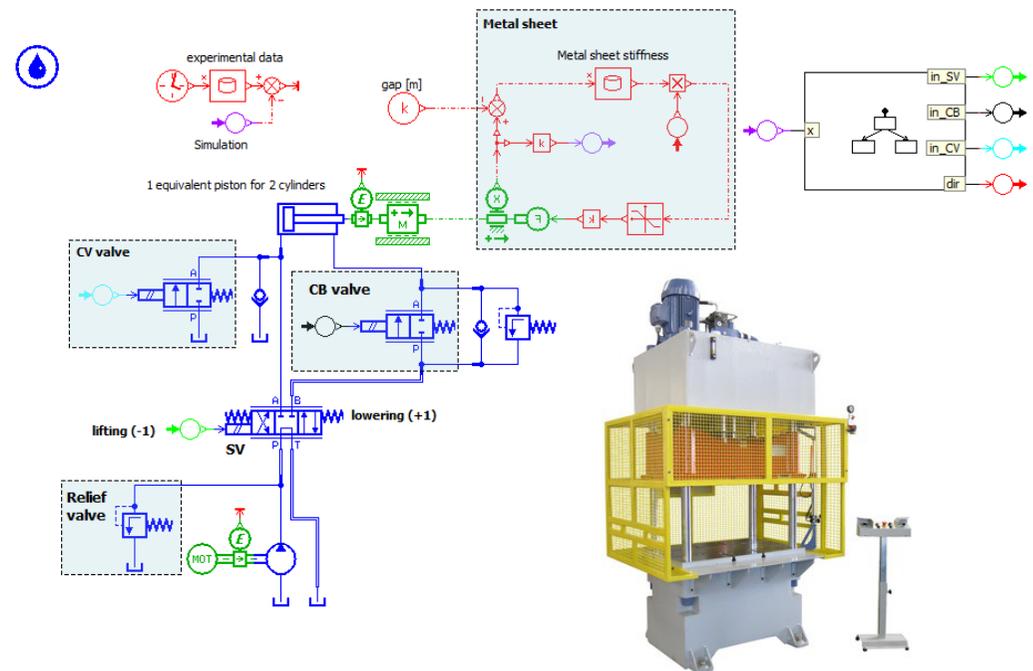
# Use case: Improving the energy consumption of a press-brake

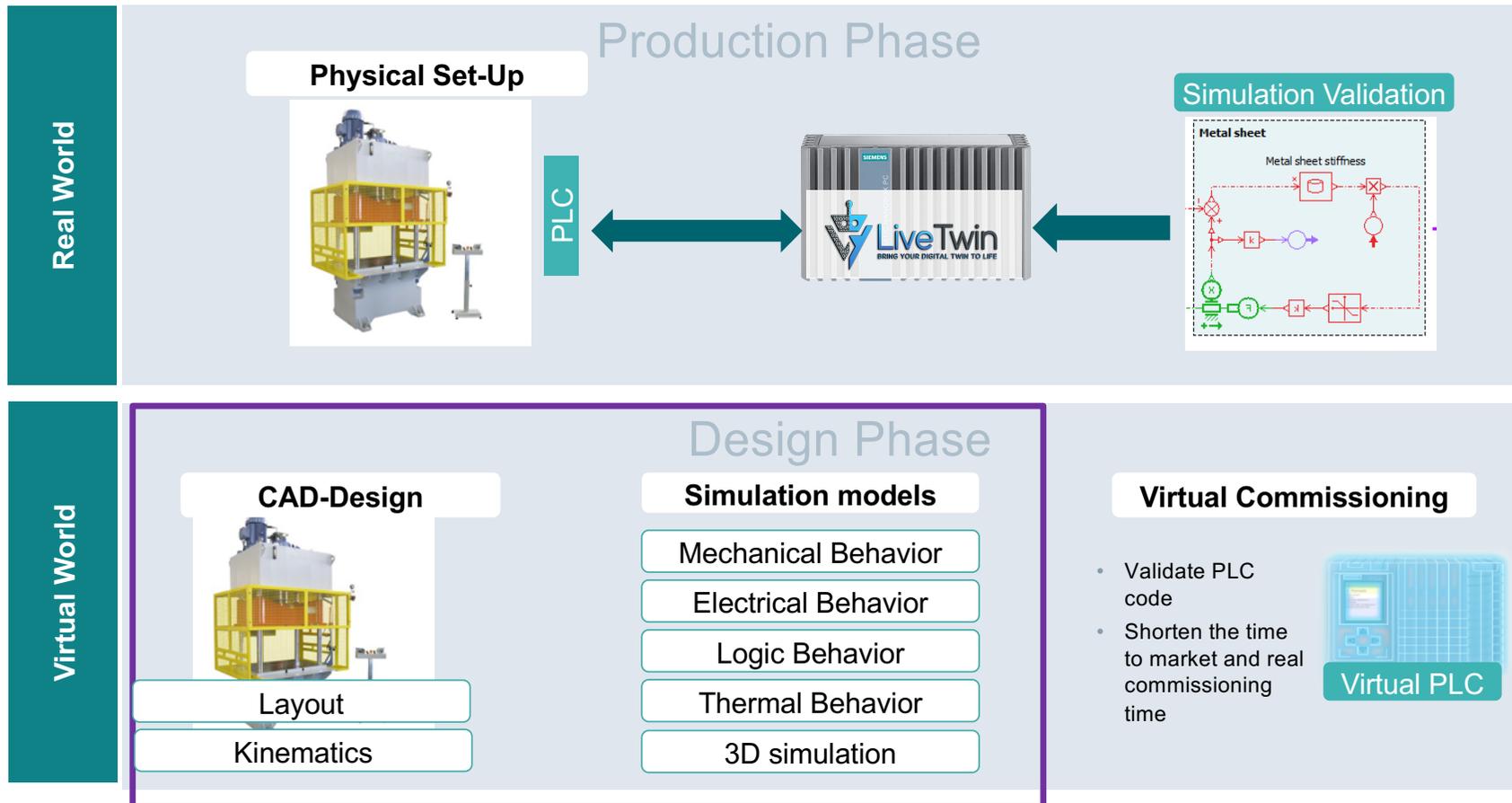
## Objectives

- Optimize its energy efficiency
- Maintain its performance

## Means

- Pinpoint the energetic losses
- Propose modification
- Check the improvement by simulation
- Virtual Commissioning
- Continuous verification and optimization





