

OCTOBER 26, 2023

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# Development of process digital twin and how AVEVA™ PI System™ helped

AGC Inc.

Kosuke Nakai, Ryosuke Kobayashi

AVEVA

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# Agenda

1. Company Profile
2. Overview of the Presentation
3. AGC Chemicals DX Strategy and AVEVA PI System
4. Concept of Process Digital Twin
5. Process Digital Twin Development
6. How PI System helped Process Digital Twin Development
  - ✓ PI System as Infrastructure
  - ✓ PI System as User Interface
  - ✓ PI System covers the Last Mile
7. Benefits and Further Use
8. Summary

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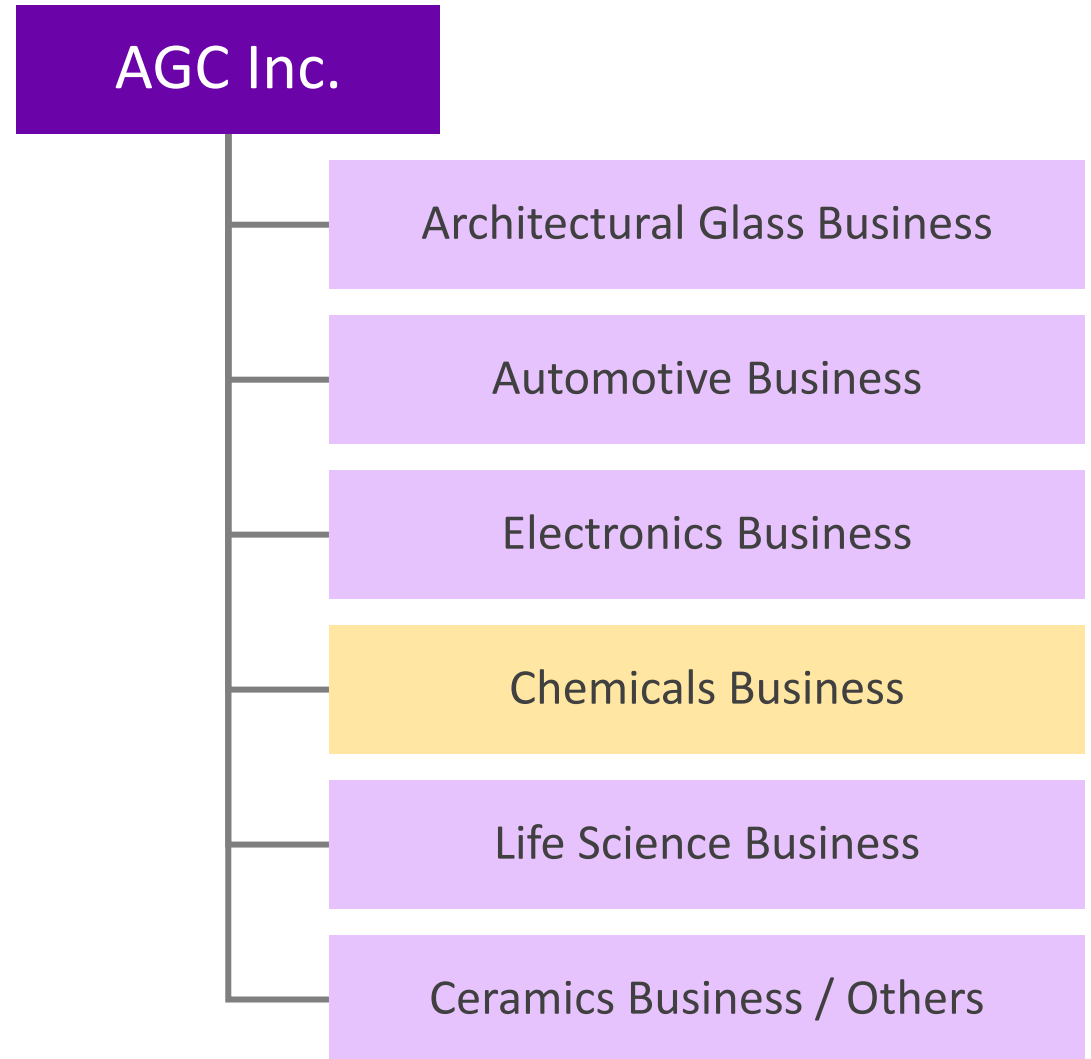
# Company Profile



