



# **YOKOGAWA's Digital Solutions -Integration and Automation to Accelerate Process Development-**

**Yokogawa Electric Corporation**

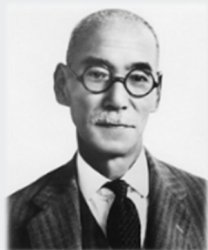
Shahzad Khan, Hiroaki Yamanaka PhD.

August 20, 2025

# Agenda

1. About YOKOGAWA
2. Issues and Challenges in Bioprocess
3. Introducing BioPilot for Smarter Bioprocessing
4. BioPilot in Action / Real-world Applications

# Yokogawa: Trusted Partner in Bioprocess Innovation



Dr. Tamisuke Yokogawa  
Founder

*“Quality First”  
“Pioneering Spirit”  
“Contribution to Society”*

Dr. Yokogawa's  
Founding Spirits, in 1915



Kunimasa Shigeno  
President & CEO

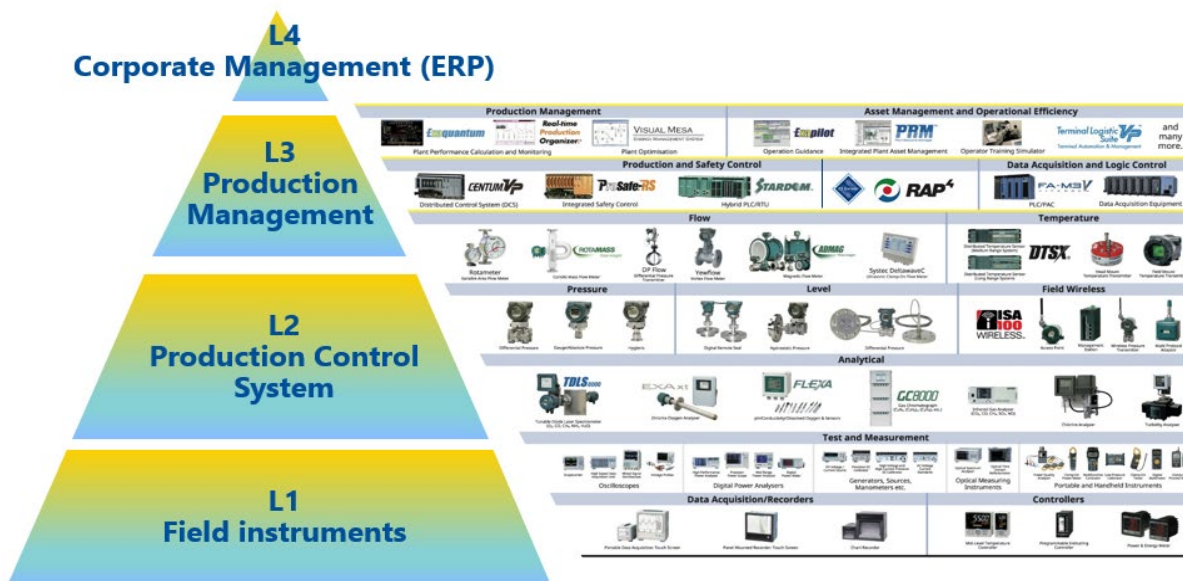
1975  
World's 1st  
DCS

1991  
World's 1st Digital  
Pressure Transmitter

2025

- Listed on Tokyo Stock Exchange “Prime”
- Paid-in Capital: 43.4 billion (≈\$0.3B)
- Sales: 540.2 billion (≈\$3.7B)
- Operating Income: 78.8 billion (≈\$0.5B)
- Businesses: **Automation, Control, Measurement**
- 17,000 employees from 85 nationalities in 61 countries

(Data as of FY2023)



# Why Digital Transformation is Critical Today

## ❑ Increasing complexity in bioprocessing workflows

- Modern bioprocessing complexity demands integrated coordination to eliminate inefficiencies, errors, and delays in tech transfer

## ❑ Regulatory pressure for GMP and data integrity

- Stricter regulatory demands make real-time data integrity and compliance essential—manual processes risk non-compliance and costly batch failures

## ❑ Demand for scalability and reproducibility

- Biotech scalability demands consistent, reproducible processes—manual variability and disconnected systems threaten tech transfer and commercial success

## ❑ From Data to Decisions - Faster, Smarter, Better

- AI, machine learning, and PAT are revolutionizing bioprocessing with predictive insights, automation, and real-time optimization—giving adopters a clear edge in speed, quality, and cost

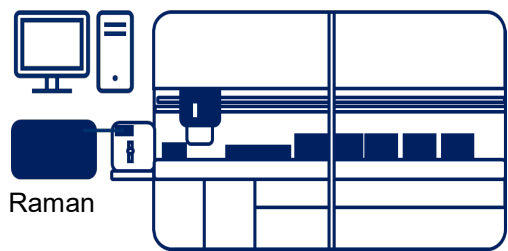
# Challenges in Bioprocess Automation, Analytics and Control

1.

## Lack of standardization across equipment:

Bioprocessing uses instruments from wide range of manufacturers, each with its own communication protocols. This leads to significant integration challenges.

PAT Software



Lab-scale Bioreactor

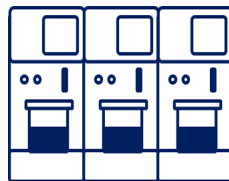
2.

## Lack of Data Management:

Various sources of data make it difficult to integrate records, hindering tech-transfer and scaling up.



Pump

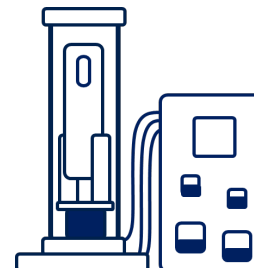


Parallel Bioreactors

3.

## Manual Operations & Low Automation:

Many tasks are still operated manually, leading to low reproducibility and increased work burden on operators. Lack of experienced operators.



Production Bioreactor

4.

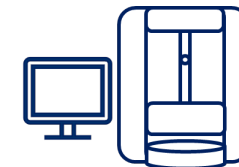
## Batch-to-batch variability

Batch and continuous processes require real-time monitoring, which can be challenging and time-consuming.