# Simcenter™ Portfolio for Predictive Engineering Analytics

## Simcenter Amesim

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Model-based system testing

**Industry specific**

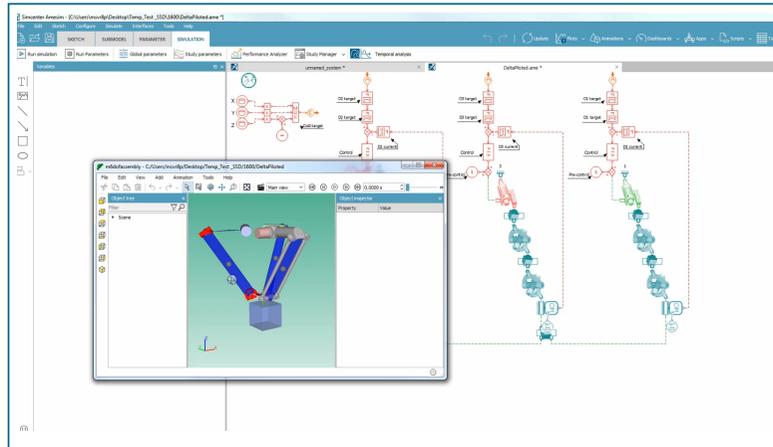
- Thermal systems
- Electrical systems
- Pumps and compressors
- Electrohydraulic valves
- Fluid actuation systems
- Heat exchangers
- Heat pumps / refrigerators