# AGC Inc.

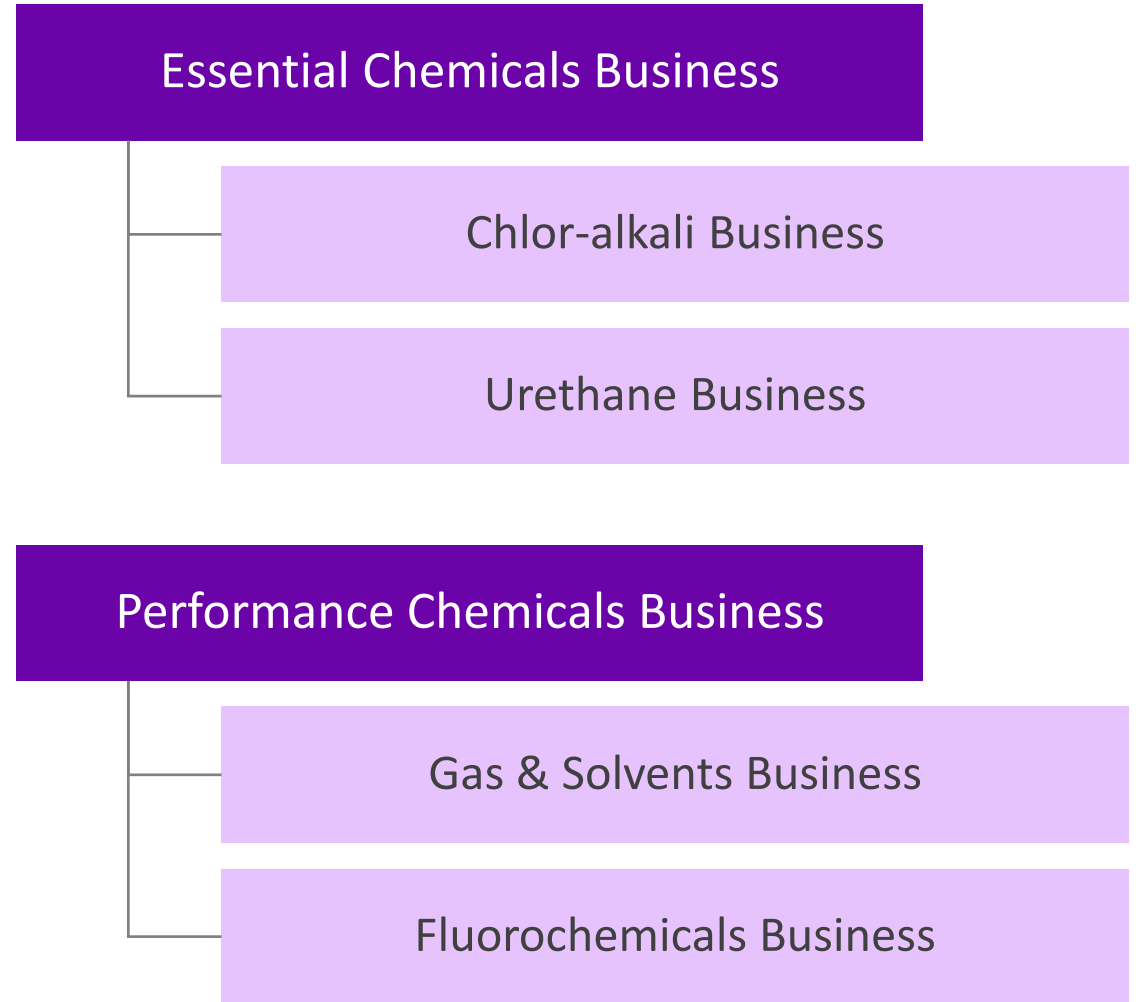
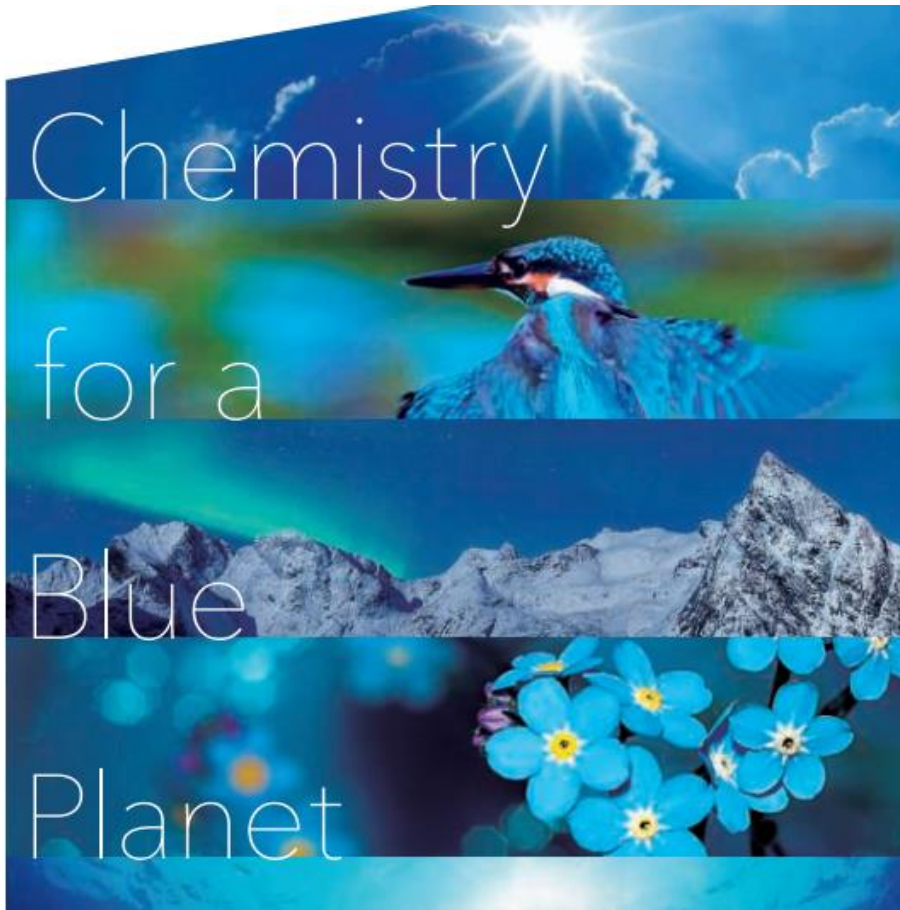
Head Office	Tokyo, Japan
Founded	Sep 8, 1907
President & CEO	Yoshinori Hirai
Capital*	91 billion JPY (~690 million USD)
Consolidated Net Sales*	2,036 billion JPY (~15 billion USD)
Subsidiaries*	201
Employees* (Consolidated Companies)	57,609

\* As of Dec 31, 2022



# AGC Chemicals Company

## Company Vision



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# Overview of the Presentation





# AGC Chemicals combines AVEVA™ PI System™ with process digital twin to optimize operations

## Challenge

- VCM plants are difficult to operate, and production losses due to unplanned shutdowns occur.
- Plant operations have multiple trade-offs and are difficult to optimize manually.

## Solution

- The digital twin, which combines first-principles models with statistical models, is developed to provide unprecedented process monitoring and operational optimization.

## Results

- **The status of the process, which could not be monitored before, has been visualized, allowing the staff to understand the situation accurately and make decisions based on the data.**
- **As a preliminary study for adding the optimization module to our digital twin, it is confirmed that fuel gas efficiency is improved by 6%, resulting in energy cost savings of approximately \$400,000 per year.**



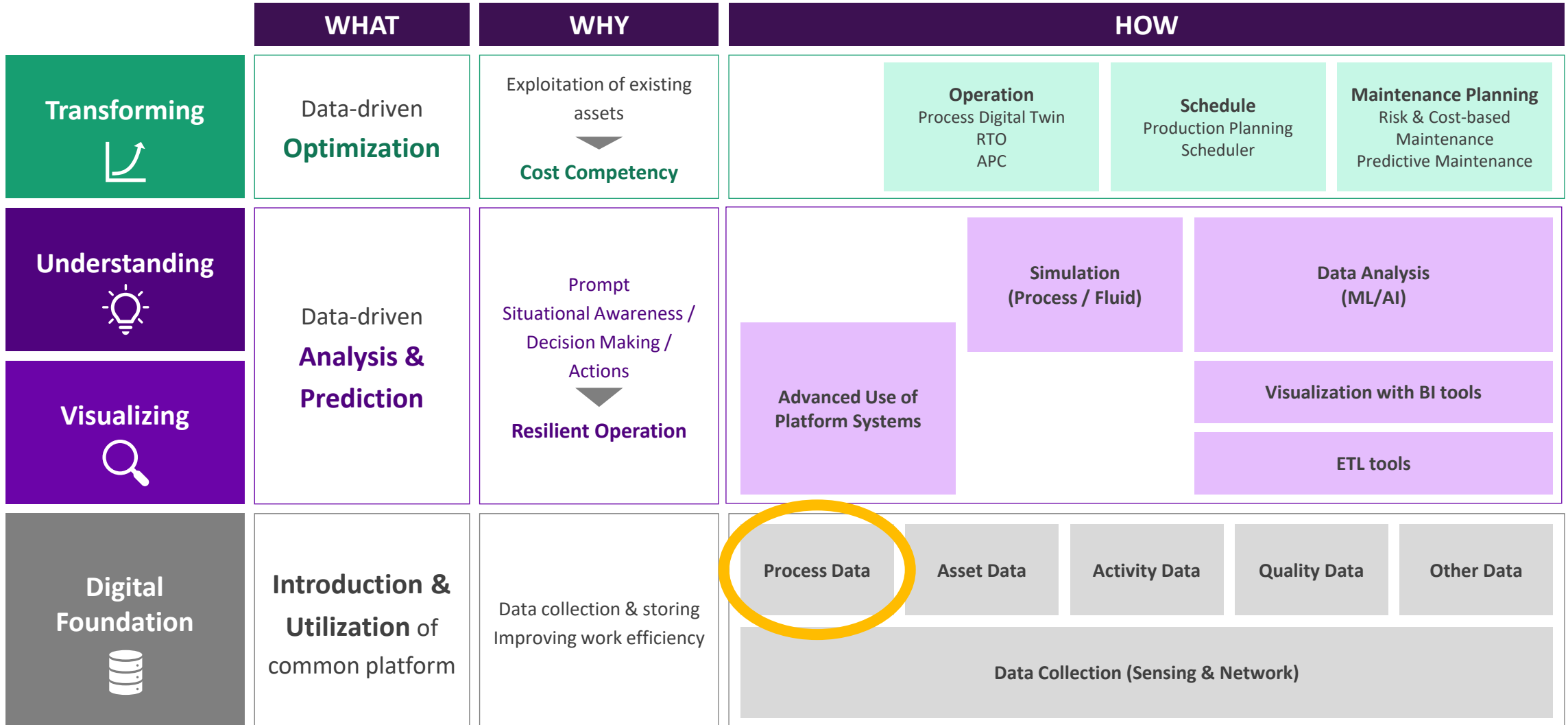
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# AGC Chemicals DX Strategy and AVEVA PI System





