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# Digital Transformation

Unlocking the power of data

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**AVEVA**



**sanofi**

**AVEVA**

# Sanofi Geel

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Employees: Approx. 800

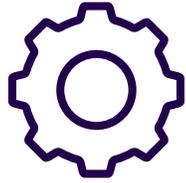
Key activities: Biomanufacturing of therapeutic proteins (enzymes & monoclonal antibodies)

Capacity:

- 12,000 L perfusion cell culture capacity
- 80,000 L fed-batch cell culture capacity
- 1600 m<sup>2</sup> QC laboratories
- 930 m<sup>2</sup> MSAT laboratories



# Digital Transformation – Factory of the Future



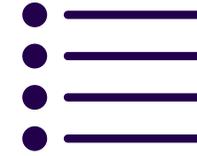
## Challenge

Building a state-of-the-art biotechnological production facility with real-time monitoring and analytics capabilities.



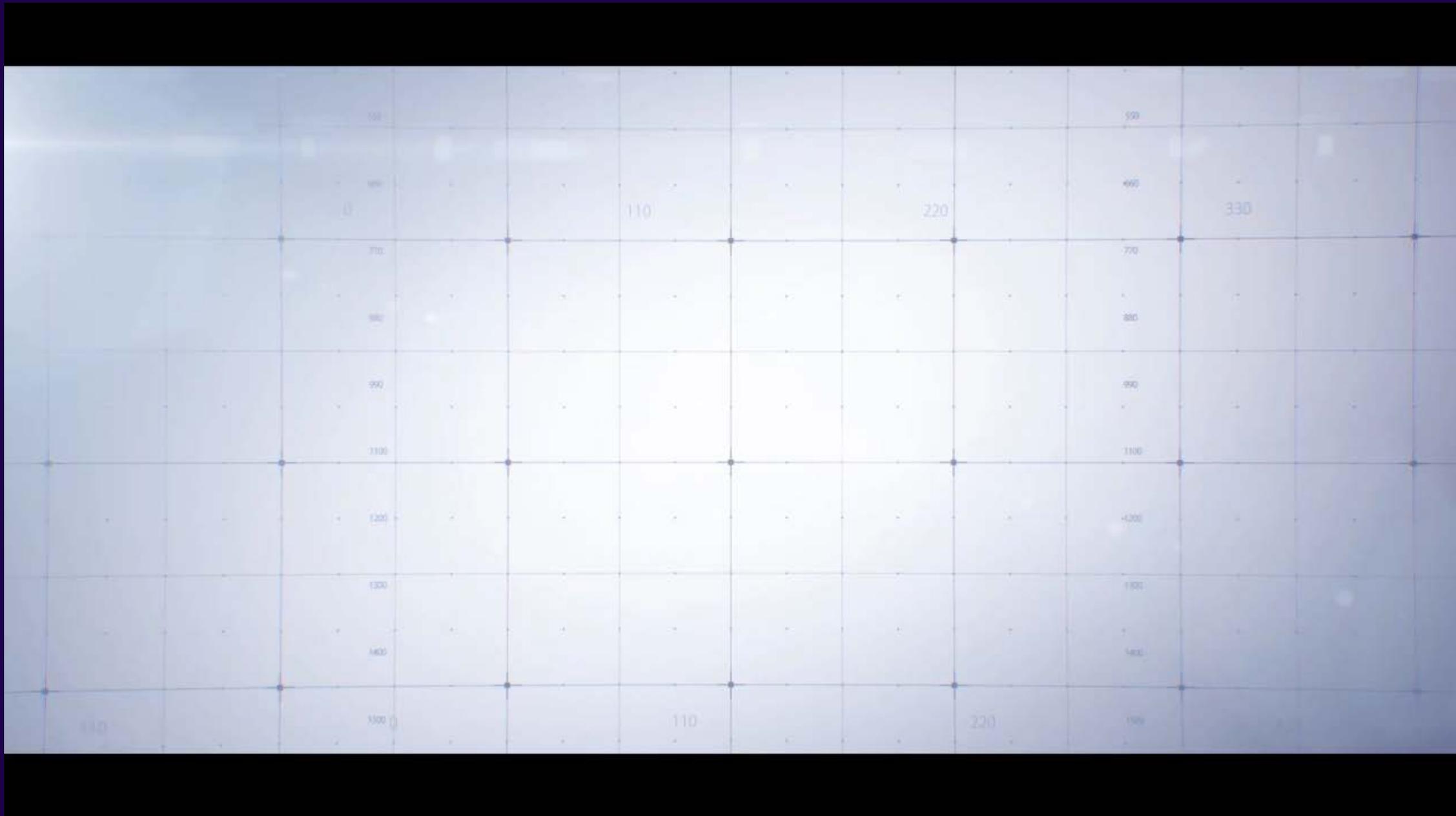