**Pre-design**

**Systems sizing and integration**

**Performance balancing**

**Controls validation**



**Scalable simulation**

**Connecting “mechanical” – “controls”**

**Model reduction for real-time**

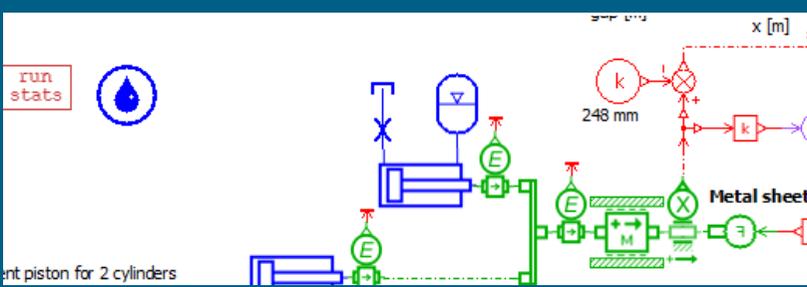


Interface with PLCs

**Open and customizable**

**>48 libraries**

**>6,500 multi-physics models**



**Hydraulics**

**Pneumatics**

**Thermal**

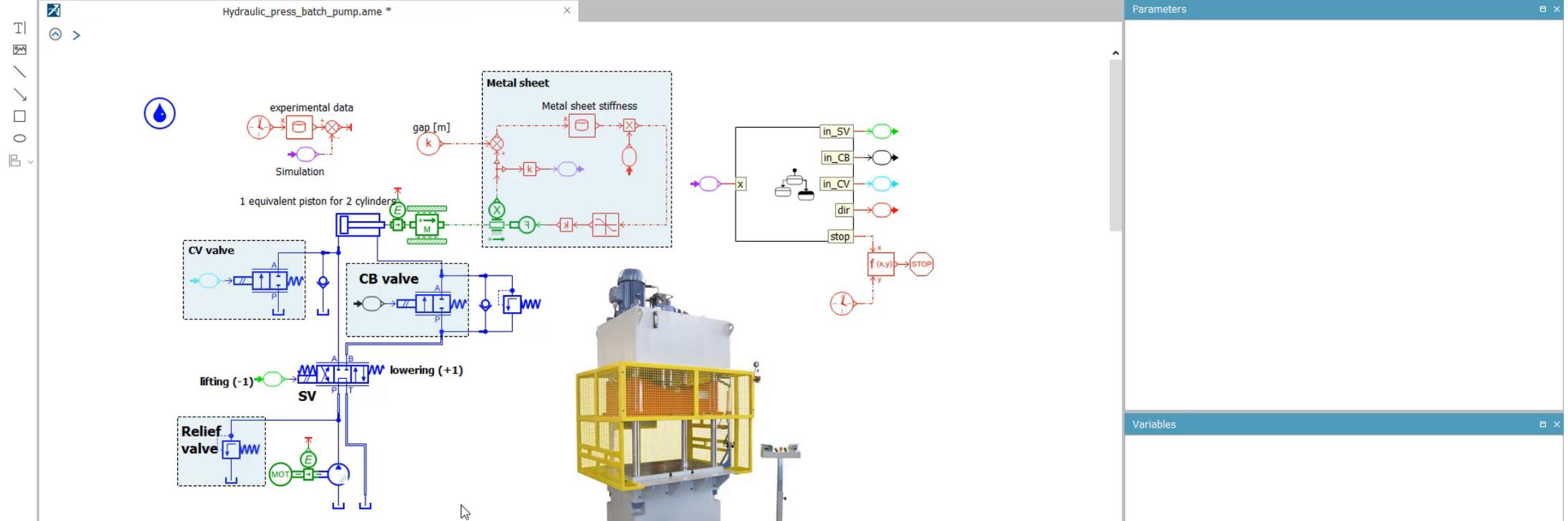
**Electrical**

**Mechanical**

**Signals**

Library	Component	Model Name	Model Type
Hydraulic	Valve	Valve_01	Hydraulic
Hydraulic	Pump	Pump_01	Hydraulic
Hydraulic	Motor	Motor_01	Hydraulic
Hydraulic	Resistor	Resistor_01	Hydraulic
Hydraulic	Capacitor	Capacitor_01	Hydraulic
Hydraulic	Inductor	Inductor_01	Hydraulic
Hydraulic	Diode	Diode_01	Hydraulic
Hydraulic	Transistor	Transistor_01	Hydraulic
Hydraulic	Relay	Relay_01	Hydraulic
Hydraulic	Switch	Switch_01	Hydraulic
Hydraulic	Control	Control_01	Hydraulic
Hydraulic	Signal	Signal_01	Hydraulic
Hydraulic	Logic	Logic_01	Hydraulic
Hydraulic	Timer	Timer_01	Hydraulic
Hydraulic	Counter	Counter_01	Hydraulic
Hydraulic	Comparator	Comparator_01	Hydraulic
Hydraulic	Math	Math_01	Hydraulic
Hydraulic	Function	Function_01	Hydraulic
Hydraulic	Block	Block_01	Hydraulic
Hydraulic	Subsystem	Subsystem_01	Hydraulic
Hydraulic	Model	Model_01	Hydraulic
Hydraulic	Simulation	Simulation_01	Hydraulic
Hydraulic	Analysis	Analysis_01	Hydraulic
Hydraulic	Report	Report_01	Hydraulic
Hydraulic	Help	Help_01	Hydraulic

**System architecture management**



Parameters

---

Variables

# Trade-off analysis

A3	Cycle time	globMax(ame_simulation_time)	ref
A4	Max torque	globMax(torque@pump01)	ref