# AGC Chemical's Smart Plant Framework





**Enterprise Program Agreement was signed in 2021**

# Why is Enterprise Program needed?

## Selected as a Global standard PIMS

- ✓ AVEVA PI System was selected as the standard PIMS for AGC Chemicals on a global basis.
- ✓ In addition, "Integrated PIMS" was developed to consolidate operational data from all sites on the headquarter cloud environment.

## Expanding the scope of data collection

- ✓ Expand the scope of data collection in the existing data sources such as DCS (ON/OFF signals, controller modes, etc.)
- ✓ Start collecting data from new data sources such as IoT sensing (vibration, analog meter readings, etc.)

**Need to increase the number of Tags**



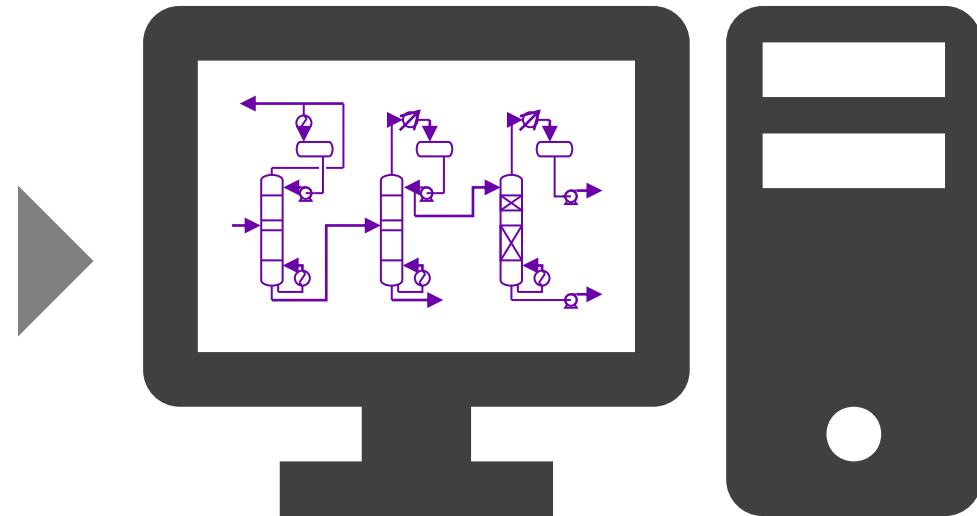
**AVEVA PI System is also key enabler  
for process digital twin development**

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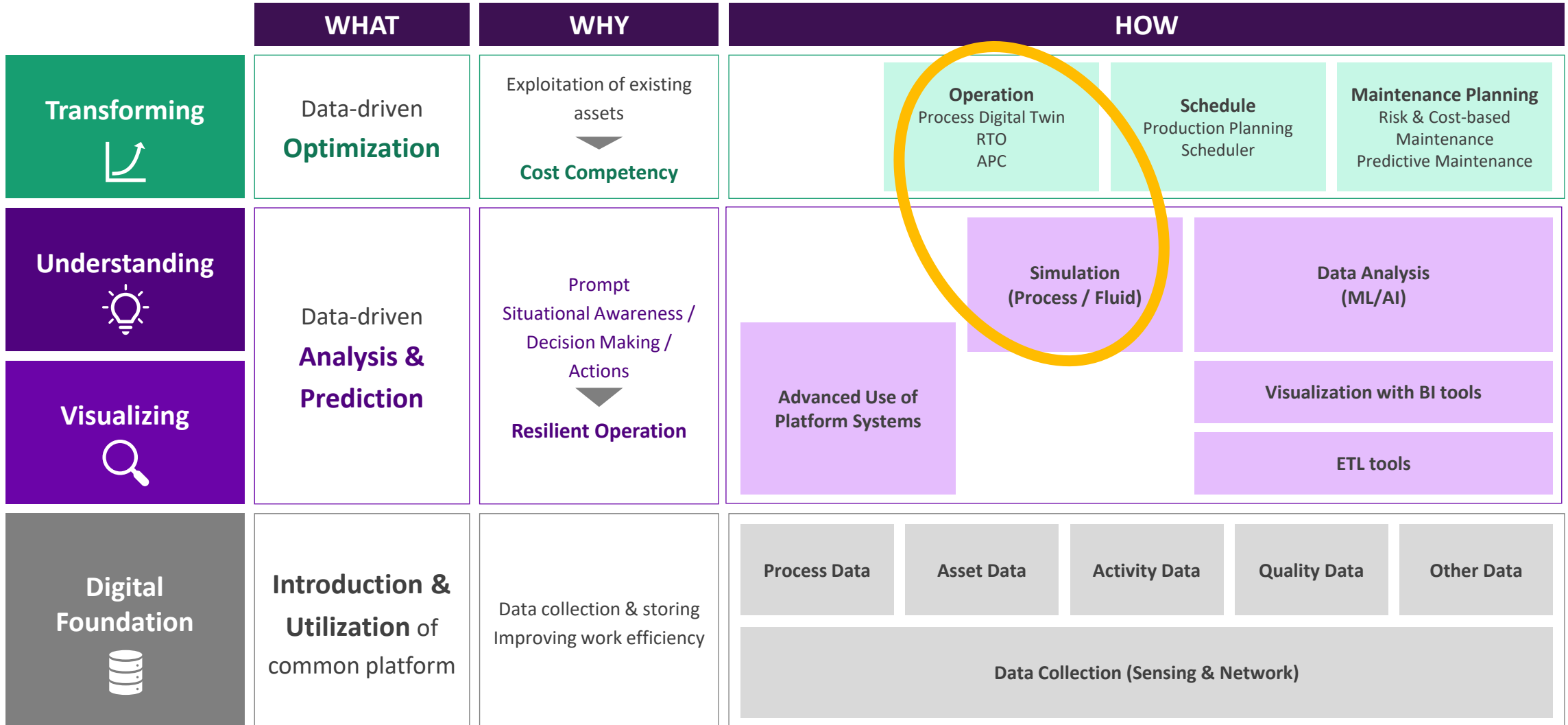
# Concept of Process Digital Twin

# What is “digital twin”?

- A **digital twin** is a digital representation of a physical object that is built with the data obtained from the real world
- In particular, the one reproducing the behavior of process plants is called **Process Digital Twin** in AGC



