Sigmafine analyses for the PI System improve accuracy in process and supply chain management

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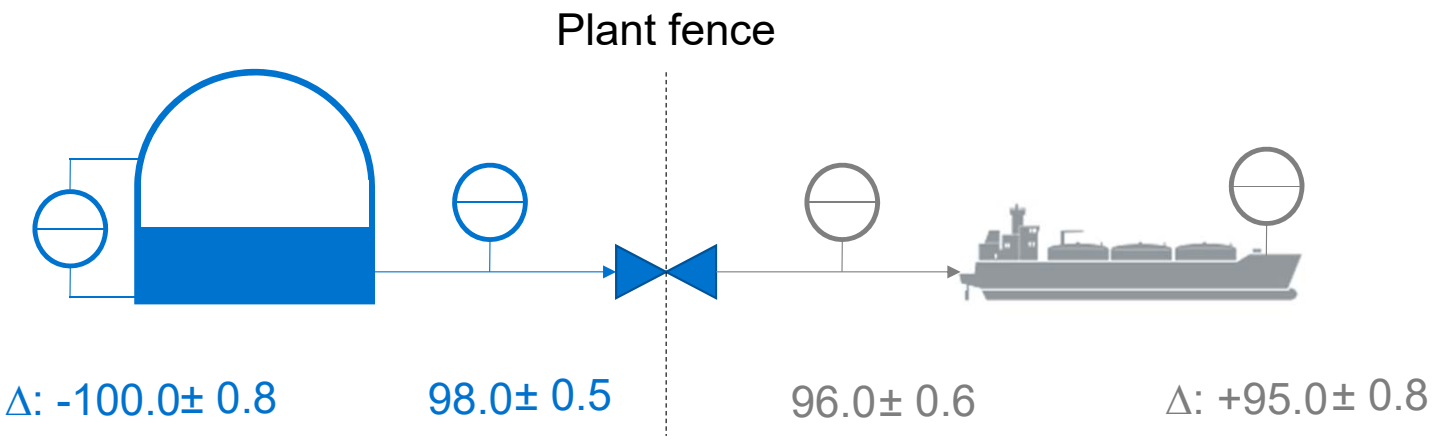
Accuracy: who is right?



What is a fair value for both seller and buyer?

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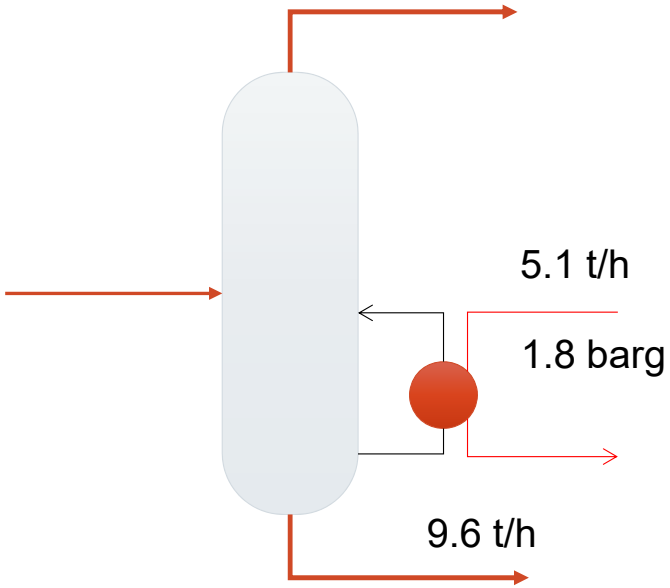
Accuracy matters when evaluating KPIs

Specific energy consumption per ton of valuable product

Product rate	9.6 t/h	±1.5%
Steam rate	5.1 t/h	± 2.5%
Steam latent heat	2168 MJ/t	± 0.5%
Specific consumption	1152 MJ/t	± 3.0%



What can be done to improve KPIs' accuracy?

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A path towards better accuracy

Accessibility

PI System archive

From multiple data sources to one data lake

Contextualization

PI Asset Framework

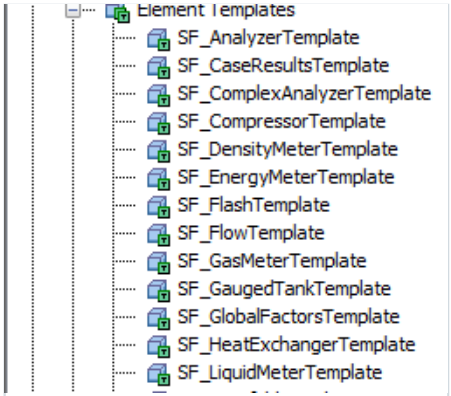
Data are structured in operational assets

Reconciliation

Sigmafine

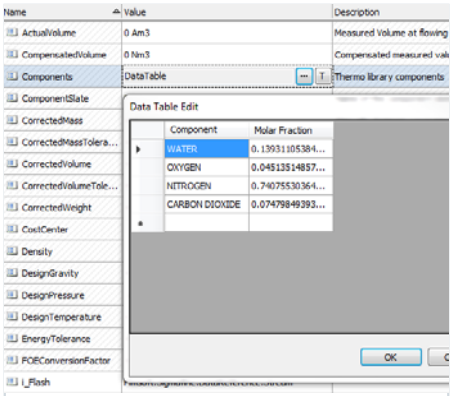
Assets are related together in a model and reconciled

Sigmafine provides modeling capabilities plugged in the PI Asset Framework



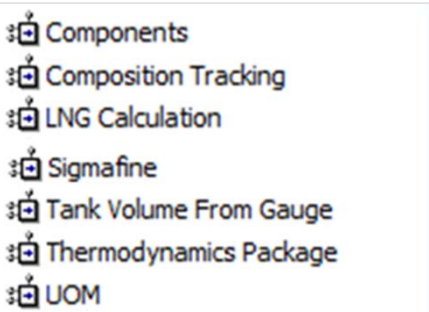
Templates

Ready made template for equipment, tanks, meters,…



Elements

Assets are joined together in a model



Data references

Data preparation such as meter and inventory compensation, thermodynamic calculations, etc.