Variables Watch variables

# Use case: Improving the energy consumption of a press-brake

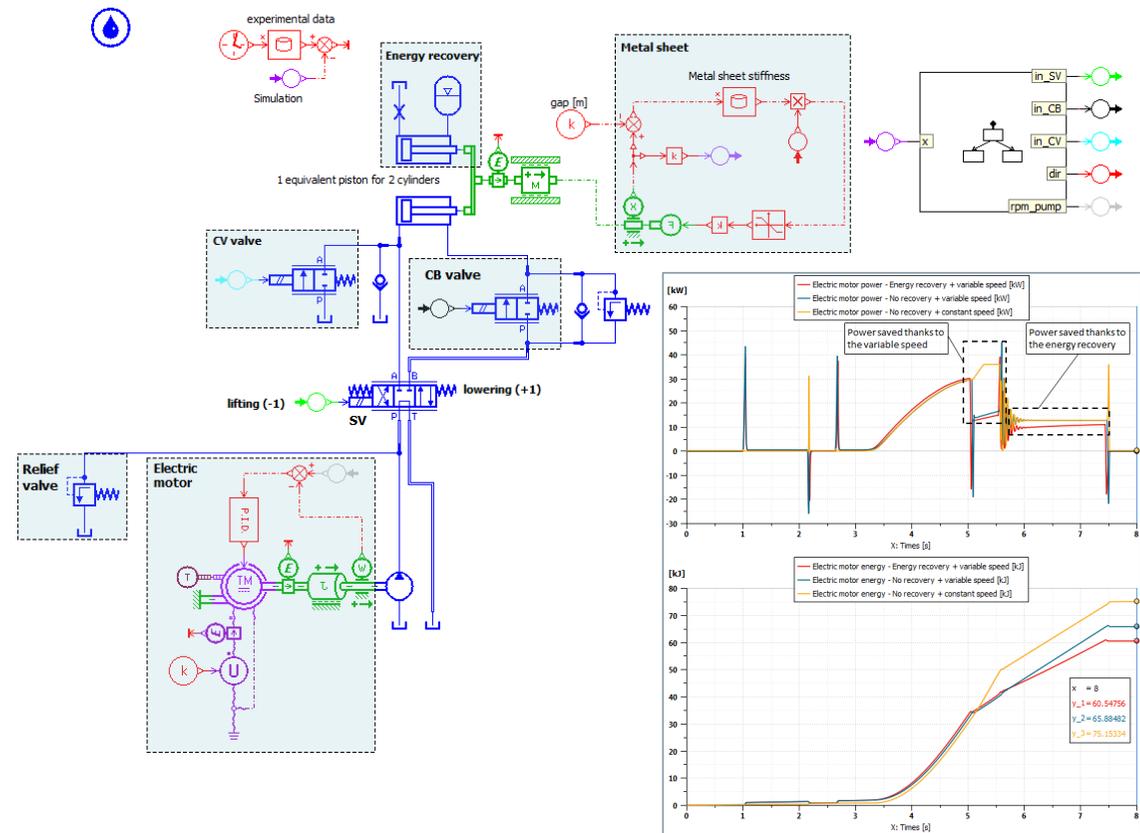
## Results

### Proposed modification

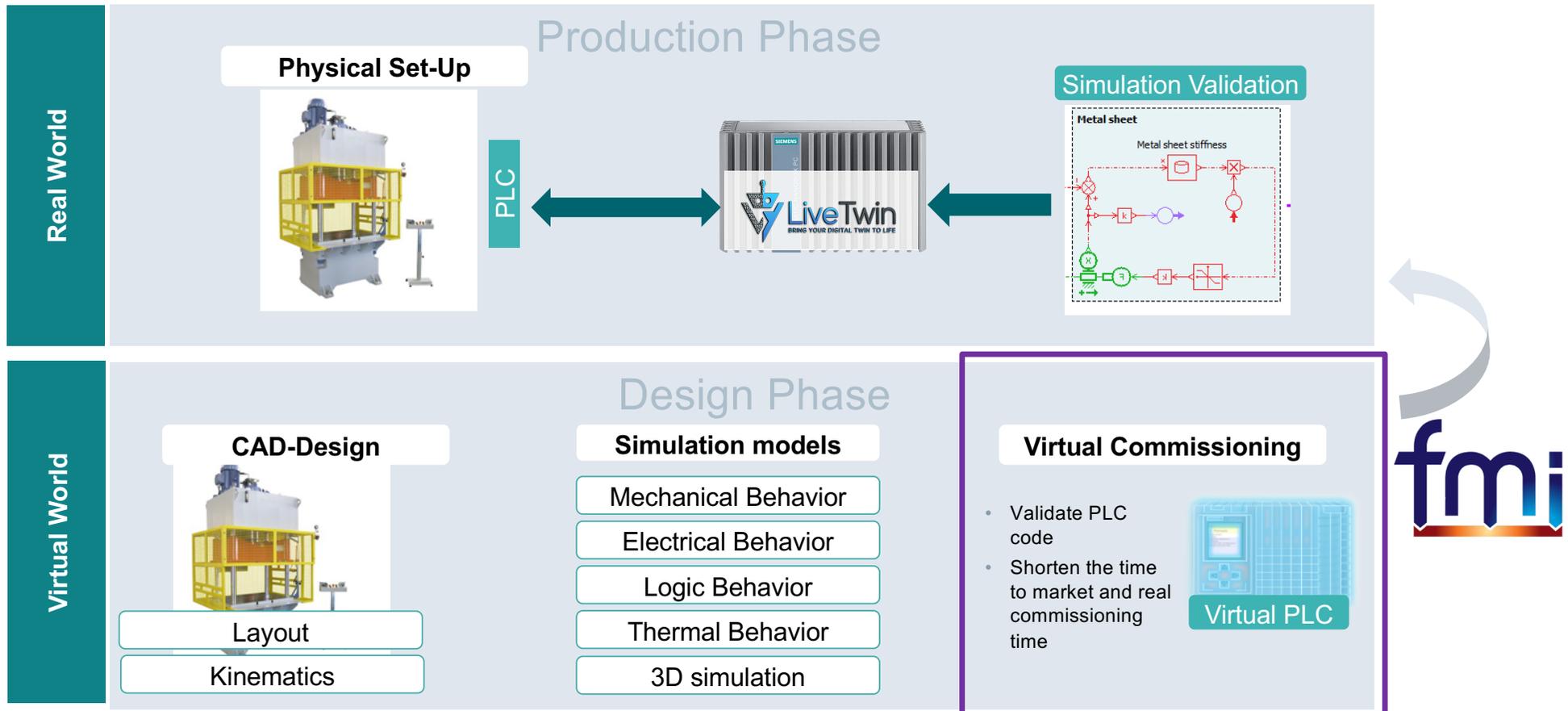
- Reduce the velocity of the pump during the folding phase using an inverter to improved energy consumption
- Add an accumulator to store energy when hydraulic press goes down

### Achievements

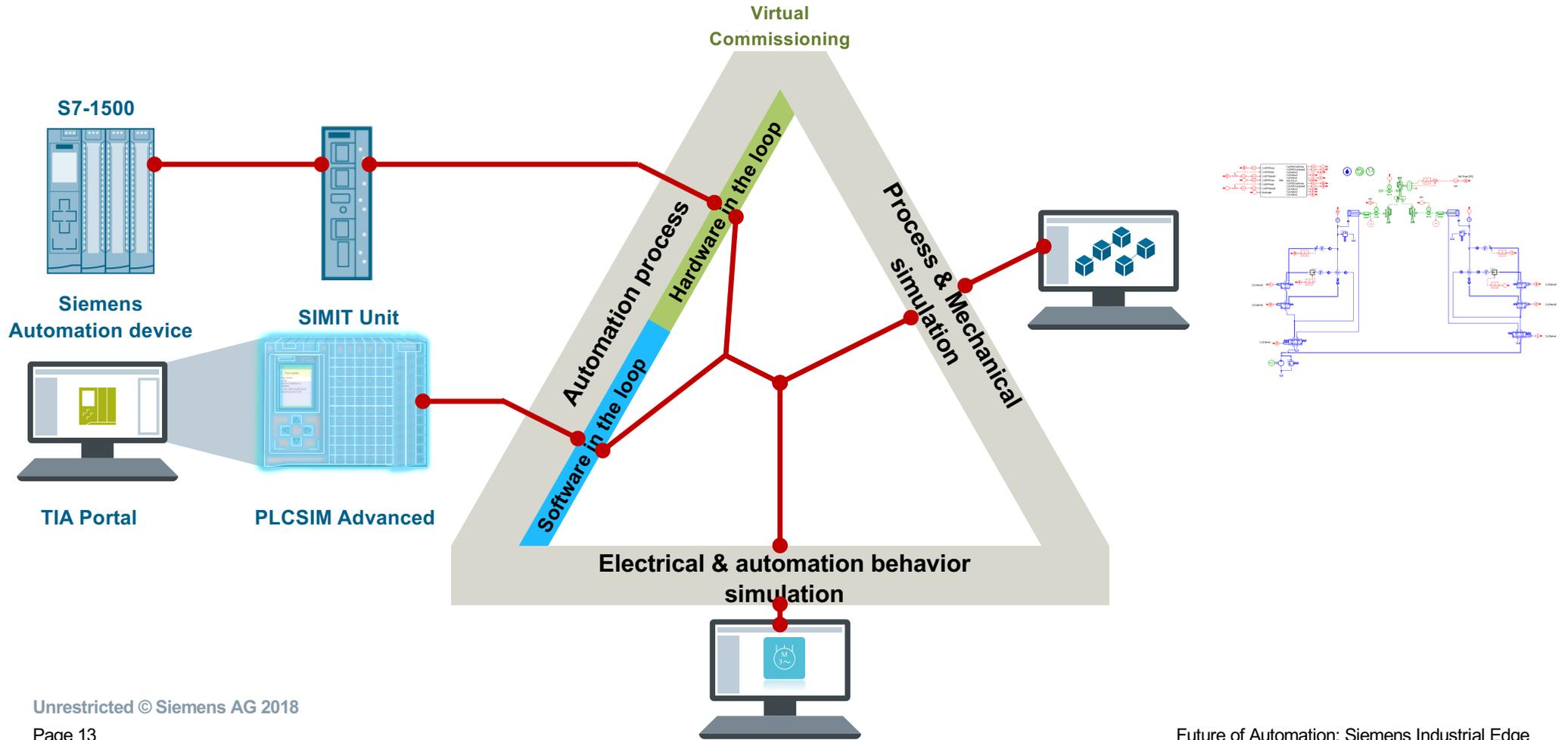
- 12% of energy reduction with variable pump speed
- 19% of energy reduction with variable pump speed and energy recovery