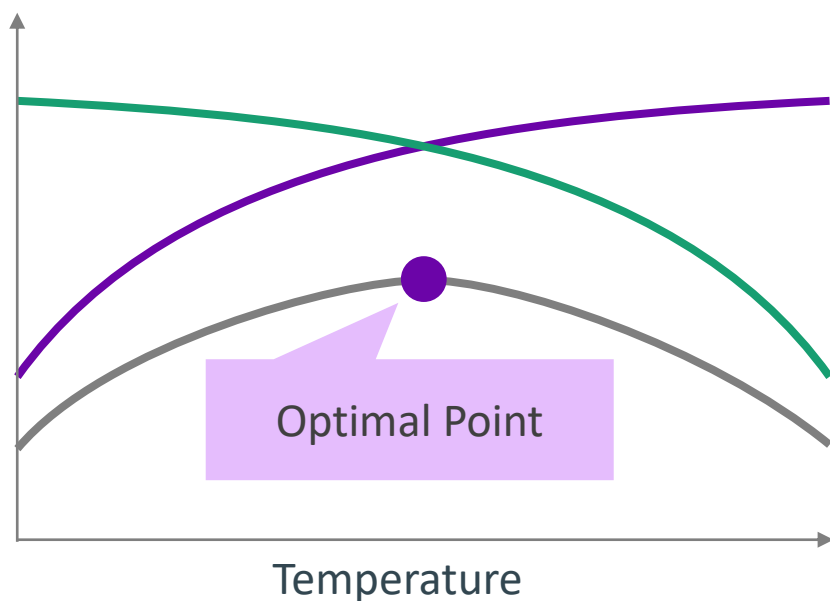
# AGC Chemical's Smart Plant Framework





# What is operational optimization?

## Temperature & Reaction



—: Conversion rate

What percentage of the raw material reacts?

—: Selectivity

What percentage of the product is the desired product?

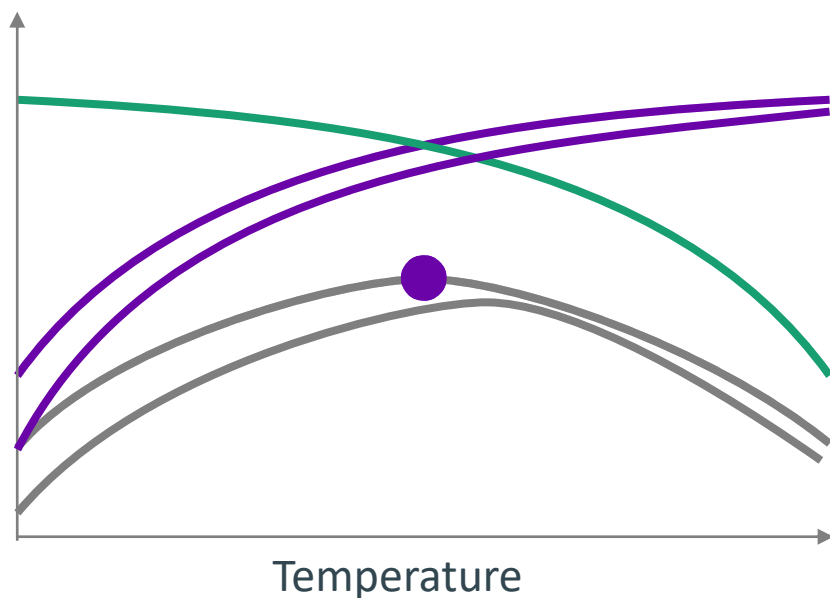
—: Yield

What percentage of the raw material will be the desired product?

Conversion rate X Selectivity

# What is operational optimization?

## Temperature & Reaction



—: Conversion rate

What percentage of the raw material reacts?

—: Selectivity

What percentage of the product is the desired product?

—: Yield

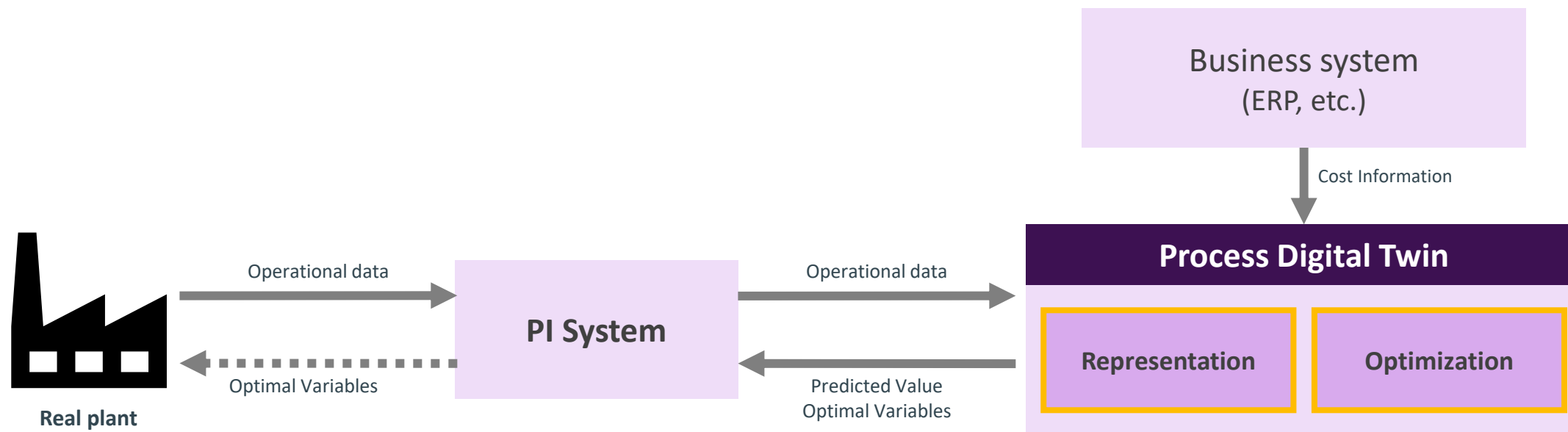
What percentage of the raw material will be the desired product?

Conversion rate X Selection rate

Real plants are not so simple!

Then, how to **optimize**?