Human Error  
Non-reproducible  
Batch Failure



Medium Analyzer

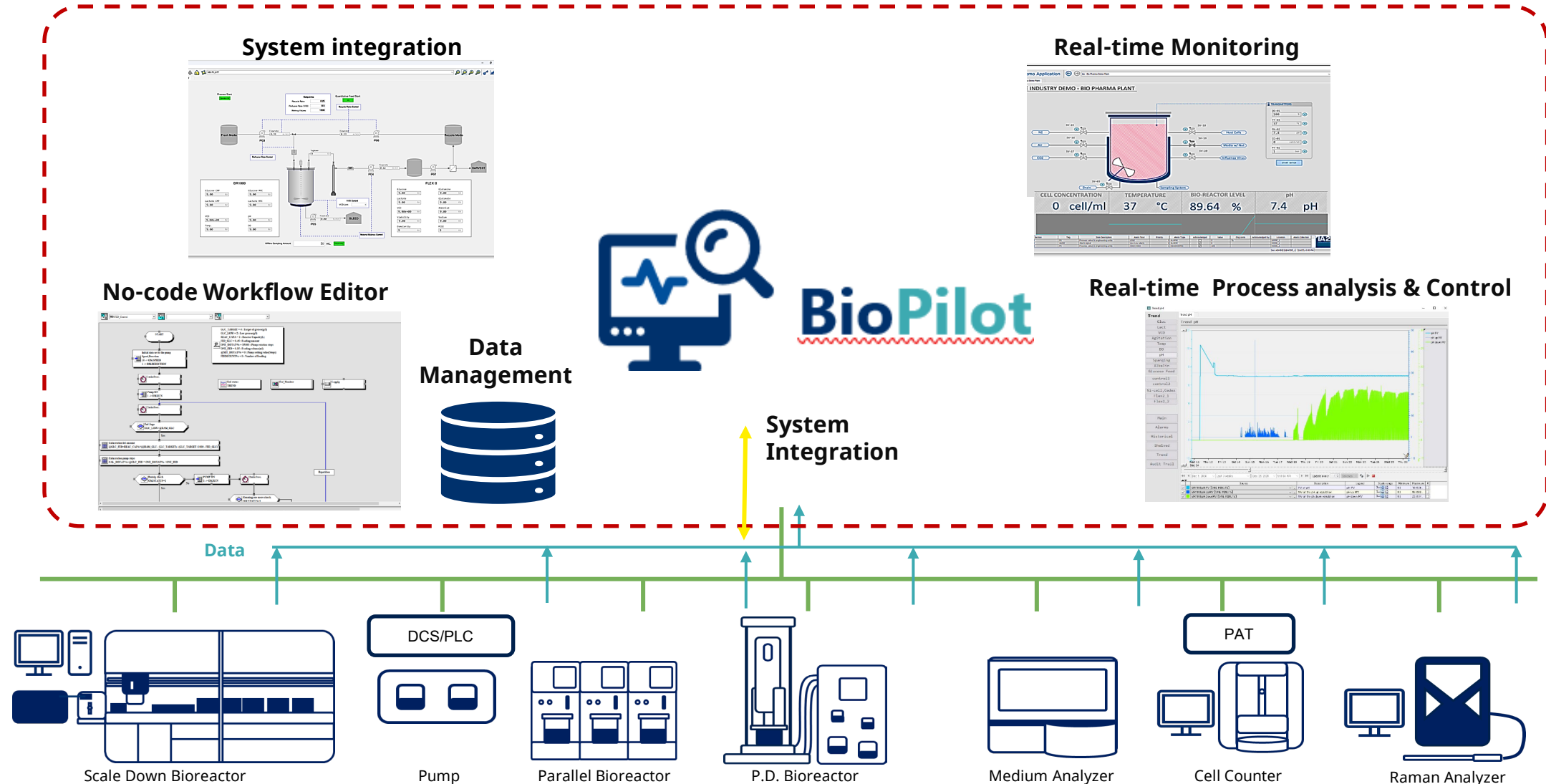


Cell Counter



Raman Analyzer

# BioPilot – for Smarter Bioprocessing





# BioPilot in Action / Real-world Applications

## System Integration and monitoring

- Integration of process control system, PAT analyzer and analytical instruments – vendor agnostic.
- Real-time equipment and instrument health monitoring.