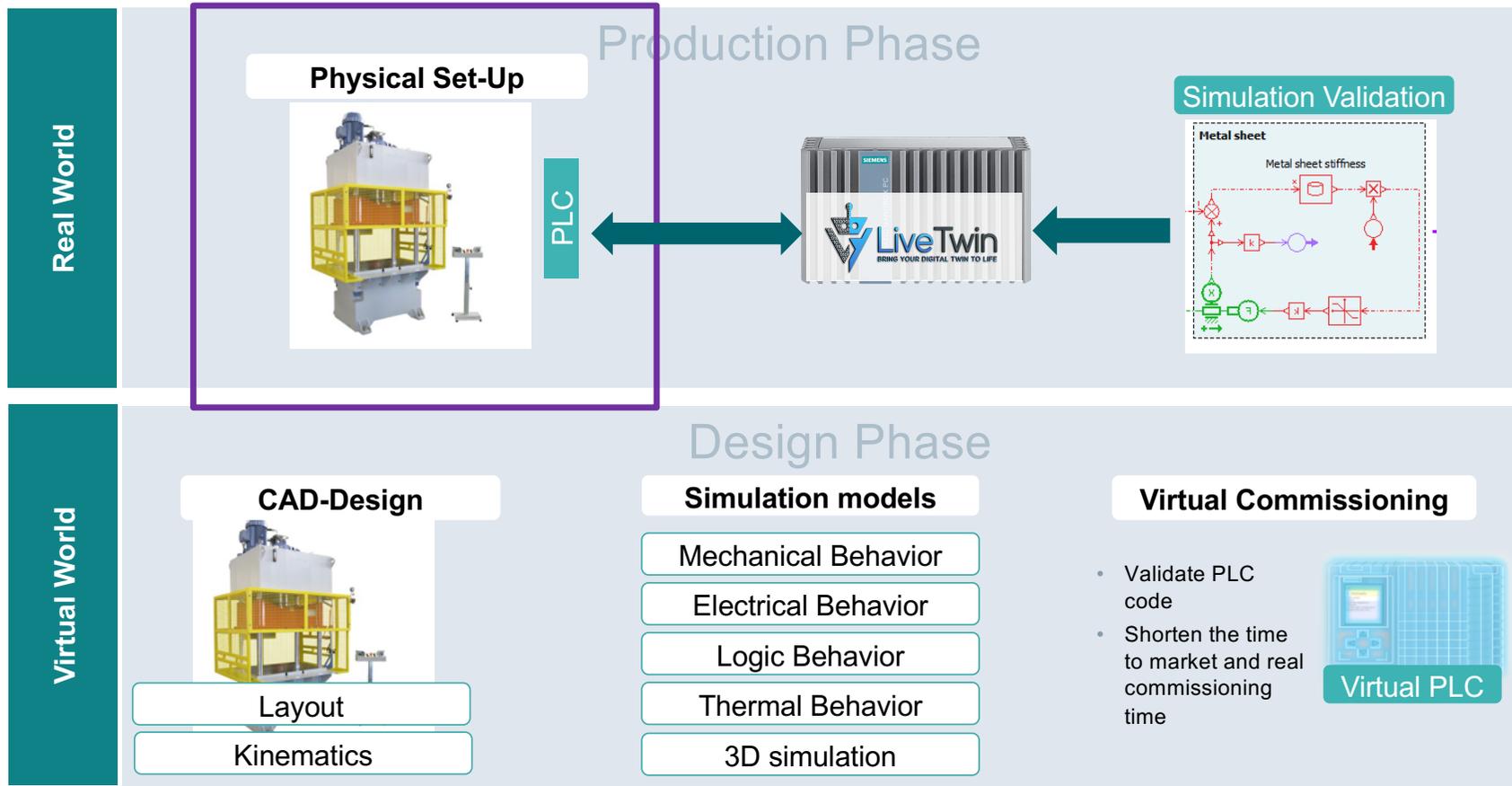
# Process



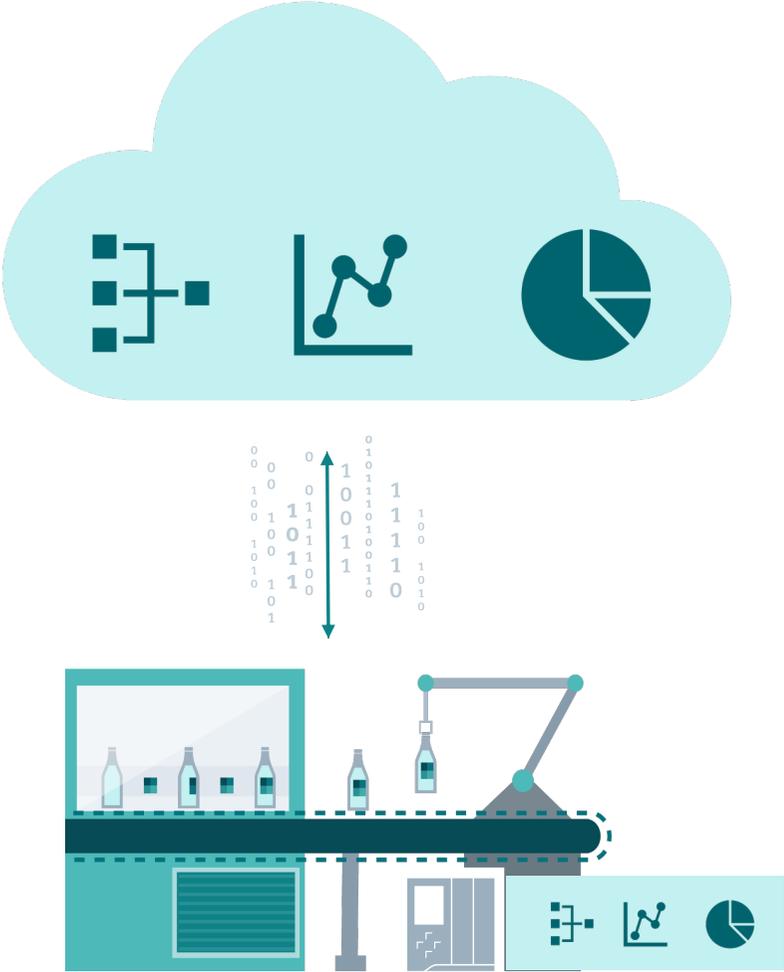
# Virtual Commissioning



# Process



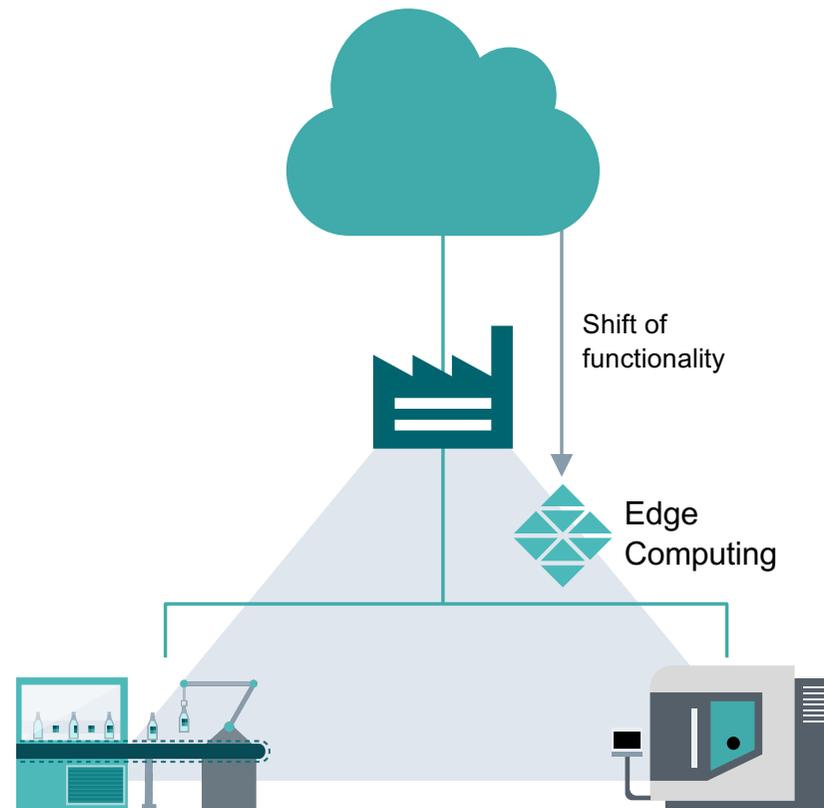
