



PI System (and PI AF) – Enabling Business Transformation

The Journey from Refinery Business Unit to Group Downstream Level...and the Enterprise

Presented by **Tibor Komróczki (remote)**
Craig Harclerode O&G Industry Principal



MOL Group Downstream

6 production units

~500KBPD refining capacity

2.1 mtpa petrochemicals capacity

>1,900 filling stations

under 8 brands in 11 CEE

370 000 PI Tag capacity in 4 PI systems

Extensive use of PI AF

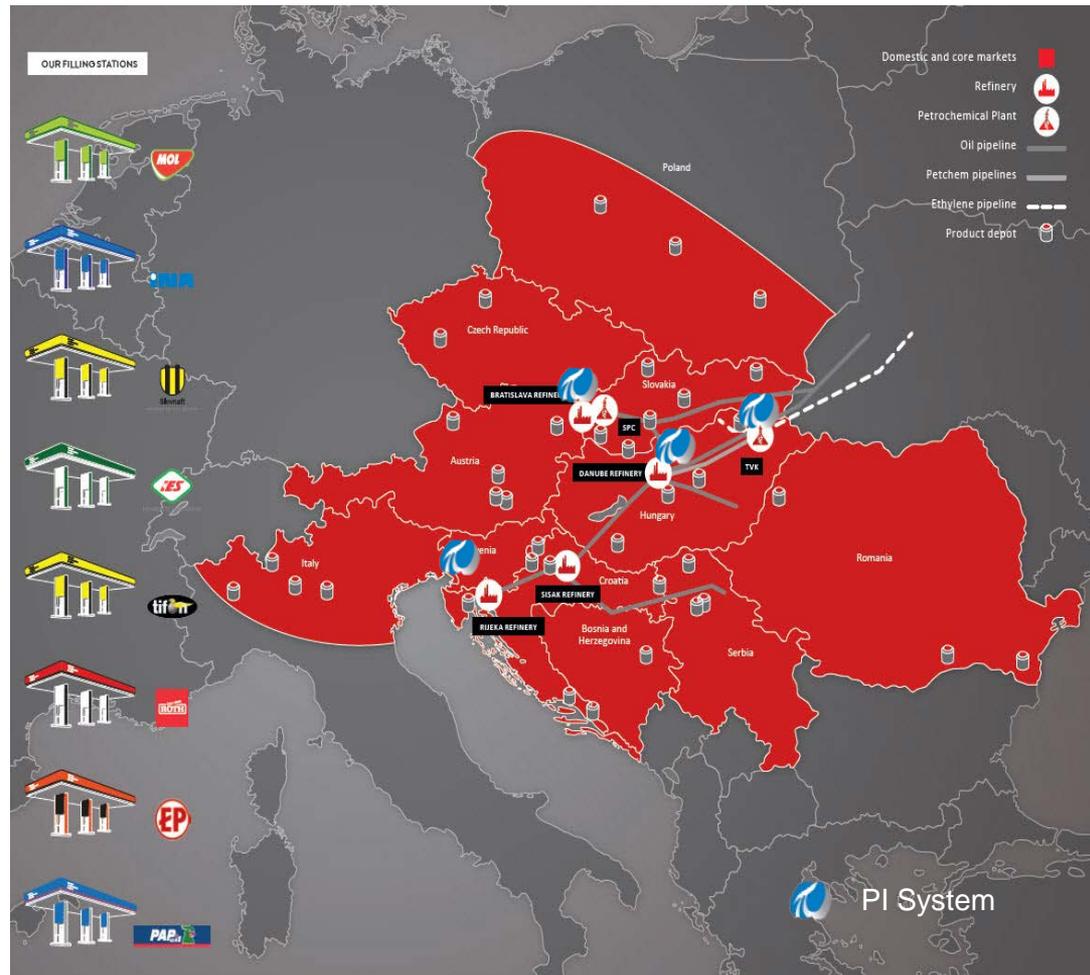
> 6 500 Elements

70 Element templates

30 Event Frame templates

11 Notification templates

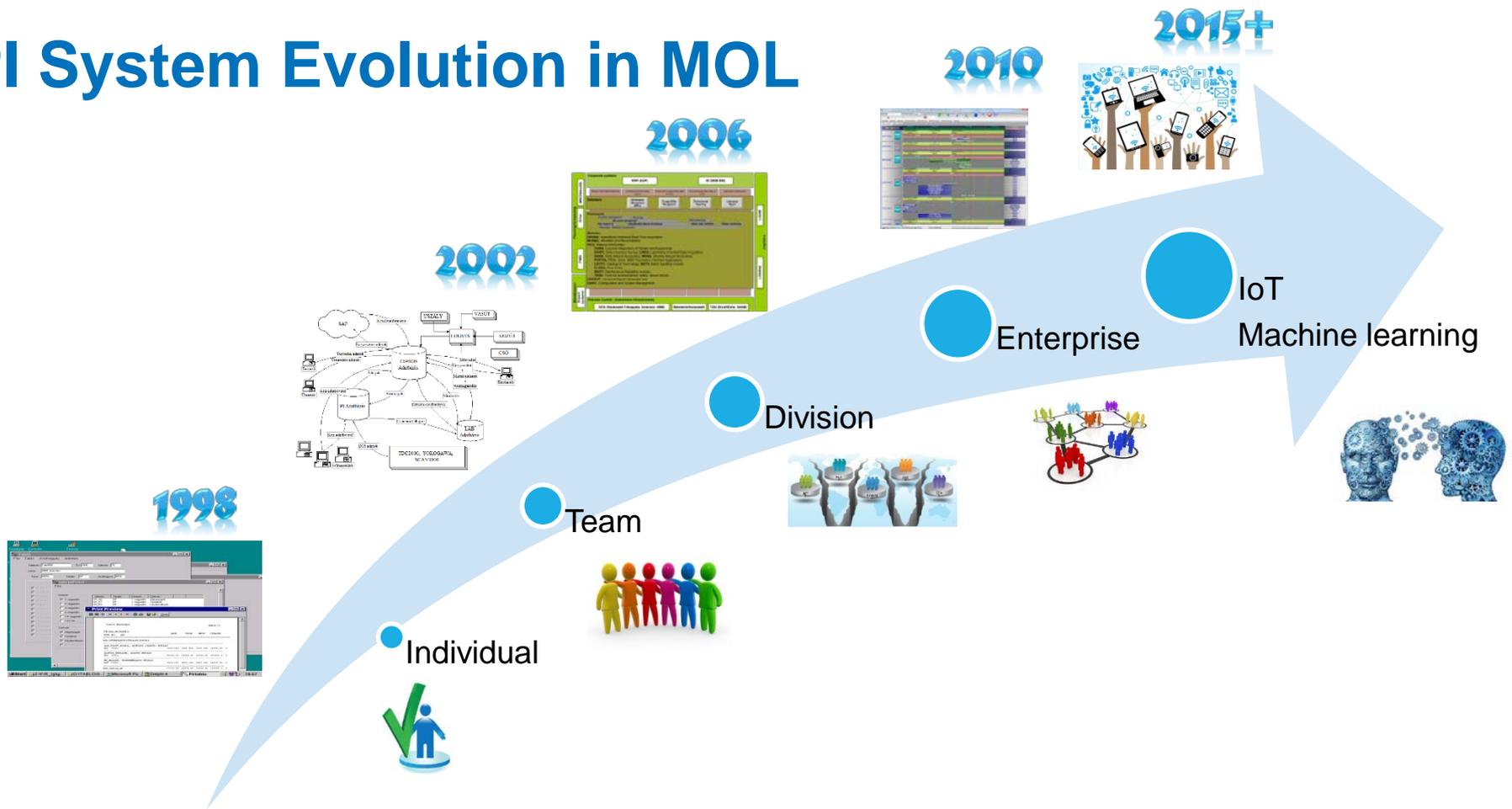
~ 105 000 Attributes



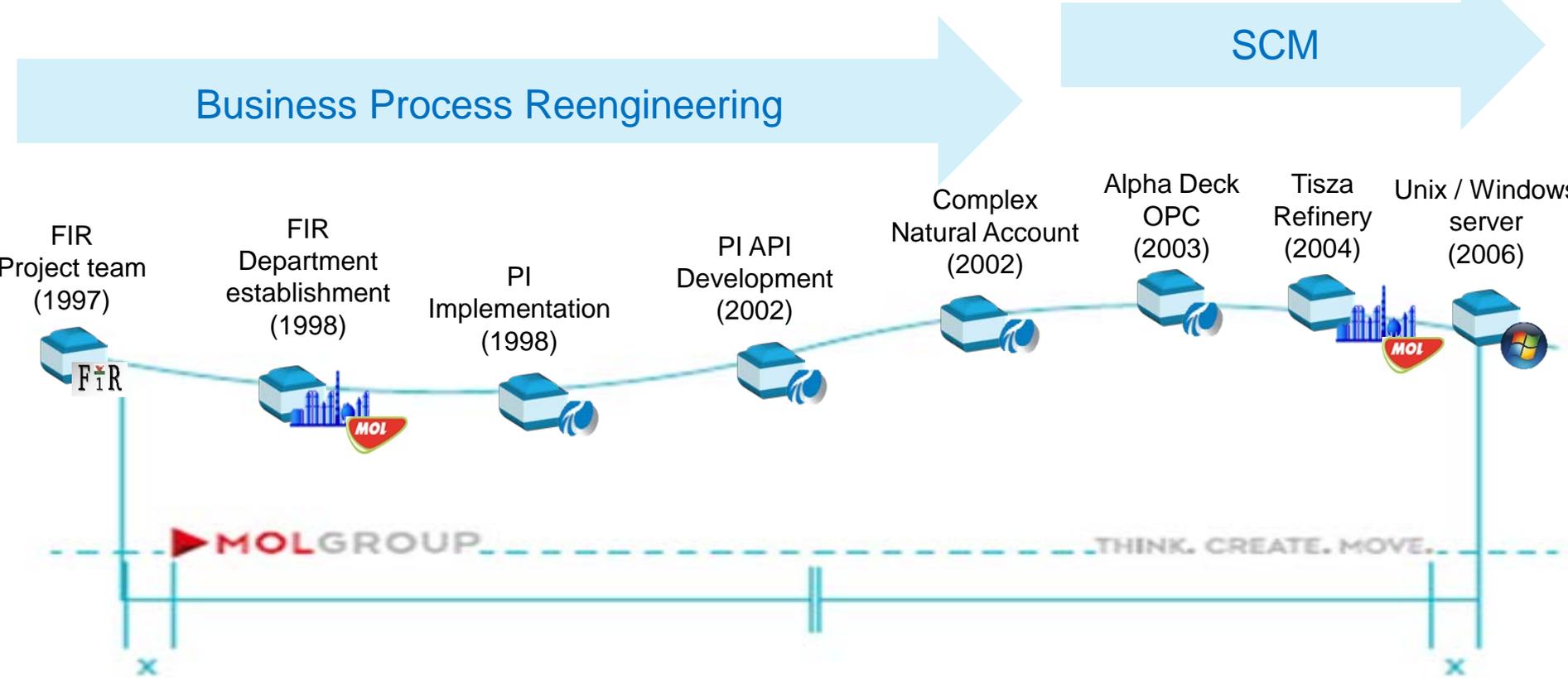


PI System Journey

PI System Evolution in MOL

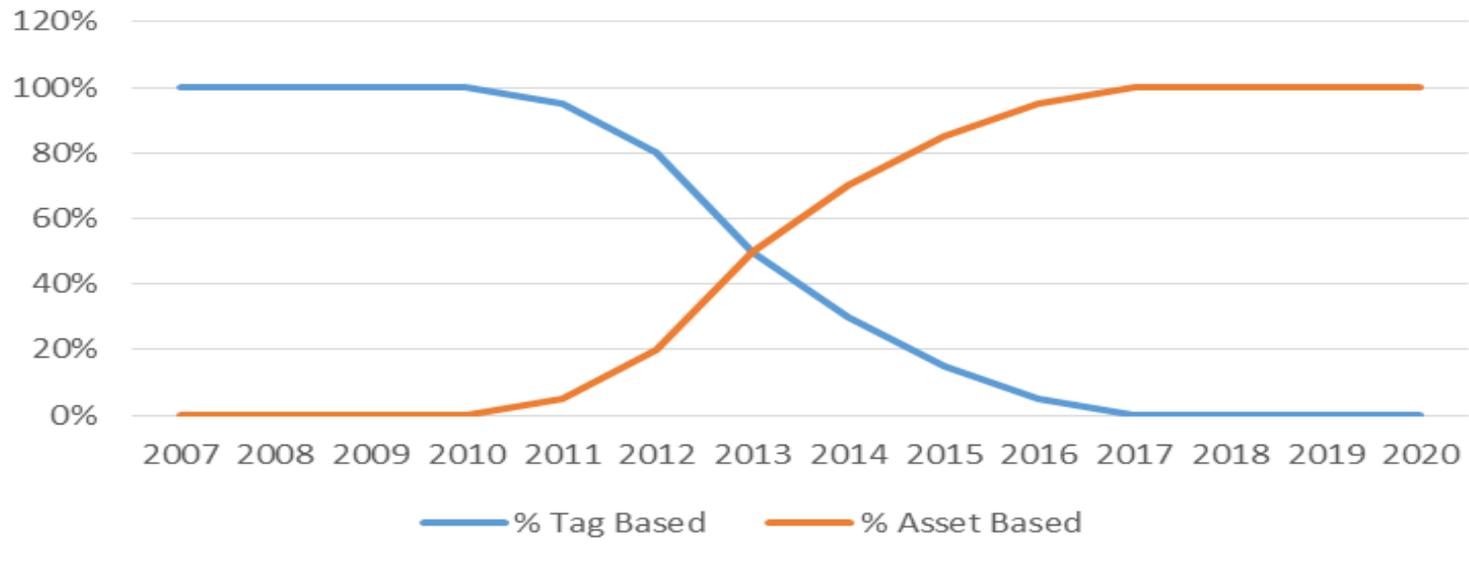


MOL Downstream / History I.



MOL Downstream / History II.

Estimate of the % Primary Use of the PI System in Analytics & Visualization in MOL Downstream



Visi

