Real Time Analytics at Hershey

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IS Global Supply Chain Solutions

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Hershey Story – Do Well by Doing Good

Year	Event
1894	Milton S. Hershey establishes the Hershey company.
1905	The Hershey Chocolate factory begins operations and the Hershey Trust Company is established.
1909	Mr. Hershey and his wife Catherine establish a boarding school for orphan boys.
1918	Milton establishes the Hershey Trust Fund to benefit children in need.
1935	Milton establishes the M.S. Hershey Foundation to provide educational and cultural enrichment for Derry Township residents and visitors. (Penn State Medical Center, The Hershey Story, Hershey Gardens, Hershey Theatre, and Hershey Community Archives)
Today	Manages the $12 billion trust to grow and maintain the Milton Hershey School which is a coed boarding school benefiting over 2,000 students from pre-K through High School.

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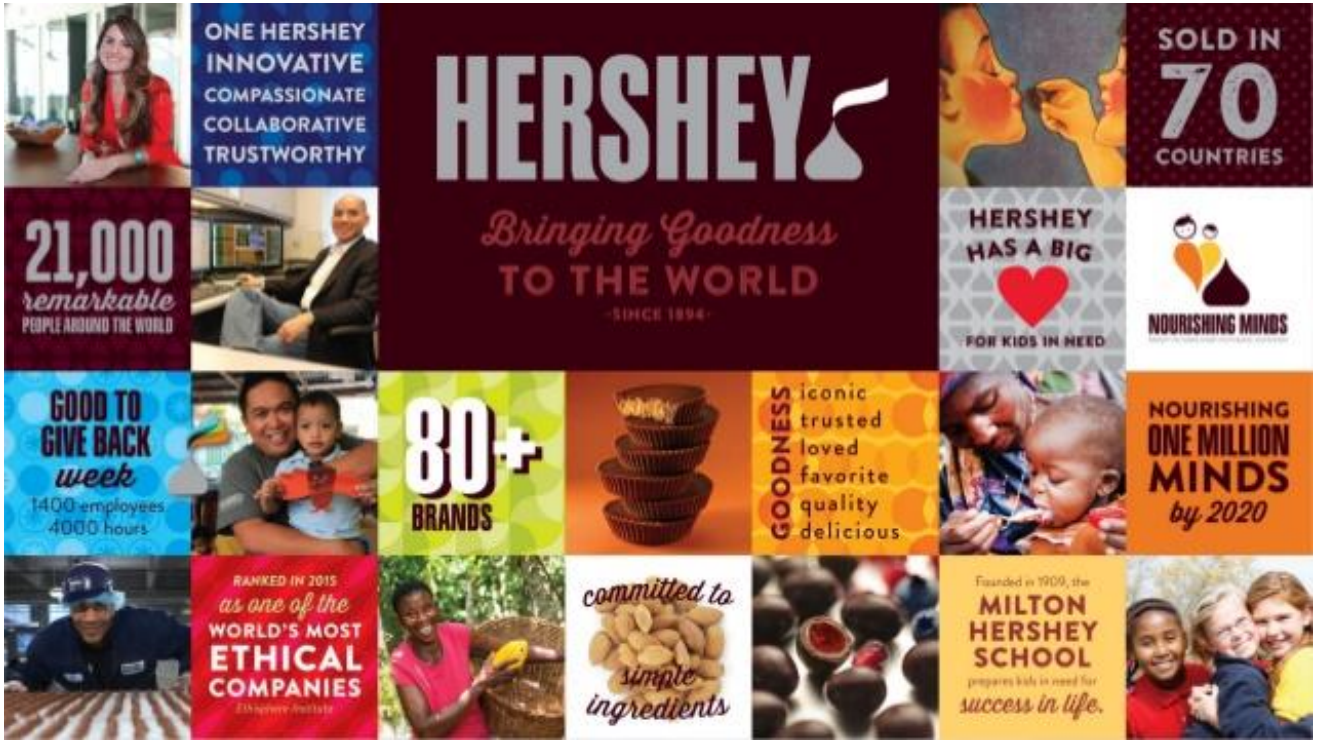
The Hershey Company

