



Sigmafine Users Conference
San Francisco, March 28, 2011

Sigmafine Value Pyramid for the Power Industry

Sigmafine Industry Stories

Dr. Roberto Linares, Vice President, Visiant Pimsoft

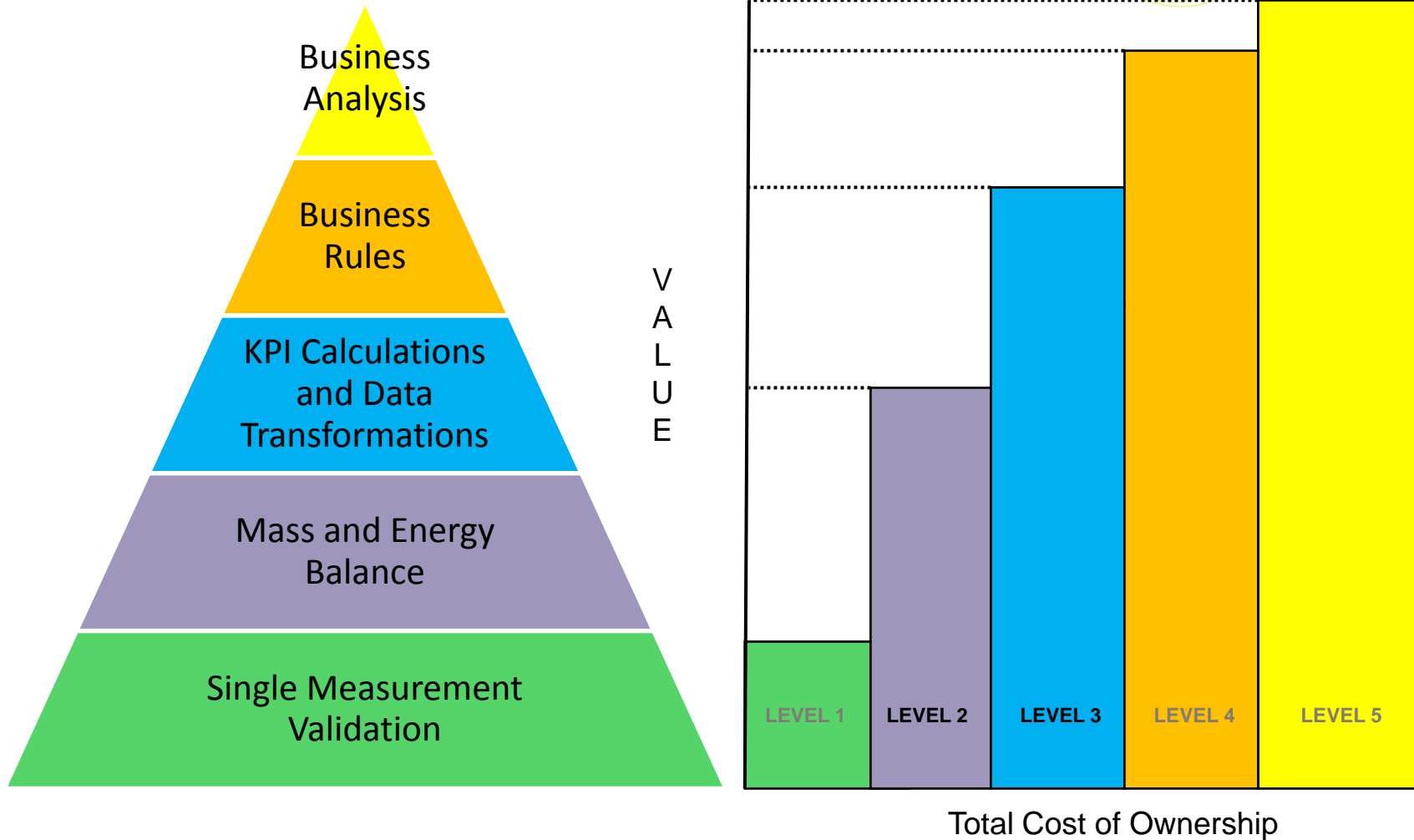


Agenda

Generating Value At Every Step...

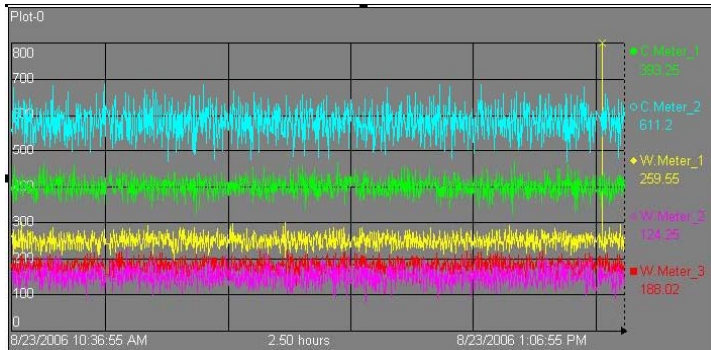
- **Sigmafine Value in the Power Industry**
- **Single Measurement Validation**
- **Mass and Energy Balance**
- **KPI Calculations and Data Transformations**
- **Business Rules**
- **Business Analysis**