# Industrial Cloud



# Industrial Edge

## Limitations in the cloud...

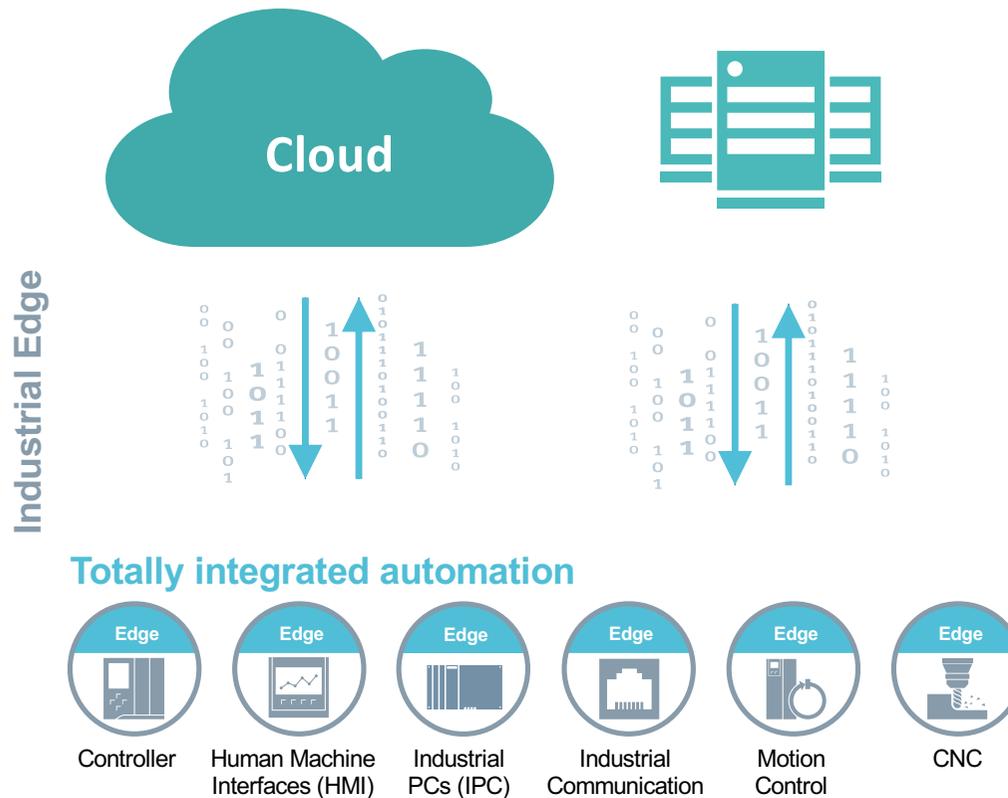
- **Technical**
- **Legal**
- **Economical**