Slovnaft (2007) Rt V



ogram

SN Upgrade (2015)



Tag Based

Asset Based

Focus areas of New Downstream Program (NDP)

NDS is targeting \$500M-550M EBITDA improvement by 2016



MOL Downstream PI AF Based Applications

Safety and Asset Integrity

- Interlock statuses
- Operating envelopes
- Corrosion control (HTHA)
- Alarm management
- Control rooms' temperature

Energy

- Energy Monitoring and Management
- Energy KPI breakdown (6 tiers)
- Column Energy Efficiency Dashboards
- Hydrogen, Utilities, and Energy balances
- Flaring

Yields

- Crude Blending Control
- Yield Optimization/Reporting
- Product Quality
- Analyser Reliability

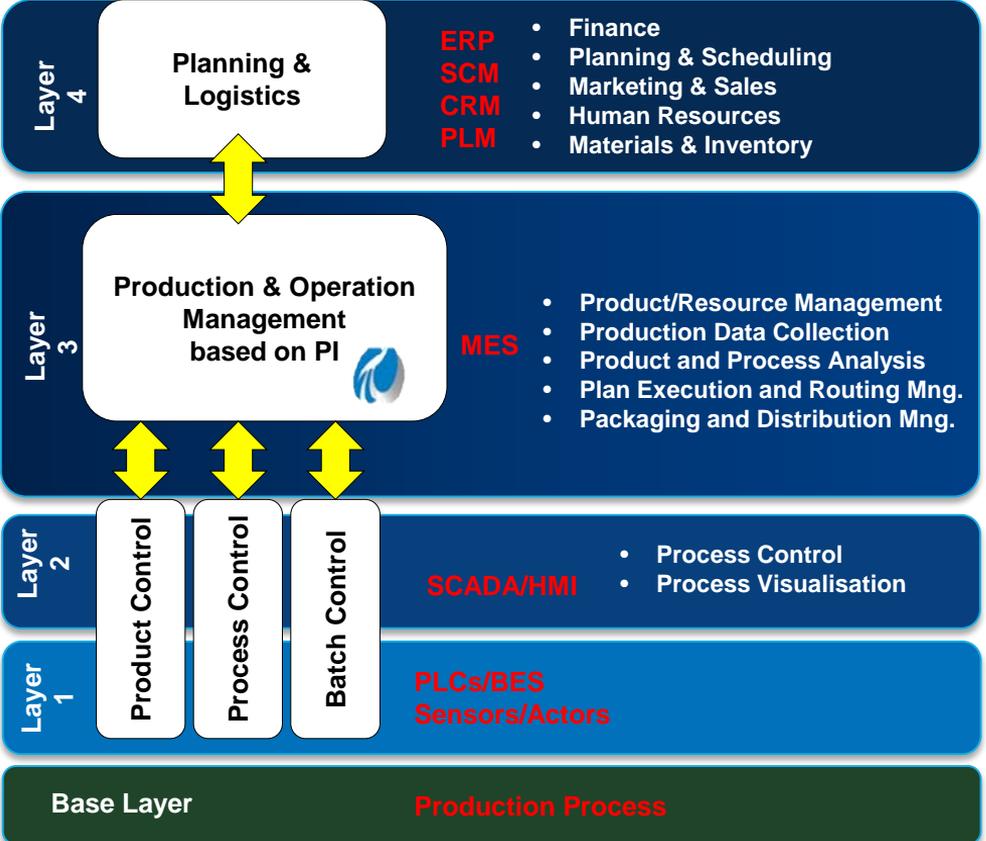
Operational Optimization

- Plan vs Actual Analytics with Future Data
- NG and Fuel Demand gas forecasting
- Peak Electrical forecasting
- Normal mode of control loops
- APC monitoring
- PI AF and Sigmafine (PI AF) used for yield accounting & Material Movement