- 18,000 employees
- 80 Brands
- *70 Countries*
- $7.4 billion revenues



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Some Hershey Initiatives

- **Cocoa Sustainably-** *CocoaLink*, *Learn to Grow* , *CocaAction* are all part of meeting our 21st Century Cocoa Sustainability Goal of 100% certified and Sustainable supply by 2020. *(2016 - Over 48,000 farmers and 60 % sustainable sourcing)*
- **Nourishing Minds**: Improving the lives of children by developing and supporting manufacturing of daily nutritional supplement. *(Reaching over 50,000 kids in Ghana each day.)*
- ***Rise Against Hunger –*** Annual event where over 700 employee volunteers pack meal packs to feed school children. *(Over 1 M meals packed in 4 years 285,120 meals in one afternoon)*
- **Packaging Sustainability** –Reduce 25 Million pounds of packaging by 2025. *(3.5 M lb. reduction through new innovative retail ready cases and over 9 M LB. reduction since 2014.)*
- **Simple Ingredients:** No artificial flavors, no preservatives no artificial sweeteners and natural colors. *(Milk Chocolate: Kisses, Nuggets, Bars and Simply 5-Syrup)*
- **Smart Labels:** Goes beyond the printed labels to provide scannable code for quick online access to detailed ingredient information and certifications. *(70 % complete and 90% by 2018).*

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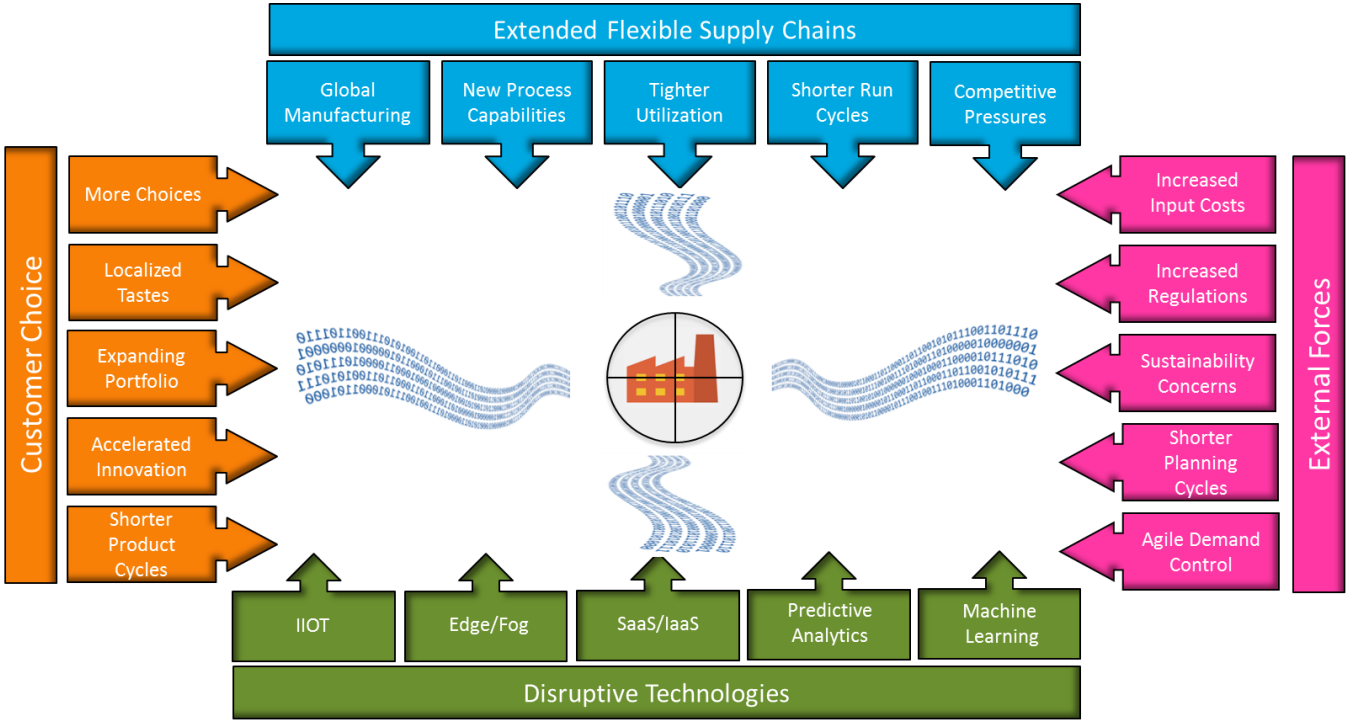
Supply Chain Challenges

Key Capabilities

- Visibility
- Insights
- Speed
- Agility
- Efficiency
- Sustainability
- Scalability



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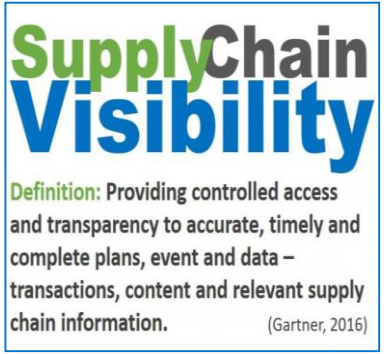
Visibility

Results of an IBM survey of over 400 supply chain executives in over 25 countries and 29 industries.