Analyses

PI AF capabilities are extended with model based data reconciliation and tracking

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Sigmafine Overview

Data Reconciliation

Mass, Volume, Energy, Component

Tracking & Genealogy

Material, Ownership, Physical properties, Business categories

Asset Database

Fully configurable and expandable

Scalable in size

From 250 to 25000 assets

Scalable in resolution

Hourly (or less), daily, monthly, on event

Seamless Integration

PI system, Planning/Scheduling systems, Movement systems, ERPs, Business Intelligence

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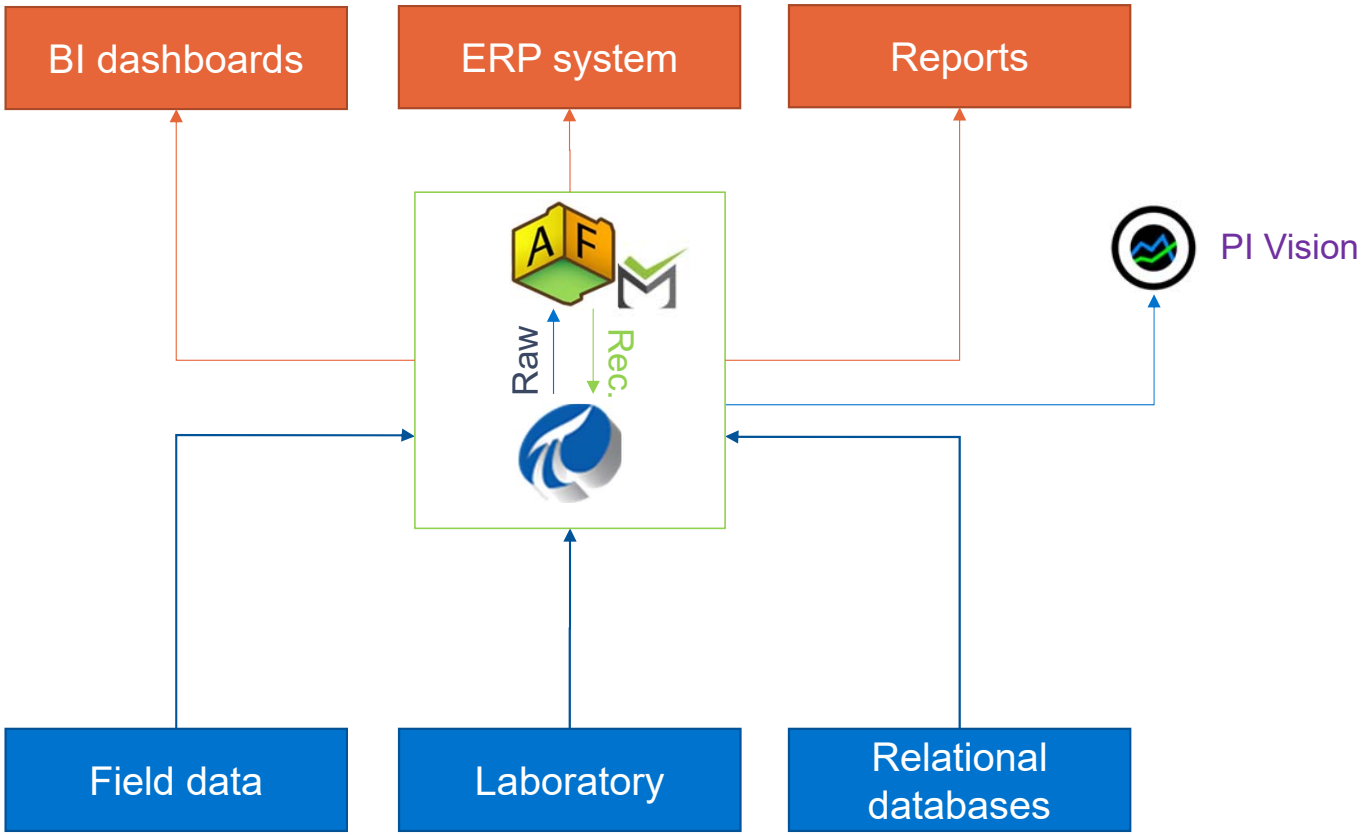
Typical Architecture



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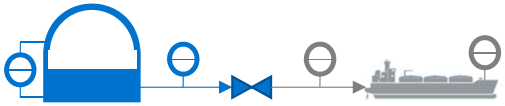
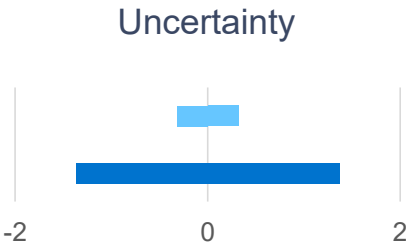
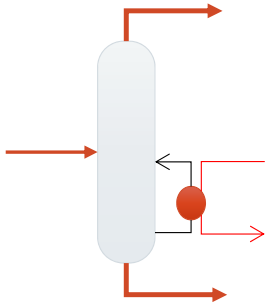
Sigmafine answers the accuracy problem