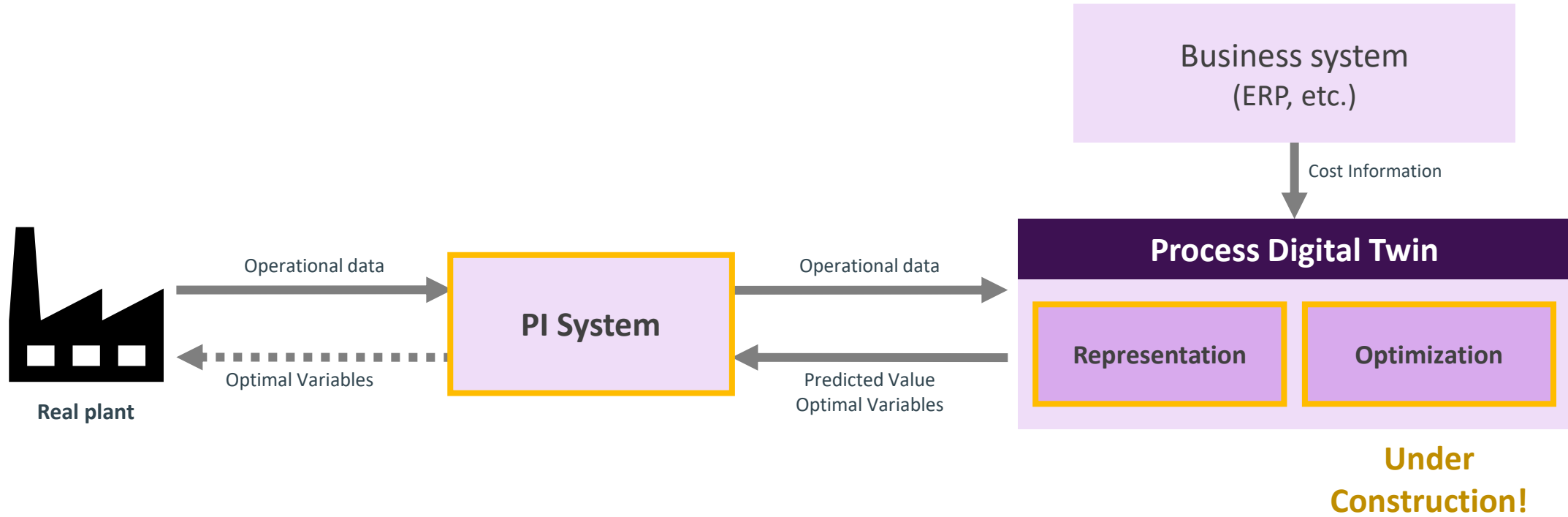
# Process Digital Twin



## Real-Time Optimization(RTO)!

One of the goal of DX (Digital Transformation)  
for the continuous process plant

# Today's presentation focus

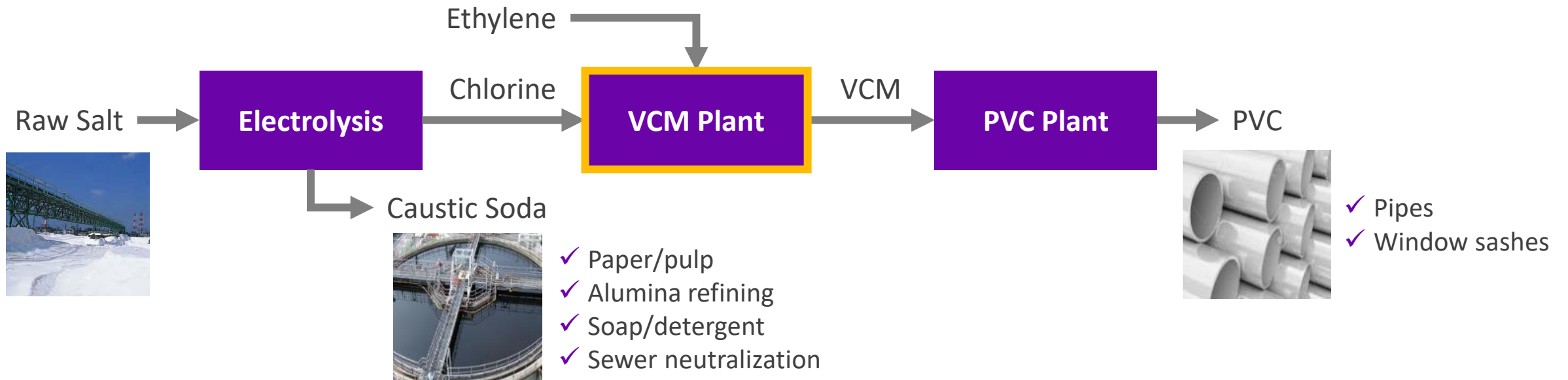


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# Process Digital Twin Development

# Chlor-Alkali Business

- Caustic soda and chlorine are produced from electrolysis of salt.
- Caustic soda is used in a wide range of application as a typical alkaline product for industrial use.
- Chlorine is processed with ethylene to produce vinyl chloride monomer (VCM) and VCM is processed into a polyvinyl chloride (PVC).





# Target Process

- P.T. Asahimas Chemical
  - VCM Plant
    - Direct Chlorination Unit: Produce Ethylene Dichloride(EDC)
    - Oxychlorination Unit: Produce EDC
    - EDC Purification Unit
    - **EDC Cracking Unit: Produce VCM**
    - **VCM Purification Unit**

} **Target Process**

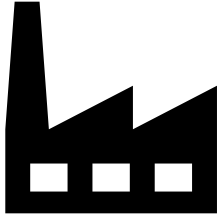
VCM is produced by EDC vapor at Cracking Furnace



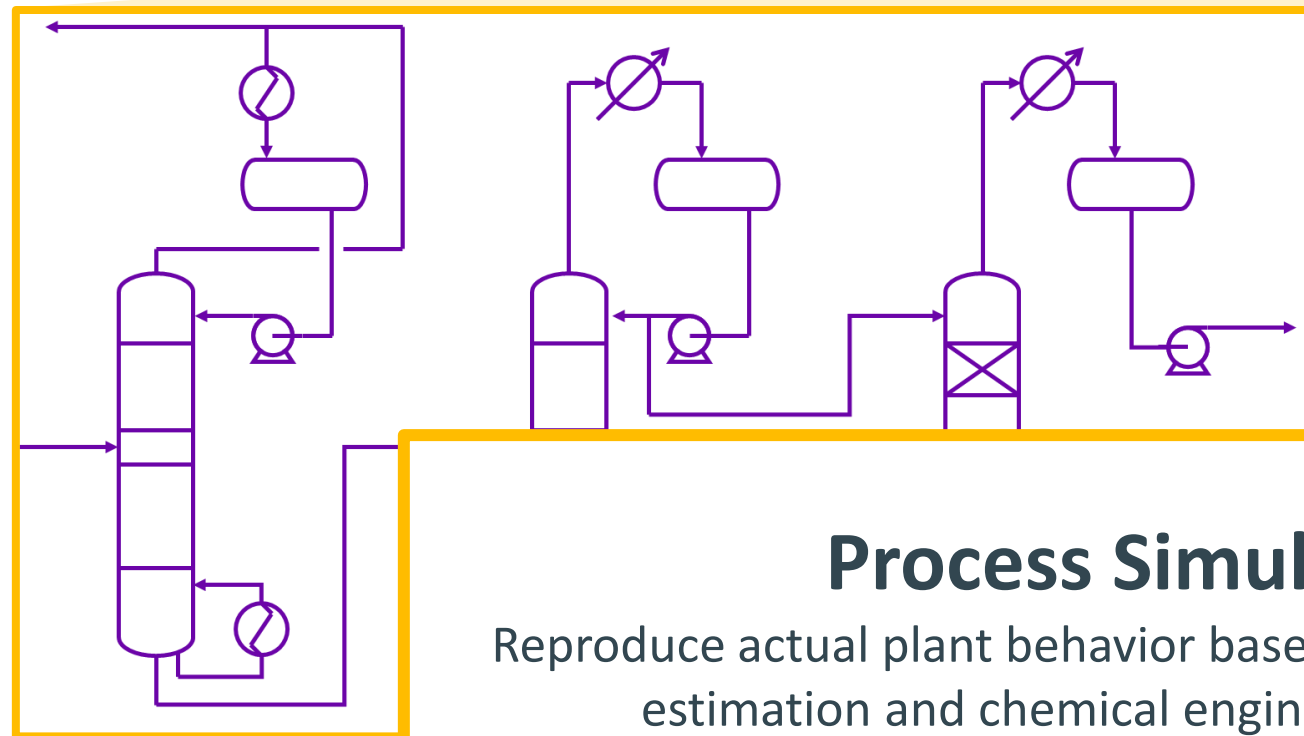
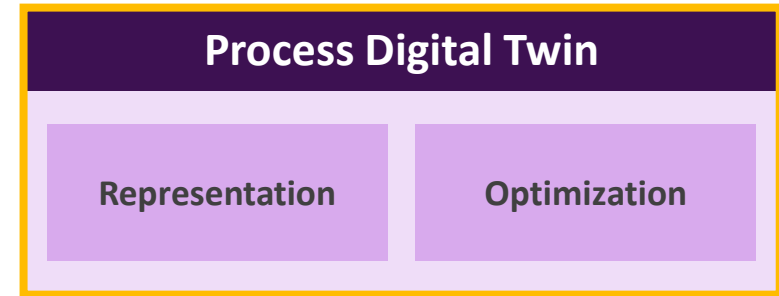
Endothermic Reaction,  
Require Energy