## Solution

Deployed the latest AVEVA PI System technology including PI AF/EF and PI Vision as an advanced foundation for Process Monitoring, Condition Based Maintenance & Advanced Analytics



## Benefits

Increased production and operational efficiency, reduced costs, mobile inspections, exception-based surveillance, significantly accelerated 'Time to Value' for Advanced Analytics & Machine Learning projects

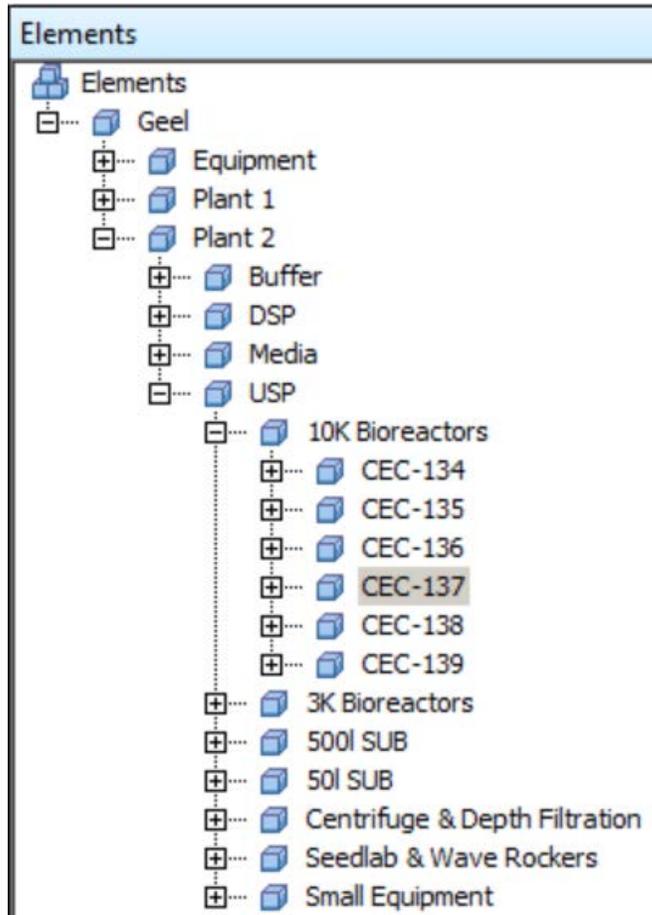


# Building Blocks

- 1 Building the framework  
BUILDING THE AF/EF FRAMEWORK
- 2 Run-to-Run analysis  
PROVIDING THE DATA TO THE SHOPFLOOR
- 3 Raman Technology  
PROCESS ANALYTICAL TECHNOLOGY
- 4 AA & ML  
MOVING TO THE CLOUD
- 5 Sustainability  
GO GREEN



# 1. Building the framework



An Asset Framework was built to map the site and its processes

The following is in a validated state:

240 templates

10864 elements

79 GxP PI Vision displays

76 tables

1607 analyses based on 617 analysis templates (170 EF analysis templates & 447 expression analysis templates)