Sigmafine Value Pyramid For Power Plants



Single Measurement Data Validation

Basic Analysis



File View Help

Database New Check In Apply Cancel UOMs

UpstreamDemo

- Models
 - SingleStage
 - TwoStage
- Element Templates
- Elements
- Trunkers
- Tables
- Categories
- Plug-Ins

Name	Description	Type
C.Meter_1	Compressor Meter	Measurement
Compressor_1	Stage One Compressor	Node
SingleStage\Loc...	Flow connection for wells and compr...	Flow
SingleStage\Loc...	Flow connection for wells and compr...	Flow
SingleStage\Loc...	Flow connection for wells and compr...	Flow
W.Meter_1	Well Meter	Measurement
W.Meter_2	Well Meter	Measurement
Well_1	Stage One Well	Node
Well_2	Stage One Well	Node

Single Validation

- Data monitoring against normal statistics
 - ✓ Data References
 - ✓ Analysis Rules
 - ✓ Sigmafine tables
 - ✓ Automatic scheduling
- Find if measurement in steady state
 - ✓ Steady State Detector
- Write results back to Sigmafine cases or historian
- Notify critical problems of data ranges

Examples:

- Validation of all temperatures and pressure according to correct operation conditions

Mass and Energy Balance Aggregation and First Principles

PI ProcessBook - [DEMO POWER.PDI]

AF Case Runner
Publish: Complete: 11/12/2010 9:20:17 AM.

AF Browser
Power
Elements Templates Model
DemoPower
Elements
Layers

AF Property
General Elements Attributes Ports
SF_HeatExchanger in Case Case 11/9/2010 12:00:00 AM - 11/10/2010 12:00:00 Show Categories

Name	Value
CostCenter	=
EnergyBalanceFlag	True
ObjectStatus	IS
ReconciledEnergyImbalance	11166.9528464041 kJ
ReconciledEnergyTest3	6.31359092929898E-02
ReconciledEnergyTest4	4.96612021031392E-02
ReconciledEnergyVariance	255333.025774001 kJ
ReconciledMassShellImbalance	4.46561688265 kg
ReconciledMassShellTest3	0.259
ReconciledMassShellTest4	0.178
ReconciledMassShellVariance	17.6043054332145 kg
ReconciledMassTubeImbalance	109773.441863285 kg
ReconciledMassTubeTest3	0
ReconciledMassTubeTest4	0
ReconciledMassTubeVariance	0 kJ/kg
ReconciledShellResidual	-0.11
ReconciledTubeResidual	0

Ready

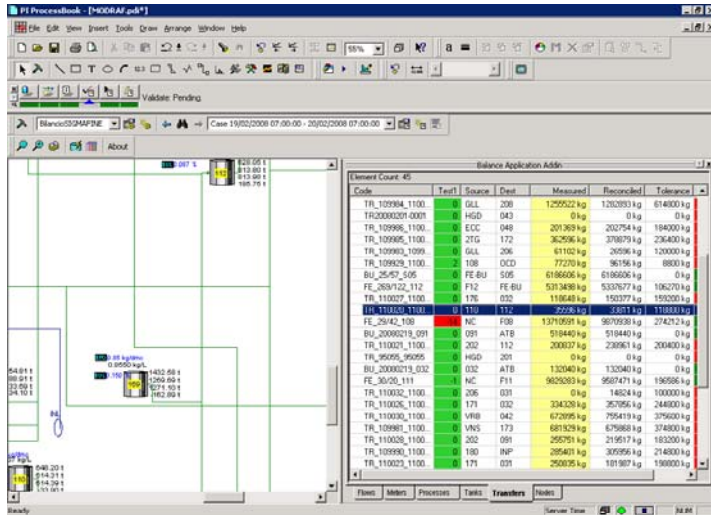
Server Time 4:25 PM

Mass and Energy Balances

Key Benefits, Methodology, and Tools

- Key Benefits
 - ✓ Cross checking of measurements based on connectivity models
 - ✓ Estimates for unmeasured variables, providing more information for analysis
 - ✓ Reconciled KPI
 - ✓ Inventory and fuel consumption cross check
- Methodology
 - ✓ Best estimates based on data reconciliation principles
 - ✓ Steam tables calculations are used for energy and efficiency calculations
 - ✓ Automated and unattended reconciliation only during steady process
- Main Tools
 - ✓ Sigmafine energy balance
 - ✓ Steam table data reference
 - ✓ Sigmafine data reference
 - ✓ Scheduler