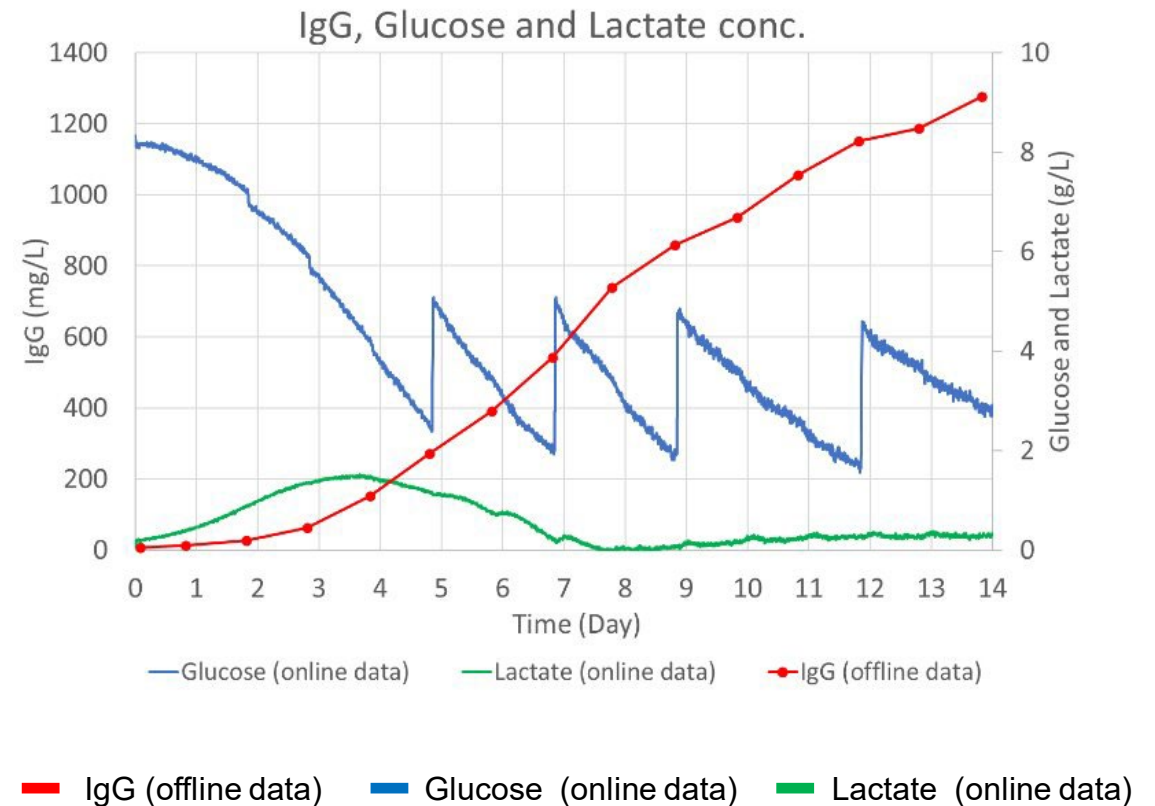
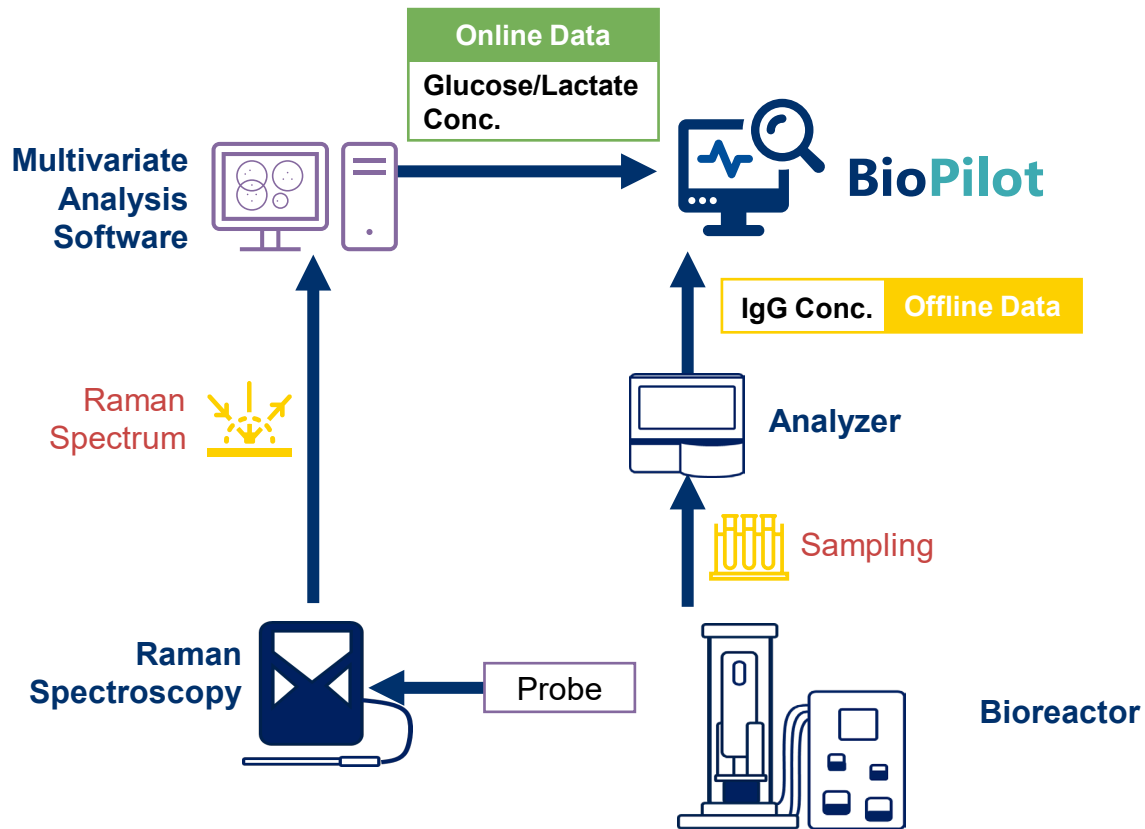
## Automation and Operator Assistance

- No-code workflow editor automates daily tasks.
- Assistance guidance helps operators to reduce human error.
- Training and consultation service available post installment.

## Data management, analytics and control

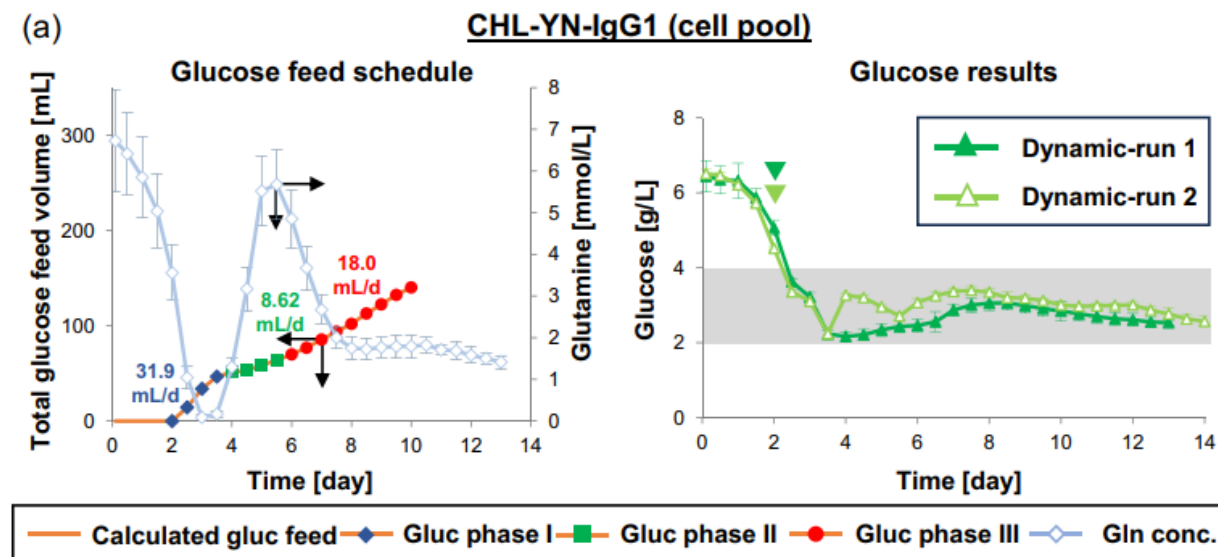
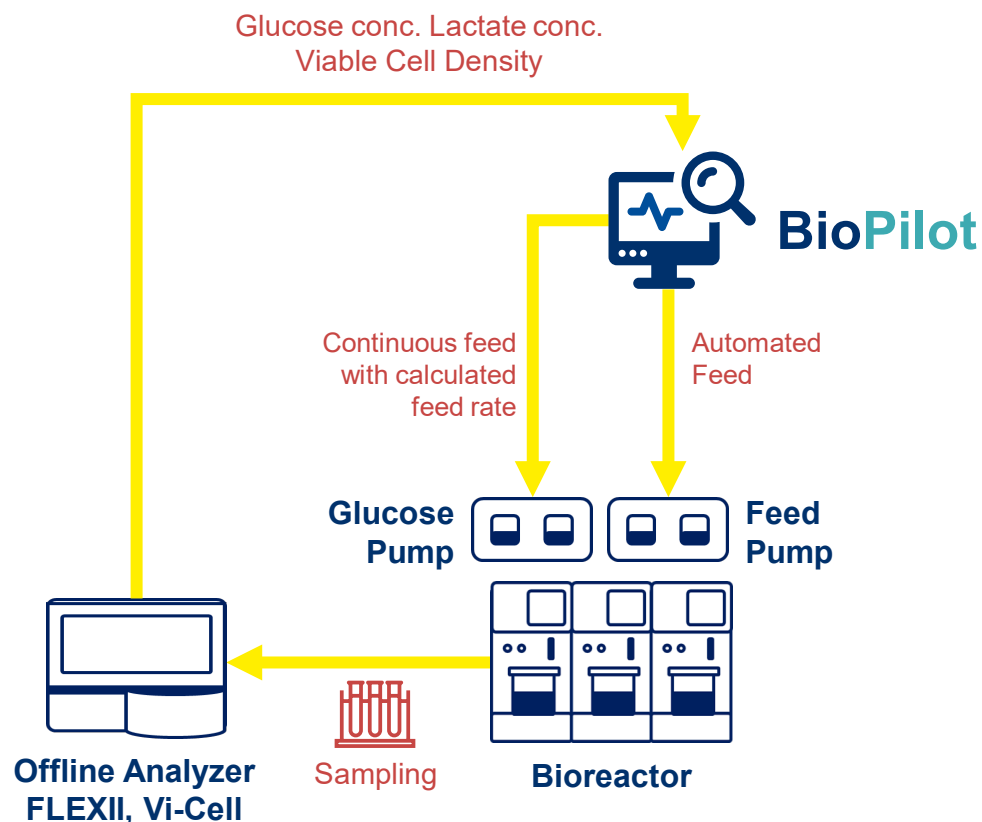
- Both online data and offline data are managed.
- Standardize various data formats.
- Data are integrated, aligned and processed for analytics and control.