"70% of the executives stated their biggest challenge was visibility. They don't have the appropriate level of insight into what is happening within their operations on the ground-level or on the production floor in real time, and this lack of insight hampers their ability to make the right decisions at the right time."

IBM - Driving operational excellence with predictive analytics



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Real Time Enterprise

"The Real-Time Enterprise monitors, captures and analyzes root-cause and overt events that are critical to its success the instant those events occur to identify new opportunities, avoid mishaps and minimize delays in core business processes.

The Real-Time Enterprise will then exploit that information to progressively remove delays in the management and execution of its critical business processes."

Gartner

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Achieving Operational Intelligence

Evolutionary Process

- Move from reactive to proactive environment.
- Move from slow control responses to fast responses.
- Move from post event investigations to prevention.
- Move from data display to operation insights to predictive analysis.

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Operational Intelligence Transformation Stages

ASSESSMENT

Create the blueprint for a secure and collaborative operation.

SECURE & INTEGRATE

Securely integrate IT/OT networks and systems to modern information-enabled technologies.

LIBERATE DATA

Define and organize operational data to deliver performance-critical information for better real-time decision making.

ANALYTICS

Transform data into operational information that can help lower cost, increase productivity and improve customer satisfaction.

OPTIMIZE

Leverage predictive capabilities to respond faster to external events and changing market conditions.

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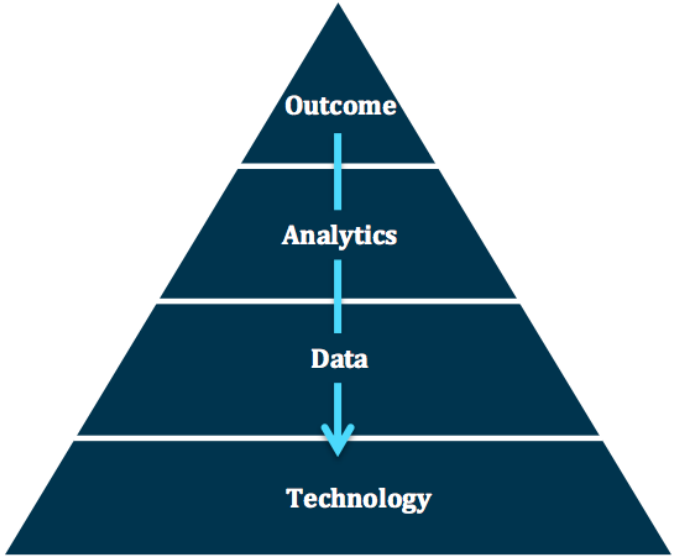
Assessment - Start with the End in Mind

1. What are the desired business outcomes?
2. What are the measured business objectives?
3. How do plant objectives align to meet business objectives?
4. What methodologies are deployed to achieve the objectives?
5. What key insights/actions are required to determine effectiveness of deployed methodologies.
6. What KPI's best measure the operational results?
7. What are the key inputs and outputs for each KPI?
8. How can the inputs be economically captured?
9. What technology investments will best facilitate the entire process?