Integration

MES Standardization in MOL Group level



Separate group and local level responsibility

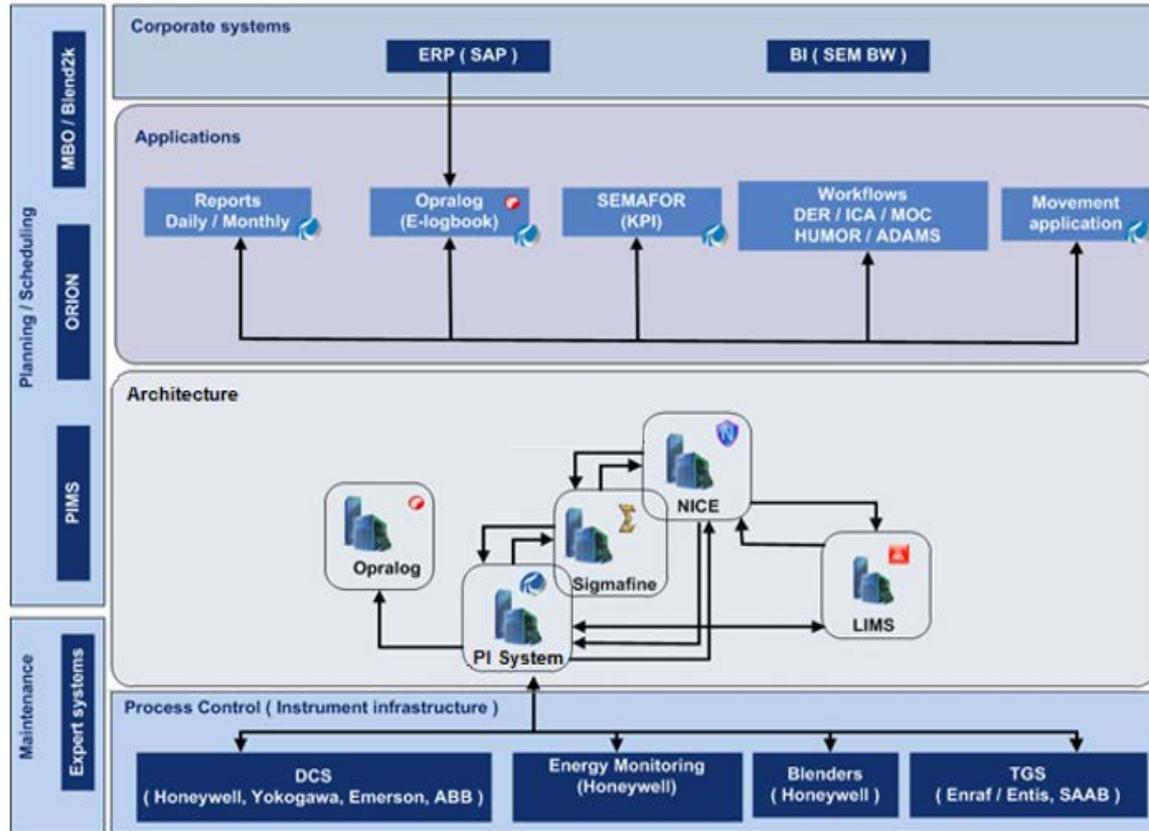
Determine standardization goals according to common principles

Establish unified software architecture based on PI system

Ensure equivalent PI system structure in MOL Group refineries

Create efficient contract management system with vendors (PI System as an Infrastructure)

Danube Refinery MES portfolio



Software components

PI System – **(PI AF is key)**

Sigmafine(PI) (Reconciliation)

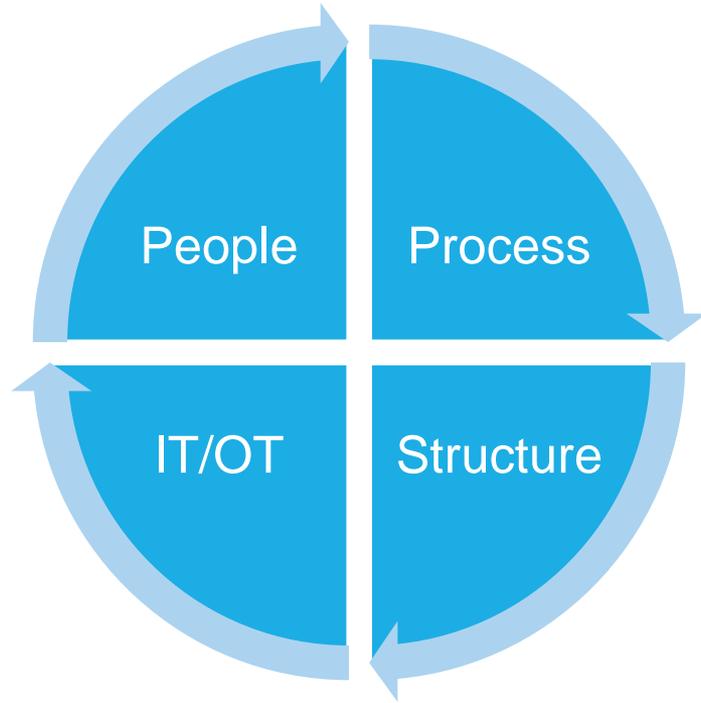
LIMS (Laboratory)

Opralog (E-logbook)

SEMAFOR (KPI system)

NICE (Natural Info –center)

MES integration efforts - A Change Management Effort



Main objectives

Shape the strategy via four domains

Merge Business and IS project goals

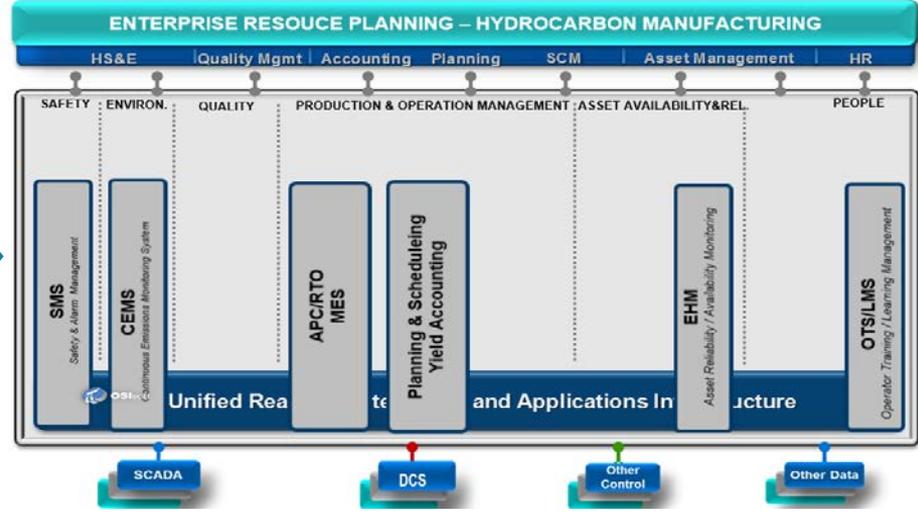
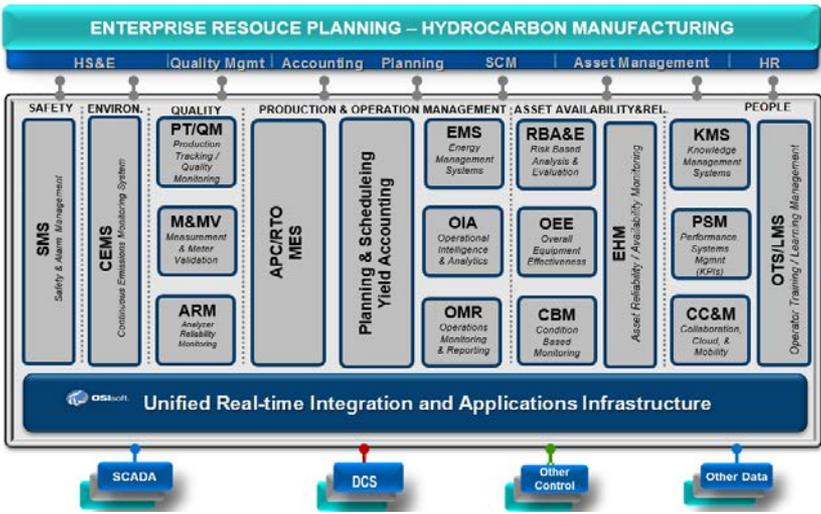
Share ideas and resources

Create long term plan

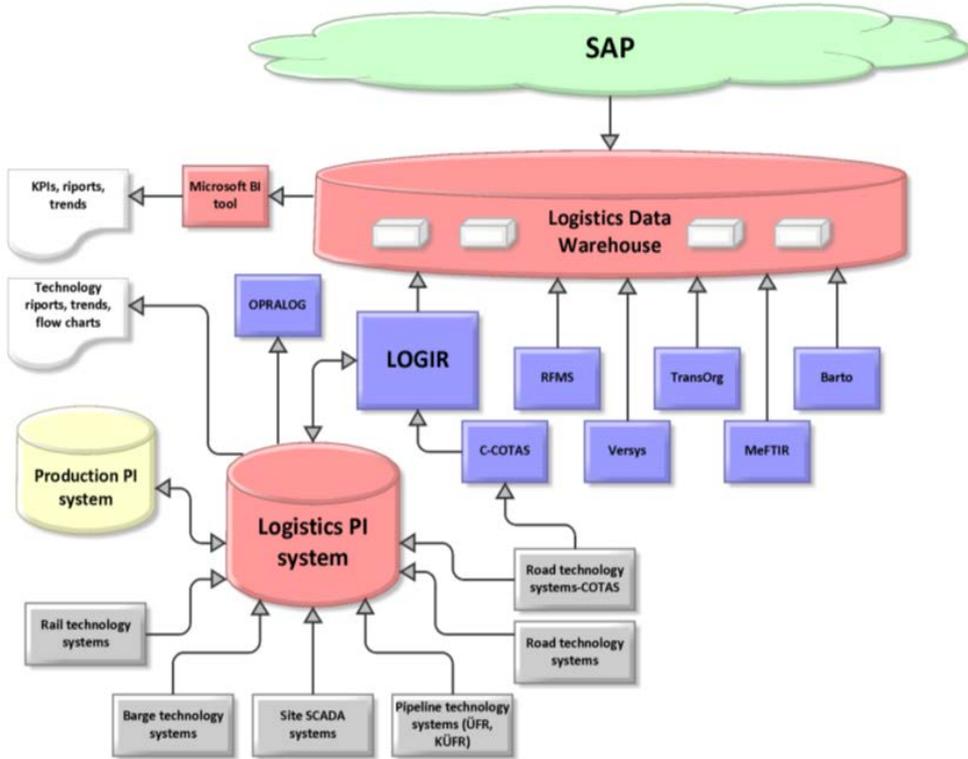
Involve the following areas:

Downstream, SCM, HSE, Logistic

Production (Refinery & Petchem) & Logistic standardization



MOL Logistics - Fuels Value Chain Integration



Project initiations

Visualizing and monitoring logistics outside of SCADA

Supporting preventive maintenance and asset reliability

Ensuring KPI measurement across the fuels value chain

Notification of events

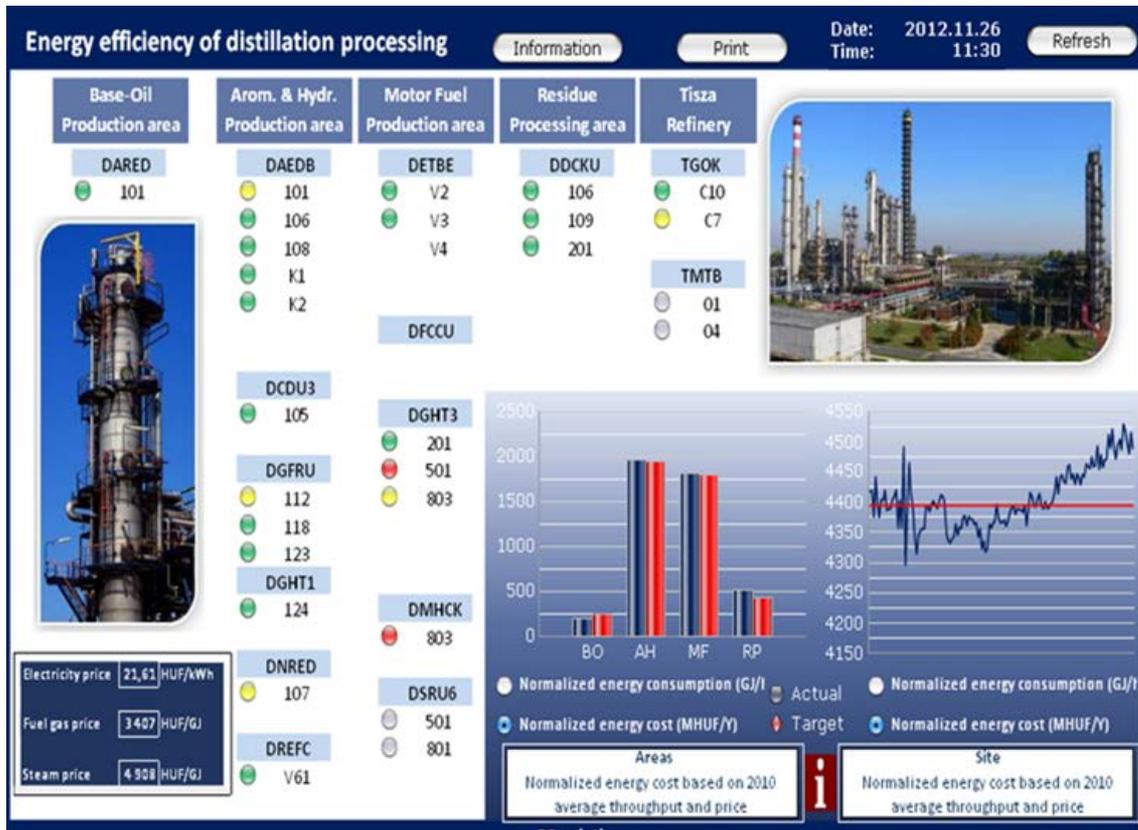
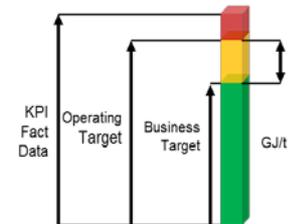
Holistic Inventory management and Optimization including MBST*

* MBST = Make-Buy-Sell-Trade Decision support

Business Value Leveraging the PI System & PI AF



1- Energy Monitoring & Reporting



Benefits

Continuous monitoring of the parameters

Normalized, unified, and quality information leveraging PI AF

Easy maintenance and Governance of the PI AF templates

Structured format

Increased production as a result of improved energy and environmental constraint visibility and forecasting

Templates of the Energy KPI System

- The structure of the Energy KPI System is based on element templates
- The parent and child elements are linked to each other
- The templates include the basic energy calculation

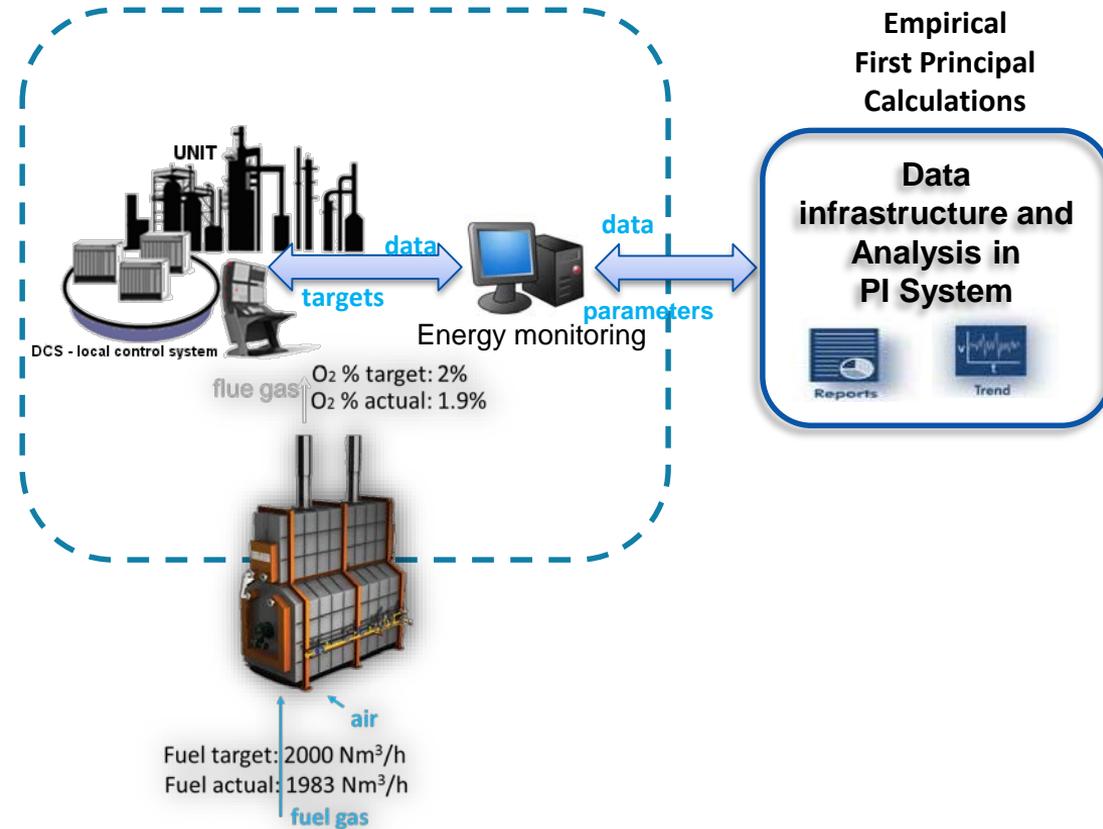
The screenshot displays the Energy KPI System interface. On the left, a hierarchical tree shows the structure of the system, starting with 'Energy KPI System' and branching into various units and processes, including 'Dunai Finomito', 'Aromas es Energiaszolgaltas', and 'Desztillacio'. The 'DAV2 Futoanyag Fogyaszas' element is highlighted. Below the tree, a list of elements is shown, including 'Energy Monitoring', 'EzItEgyTeszt', 'Flare Monitoring', 'Interlock Monitoring', 'IOW', 'Sidfok', 'Solomon Szamitasok', 'Statistical Quality Control', 'System', 'Tank Quality Integration', 'Tanks', 'Technology DataSheet', 'Tisza Refinery', 'Water Monitoring', and 'Zala Refinery'.

On the right, a data table displays the values for various elements. The table is organized into categories: Auxiliary Calculations, Consumption Data, Data for Aggregation, Feed, and General Attributes.