45 Event Frame Templates

3 enumeration sets

15 custom UOMs

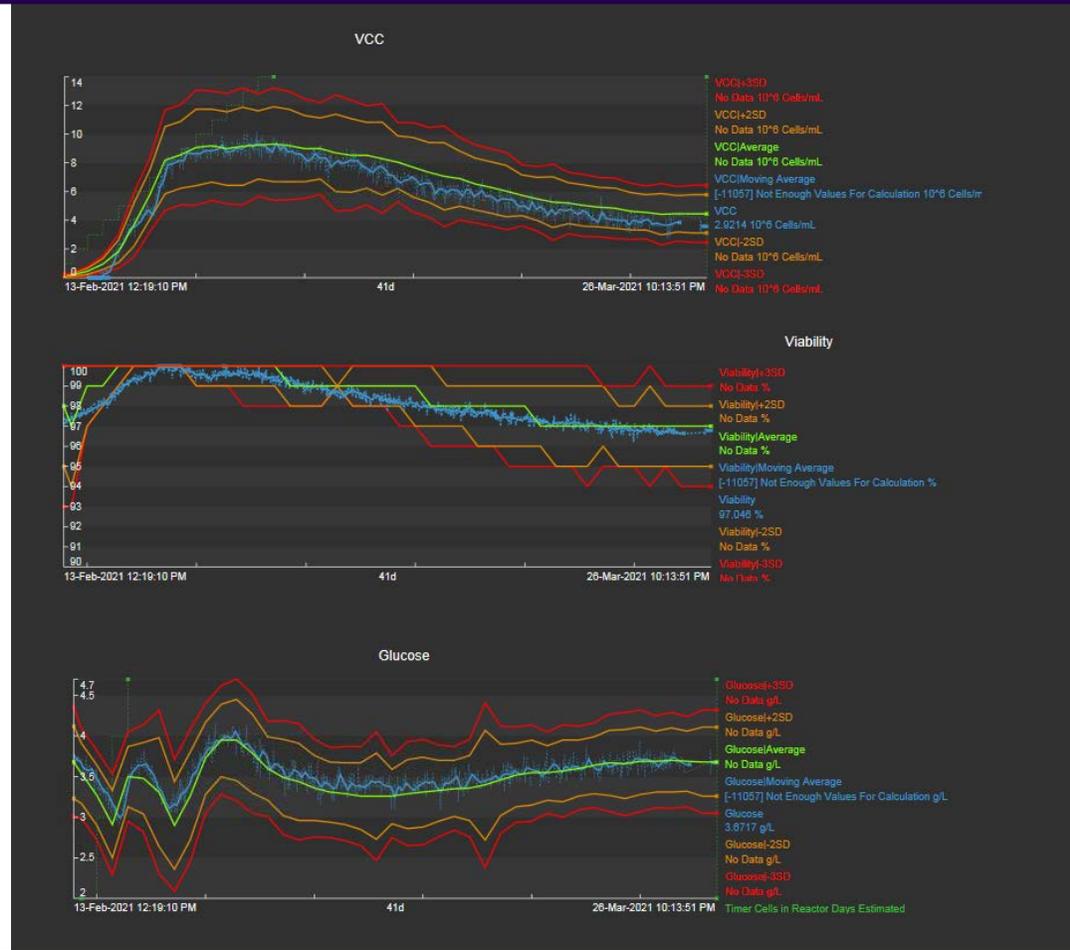
884 formula attribute templates

1379 table lookup attribute templates

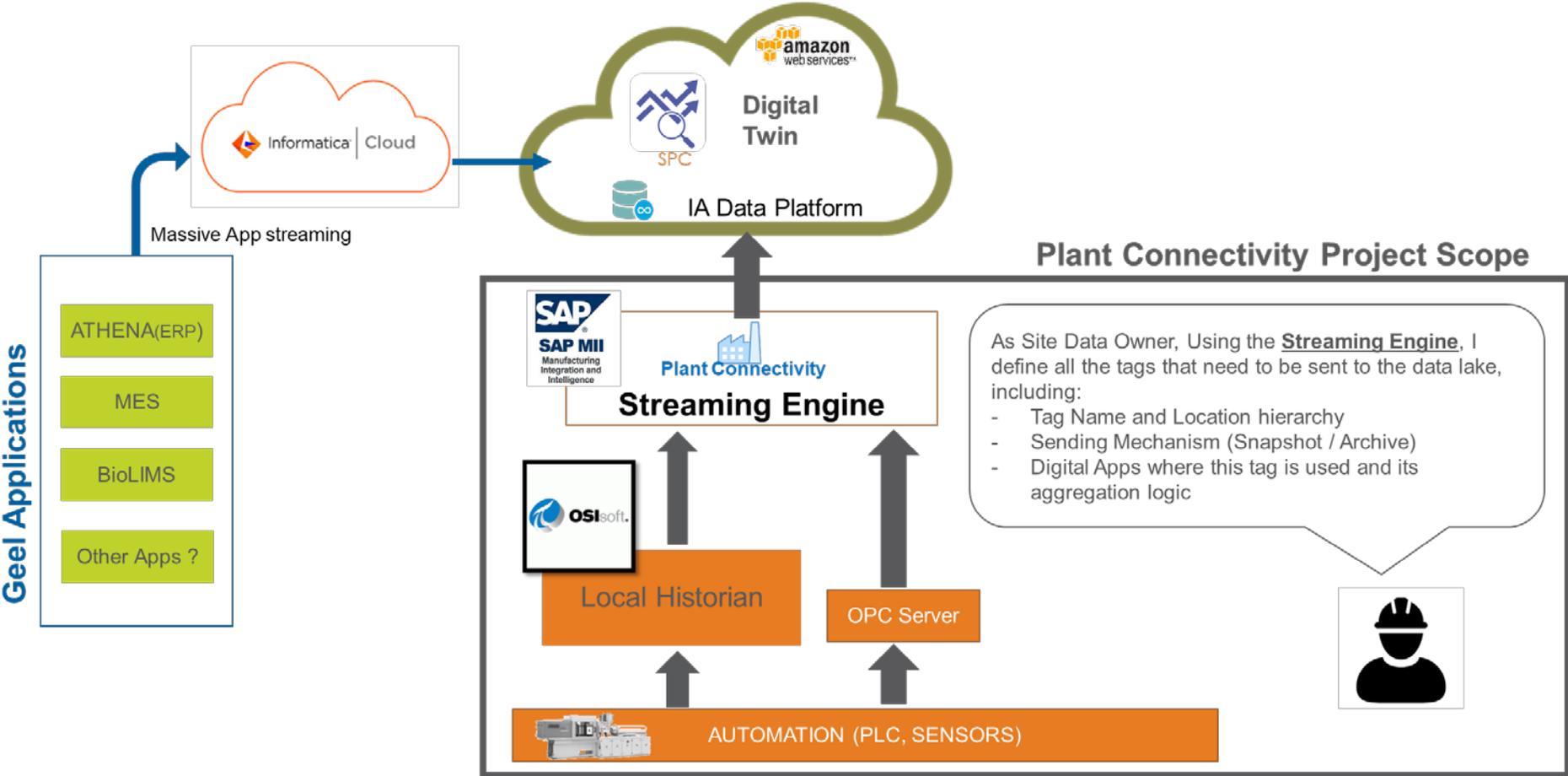