Mass and Energy Balance Advanced Diagnostics



Balance Application Results

Meter	OS	Test#	Tolerance	Connection	Measured
HGO_IN	IS	11	32284 kg	32905 kg	1514207 kg
RES_IN	IS	50	41921 kg	2061469 kg	2096060 kg
ECC_IN	IS	11	33771 kg	2712 kg	168953 kg
INP_IN	IS	3	12785 kg	43245 kg	63824 kg
GLL_IN	IS	0	0 kg	0 kg	2010489 kg
GAS_IN	IS	1	1426 kg	810 kg	71310 kg
IRL_IN	IS	2	6892 kg	14327 kg	344988 kg
VNF_IN	IS	3	13236 kg	3742 kg	661752 kg
SGO_IN	IS	0	0 kg	0 kg	0 kg
ZOLFO_IN	IS	0	1033 kg	18 kg	51649 kg
HGO_IN	IS	6	16438 kg	99720 kg	621906 kg
HZ_IN	IS	0	266 kg	62 kg	18226 kg
CARICA	IS	5	30405 kg	1541897 kg	648626 kg

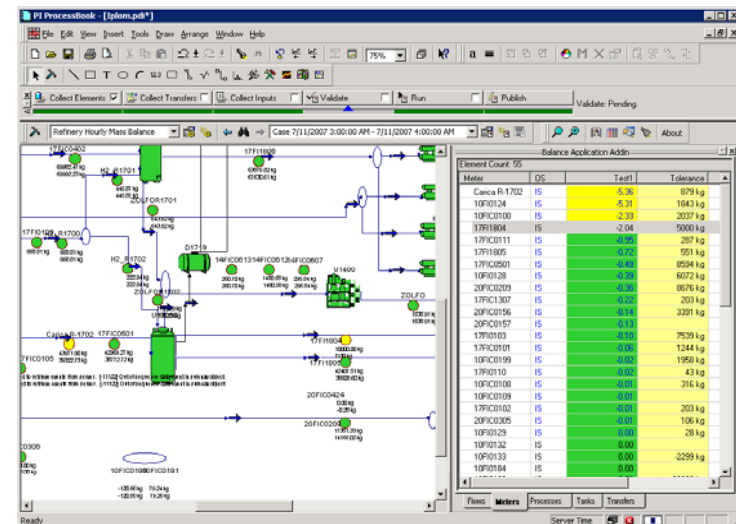
Properties for Element: 103

Element	Value	Value Type	Date Reference	Settings
Defl/Inch	0.0000000000	INCH	(None)	
Defl/Inch/Rate	0.0000000000	INCH	PI Peak	VAL_SERVER_20091018_1
Length/Inch	214.0000000000	INCH	PI Peak	VAL_SERVER_20091018_1
Maximum	604	(None)	(None)	
Minimum	0.0000000000	INCH	PI Peak	VAL_SERVER_20091018_1
Minimum	0.0000000000	INCH	(None)	

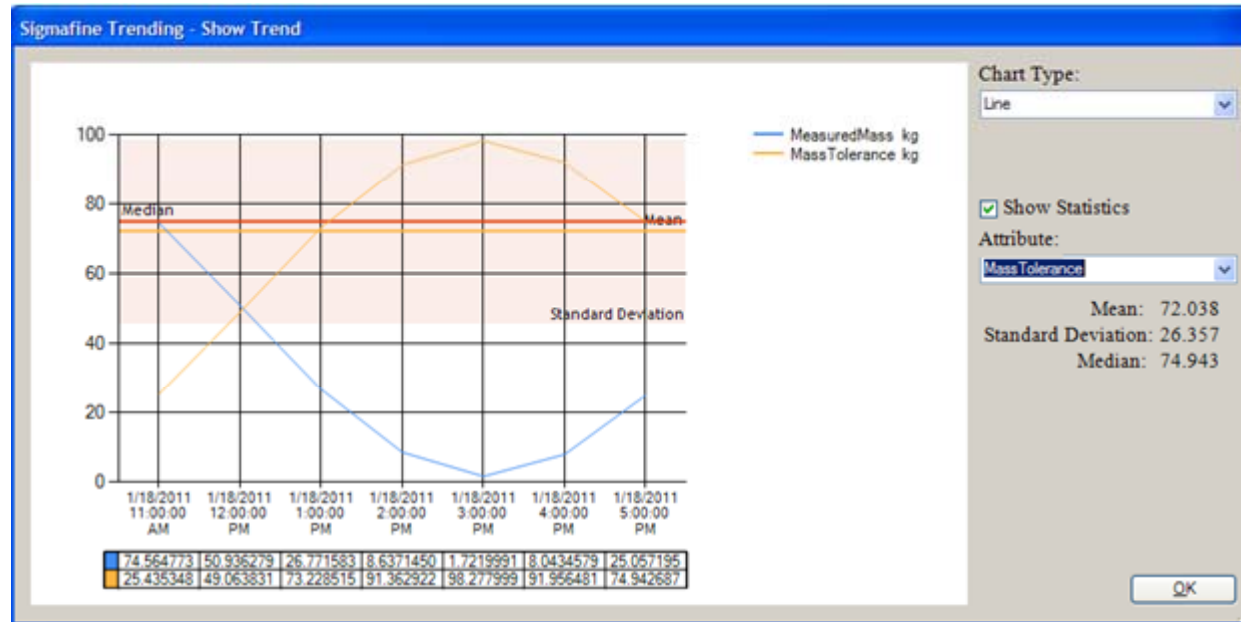
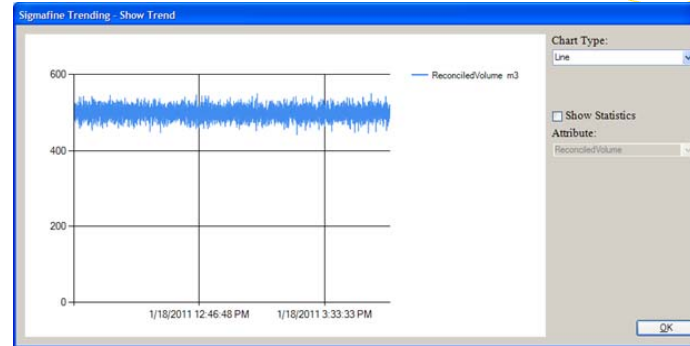
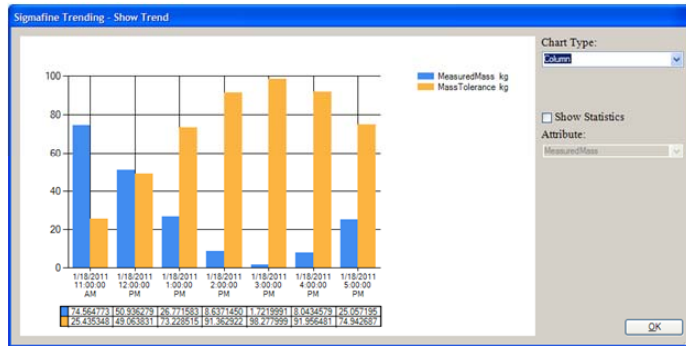
Set Value for Attribute: ResidualMass