System uncertainty: **97.2 ± 1.37**

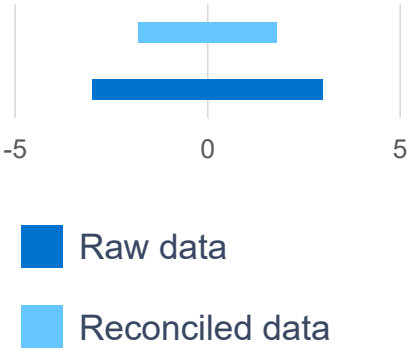
A fair value is **97.3± 0.32**





KPI uncertainty: **1152 ± 3.0%**

Reconciled KPI: **1096 ± 1.8%**



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Use case #1

Improve energy monitoring of an ethylbenzene-styrene purification column

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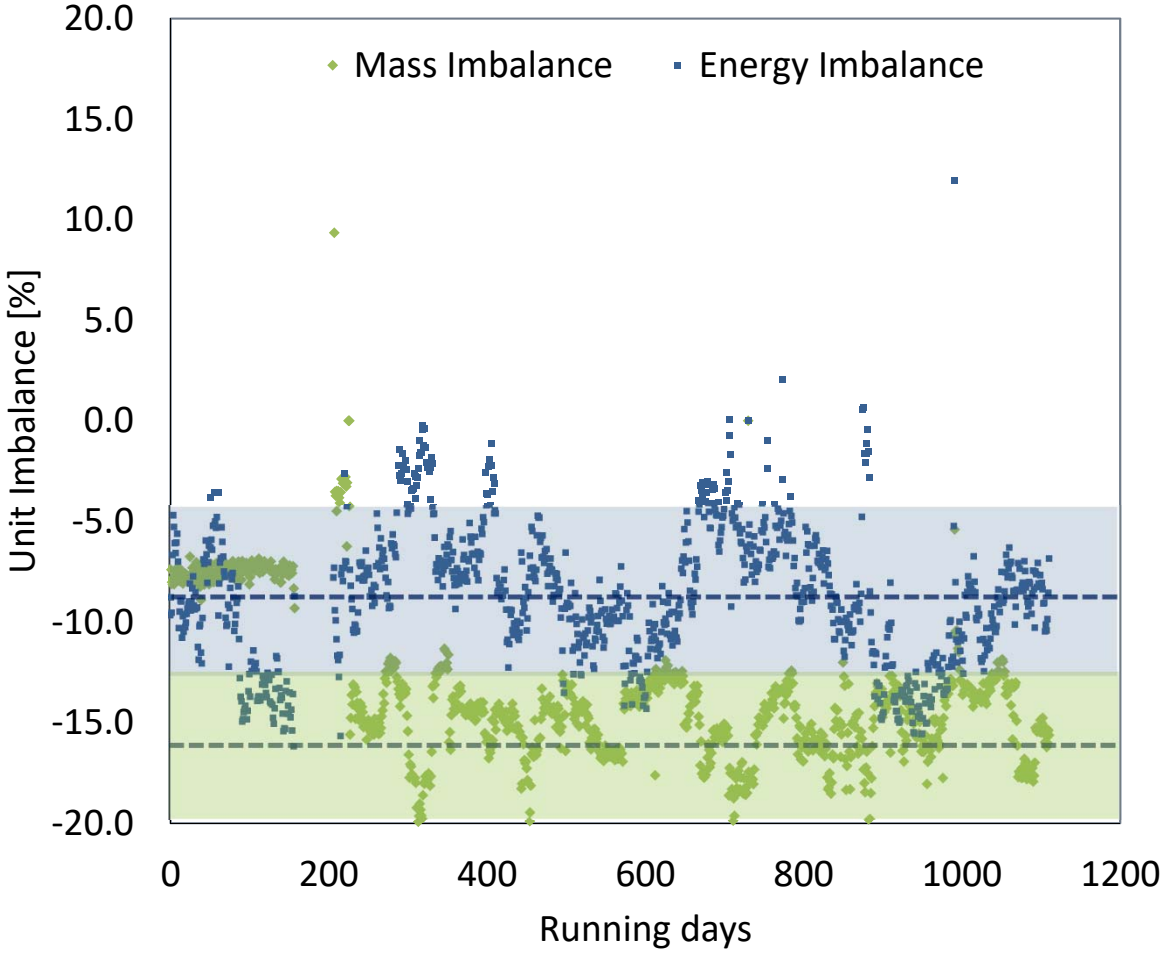