# 3. Raman Technology

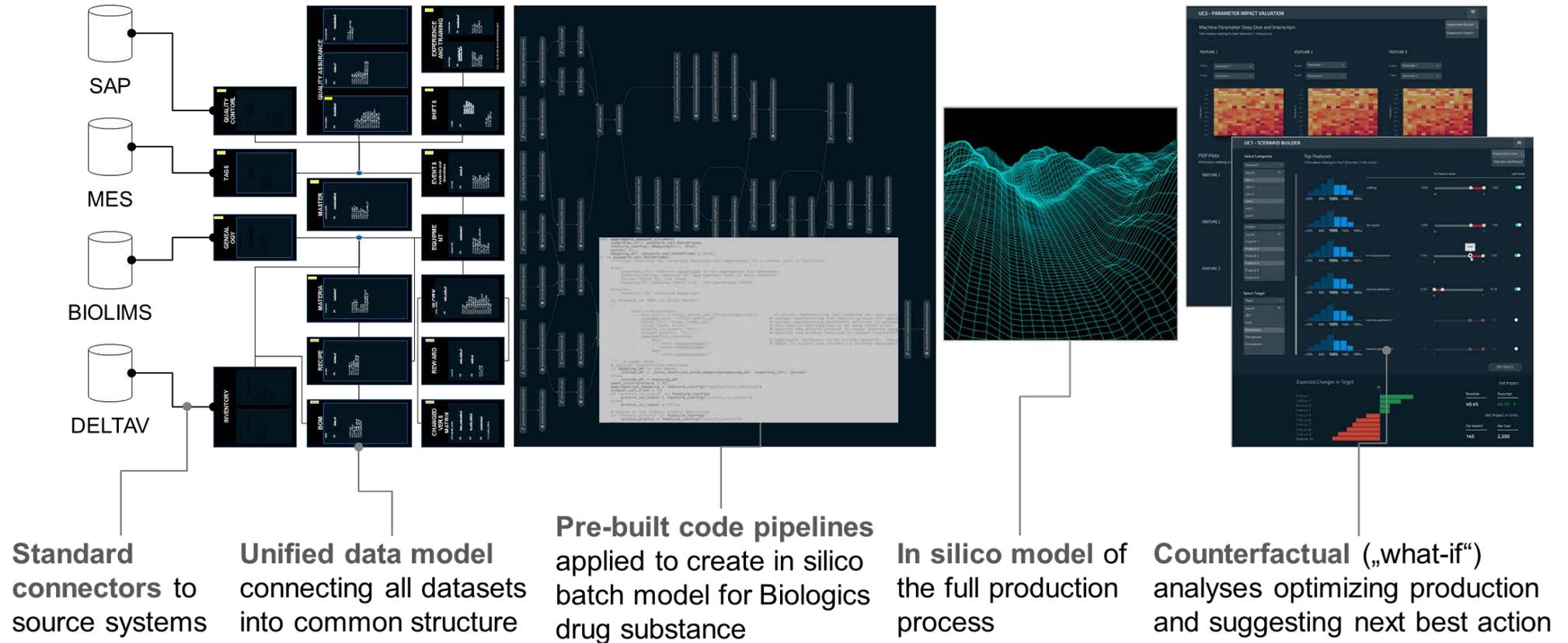
- Use of **Raman technology** (spectroscopic technique typically used to determine vibrational modes of molecules)
- Enable the elimination of offline sampling and analysis @bioreactors.
- Significantly reducing our day-to-day offline sampling & associated cost and product loss
- Direct Link with SynTQ software and PI AF.