Current Value: 1200000.000000

New Value: []

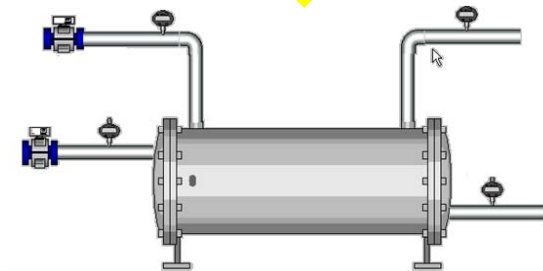
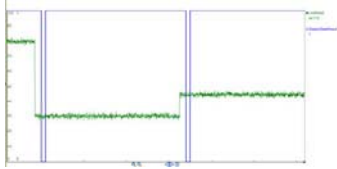
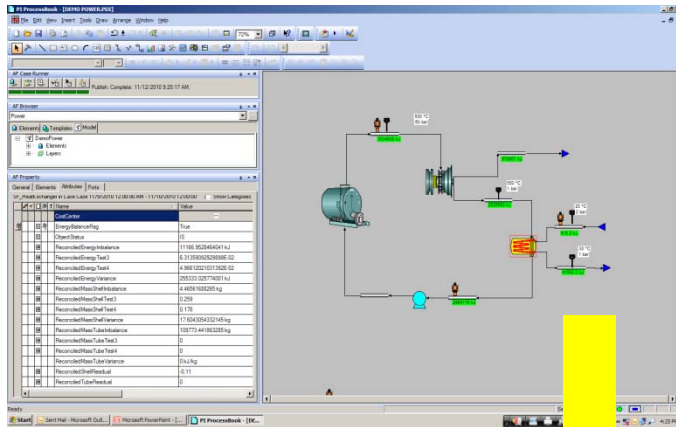


Meter Performance Management Advanced Diagnostics



KPI Calculations and Data Transformations

Monitor Conditioned Variables



Equipment KPI Calculation

Heat Exchanger Example

- Collect Data
 - ✓ Data References
- Run Steady State Detector
- Perform data transformations
 - ✓ Temperature, pressure to enthalpy using Sigmafine steam tables
 - ✓ Perform Efficiency Calculations using Sigmafine libraries
- Publish Efficiency for Data Analysis
- Notify Appropriate Users
- Other Examples:
 - ✓ Turbine Efficiency
 - ✓ Pump Curve Analysis
 - ✓ Boiler Efficiency

Data Transformations

Steam Tables

Pimsoft.DataReference.Steam

Eng Units Selection

English Units SI Units

Function Category Selection

Pressure Entropy

Enthalpy Temperature

Vapor Specific Volume Steam Quality

Next > Cancel

Pimsoft.DataReference.Steam

Function Selection

Saturation enthalpy as a function of pressure (hsatp) Liquid enthalpy as a function of pressure and temperature (hpl)

Saturation enthalpy as a function of temperature (hsatt) Enthalpy as a function of pressure and entropy (hps)

Enthalpy as a function of pressure and temperature (hpt) Enthalpy as a function of pressure and steam quality (hpx)