# Process Digital Twin Development



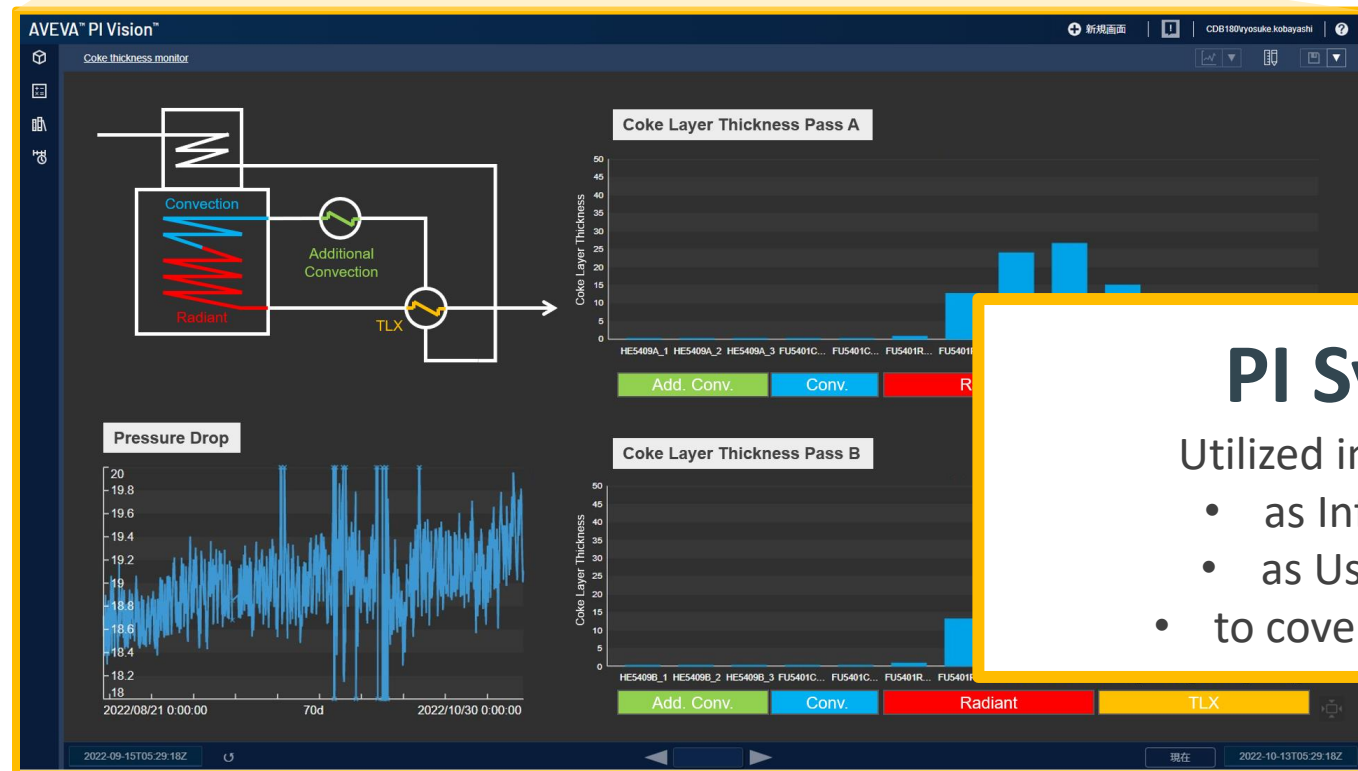
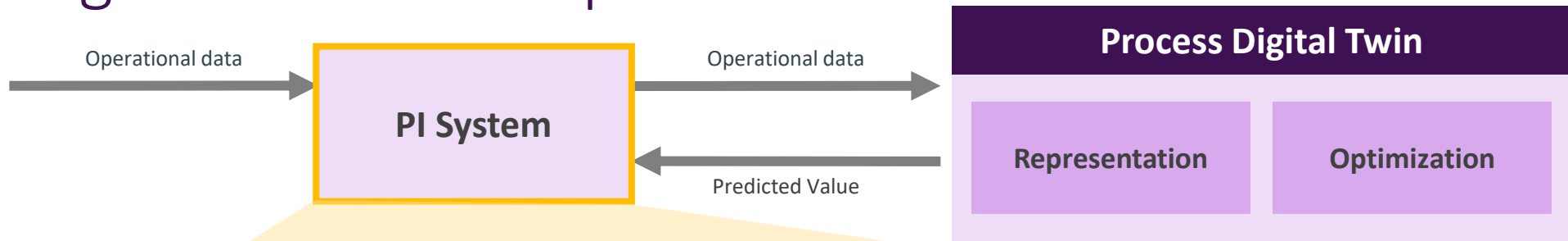
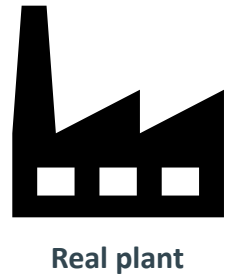
Real plant



## Process Simulator

Reproduce actual plant behavior based on physical property estimation and chemical engineering principle

# Process Digital Twin Development



**PI System**

Utilized in many ways:

- as Infrastructure
- as User Interface
- to cover the Last Mile

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# How PI System helped in Process Digital Twin Development

**AVEVA**

PI System in Process Digital Twin

# AVEVA PI System

1



As Infrastructure

2



As User Interface

3



To cover the Last Mile

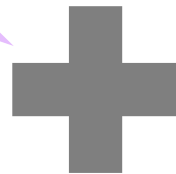
# PI System as Infrastructure



## No Risk!

- ✓ The process simulator was able to obtain the real-time data from the plant without any operation risk since PI System works as the bridge.

## Benefit of Enterprise Program



## No Limit!

- ✓ Although the number of calculated tags increased, Enterprise Program allowed us to carry out the project without worrying about the number of tags.
  - Temperature profile in columns
  - Composition at any point
  - etc.