**Operations Level**



**Automation level**

## Edge Management

- Device Management
- Edge App Management
- Edge App Store

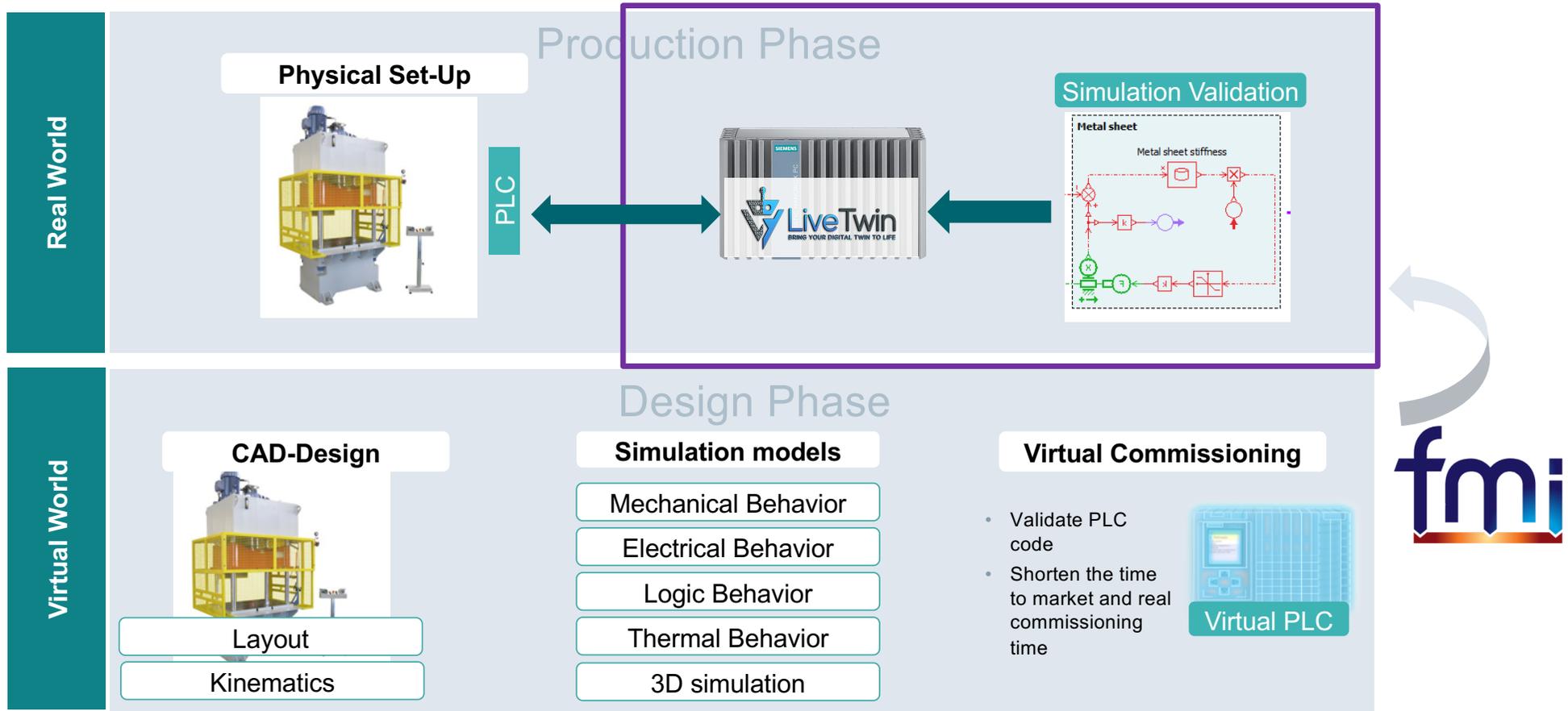
## Edge Apps

- Connectivity & storage integrated
- Visualization apps
- Analytics & computing
- Apps provided by Siemens, Partners and own developed

## Edge Devices

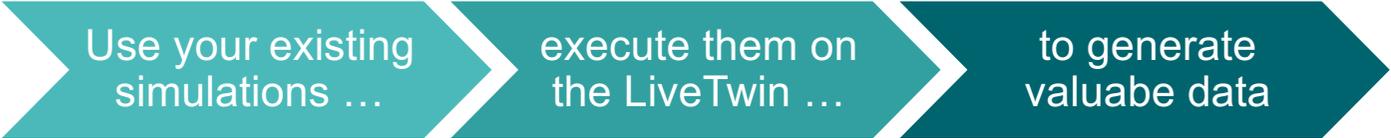
- Edge runtime to execute Apps
- Security and connectivity integrated

# Process



# Simatic LiveTwin Edge App

## Use your existing simulations



Simcenter  
Amesim



MATLAB  
Simulink®



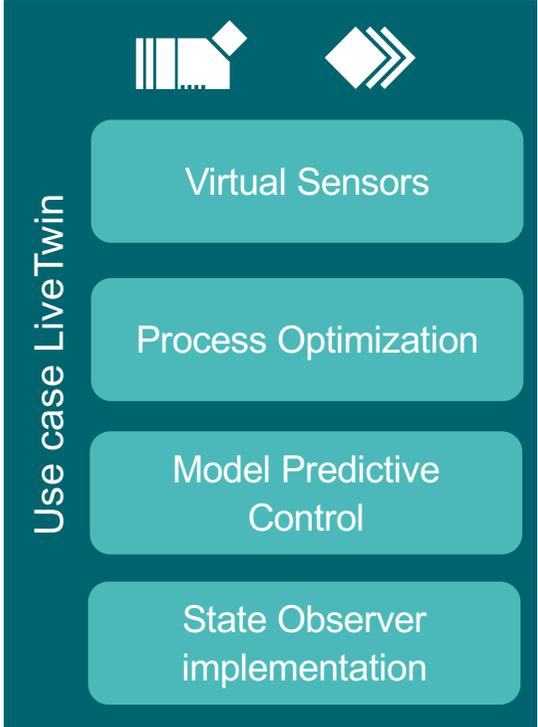
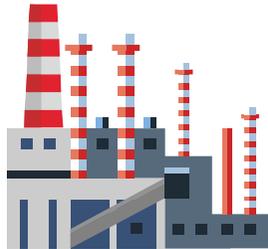
Open  
Modelica