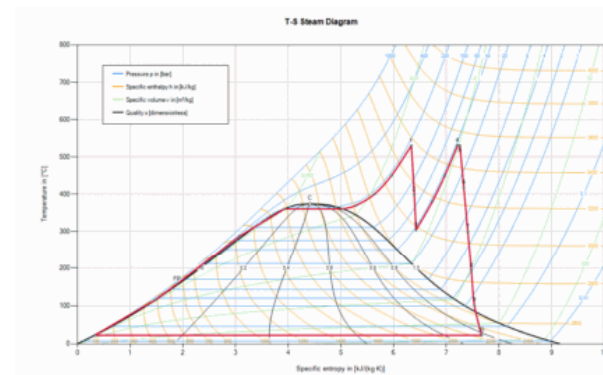
Set the attribute/s

Pressure bar

< Back Finish Cancel

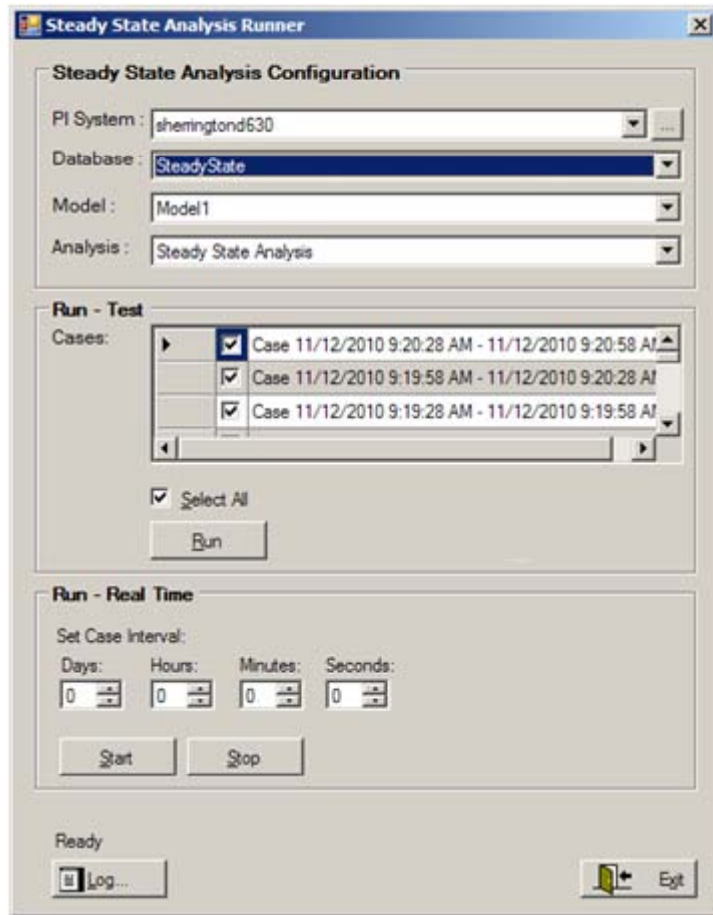
Efficiency Calculations

- Turbines
- Boilers
- Available Properties:
 - ✓ Enthalpy
 - ✓ Entropy



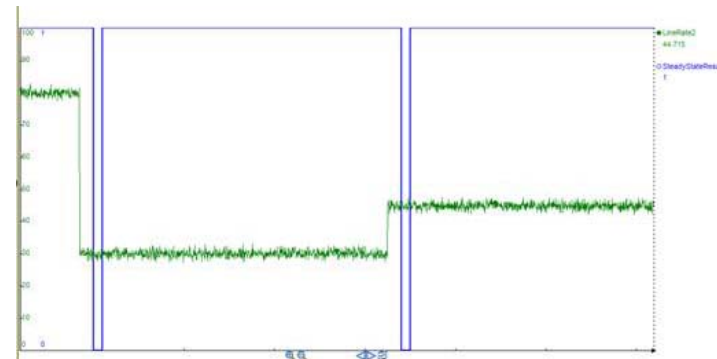
Data Transformations

Steady State Detection



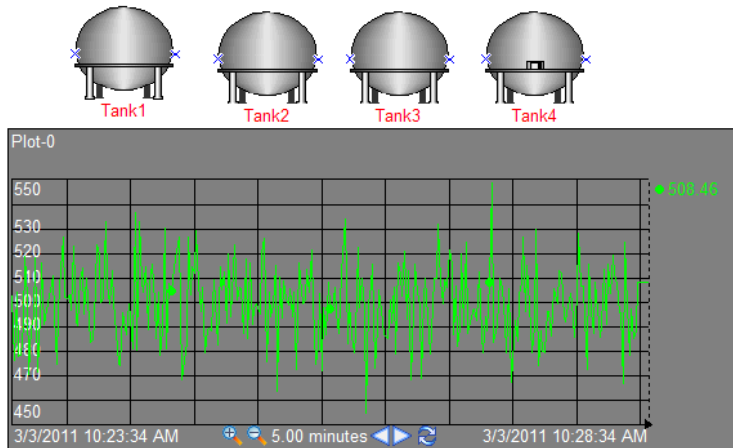
Perform calculations under steady conditions

- Smooth calculations of coefficients for heat exchangers and other equipment
- Perform meter corrections under steady conditions (i.e., not real gross errors)