Ethylbenzene-Styrene purification column

KPIs

- Purity of top and bottom distillate
- Steam consumption at reboiler

Biased data

- Mass imbalance: -14.9%
- Energy imbalance: -8.3%

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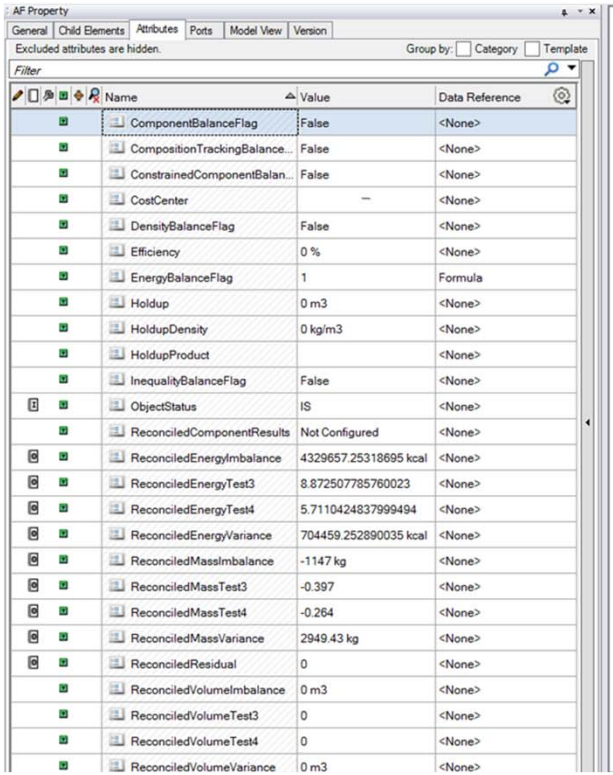
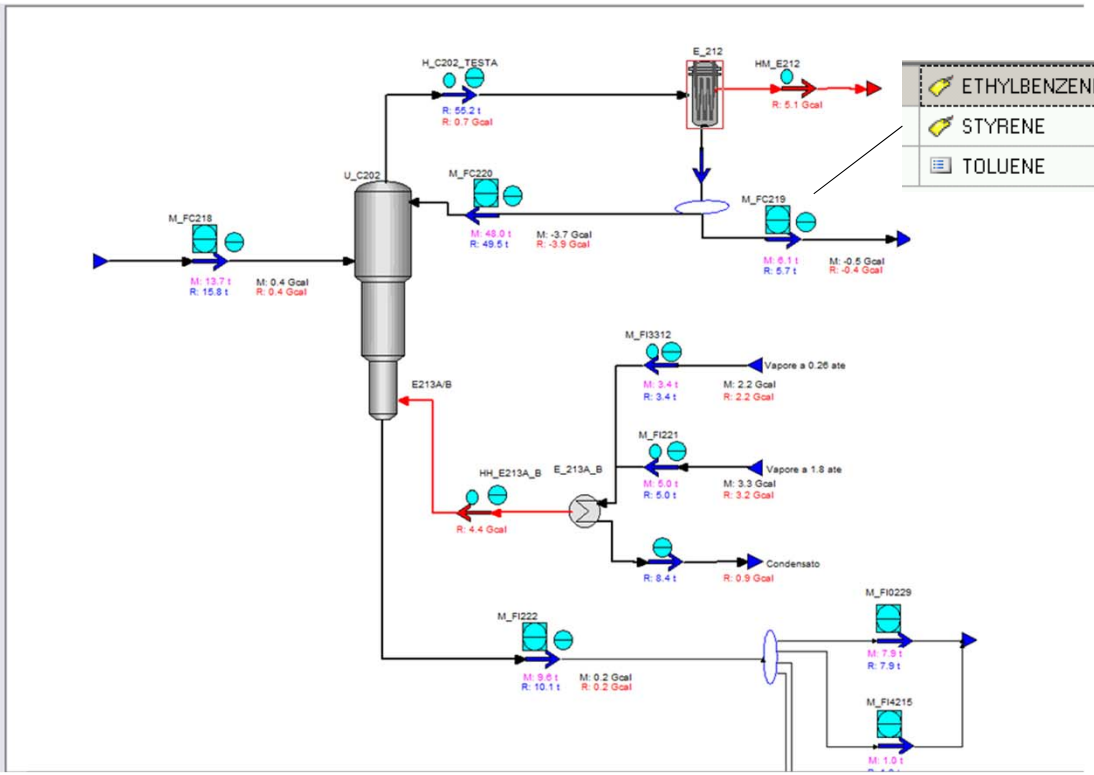
Sigmafine model building blocks are PI AF assets





ETHYLBENZENE	96.4500858825207 %
STYRENE	2.00479501481185 %
TOLUENE	1.54511910266746 %

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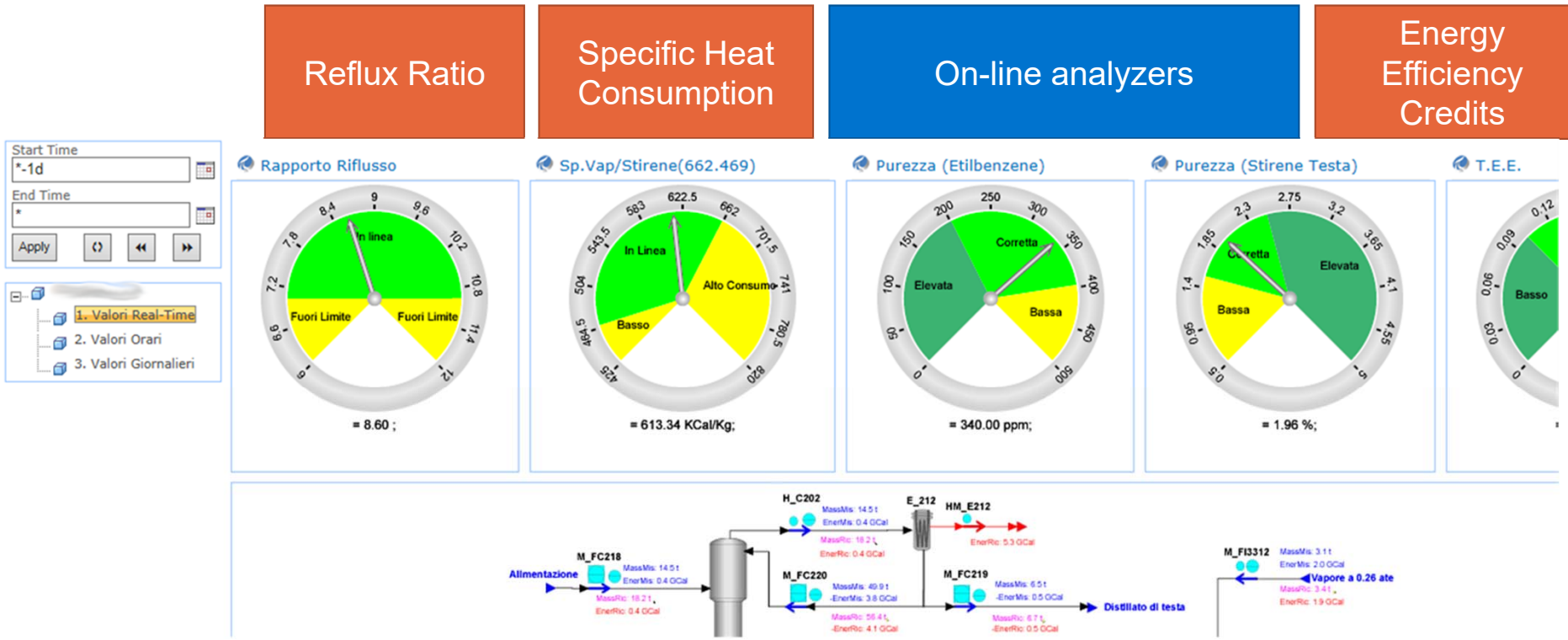
Sharepoint based dashboard integrating PI system data and Sigmafine results