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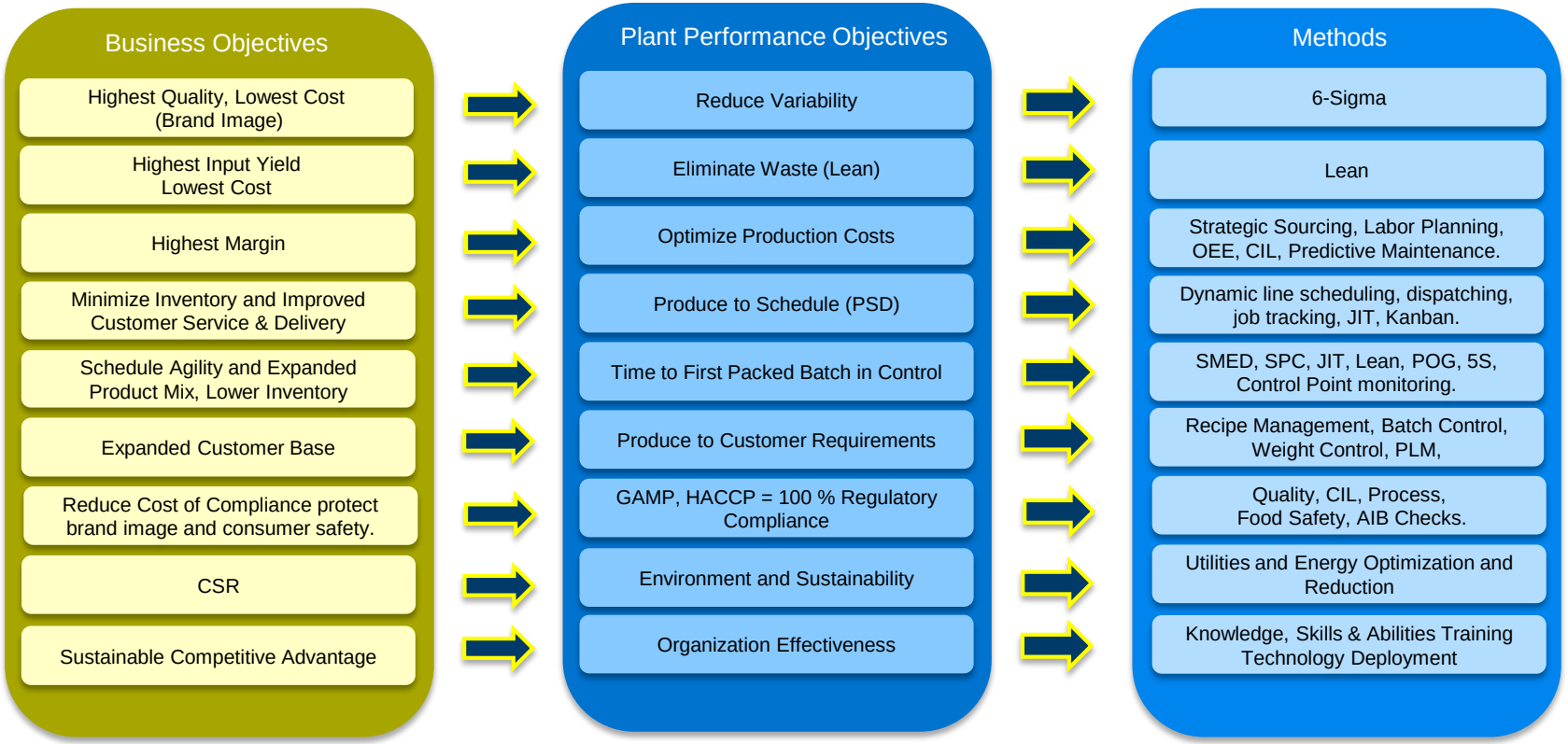
Align Objectives and Methods



(Adapted from ARC Research)

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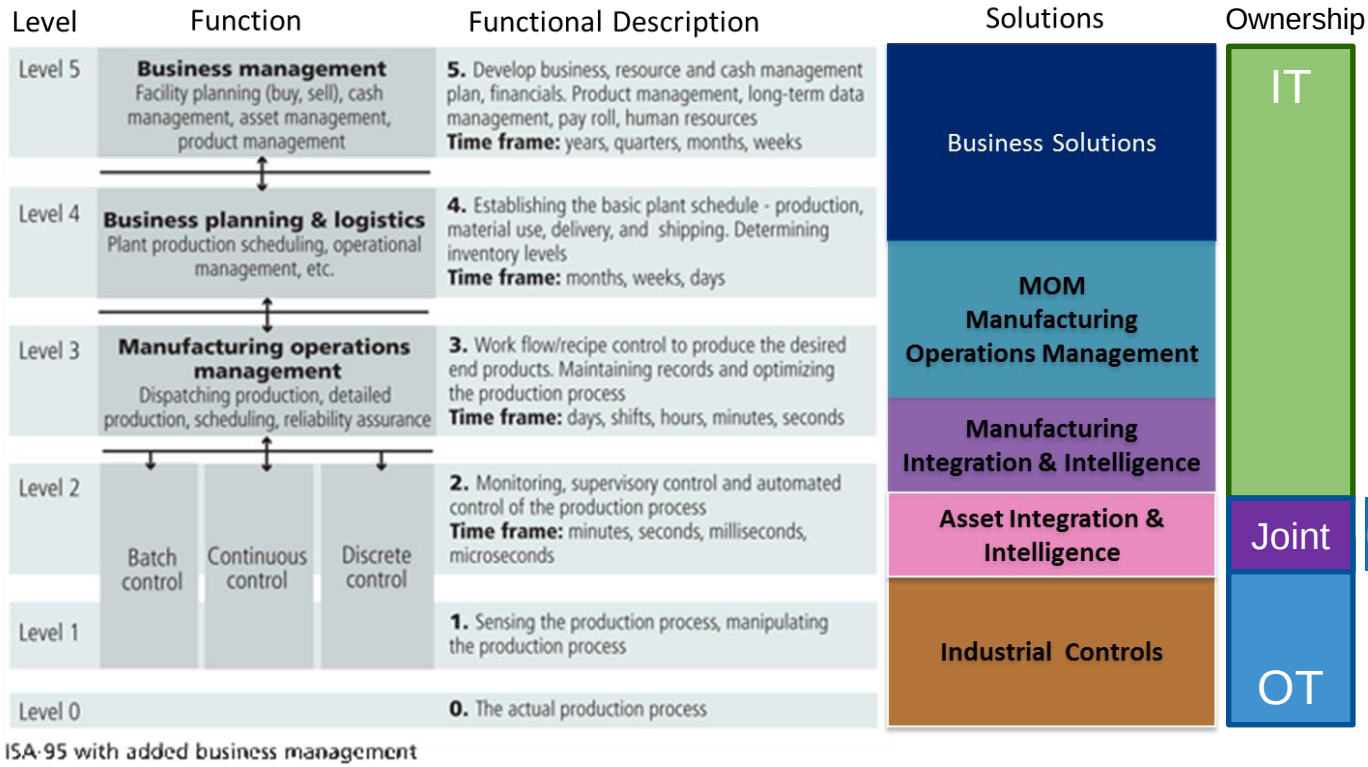
PI System – A Bridge Between IT and OT.