Challenge:	<b>Manual integration</b> of online and offline data from various analyzers <b>is time-consuming and error-prone.</b>
<b>BioPilot</b>	<b>Automatically combines and synchronizes data from multiple sources, enabling efficient data integration.</b>





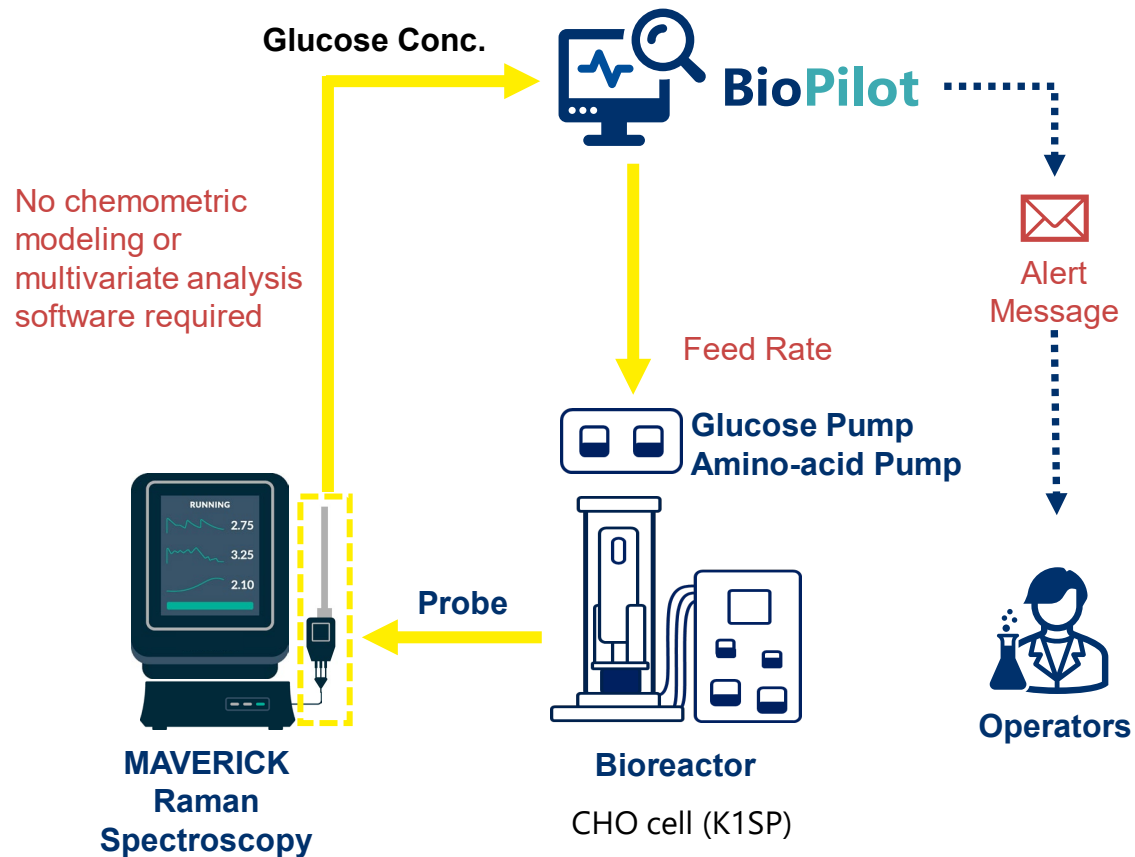
Challenge:	CHL-YN cells <b>rapidly consume glucose</b> , making it <b>difficult to maintain desired levels</b> .
<b>BioPilot:</b>	<b>Maintains glucose concentration cost effectively leveraging offline analyzers.</b>