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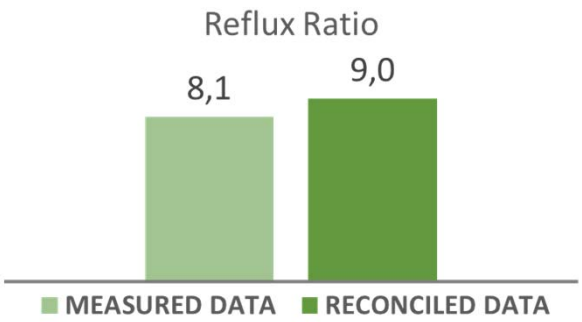
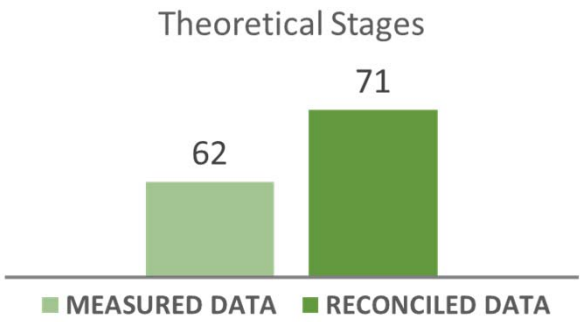
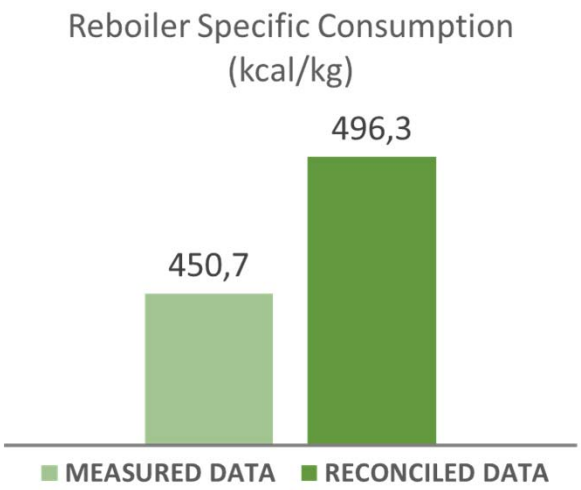
Comparison of raw and reconciled based KPIs







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CHEMICALS

Model based performance monitoring

Challenge

Improve monitoring and KPIs accuracy of the most energy intense equipment in the facility

Solution

Analyse and reconcile raw data through Sigmafine asset based model and Thermodynamic app for the PI system and publish results in PI and on a web dashboard

Benefits

Identified over-consumption of steam by reboiler in the range of 2000€/day

Increased accuracy associated to EnPIs required within the ISO 50001 framework; 6500€/day of creditable EECs*

*Assuming an Energy Efficiency Credit value of 100€

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Use case #2

Infer composition, monitor yield and improve supply chain of an aromatic plant

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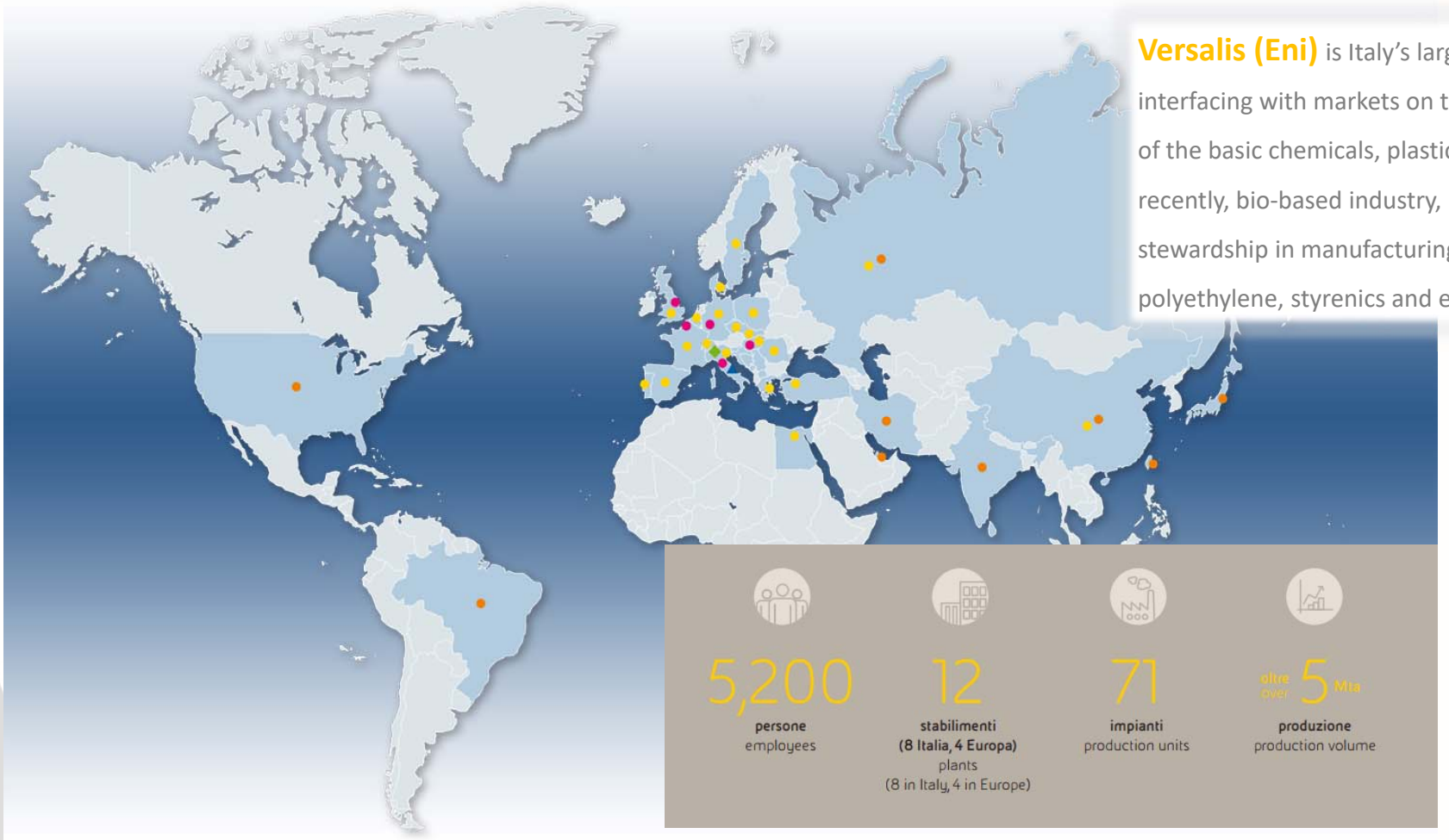
Eni Chemicals, Versalis