ISA-95 with added business management

With the PI System changes in process or business conditions can be:

- **Sensed with the proper context.**
- **Analyzed in the proper perspective.**
- **Delivered through multiple channels.**
- **Responded to rapidly.**

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Overcoming Challenges with the PI System

Integration	Manage Risk	Unified Architecture	Analyze	Deliver
• Legacy Controls • Multiple Vendors, Models • Multiple Logic Models • Variable Process Types. • IIOT	• Minimize touch points. • Layered Security • HA Service • Single Source for Asset Data • Windows User Security	• Configurable • Scalable • Flexible • Expandable • Proven	• Streaming Data • High Fidelity • Event Capture • Data Structure • Meta Data • Data Aggregation • BI Capable	• Open Standards • Multiple Data Delivery Methods • Integrated Client Tools • Handle Streaming Data
• PI Interfaces 400 + • PI Connectors • PI Developer Tech. • PI Manual Logger	• IT Monitoring • High Availability • User & Role Based Security • Trust Tables • Audit Trail • Data Bridge	• PI Data Archives • PI Interface Servers • PI HA • 1,000,000 + points. • PI AF	• AF Data Analytics • AF Element Templates • AF Event Frames • Analytics • Fast Response • Generate & Track Events • Aggregate • Reusable	• Pi Vision (Coresight) • PI Process Book • PI DataLink(Excel) • PI WebParts (SharePoint) • PI Batch View • PI OLEDB • PI ODBC • PI SDK

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Hershey Operational Intelligence Solutions

Manufacturing Intelligence

Asset Intelligence

Web Apps

SAP Manufacturing Integration & Intelligence

OSIsoft.

SAP
- PM-Plant Maintenance.
- PP-Production Planning
- WM-Warehouse Mgmt.
- MM- Material Mgmt.