# 4. Moving to the Cloud



# 5. Advanced Analytics & Machine Learning



# 5. Advanced Analytics & Machine Learning

```
GoldenBatchjynb
Python 3
[1]: import pandas as pd
import datetime
import IPython.display as widgets
from IPython.display import clear_output
import matplotlib.pyplot as plt
import os
import sys
import numpy as np
import random

#####
# LOADING BASIC DATA INTO DATAFRAMES
# dFEF - LOAD EVENTFRAMES FROM CSV - to be updated when EF's Available in Datalake

# Load .csv file
dFEF = pd.read_csv('Files/EFsDatalake.csv', sep=',')

# Remove all eventframes not of type 'Cells in Reactor'
dFEF = dFEF[dFEF.EventFrameTemplateName == 'Cells in Reactor']

# set end time to now for EF's that are open (EEnd = NaN)
nowstr = datetime.datetime.now().strftime("%Y-%m-%d %H:%M:%S")
nowstr = nowstr + ".000000"
dFEF['EEnd'] = dFEF['EEnd'].fillna(nowstr)

# Remove EventFrames without BatchID
dFEF.dropna(subset=['BatchID'], inplace=True)

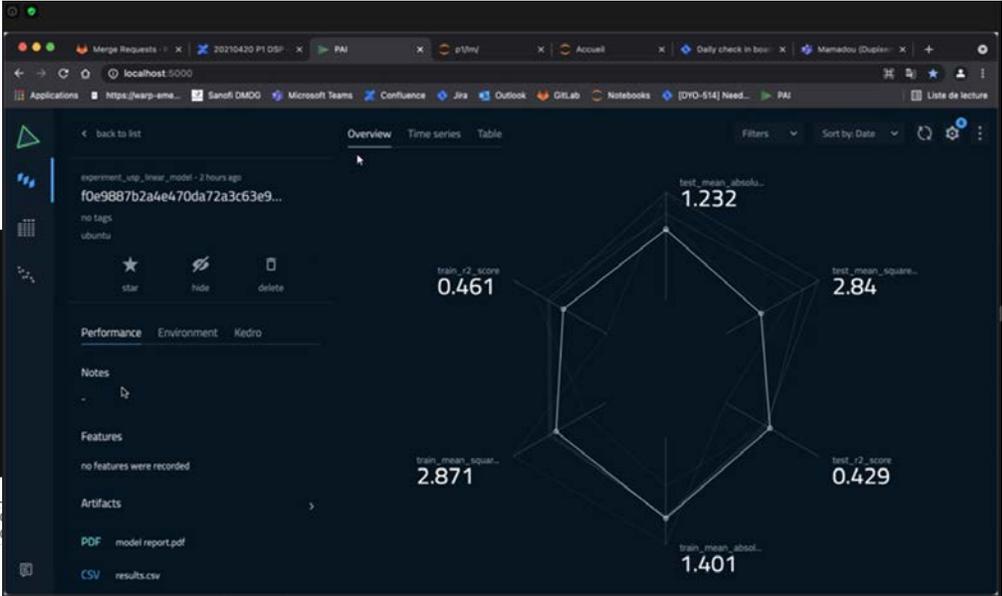
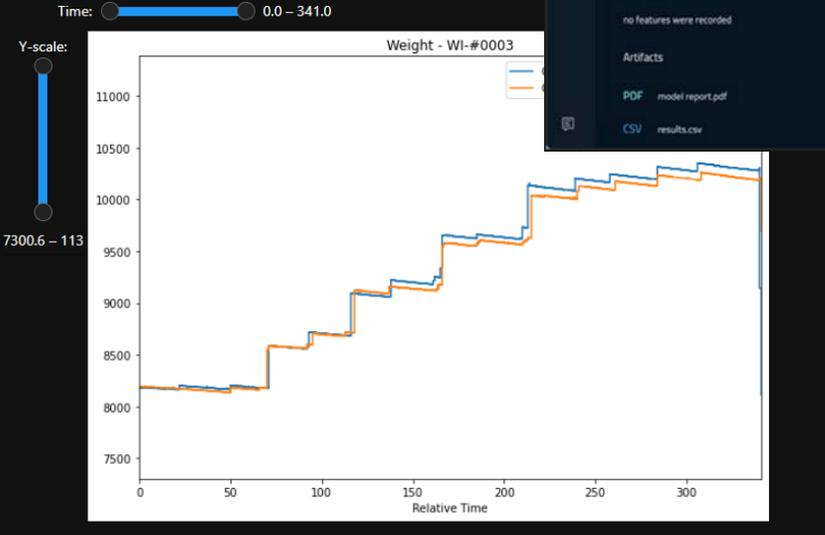
# Remove EventFrames with incorrect batch ID's - not containing '00'
dFEF = dFEF[dFEF['BatchID'].str.contains('00')]

# drop EF's that are not of 10k Bioreactor i.e. not containing substring 'CEC-134' > 'CEC-139'
lst_reactors = ['CEC-134', 'CEC-135', 'CEC-136', 'CEC-137', 'CEC-138', 'CEC-139', 'CEC-132', 'CEC-133']
dFEF = dFEF[dFEF['ElementName'].isin(lst_reactors)]

# Sort EF's newest to oldest
dFEF = dFEF.sort_values(by=['EStart'], ascending=False)

# create additional column that concatenates all information
dFEF['display'] = (dFEF['BatchID'] + ' - ' + dFEF['ElementName'] + ' - ' + dFEF['EventFrameTemplateName'] + ' - ' +
                  dFEF['EStart'] + ' - ' + dFEF['EEnd']).astype('string')
```

Golden BatchID: BGG657CC - CEC-134 - Cells in Reactor - 20  
Reference batch ID: BGG8275CC - CEC-134 - Cells in Reactor - 20  
Instrument: Weight - WI-#0003  
Query data  
Query executed - proceed to plot the data  
Display Chart Clear



## 6. Go Green



# Our 5 environmental commitments



**Fight climate change: chase after carbon neutrality by 2030 and net zero emissions by 2050**

By engaging Sanofi towards the 1,5°C global warming trajectory



**Limit our environmental footprint and aim for circular solutions**

By optimizing the use/reuse of resources and reducing impact of emissions



**Improve environmental profile of products**

By delivering eco-innovative products and fostering a sustainable use of medicines