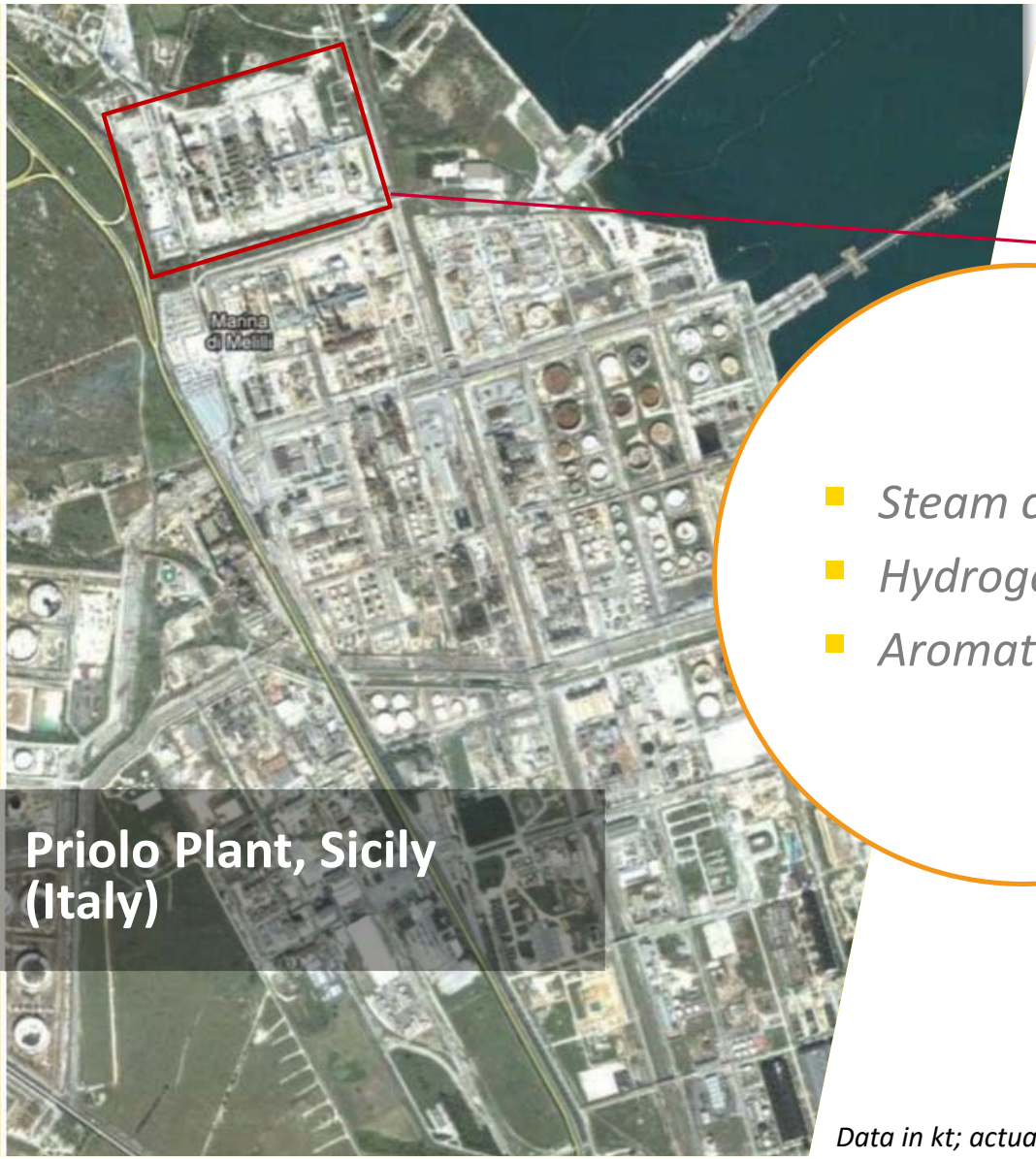
Versalis (Eni) is Italy's largest chemical company interfacing with markets on the international scene of the basic chemicals, plastics, rubber and, recently, bio-based industry, holding market stewardship in manufacturing intermediates, polyethylene, styrenics and elastomers