MOM
- Multi Platform
- Multi Vendor
- Custom Solutions

SCADA
- Multiple Vendors
- Multiple Platforms
- Multiple Versions

Controls
- Multiple Vendors
- Multiple Platforms
- Multiple Vintages

Devices
- Instrumentation
- Metal Detectors
- X-Ray
- Scales
- Vision Systems

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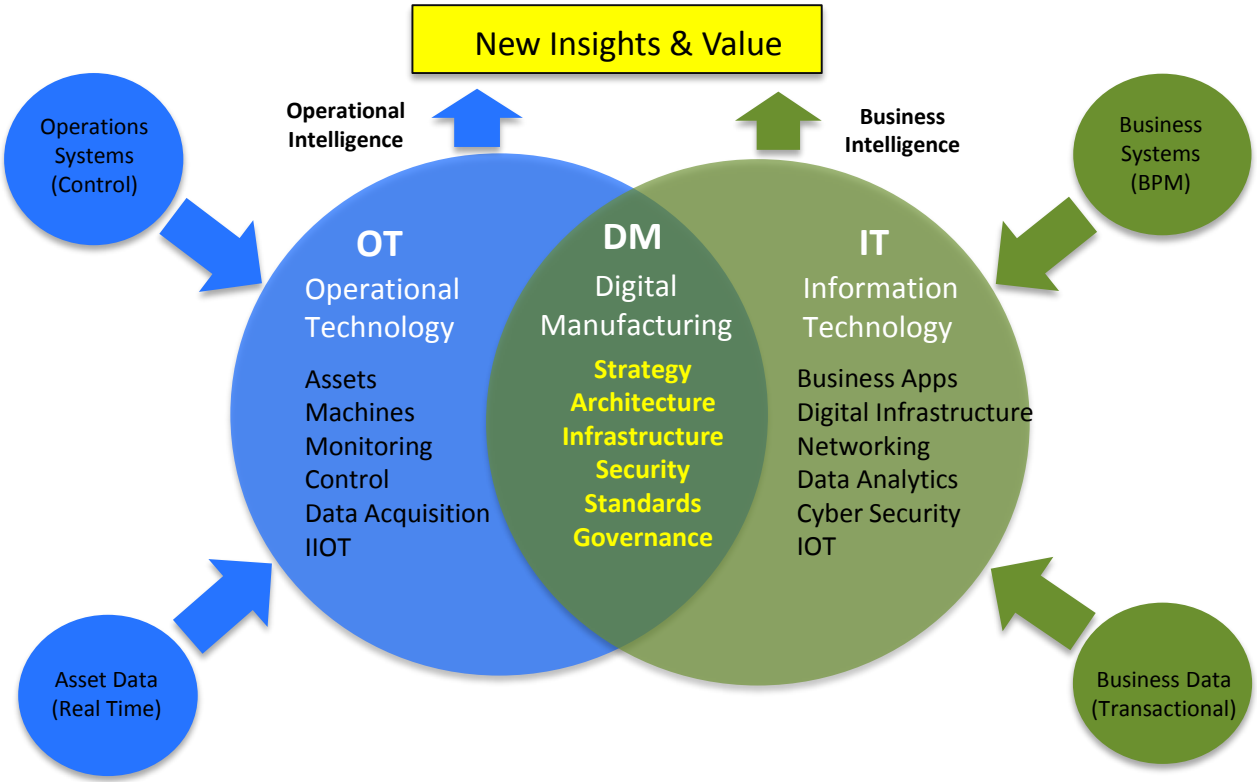
IT/OT Collaboration is no longer optional



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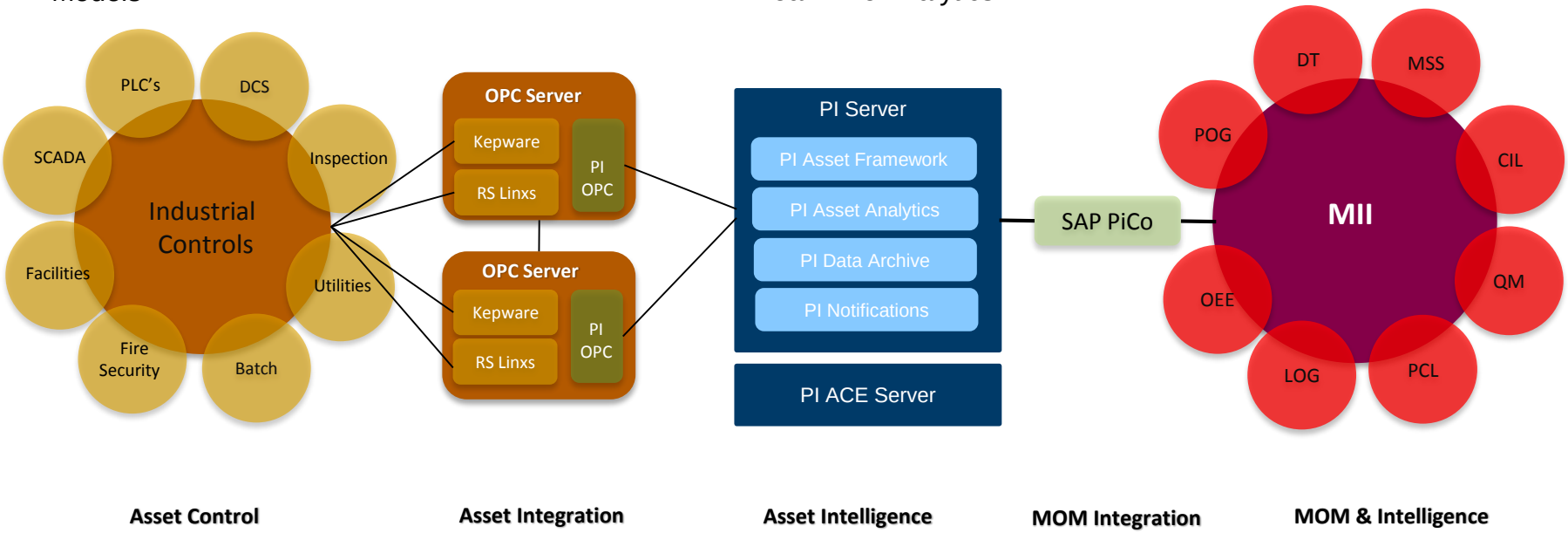
Hershey Operational Intelligence Solution Architecture