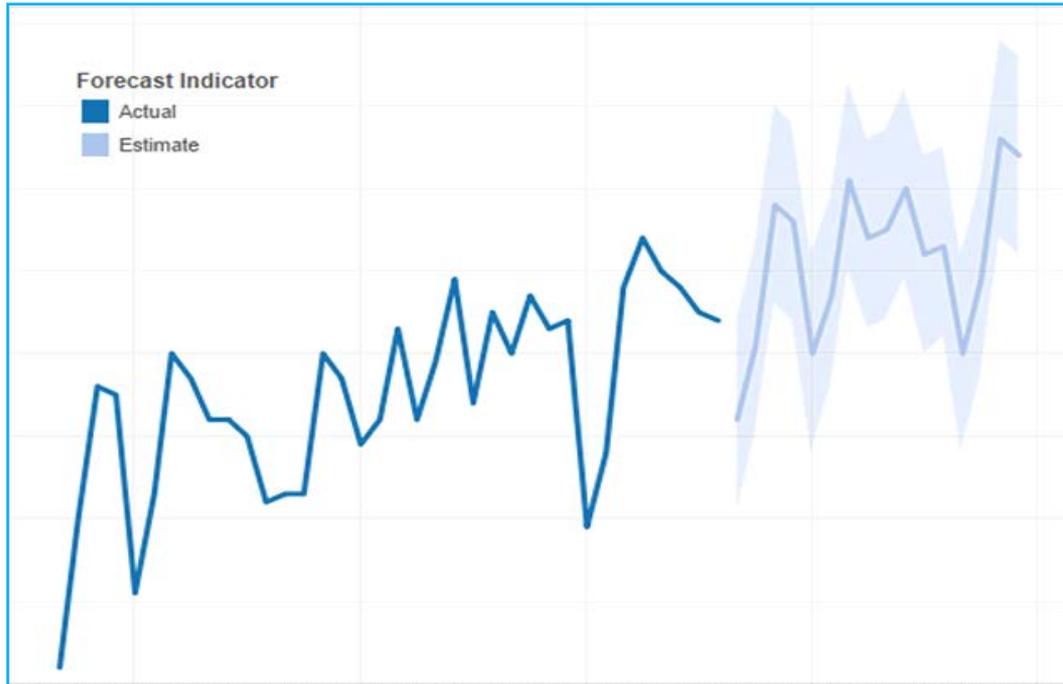
Name	Value
Category: Auxiliary Calculations	
Cumulated KPI Actual Value Evaluate	2
Cumulated KPI Actual Value Evaluate H Limit	0.1
Cumulated KPI Actual Value Evaluate HH Limit	0.2
KPI Engineering Units	GJ/t
Specific Divider Engineering Units	/t
Specific Divider Limit	0.1
Time Comulated Engineering Units	GJ
Category: Consumption Data	
Energy Cons COR	249.04598999023438
Energy Cons RAW	240.35787963867188
Energy Cons Target BP	219.09304809570313
Energy Cons Target OT	240.04478454589844
Energy Cons Target RP	229.64166259765625
Category: Data for Aggregation	
AGG Coefficient	1
AGG Energy Cons COR	249.045989990234 GJ/h
AGG Energy Cons RAW	240.357879638672 GJ/h
AGG Energy Cons Target OT	240.044784545898 GJ/h
Category: Feed	
Unit Feed BP	324.341033935547 t/h
Unit Feed COR	349.790649414063 t/h
Unit Feed RAW	350.962982177734 t/h
Unit Feed RP	337.708343505859 t/h
Category: General Attributes	
Block ID	DDESTB
Block Name	Desztillacio
Element Name	DAV2 Futoanyag Fogyaszas
Energy Type	FUEL
Unit ID	DAV2
Unit Name	Atm. es Vakuumdeszt. 2.
Usage Type	CONS

#2 Energy Monitoring & Management System (EMMS)

- On-line, open loop, model based (PI AF Based) EMMS system
- Calculates targets for assets, unit, and plant
- Detects excess energy consumption, and advises corrective interventions to the operators.
- The EMMS system helps to evaluate the operation of the units.



Energy Demand Forecasting with Future Data



Improve energy trading by

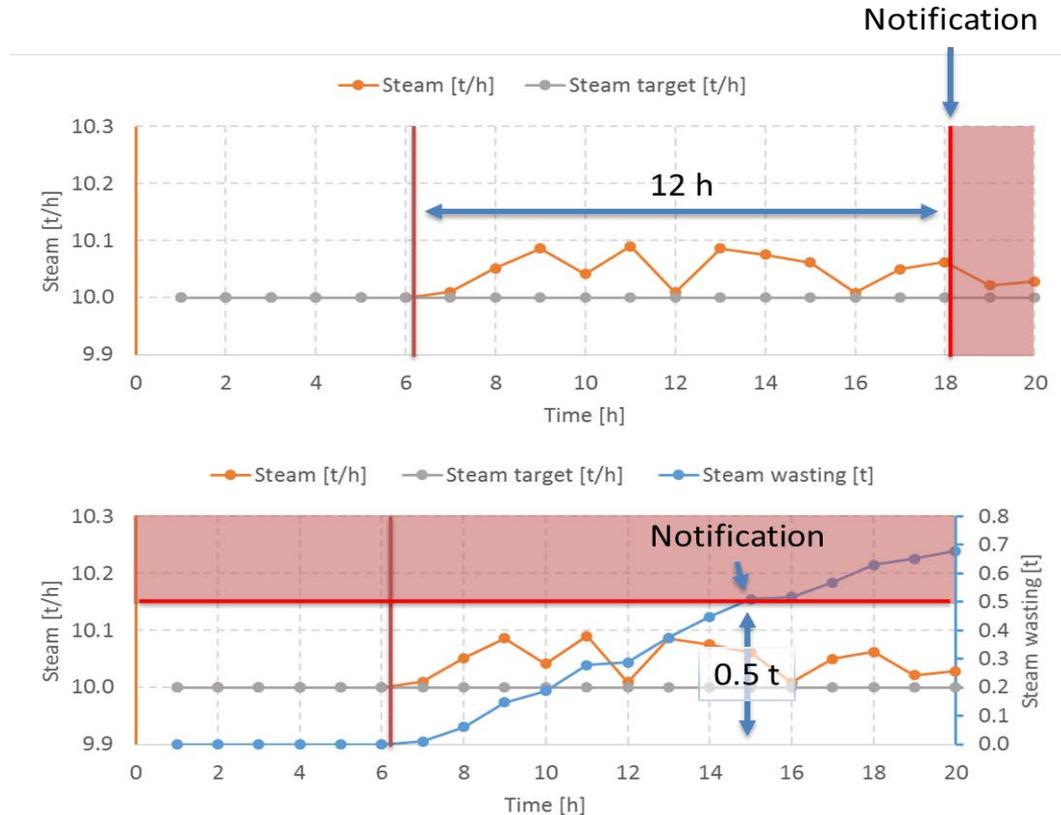
Collect real-time data

Train energy consumption models

Predict energy consumption based on production plan

Monitor and update models

PI Notifications - EMMS Notifications triggers



Types of Notification:

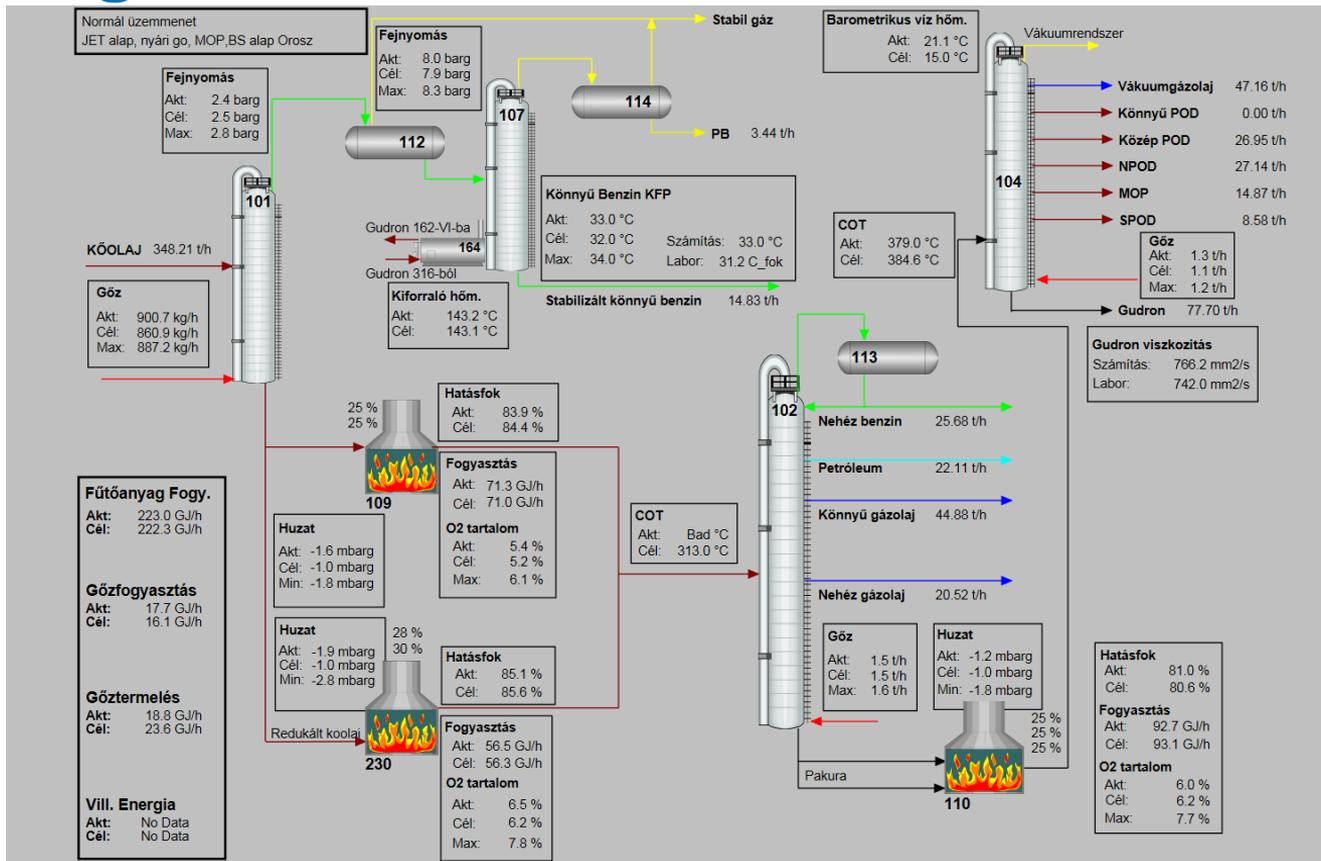
1. Period time of the event
2. Cost of the event