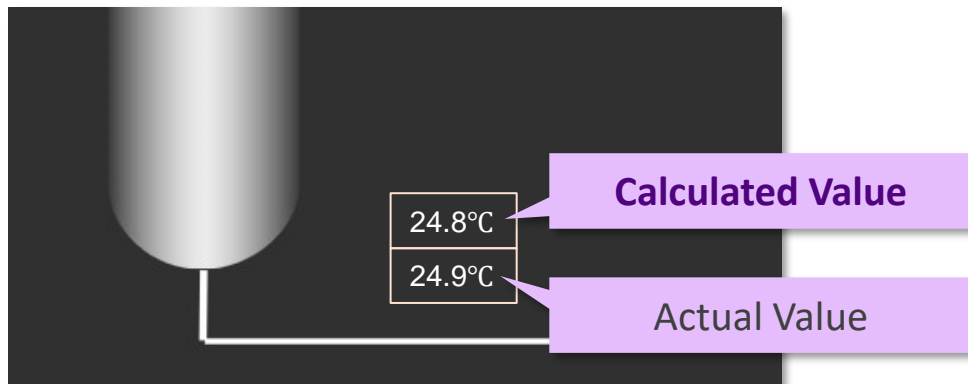


# PI System as User Interface

- We didn't have to develop any dedicated user interface since we already had PI Vision.

## Add to Existing Display!

- ✓ It was also possible to add calculated results on the existing displays



## Create New Display!

- ✓ Each user can edit the newly-developed insightful displays as they wants to see.

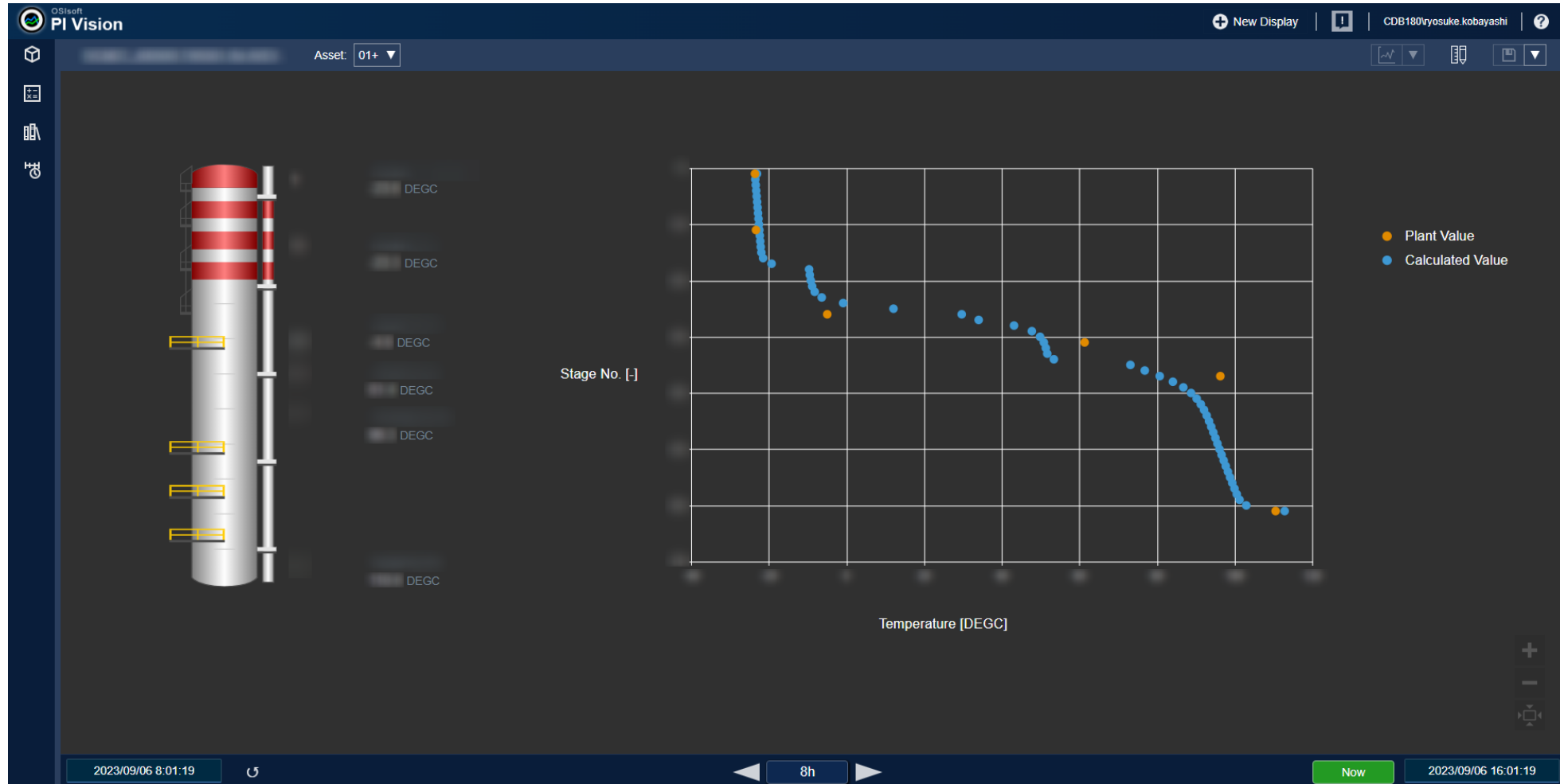


**It's possible because we are already familiar with PI Vision!**

# Coke Thickness



# Column Temperature Profile



# TLX Efficiency

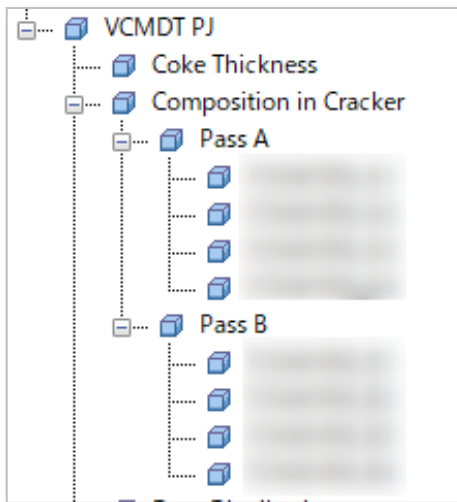


# PI System covers the Last Mile



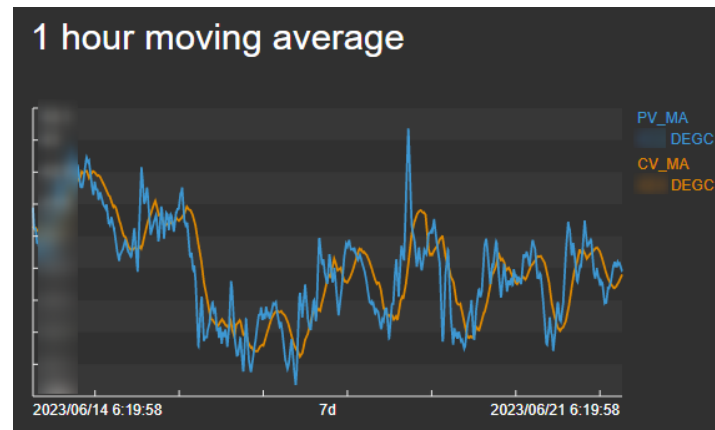
## Calculated Tag Management by AF

- ✓ Huge amount of newly generated calculated tags are organized and managed using PI Asset Framework.