5,200	12	71	oltre / over 5 Mta
persone employees	**stabilimenti (8 Italia, 4 Europa)** plants (8 in Italy, 4 in Europe)	**impianti** production units	**produzione** production volume

The two data pillars of the MES infrastructure

PI System	Sigmafine

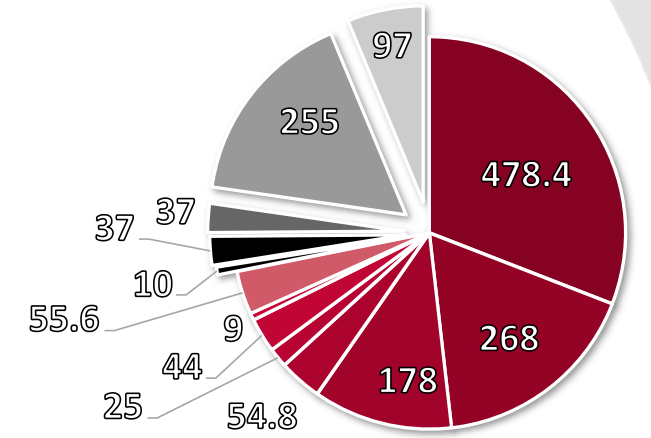
- *Both Distributed and Centralized data infrastructure*
- *Production accounting*
- *Daily reconciliation and monthly aggregation*
- *Inventory checks and bill of material validation*
- *Auditing data chain (raw value, user validation, reconciled figure)*
- *Automatic Email notification*
- *Advanced algorithms (e.g. quality tracking)*



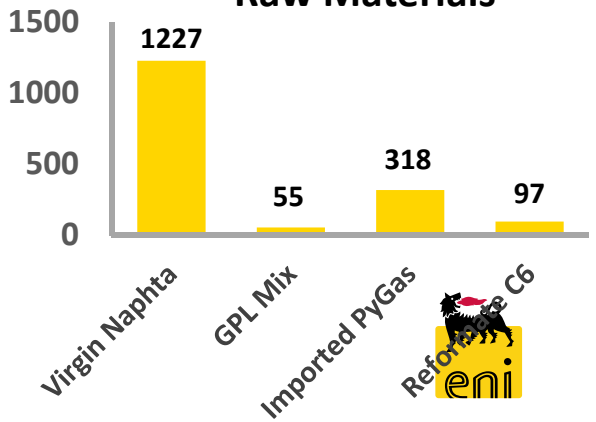
Priolo Plant, Sicily (Italy)

- *Steam cracking*
- *Hydrogenation*
- *Aromatic plant*

Productions



Raw Materials



Data in kt; actuals 2016; source: eni versalis

Main target

Daily Plant efficiency monitoring

- Daily monitoring of plant efficiency and yields to spot inconsistencies between expected and actual yields, resulting a faster and timely response and action

Accurate daily inventories and consumption

- Get accurate daily inventories and consumption by material to update ERP material movements

Strong correlation between material qualities and plant efficiency & production data