PI Coresight screens based on AF template

- PI ProcessBook (PI PB) graphics linked to AF templates
- The AF structure was converted easily into PI PB display
- The display is published in PI Coresight

		Kiegyenített értékek			Nyers értékek	
		Üzleti terv	Gördülő terv	Tény	EMB cél	Tény
DAV1 Uzem	Beföldelés	t	2753.91	2733.33	2742.03	2752.03
	Energia	GJ/t	0.96	0.96	0.96	0.90
DAV1 Elektronos Fogyasztás	kWh/t	8.80	8.80	8.92	9.10	8.90
DAV1 Fűtőanyag Fogyasztás	GJ/t	0.81	0.81	0.86	0.79	0.83
DAV1 Gáz Fogyasztás	GJ/t	0.13	0.13	0.13	0.12	0.13
DAV1 Gáz Fűtési célú felhasználás	GJ/mo	1300.00	1300.00	2377.00	470.90	470.86
DAV1 Gáz Termelés	GJ/t	0.06	0.06	0.06	0.06	0.06
		Kiegyenített értékek			Nyers értékek	
		Üzleti terv	Gördülő terv	Tény	EMB cél	Tény
DAV2 Uzem	Beföldelés	t	7789.03	8106.00	8376.47	8433.64
	Energia	GJ/t	0.72	0.73	1.26	0.74
DAV2 Elektronos Fogyasztás	kWh/t	7.80	7.00	6.57	6.44	6.66
DAV2 Fűtőanyag Fogyasztás	GJ/t	0.68	0.68	0.70	0.68	0.68
DAV2 Gáz Fogyasztás	GJ/t	0.06	0.06	0.06	0.06	0.06
DAV2 Gáz Fűtési célú felhasználás	GJ/mo	1400.00	1400.00	3913.46	1673.39	1673.76
DAV2 Gáz Termelés	GJ/t	0.06	0.07	0.06	0.06	0.06
		Kiegyenített értékek			Nyers értékek	
		Üzleti terv	Gördülő terv	Tény	EMB cél	Tény
DAV3 Uzem	Beföldelés	t	9973.75	10480.83	10020.62	9940.91
	Energia	GJ/t	0.66	0.68	0.67	0.69
DAV3 Elektronos Fogyasztás	kWh/t	8.00	8.00	6.71	7.66	6.68
DAV3 Fűtőanyag Fogyasztás	GJ/t	0.68	0.68	0.68	0.72	0.67
DAV3 Gáz Fogyasztás	GJ/t	0.07	0.07	0.06	0.07	0.06
DAV3 Gáz Fűtési célú felhasználás	GJ/mo	2300.00	2300.00	2476.93	2736.63	2737.84
DAV3 Gáz Termelés	GJ/t	0.15	0.15	0.13	0.17	0.14

PI Coresight screens



3 – Energy Intensity Index (EII) and Solomon Index

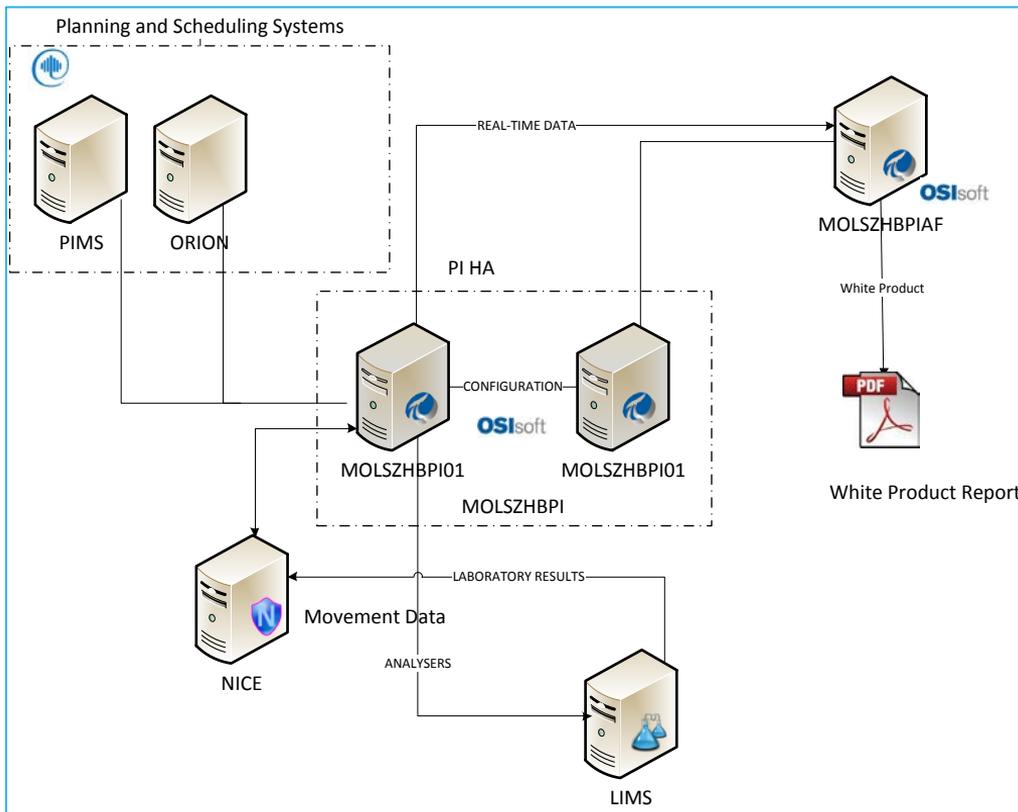
The screenshot displays the PI System Explorer interface. The left pane shows a tree view of elements, with 'DAV1 Üzem' selected. The right pane shows the configuration for 'DAV1 Üzem' in the 'Attributes' tab. The table below represents the data shown in the right pane.

Name	Value	Description	Configuration Item	Unit
Category: Consumption Data				
Standard sum energy	Pt Created	Összes energia standard	False	<None>
Calculation Formula	Analysis Calc	Képlet	False	<None>
Description	DAV1 EII Standard összes energia	Leírás	False	<None>
Engineering Units	GJ/d	Mértékegység	False	<None>
PI Tag	DAV1_EII_STANDARD_UNIT_ENERGY_CONS	PI Tag	False	<None>
Category: General Attributes				
Atm.Res.Dens	907		True	<None>
Operating Mode	27		True	<None>
Unit ID	DAV1	Üzem azonosítója	True	<None>

New PI AF structure & workflow to calculate key SOLOMON indicators:

- Energy Intensity Index (EII)
- Utilized Equivalent Distillation Capacity (UEDC)
- Complexity-Weighted Barrel

4 – White Product (Yield) Analytics & Reporting



Report content

Future data from Business Plan

Future Scheduling data

Calculated movement data from PI AF
Analyses Rules

Forecast data used in PvA analytics

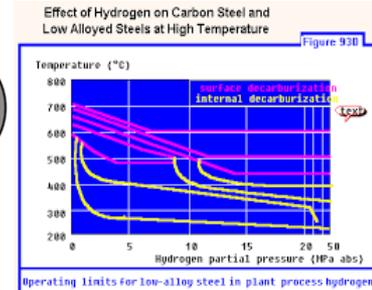
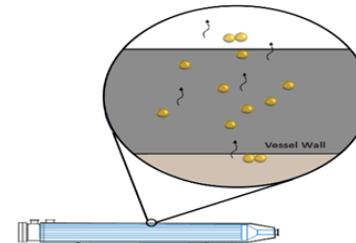
Integrated \$/loss from deviation from
PvA summed over periods of time

5 - Improving Asset Integrity with Advanced Corrosion Analytics

- High Temperature Hydrogen Attack (HTHA)
- f^x (metallurgy, temperature, hydrogen partial pressure(PP), length of exposure)

Developed PI AF template that:

- Determine partial pressure
 - Attribute of pipe class
 - Temperature and length of exposure limits
 - Total time above Temp and PP
 - Alerts/notification/event frame
-
- Tested and rolled out in 6 units < 1 week
 - Expanding to all plants in 2015.



Screenshot of the PI System Explorer interface showing the configuration of an HTHA limit F attribute.