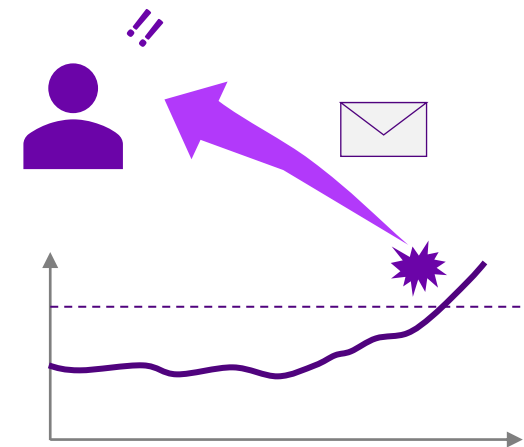
## Processed Data Creation by AF

- ✓ AF Analysis was used to generate processed data necessary for simulation
  - Moving average
  - Running time



## Abnormality Detection by Notification

- ✓ Notifications tells staff in case plant value and calculated value have significant deviation.



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# Benefits and Further Use of Process Digital Twin

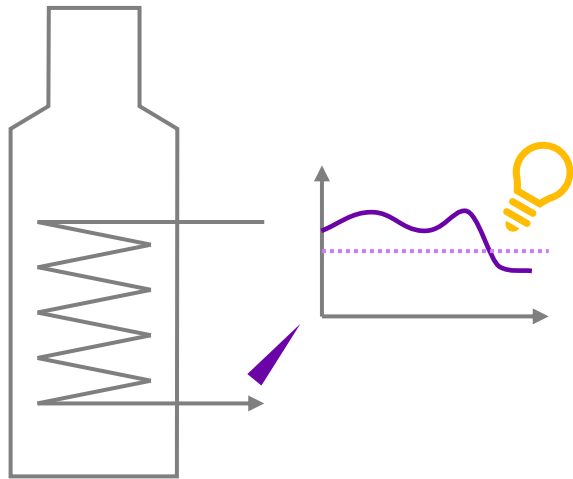
**AVEVA**



# Benefits of Process Digital Twin

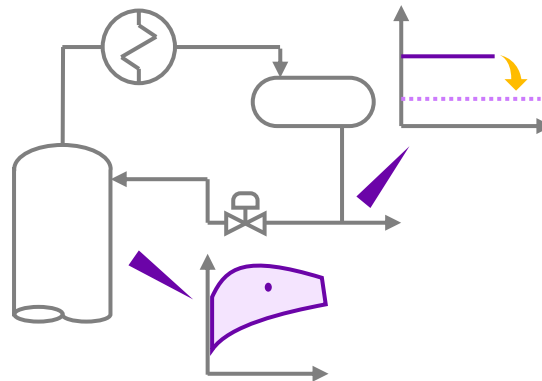
## Reduce the potential trouble

- ✓ It reduces the potential troubles by showing process insights such as temperature profile in columns and composition at any point.



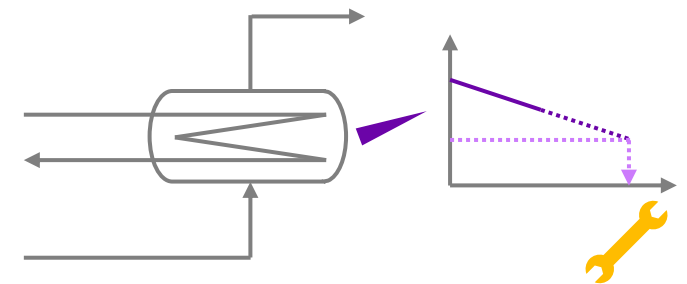
## Efficient Operation

- ✓ It helps realize efficient operation
- ✓ (e.g.) Composition at column outlet and tray performance are now visible, we can minimize the steam amount.



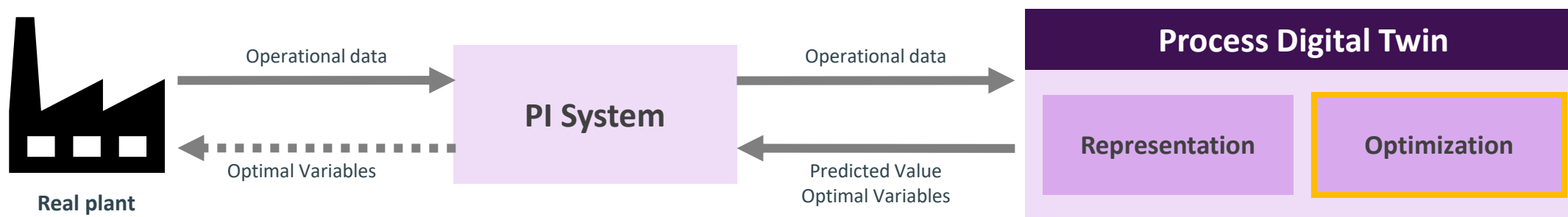
## Optimize Maintenance Timing

- ✓ It generates the chance of optimizing maintenance timing. Since the asset performance is now visible, we can schedule the best maintenance timing.



# Future use of Process Digital Twin

- AGC is going to add an optimization module to further leverage the process digital twin.
- While a typical RTO only covers operations that are automatically controlled by DCS, our study also includes the manual adjustment of the cracker because it is one of the greatest energy consumers



# Preliminary study for optimization

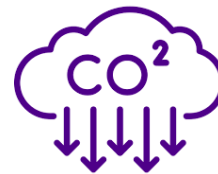
- As a preliminary study, the energy-saving effect of changing the heat distribution in the cracker was investigated in offline simulation.



- Results suggest a potential 6% improvement in fuel efficiency



Cost Reduction  
**Approx.**  
**400k** USD/year



CO2 Reduction  
**Approx.**  
**3500** Ton/year

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# Summary

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# Summary

- RTO using Process Digital Twin is the one of the DX goal of continuous process.
- AGC Chemicals have partially realized Process Digital Twin in one of their plants.
- PI System plays an essential role in many ways in the system.
  - As infrastructure
  - As user interface
  - To cover the last mile
- Even though the system is not complete yet, it generates huge amount of value.
  - Reduce the potential troubles
  - Generate the chance of saving energy
  - Generate the chance of optimizing maintenance timing
- Preliminary study for the introduction of the optimization module was conducted and its potential was confirmed.



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## Kosuke Nakai

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## Ryosuke Kobayashi

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# Questions?

Please wait for the microphone.  
State your name and company.



# Please remember to...

Navigate to this session in the mobile app to complete the survey.



# Thank you!



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#### ABOUT AVEVA

AVEVA is a world leader in industrial software, providing engineering and operational solutions across multiple industries, including oil and gas, chemical, pharmaceutical, power and utilities, marine, renewables, and food and beverage. Our agnostic and open architecture helps organizations design, build, operate, maintain and optimize the complete lifecycle of complex industrial assets, from production plants and offshore platforms to manufactured consumer goods.

Over 20,000 enterprises in over 100 countries rely on AVEVA to help them deliver life's essentials: safe and reliable energy, food, medicines, infrastructure and more. By connecting people with trusted information and AI-enriched insights, AVEVA enables teams to engineer efficiently and optimize operations, driving growth and sustainability.

Named as one of the world's most innovative companies, AVEVA supports customers with open solutions and the expertise of more than 6,400 employees, 5,000 partners and 5,700 certified developers. The company is headquartered in Cambridge, UK.

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