- Multiple Vendors
- Multiple Models
- Varied Implementation Models

- Unified Interface
- Data Buffering
- Open Standards

- Unified Data Storage
- Unified Asset Model
- Event Management
- Real Time Analytics

- MOM Platforms
- MOM Apps
- MOM Integration



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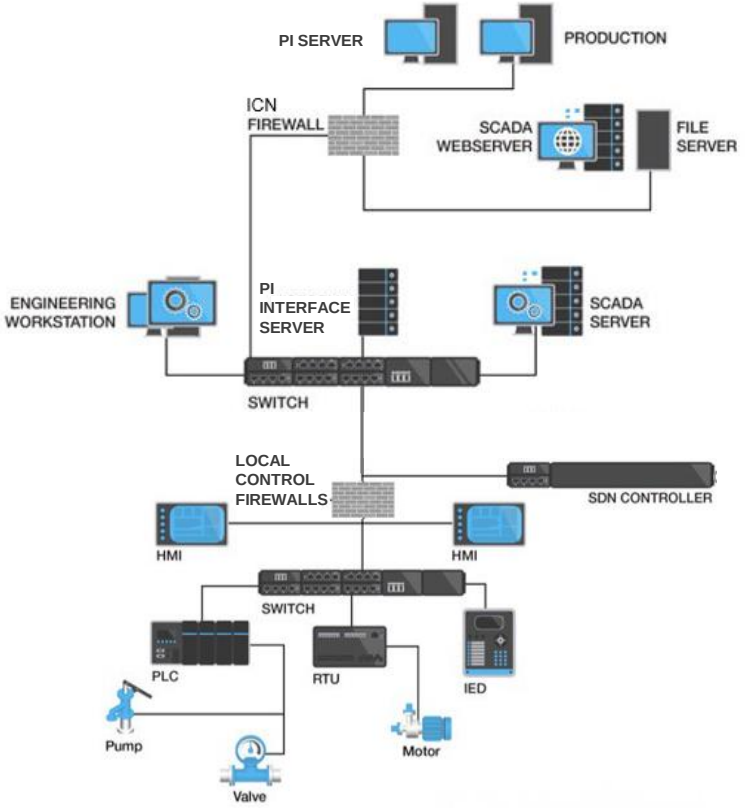
Network & Security

- Distributed Model
- Multi Level Security
- Multi Level User Authentications
- Multi Level Firewalls
- Trusts/White Listed Traffic
- Threat Detection & Monitoring
- Packet Level Sniffing



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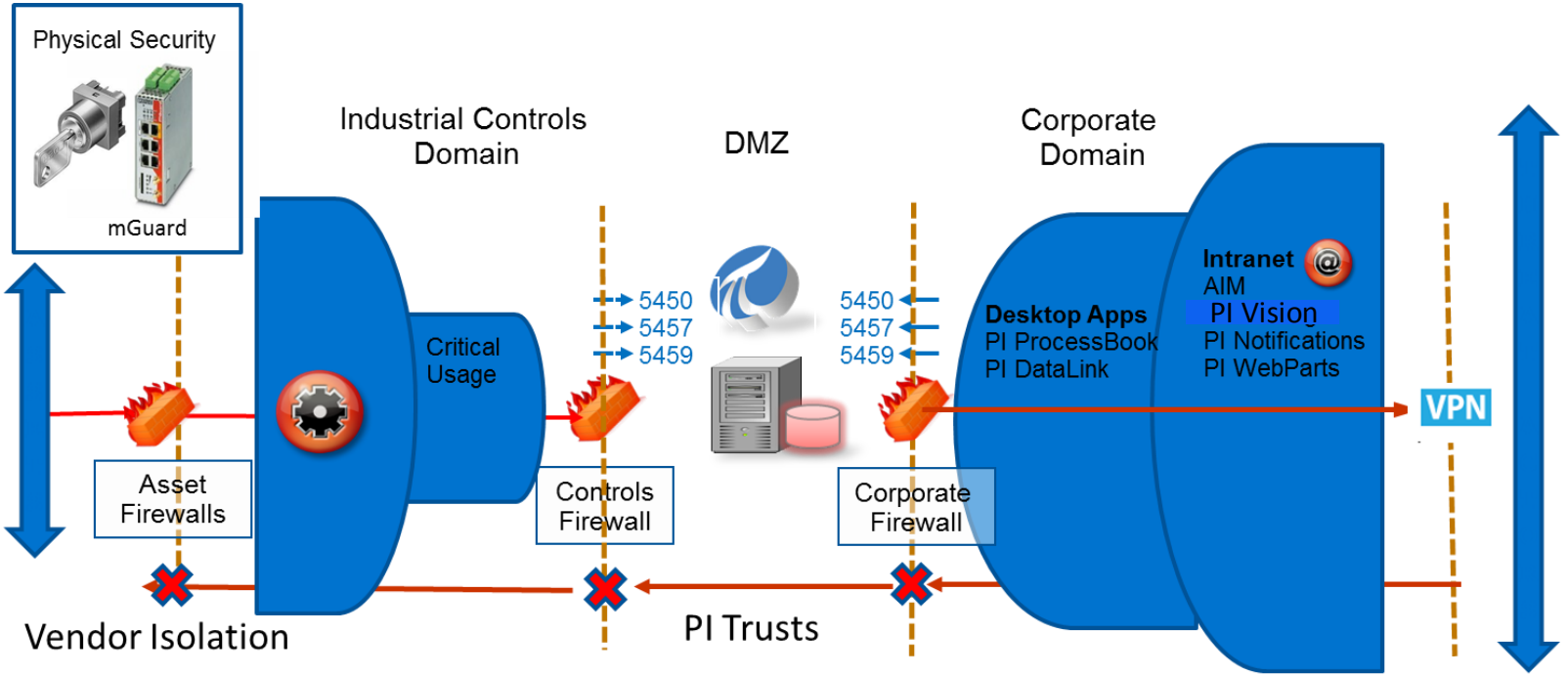
PI System – DMZ