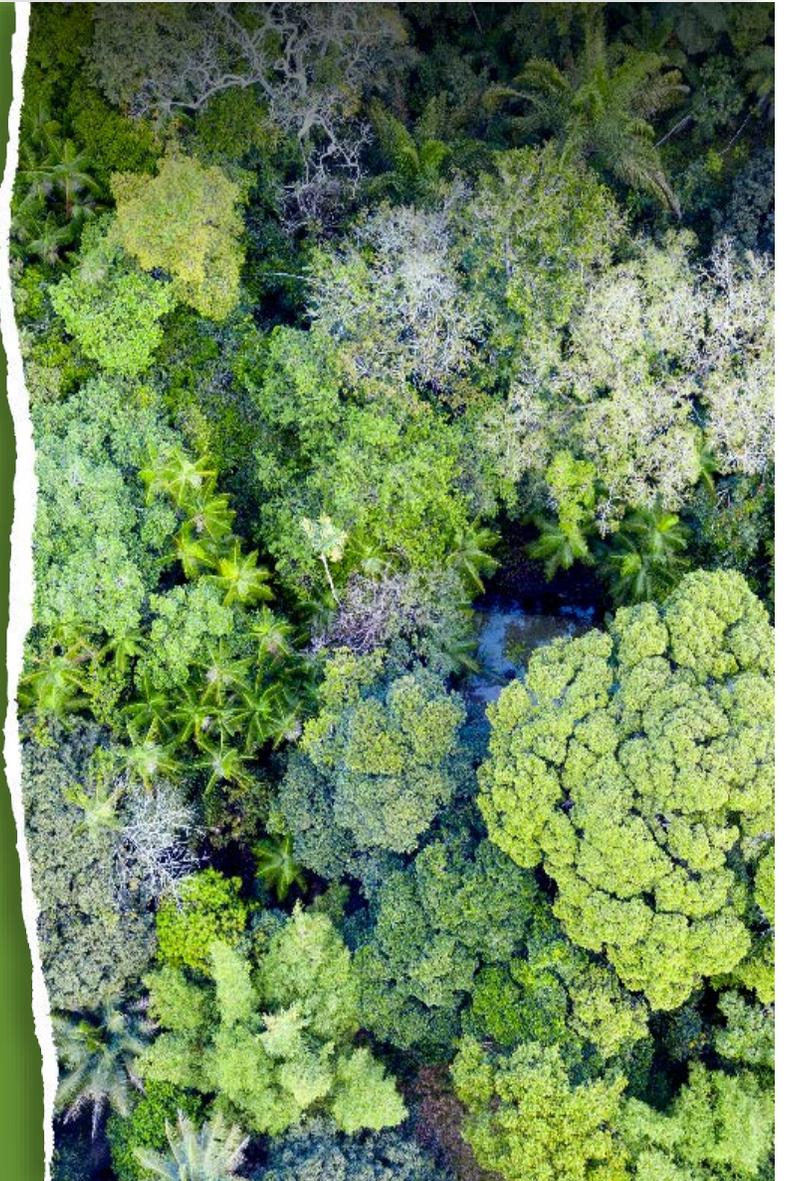
**Mobilize our people for environmental sustainability**