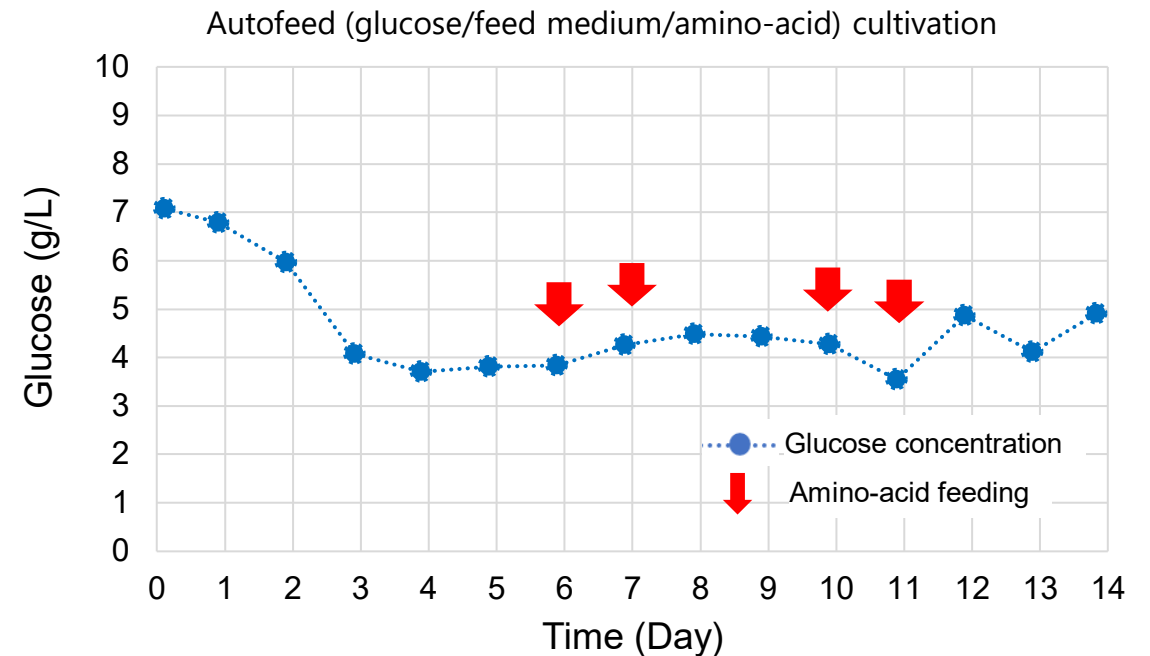
Metabolomic characterization of monoclonal antibody - producing Chinese hamster lung (CHL) - YN cells in glucose - controlled serum - free fed - batch operation, Sukwattananipaat P., et.al, *Biotechnol Bioeng.*, **121**, :2848–2867, (2024)

# Repligen MAVERICK and BioPilot: Integrated Solutions for Bioprocesses

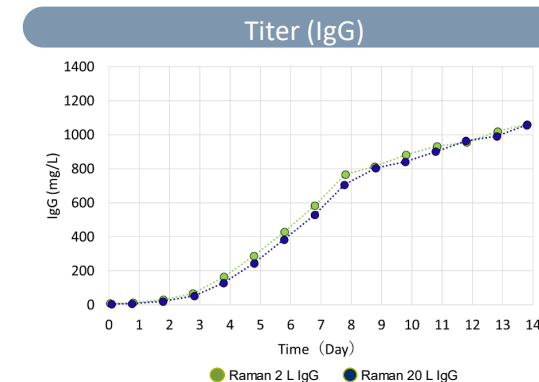
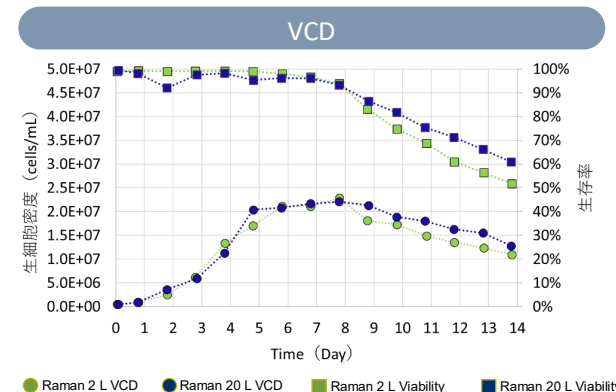
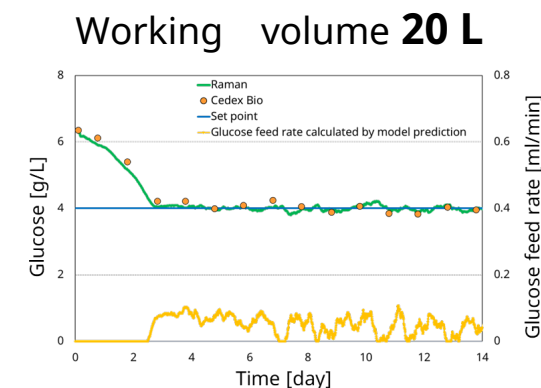
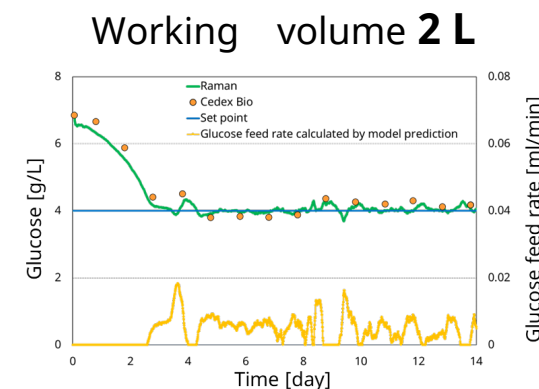
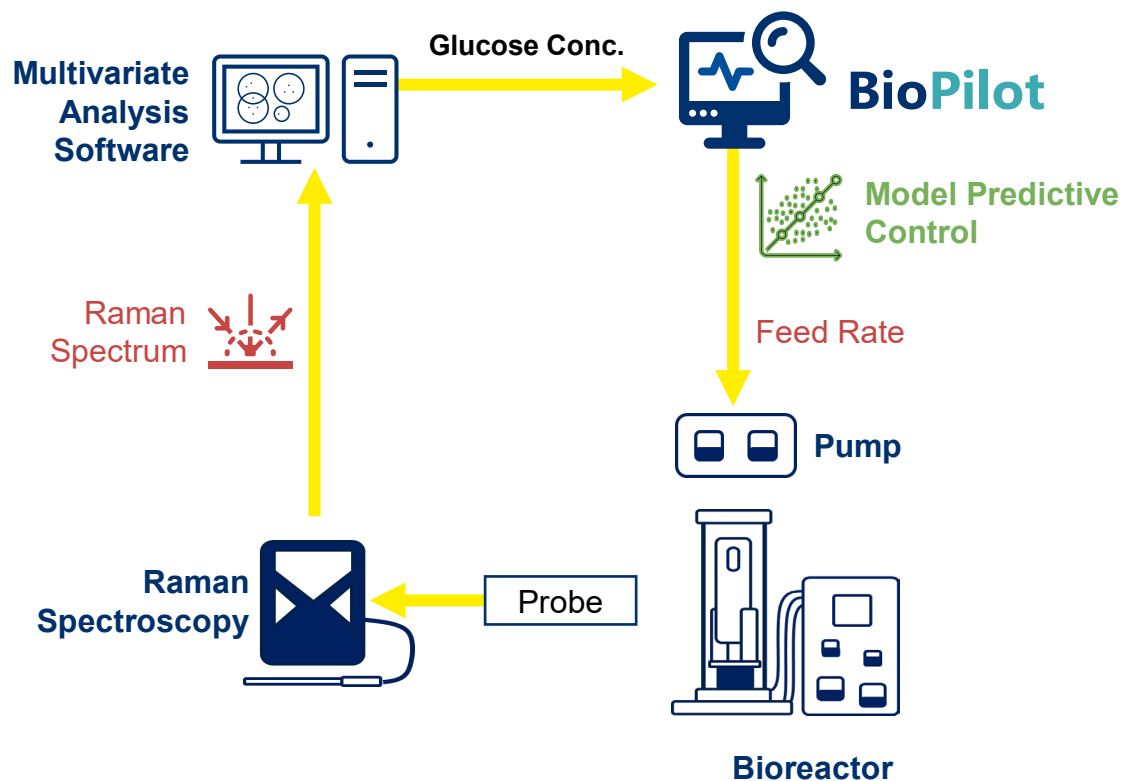
Repligen's MAVERICK Raman spectroscopy system can easily monitor glucose and lactate concentrations in-line, eliminating the need for complex calibration models. The BioPilot system automates amino acid feeding and glucose concentration control.