Data Transformations

Fuel Inventory Normalization

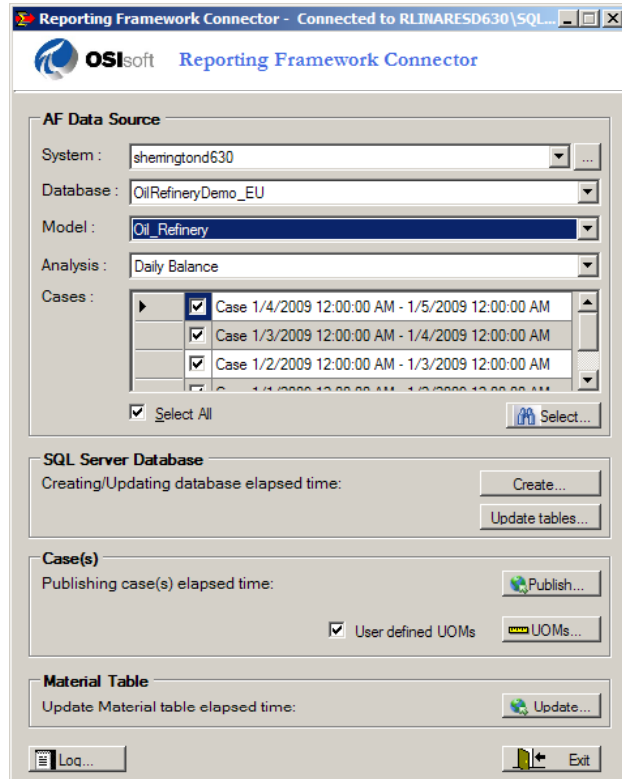


From gross volume to standard conditions

- Gauge to Volume
 - ✓ Strapping
 - ✓ Geometrical
- Volume Correction Factors based on ASTM and API
- Volume to Mass Conversion

Data Exposure

Daily Initial Inventory Positions



Material	Tank Name	Gross Gauge ft	Water Gauge ft	BSW %	Temperature F	Density API	Gross Volume bbl	Net Volume bbl	Inventory Change bbl
ALK							20000.00	25523	(348)
ANG							106600.00	191354	(28373)
CA							97500.00	96300	(1300)
	T208U/T		0	0.00		100.30		18333	0
	T208U/T		0	0.00		100.30		18333	(1300)
	T208U/T	18.50	0	0.00	144.50	100.30	87500.00	19714	0
DIESEL							74800.00	91081	(1428)
JET							45800.00	25433	(783)
LowSulfurFuelOil							22600.00	72503	(374)
LPG							73000.00	65990	(3073)
MTBE							20000.00	26070	(215)
PRG							61000.00	34137	272
REF							80000.00	175096	48
SAL							147800.00	300003	(445)
LPO							47700.00	83333	(833)
Total		289.58	0	0.00	2152.27	2194.48	796488.00	1147283	(41386)

Data Exposure

Logging of Fuel Receipts

Receipts and Shipments ReportLrdl - Report Preview

StartTime: 5/4/2007 4:00:00 AM

View Report

Receipts Report

Plant Model - Mass Balance Analysis

Material	Receipt / Shipment Point	Ending Period Receipt lb	Ending Period Shipment lb	Total Receipt lb	Total Shipment lb
ALK		0.00	1269390.00	0.00	1269390.00
ANS		36689099.88	0.00	36689099.88	0.00
BRE		14257800.00	0.00	14257800.00	0.00

Year: 2008
 Month: 5
 Start case: 22/05/2008 - 22/05/2008 23:59:59
 End case: 24/05/2008 - 24/05/2008 23:59:59

DETAILED MOVEMENTS

Material desc: (Full)