Database: Query Date | Refresh | New Element | New Attribute | Search Elements

Elements: APC, ARGUS, Control loops DR, Crude Units, Danube Refinery, Energy Consumption Predictions, Energy KPI System, Energy Monitoring, EzlTtEgyTeszt, Flare Monitoring, Interlock Monitoring, IOW, DBKS IOW, Kémmentesítő reaktor betáp előmelegítő cseppfőgő - HTHA, Kémmentesítő reaktor betáp előmelegítő cseppfőgő - Nyomás, Kémmentesítő reaktor betápjárási hőcserélő - Hőmérséklet, Kémmentesítő reaktor betápjárási hőcserélő - Nyomás, Szekletív hidrogénező reaktor betáp előmelegítő - Hőmérséklet, DIETBE IOW, DGK3 IOW, DHDS IOW, DHGY2 IOW, DKB1 IOW, Sáfok, Solomon Szamitasok, Statistical Quality Control, System, Tanks, Technology DataSheet, Tisza Refinery, TQJ, Zala Refinery, Element Searches

Kémmentesítő reaktor betáp előmelegítő cseppfőgő - HTHA

Filter: Name Value

Category	Name	Value
Current	Current	214.10000610351563
Desc	Desc	Ide kell a hosszú leírás.
Gasolin flow	Gasolin flow	82.83045
Desty	Desty	801.9
Gasolin molar flow kmol/h	Gasolin molar flow kmol/h	0.28879018023142428
Molar weight g/mol	Molar weight g/mol	230
H2 flow	H2 flow	11238.164436340332
H2 molar flow kmol/h	H2 molar flow kmol/h	1348.57973236084
HTHA limit F	HTHA limit F	605.81629193204753
Kvencia H2	Kvencia H2	86.3660355
Make up H2	Make up H2	254.211136
Molar weight g/mol	Molar weight g/mol	1
Partial pressure	Partial pressure	20.002323679218641
Partial pressure psi	Partial pressure psi	290.03369334867028
Pressure	Pressure	19.0066071
Rec H2	Rec H2	11070.3193
Suruseg kg/Nm3	Suruseg kg/Nm3	0.12
H2 Limit	H2 Limit	270
HTHA	HTHA	318.7868288511375
Is operating	Is operating	1
LO Limit	LO Limit	-1000000000
Name	Name	DBK.SRTI2017.DACA.PV
Naplo_AZON	Naplo_AZON	BK5_TK
Type	Type	
Yesterday Out of limit time	Yesterday Out of limit time	0 h

Group by: Category | Template

Name: HTHA limit F

Description: <None>

Properties: <None>

Categories: <None>

Default UOM: <None>

Value Type: Double

Value: 605.81629193204753

Data Reference: Formula

Settings...

A=Partial pressure psi; (((S74.6+(-0.03015*A))+(336.148.9/(A^-2)))

#6 - Natural Gas Consumption Predictive Analytics



BackGround

- Huge saving possibilities in the decrease of contracted natural gas daily maximum amount across the 6 production units in multiple countries.
- High penalty on daily amount exceedance
- Alerting system was needed

Approach

- Built PI AF demand forecasting model (first principle)
- PI AF was used aggregate, normalize, and perform data validation
- Used to project NG demand across multiple time horizons
- Developed analysis rules with notifications

Solution

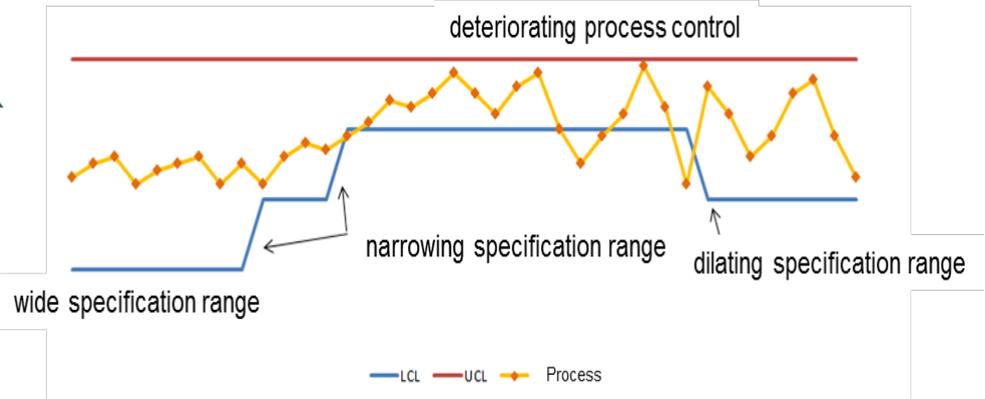
- Demand prediction calculations in PI Analysis
- Alerts based on demand vs contracted peak to enable proactive action
- Detailed information on PI Coresight display (about consumption, prediction, contacts of decision makers)
- E-mail alerting system in Notifications

The screenshot shows the PI Coresight interface. On the left is a tree view of elements, including APC, ARGUS, Control loops DR, Danube Refinery, Energy Consumption Predictions, MOLHU NatGas Cons, Energy KPI System, Flare Monitoring, IOW, Siófok, System, Tanks, Technology DataSheet, Tisza Refinery, Zala Refinery, and Element Searches. On the right is a table with columns for Name and Value. The table is filtered by 'Category: <None>'. The table contains several rows, including 'CoreSight Link', 'Auxiliary Calculations', 'Consumption Calculations', 'Exceedance Calculations', and 'Limits'. The 'Consumption Calculations' section shows 'Cumulated Daily Consumption' at 18723164 MJ, 'Current Consumption' at 1991855,5 MJ/h, and 'Predicted Daily Consumption' at 49276016 MJ.

The screenshot shows the PI Analysis configuration table. The table has columns for Name, Configuration, Schedule, Output(s), and Backfilling. The table contains four rows of calculations: 'Auxiliary Calculations', 'CumulatedDailyConsumption', 'CurrentConsumption', and 'PredictedDailyConsumption'. The 'PredictedDailyConsumption' row shows the expression: `*Cumulated Daily Consumption*+*Current Consumption**SecondsToNextGasDayTurn/3600`.

8 – Product Quality Assurance

Economical



Methodology

Key parameter affecting yields and energy consumption

PI SQC provides an excellent capability to highlight issues

Using dynamic limits increased the robustness and value

Used on 14 units and 41 critical quality specifications – expanding

PI AF & PI Analytics used extensively parameter including write back

Quality parameters & associated information are displayed in Coresight

Element template

Control Indicator	Standard/Unit/Package Code
Signal Name	Actual/Signal Name
Specification Internal Range	Specification Internal Range
Validity Check	Validity Check
Analyzer Desc	Analyzer Desc
Block Desc	Block Desc
Unit ID	Unit ID
Unit Name	Unit Name
Product Name	Product Name
Quality Name	Quality Name
Unit Desc	Unit Desc
Unit ID	Unit ID
Unit Name	Unit Name
Unit Desc	Unit Desc
Unit ID	Unit ID
Unit Name	Unit Name
Unit Desc	Unit Desc
Unit ID	Unit ID
Unit Name	Unit Name
Unit Desc	Unit Desc
Unit ID	Unit ID
Unit Name	Unit Name
Unit Desc	Unit Desc



Element

Control Indicator	Standard/Unit/Package Code
Signal Name	Actual/Signal Name
Specification Internal Range	Specification Internal Range
Validity Check	Validity Check
Analyzer Desc	Analyzer Desc
Block Desc	Block Desc
Unit ID	Unit ID
Unit Name	Unit Name
Product Name	Product Name
Quality Name	Quality Name
Unit Desc	Unit Desc
Unit ID	Unit ID
Unit Name	Unit Name
Unit Desc	Unit Desc
Unit ID	Unit ID
Unit Name	Unit Name
Unit Desc	Unit Desc
Unit ID	Unit ID
Unit Name	Unit Name
Unit Desc	Unit Desc
Unit ID	Unit ID
Unit Name	Unit Name
Unit Desc	Unit Desc

9 – eFlare – Flaring Management System



Presented by Tibor Komárczki



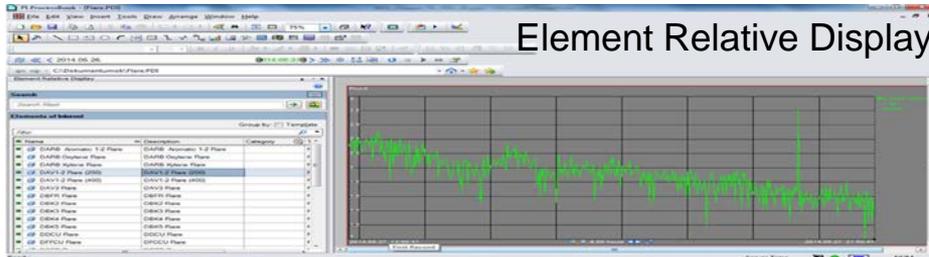
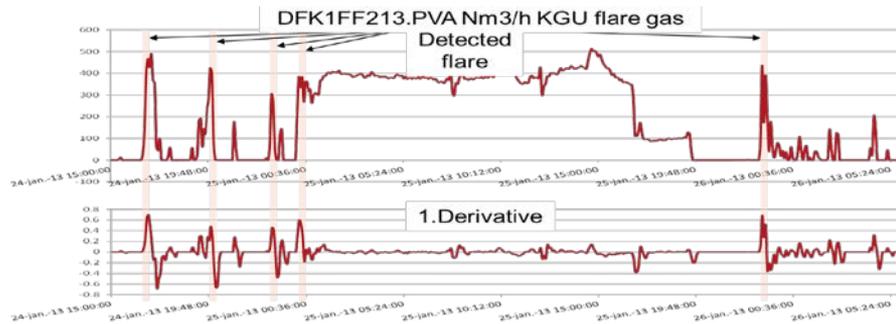
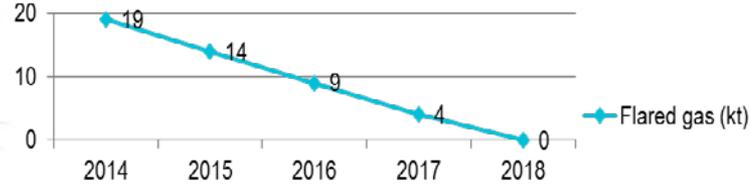
9th EMEA USERS CONFERENCE 2014