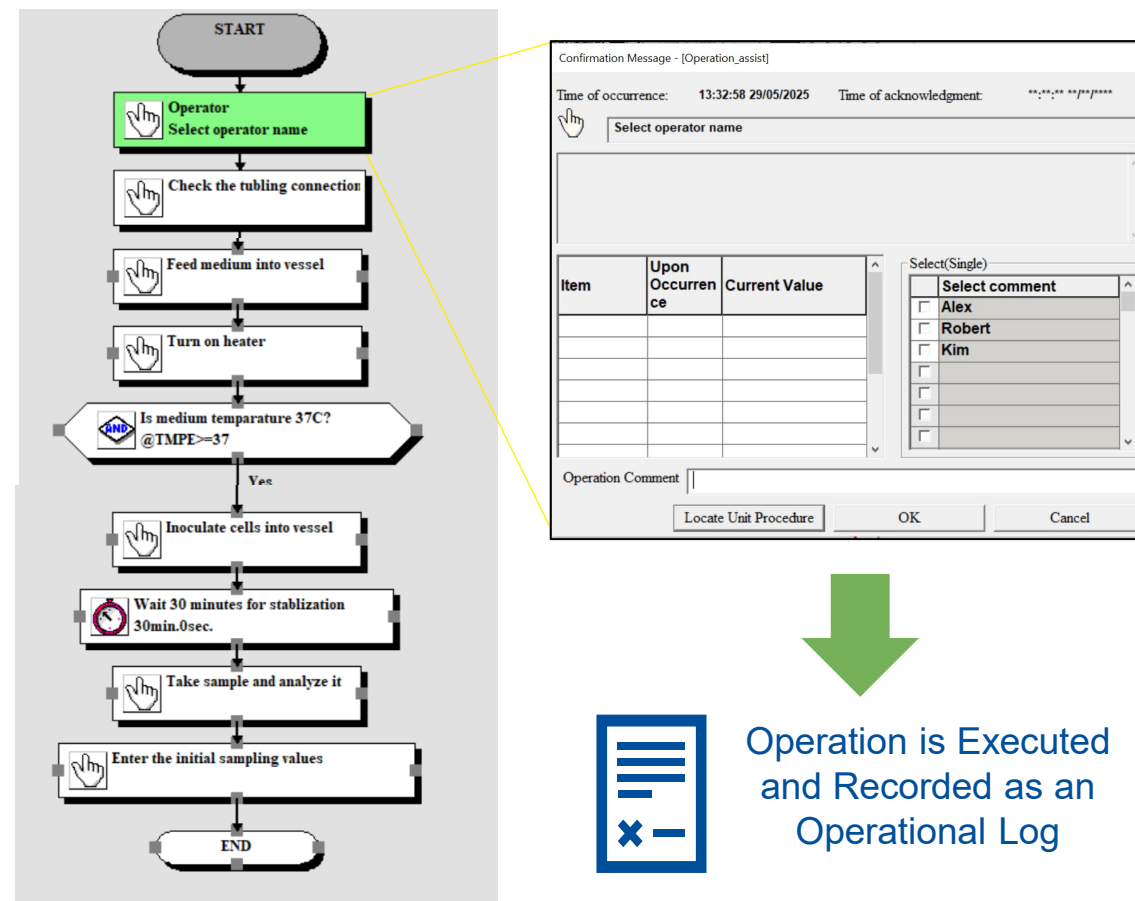
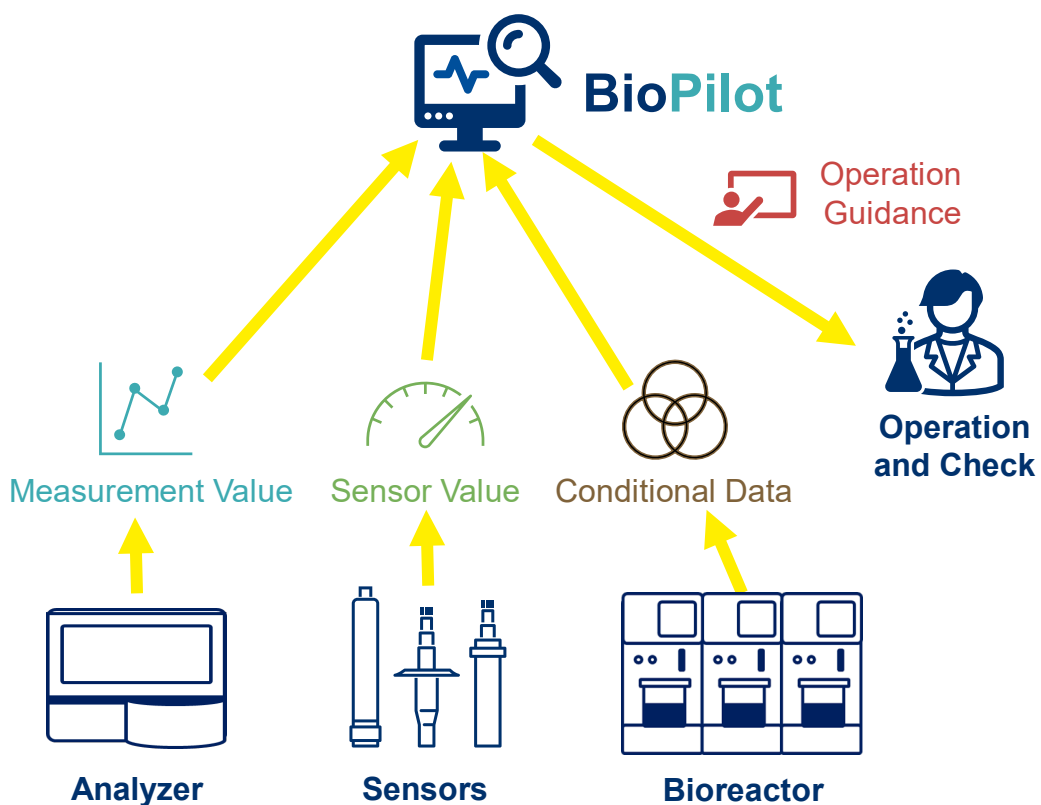
The combined use of **MAVERICK** and **BioPilot** facilitated the autonomous operation of glucose concentration control and amino-acid feeding for a **two-week period without human intervention**, with only sampling required for verification."