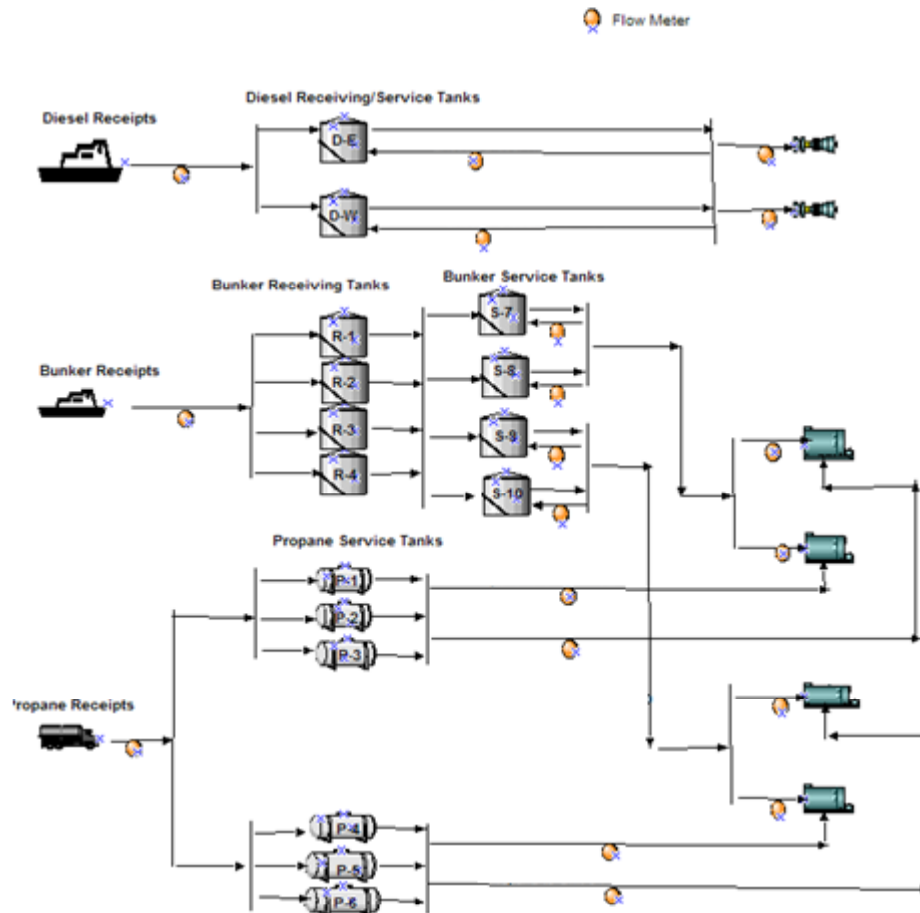
Product	Transfer	Start Date	End Date	SIC	DST	Sum of Measure/Basis
00009 - 220000190 - Item 6104	S1892490517709	22/05/2008 11:59:00	22/05/2008 11:59:00	RROAD	A00	10
00009 - 220000190 - Item 6104 Summary						10
03364 - 210000004 - GULLFAK S	C00522-00001433	22/05/2008 16:10:00	22/05/2008 23:59:59	REALANCE	A02	23.141
	O00522-00001433	22/05/2008 16:10:00	22/05/2008 23:59:59	A02	T6017	23.371
	C00522-00001434	23/05/2008 00:00:00	23/05/2008 17:01:00	REALANCE	A02	0
	C00522-00001434	23/05/2008 07:07:00	23/05/2008 16:42:00	REALANCE	A02	0
	O00522-00001434	23/05/2008 00:00:00	23/05/2008 17:01:00	A02	T6017	40.357
	O00522-00001434	23/05/2008 07:07:00	23/05/2008 16:42:00	A02	T6018	11.787
03364 - 210000004 - GULLFAK S Summary						98.666
13002 - 400000292 - Rty Gas Fuel (Fuel)	X-E BUFG_433	22/05/2008 00:00:00	22/05/2008 23:59:59	E-BUFG	SFUEL	18
	X-E BUFG_434	23/05/2008 00:00:00	23/05/2008 23:59:59	E-BUFG	SFUEL	15
	X-E BUFG_435	24/05/2008 00:00:00	24/05/2008 23:59:59	E-BUFG	SFUEL	10
13002 - 400000292 - Rty Gas Fuel (Fuel) Summary						43
16220 - 400000192 - Commercial Propane	C-00502-07295433	22/05/2008 00:00:00	22/05/2008 23:59:59	B02	DBALANCE	0
	C-CC03-4-433	22/05/2008 00:00:00	22/05/2008 23:59:59	B02	DBALANCE	0
	O00502-07295433	22/05/2008 00:00:00	22/05/2008 23:59:59	T4242	B02	384
	O00522-01201433	22/05/2008 00:00:00	22/05/2008 23:59:59	VP2017C3	T4243	229
	O00522-01202433	22/05/2008 00:00:00	22/05/2008 23:59:59	VP2017C3	T4244	227
	O00522-03001433	22/05/2008 00:00:00	22/05/2008 23:59:59	T4257	VAP5	14
	O00522-00201433	22/05/2008 00:00:00	22/05/2008 23:59:59	VP2017C3	T4257	83
	O00522-00001433	22/05/2008 05:04:00	22/05/2008 07:28:00	T4244	T4256	204
	O00522-07701433	22/05/2008 12:08:00	22/05/2008 16:45:00	T4243	T4242	289
	O00522-07702433	22/05/2008 15:42:00	22/05/2008 16:54:00	T4241	T4257	0
	O00522-09001433	22/05/2008 21:26:00	22/05/2008 22:56:00	T4241	T4257	0

Detailed Movement By Product Report

Page 1 of 4

Business Rules

Objective Functions and Constraints



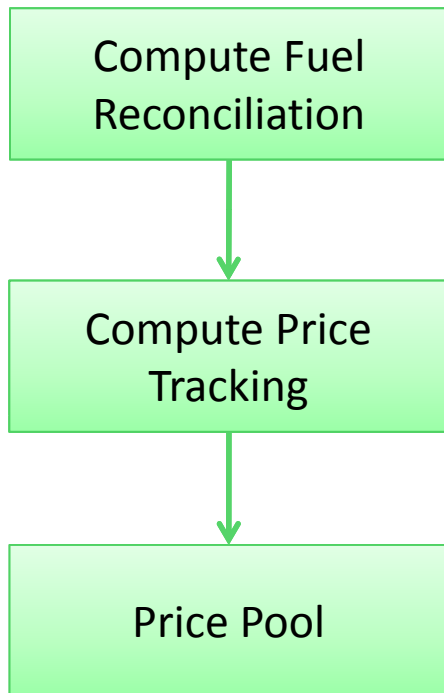
Comply with Business Requirements

- Track movements and prices
- Connect to business systems
- Balance inventory and movements
- Notify discrepancies
- Provide estimates of fuel prices
- Add specific business rules
 - ✓ Fuel price pool
 - ✓ Apply API methodology
 - ✓ Compute capacity and inventory “running” days