www.osisoft.com



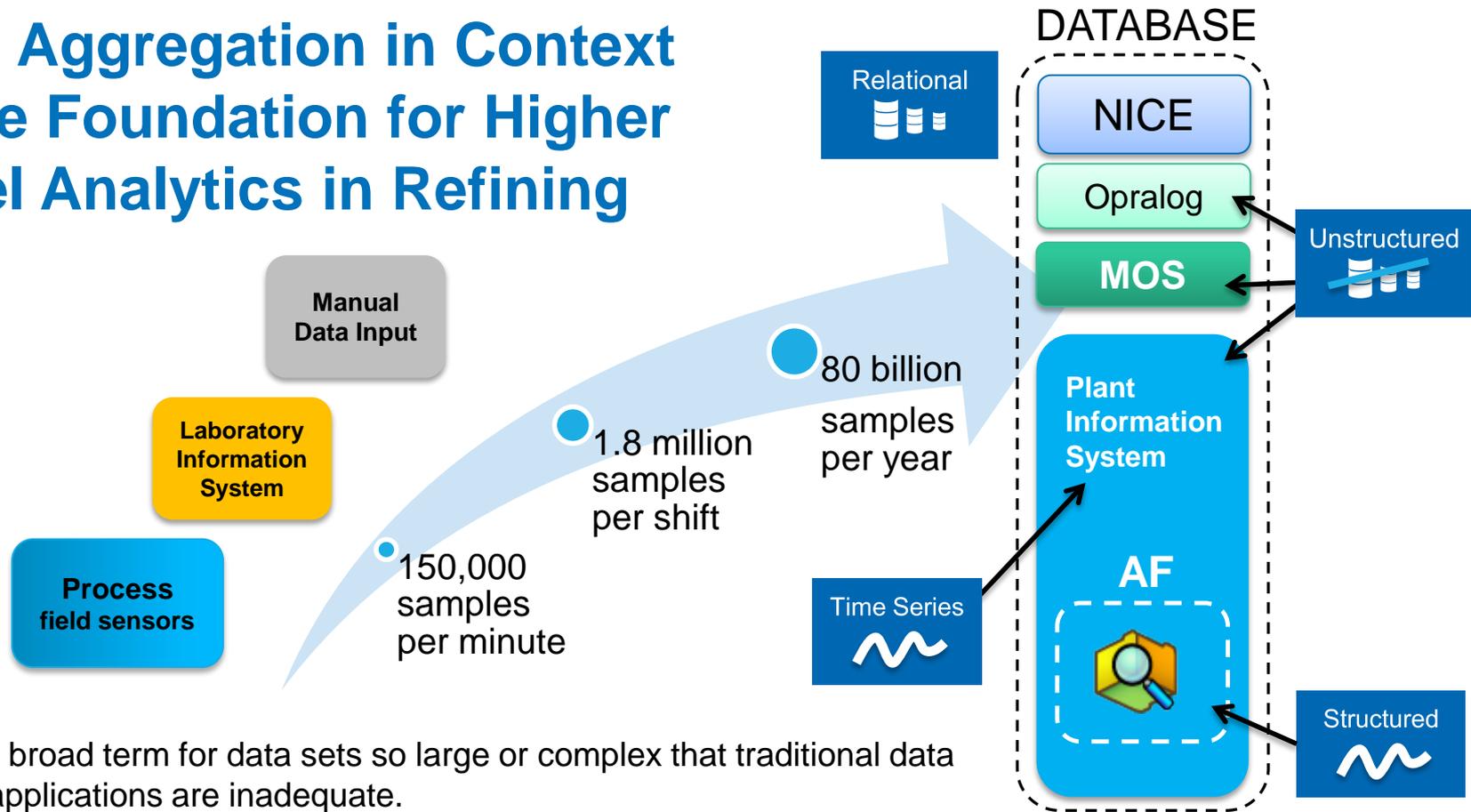
22 kt baseline in 2013

MOL roadmap for Danube Refinery



- Goal is to reduce the amount of flaring from improved data and information
- Critical to be able to take a “systems approach” to understand sources and root causes of flaring
- “what gets measured gets managed”
- PI AF/EF based
- Calculations, analytics, and events are integral to the system
- Integrated with workflow
- Displays information in context to stakeholders

PI AF and Real-Time Data Aggregation in Context is the Foundation for Higher Level Analytics in Refining



Big data is a broad term for data sets so large or complex that traditional data processing applications are inadequate.

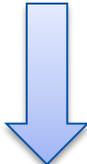
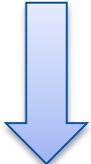
Advanced Analytic Possibilities



REFINERY
DATABASE

Predictive modeling

Data mining



Asset Monitoring Predictive Maintenance Production Modeling Energy Demand Forecast

Operation Optimization Technology Assessment

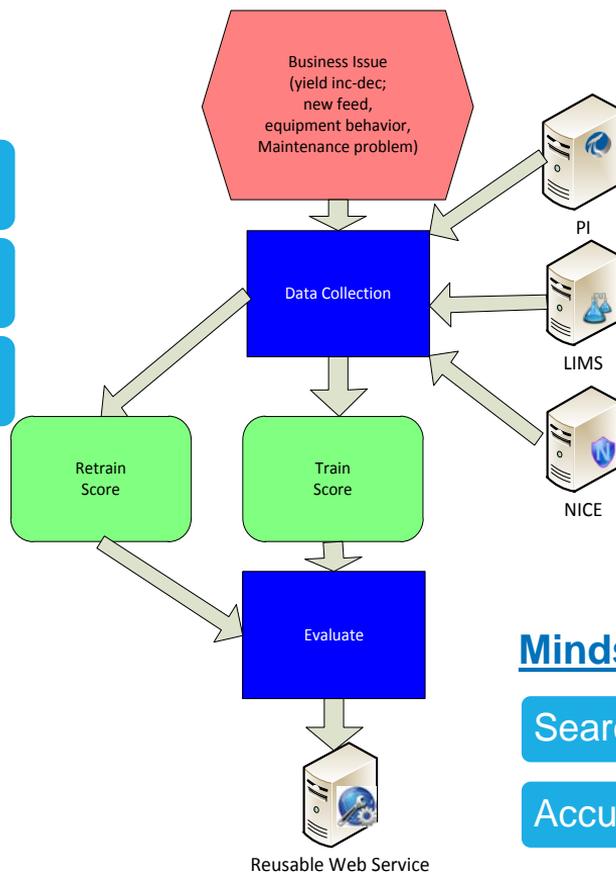
Azure Machine Learning

Business impact

Increase efficiency

Identifying development opportunities

Specific development proposal



Better understanding operation & processes

Identifying efficiency gains /losses reduction opportunities

Understanding operation optimum

Mindset changes

Searching possibilities

Accurate business reasons



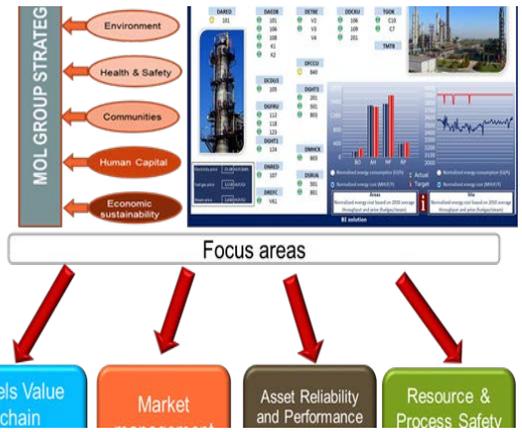
Conclusion

\$500M-550M EBITDA improvement

MOL (Global Integrated O&G Company – Hungary)

“Installing the **PI System infrastructure across our fuels value chain** was fundamental to our New Downstream Program and the **significant performance and sustainability improvement** we have seen.”

Tibor Komróczki Head of Process Information & Automation



CHALLENGES

Need to significantly improve performance of a portfolio of 6 processing facilities & related value chain

- Low cultural alignment, standardization, and use of best practices
- limited data based and proactive decision making

SOLUTION

Implemented a “New Downstream Program – NDP” based on a new data and information PI System centric strategy

- Installed the PI Systems across the full value chain
- Developed new PI System based applications in critical areas including energy & reliability

RESULTS

Significant Improvement in the fuels value chain performance in all key areas – energy, reliability, safety, & compliance

- Increased Yield – 5%
- Decreased energy consumption – 2% YOY
- Reduced HC loss: -30%
- Utilization: 1.1%



감사합니다

谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado

Köszönöm!

Děkuji

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