Challenge:	Reproducing culture conditions during scale-up is critical—but <b>difficult to achieve consistently</b> .
<b>BioPilot:</b>	Using <b>Model Predictive Control (MPC)</b> glucose concentration was maintained at both <b>2 L and 20 L scales</b> , resulting in <b>reproducible VCD and titer profiles</b> across scales.



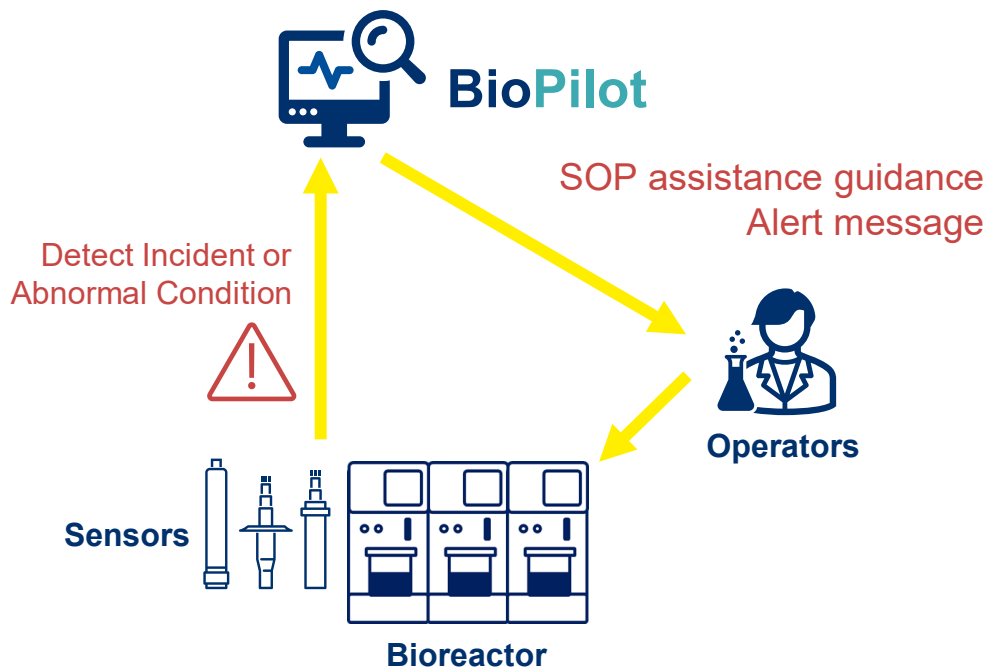
Challenge:	Operators must handle <b>complex procedures</b> . Build flow based on <b>experienced operator knowledge</b> .
<b>BioPilot:</b>	<b>Guides the operator step-by-step</b> through <b>cross-checking dialogue</b> . Enables the accumulation and transfer of knowledge and experience.



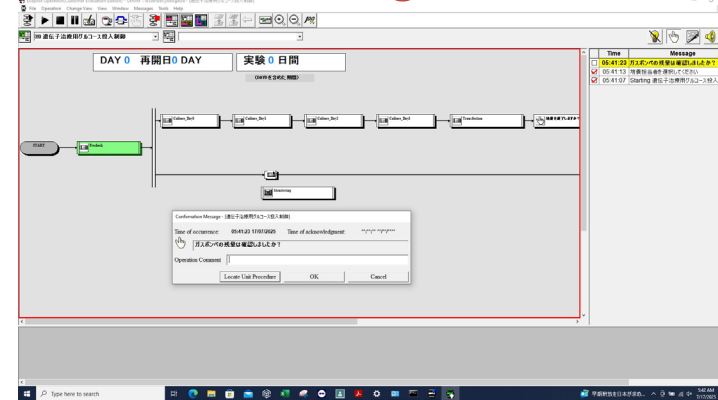
# Application case of BioPilot in AAV vector cultivation

Collaboration with Synplogen Co., Ltd., a “Gene Therapy Biofoundry™” in Japan. BioPilot ensured precise execution of 62 SOP steps, continuously monitoring cell culture conditions and prevent batch failure.