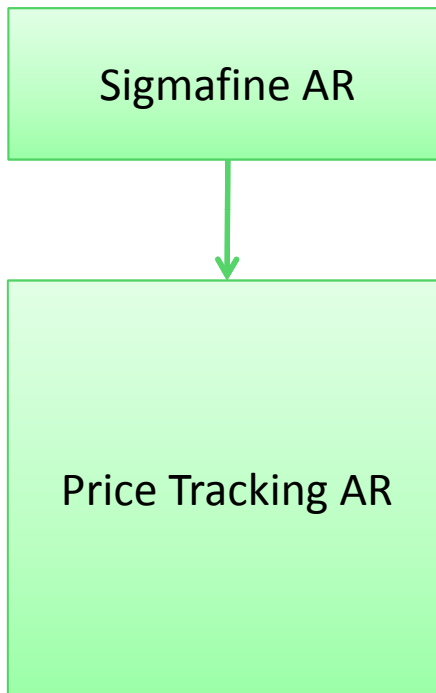
Business Rule Example

Example

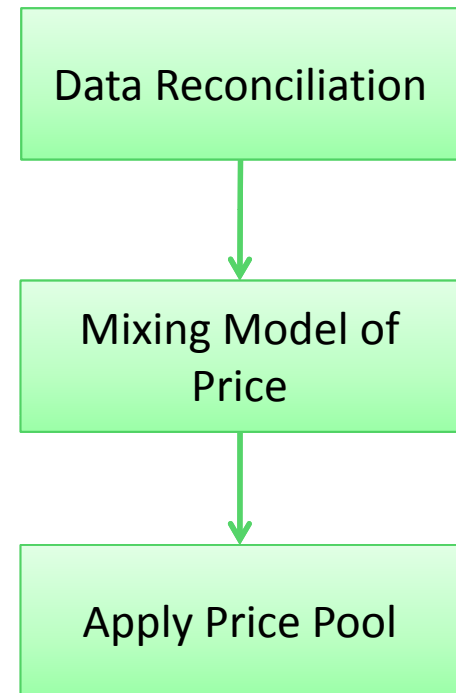
Business Requirement



Sigmafine Module



Methodology



Business Rules

Automatic Generation of Models and Formulations

- Mass Reconciliation

$$\min_x (y - x)^T \sum (y - x)$$
$$s.t. Ax = c$$

- Price Tracking

$$p^*_i = x_i p_i; Ap^* = c$$

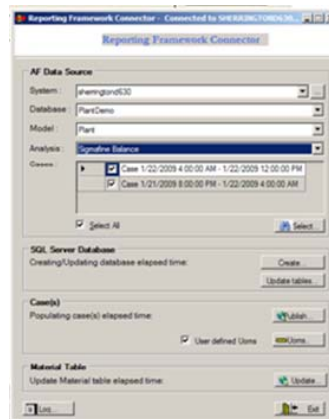
- Price Pool

$$x_p = \frac{\sum x_i p_i}{\sum x_i}$$

Business Analysis

Integration and Wide Audience Data Exposure

- Compare current operation versus planned
 - ✓ Integration with other business systems
- Use Sigmafine information for planning and purchasing of fuel
- Benchmarking between different operation units
 - ✓ Assessment of KPIs and Cost
- Optimize working capital based on planned demand
- Seasonal Analysis of Fuel Consumption



The screenshot shows the 'Meter Report - Report Preview' window. The report title is 'Meter Report' and the time range is 'From 5/4/2007 4:00:00 AM to 5/4/2007 12:00:00 PM'. The report is for 'Plant Model - Mass Balance Analysis'. The data is presented in a table titled 'Gas Meters'.

Name	Status	Measured Mass lb	Reconciled Mass lb	Molecular Weight lb/mol	Reconciled Mass Test1
Ref_Fuel_M	IS	3373464.25	320499.75	0	(30.80)
REFgas_M	IS	4526419.19	4244988.95	0	(2.12)
REFHyd_M	IS	361371.77	361709.65	0	0.03
REFHyd1_M	IS	239949.17	316066.95	0	10.80
REFHyd2_M	IS	711148.75	99566.59	0	(29.27)
REFHyd3_M	IS	360515.70	216500.36	0	(13.59)
Sgas_M	IS	2674016.80	21126.23	19.63	(33.78)
Lgas_M	IS	412555.77	299371.52	0	(9.34)

1 of 1



Thank you!

Dr. Roberto Linares

roberto.linares@visiant.com