By promoting an environmentally-conscious culture in the workplace



**Engage our suppliers in our environmental ambitions**

By sourcing responsibly and leading by example



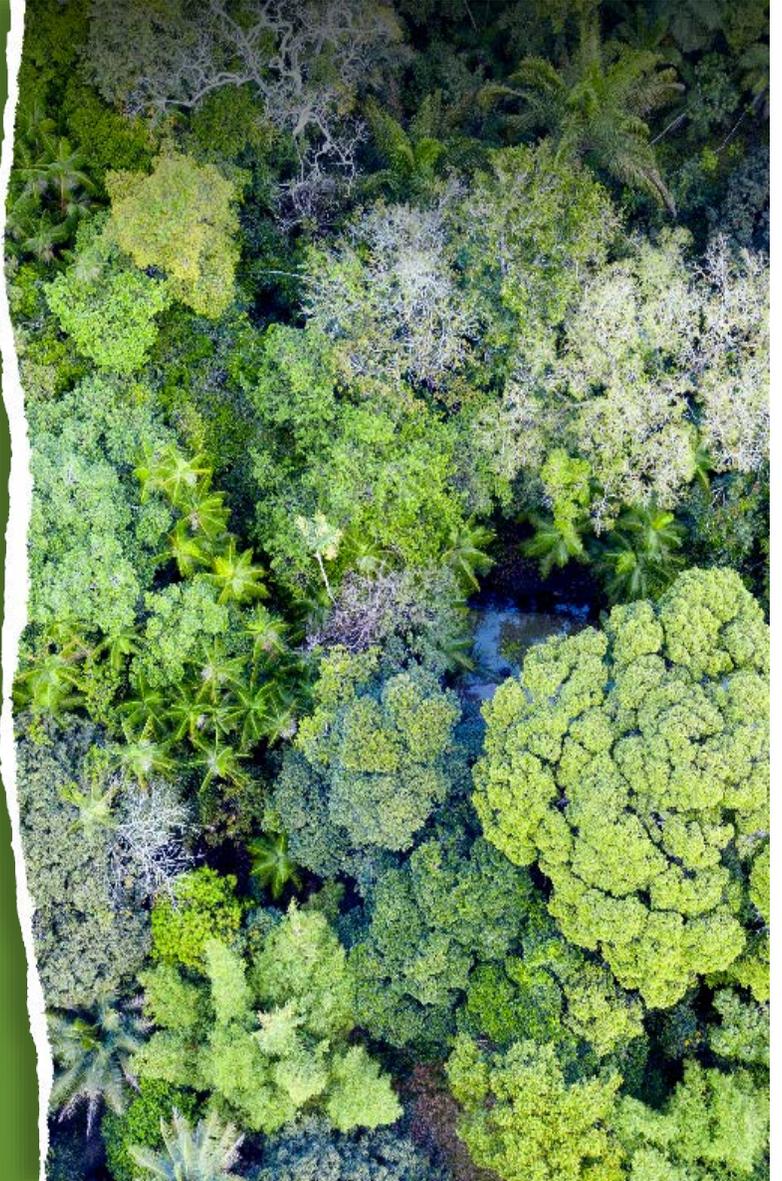
# Our 5 environmental commitments



PI will be at the heart of our environmental commitments

Delivering roughly 3000 environmental parameters from our plants & facilities cleaned and contextualized before passing through our streaming engine into the datalake.

There it will be further analyzed, and diagnostics will be performed on the data. Keeping our plants in optimal condition and exposing areas for improvement.



**Information is the oil of the 21st century, and  
analytics is the combustion engine**

**Peter Sondergaard**

THANK YOU

謝謝

DZIĘKUJĘ CI

NGIYABONGA

TEŞEKKÜR EDERİM

DANKIE

TERIMA KASIH

GRACIES

WHAKAWHETAI KOE

DANKON

TANK

TAPADH LEAT

SALAMAT

SPASIBO

GRAZIE

MATUR NUWUN

ХВАЛА ВАМ

MULŢUMESC

PAKMET CIZGE

고맙습니다

GRAZIE

شكرا

FAAFETAI

ESKERRIK ASKO

GO RAIBH MAITH AGAT

HVALA

HVALA

БЛАГОДАРЯ

GRACIAS

MAHADSANID

TI БЛАГОДАРАМ

TEŞEKKÜR EDERİM

TAK DANKE

DANKJE

EΥΧΑΡΙΣΤΩ

GRATIAS TIBI

OBRIGADO

MAHALO IĀ 'ŌE

TAKK SKALDU HA

МЕРЦИ

RAHMAT

MERCI

GRAZZI

PAKKA PÉR

ありがとうございました

DI OU MÈSI

ĎAKUJEM

HATUR NUHUN

PAXMAT CAĜA

SIPAS JI WERE

TERIMA KASIH

CẢM ƠN BẠN

UA TSAUG RAU KOJ

TI БЛАГОДАРАМ

СИПОС

WAZVIITA

FALEMINDERIT



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