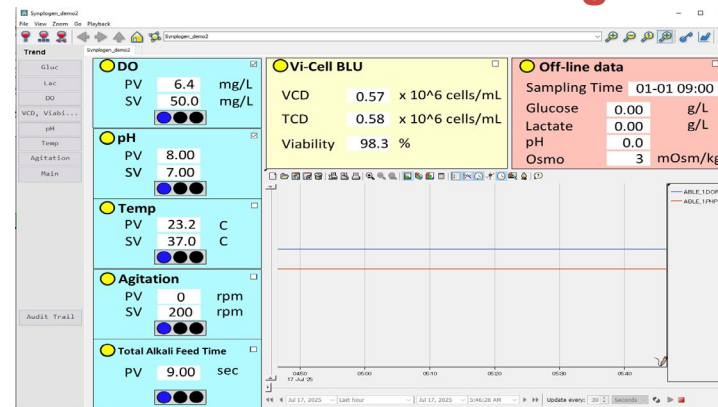
 Synplogen



## SOP assistance guidance



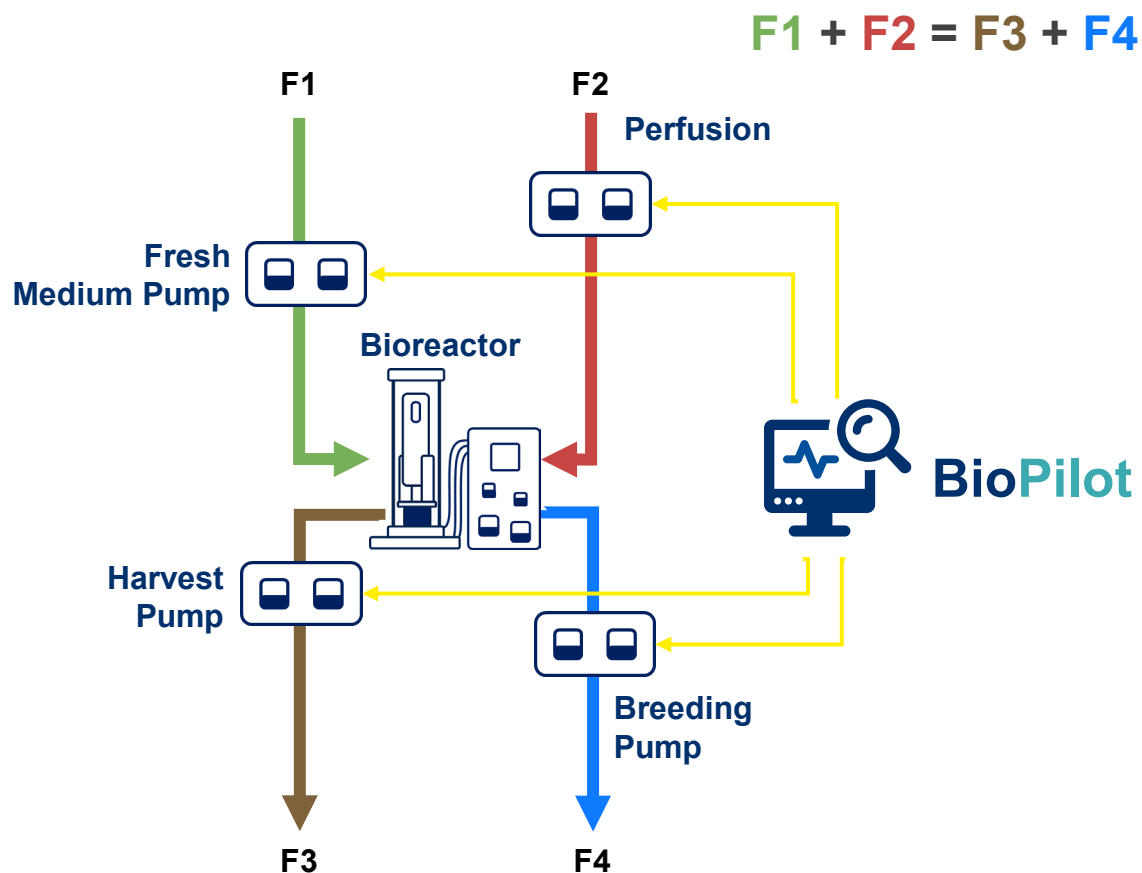
## Dashboard for monitoring



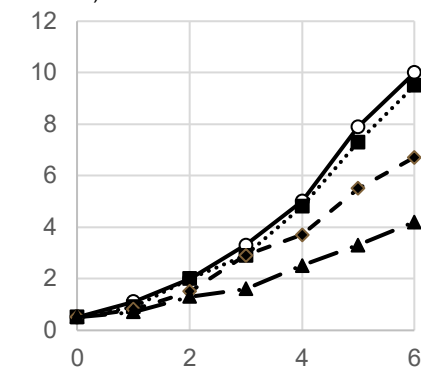
## User's comments

- BioPilot provided operators with clear, step-by-step guidance, enabling precise task execution even in complex workflows.
- Its intuitive interface allowed even newly onboarded team members to perform confidently and efficiently from the start.
- The integrated monitoring system delivered real-time, at-a-glance access to data from multiple sources, significantly enhancing operational safety and decision-making speed.

Challenge:	Coordinating multiple pumps to balance fresh, perfusion, and spent media.
BioPilot:	Maintains balanced pump flows, enabling successful cell culture with variable media mixtures.



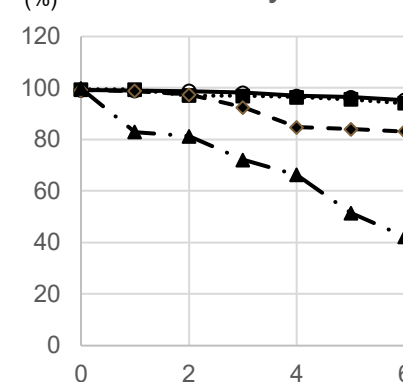
(x10<sup>6</sup> cells/mL) Viable cell density



—○— F100    ...■... F75+P25  
 -◆- F50+P50    -▲- F25+P75

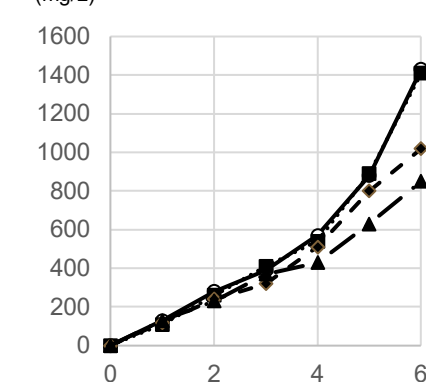
F = Fresh medium  
 P = Perfusion medium

(%) Viability



—○— F100    ...■... F75+P25  
 -◆- F50+P50    -▲- F25+P75

(mg/L) Titer



—○— F100    ...■... F75+P25  
 -◆- F50+P50    -▲- F25+P75



## Discover the Power of BioPilot

As demonstrated in our use case, BioPilot integrates diverse systems to meet your unique needs. Whether you have a specific business need or challenges, BioPilot empowers you to build your own original solution.

Its exceptional flexibility is what sets BioPilot apart.

Co-innovating tomorrow™

**Thank you**