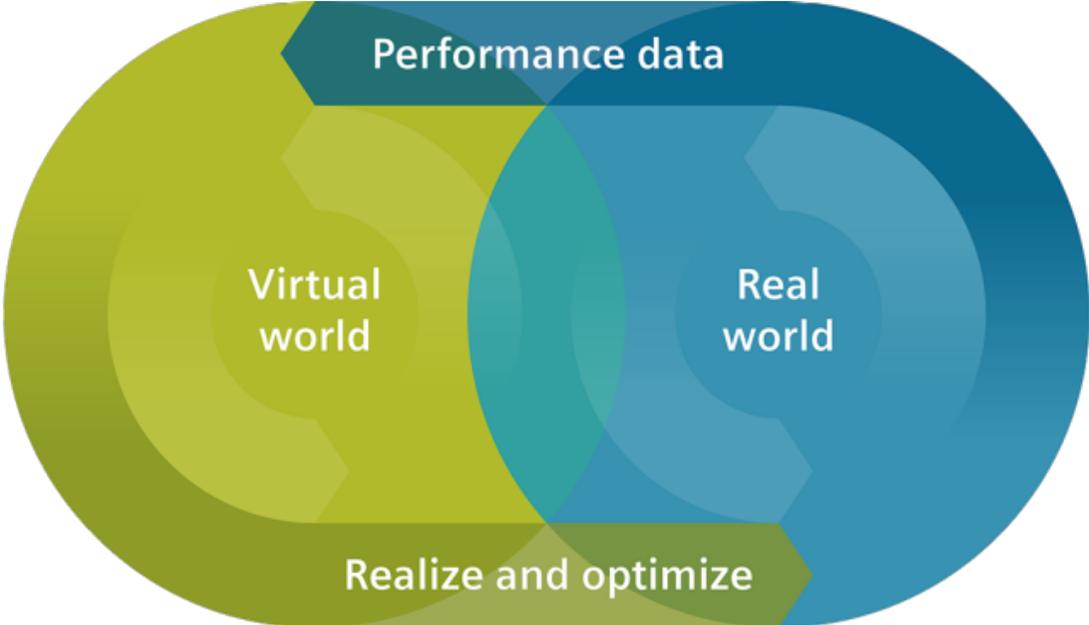
Functional  
Mockup  
Interface



>100  
tools



# Close the Loop



# Reference Project Preview

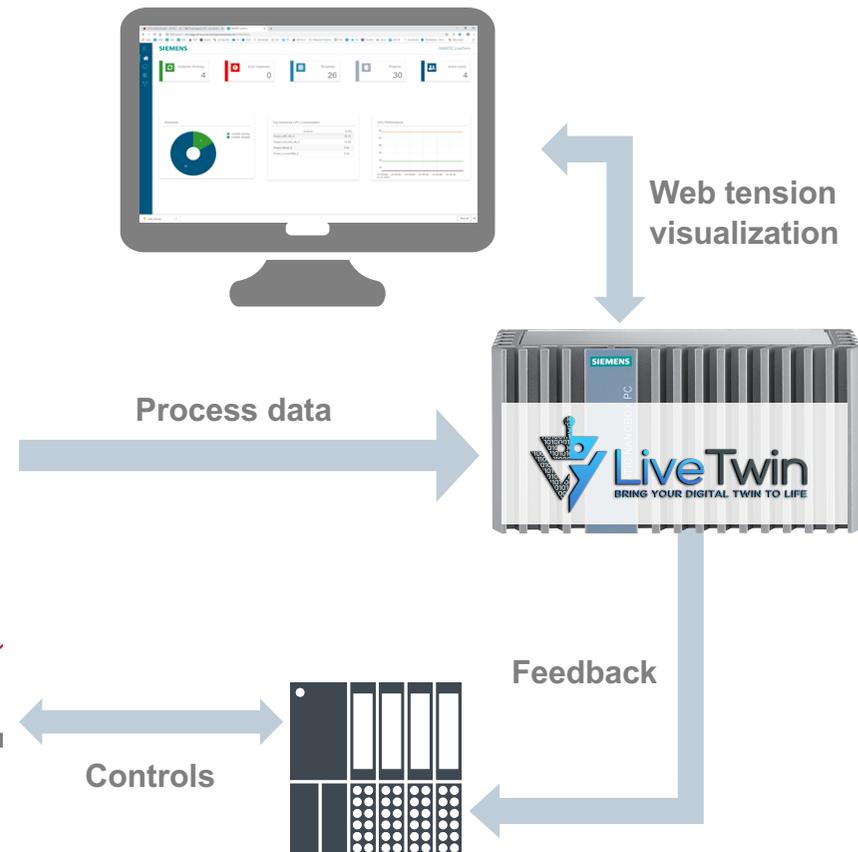
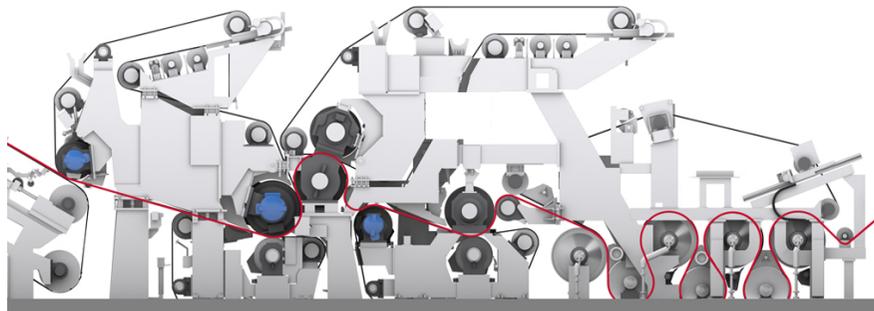
## Paper industry

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### Reduction of downtime with virtual sensors

- Paper breaks halt the production and causes downtime
- Hardware sensors (weight cells) are used to measure the web tension at critical points
- The virtual sensor compliments the tension measurements to optimize the tension control.





Elin Nordmark

Produktchef Digital Enterprise

Siemens Digital Industries

[elin.nordmark@siemens.com](mailto:elin.nordmark@siemens.com)

Henrik Orsan

Portfolio Development Executive

Siemens Digital Industries Software

[henrik.orsan@siemens.com](mailto:henrik.orsan@siemens.com)



# Automation Region

Together in a digital world.