eniversalis

Data quality related issues for Aromatic plant

automated monitoring of unit feed quality

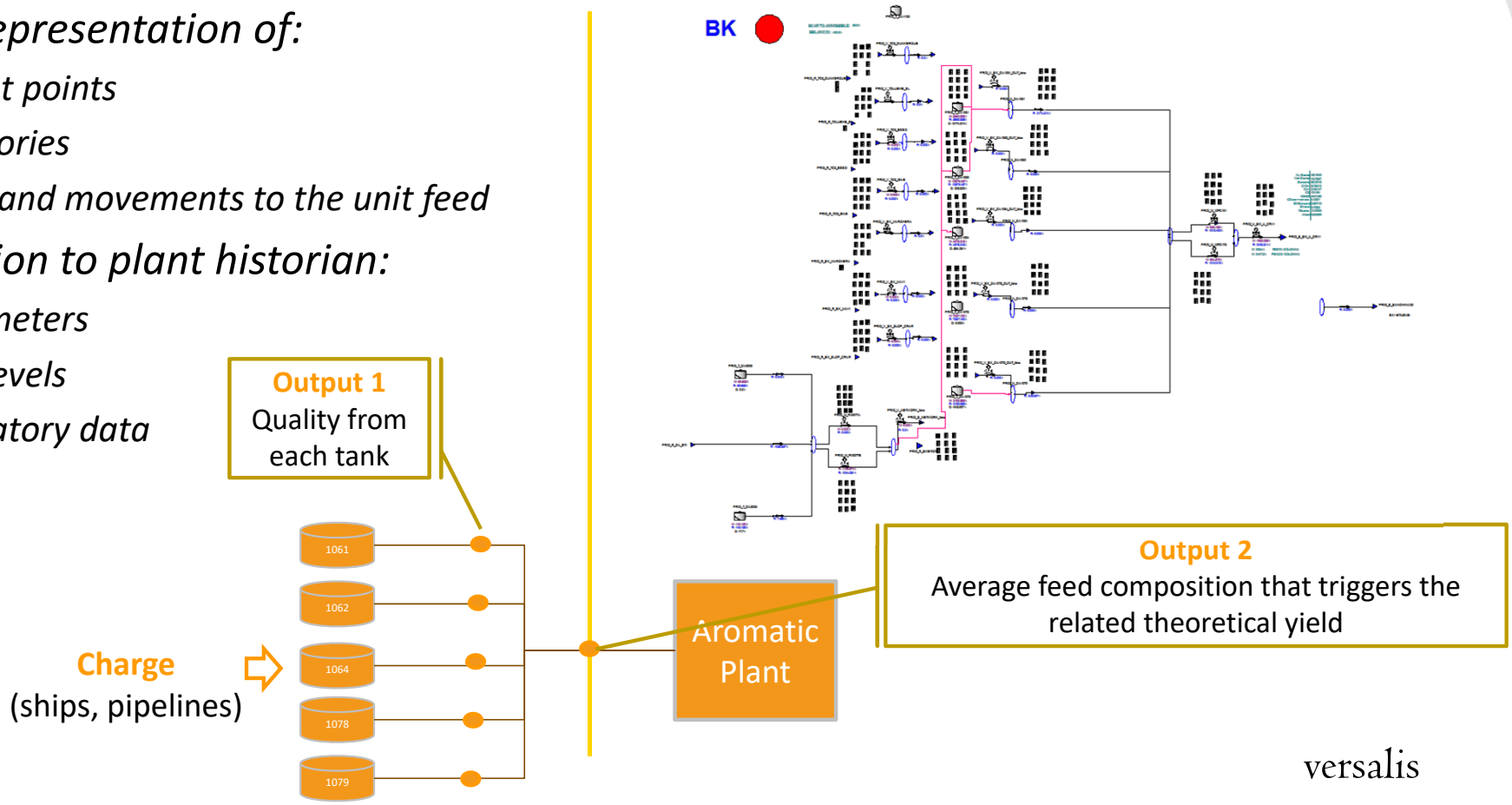
Data unavailability

- Data regarding material qualities was available in different systems (even on paper record) and not integrated into one system
- Original balance system did not include daily quantity and composition of feeds → no relation between plant flow data and material properties
- Monitoring was done off-line and limited by manual effort in retrieving data day by day, feeding a spreadsheet

Need of an automated solution that tracks most important qualities of the feed at least on a daily basis and related to actual plant data

Solution based on Sigmafine Quality Tracking for Aromatic Plant

- *Model representation of:*
  - *Receipt points*
  - *Inventories*
  - *Flows and movements to the unit feed*
- *Connection to plant historian:*
  - *Flow meters*
  - *Tank levels*
  - *Laboratory data*



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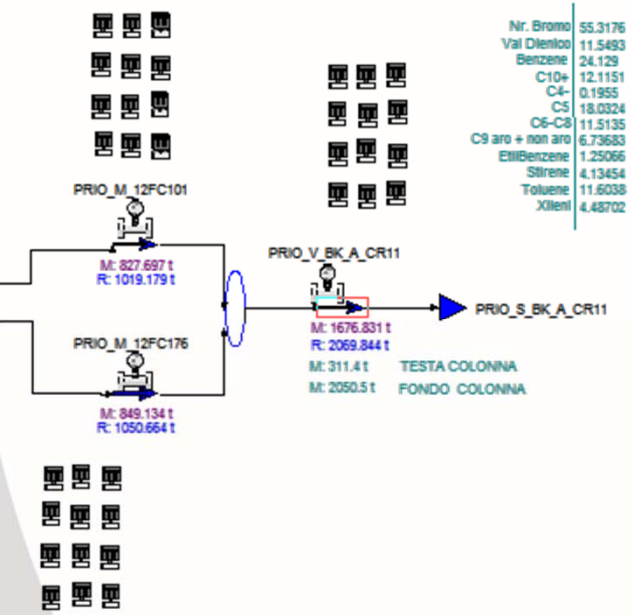
Calculated qualities at plant feed point



Overall Qualities at feed point

Data Table Ec

	Sequence	Quality	Valu
▶	1	NrBromo	55.3
	1	pBenzene	24.1
	1	pC10	12.1
	1	pC4	0.19
	1	pC5	18.0
	1	pC6C8	11.5
	1	pC9	6.73
	1	pEtilBenz	1.25
	1	pStirene	4.13
	1	pTolu	11.6
	1	pXileni	4.48
	1	ValDienico	11.5
*			

Detailed Qualities by material

Material	Quantity	Quality	Value
C6 SAT.	41893	NrBromo	0
C6 UNSAT.	35265	NrBromo	30,7
C6 SAT. EXT	9901	NrBromo	0
BK NON HYDR	1626002	NrBromo	60,9
BK RESIDUE	356782	NrBromo	39,9
C6 SAT.	41893	pBenzene	36,5
C6 UNSAT.	35265	pBenzene	71,4
C6 SAT. EXT	9901	pBenzene	0
BK NON HYDR	1626002	pBenzene	28,1
BK RESIDUE	356782	pBenzene	0,49
C6 SAT.	41893	pC10	0
C6 UNSAT.	35265	pC10	0
C6 SAT. EXT	9901	pC10	0
BK NON HYDR	1626002	pC10	13,1
BK RESIDUE	356782	pC10	10,3
C6 SAT.	41893	pC4	0

versalis

Daily business value from Quality Tracking

Run **Quality Tracking**

Read input data

Cross check with planning (consumptions & shipping)

Get expected unit yields **in near real time**

- Reliable estimation of monthly production and average unit efficiency before month closure

Improve selling, shipping and get near-real time action

- Maximize ship loading
- Reduce demurrage cost
- Optimize logistics
- Enabling operations to take action to fix production inefficiencies on time

CHEMICALS

Improve supply chain management

Challenge

Provide accurate inventories and plant yields to both improve operations and supply chain management

Solution

Deployed PI system to aggregate process and lab data and introduced Sigmafine Quality tracking to infer material composition and qualities when lab data are not available

Benefits

Reliable estimation of monthly production and average unit efficiency before month closure

Supply chain improved by changing the focus from monthly to daily operations, thus taking timely actions

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Some final thoughts…

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