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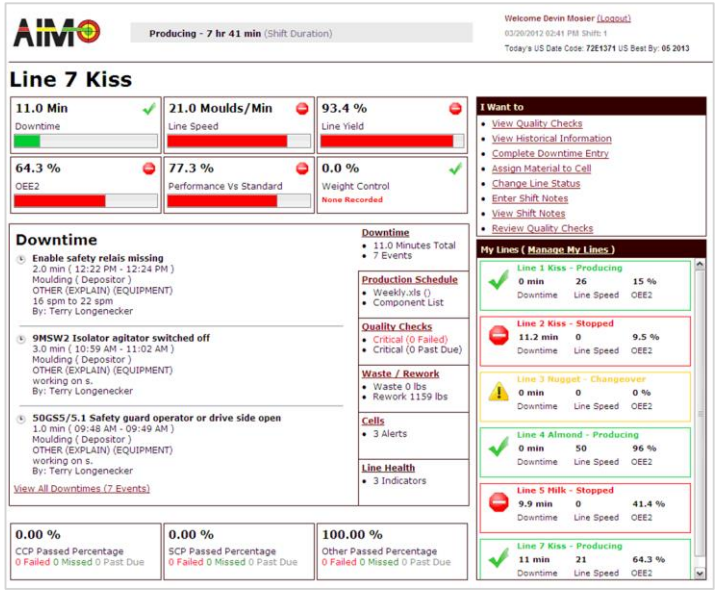
Two Hershey Value Cases

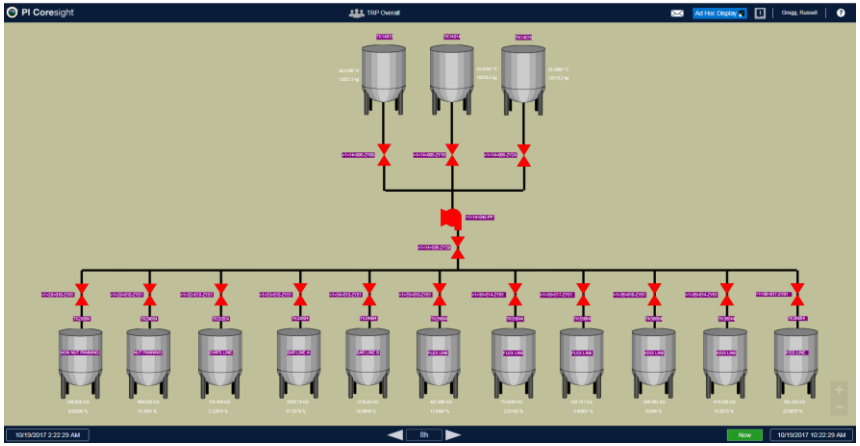
MOM Integration

Provide a structured data delivery of real time machine data to SAP MII to support Hershey AIM Machine Performance Dashboards.



Process Tracking, Visibility & Reporting

Provide real time visibility, analytics and reporting of chocolate paste production & transfer.



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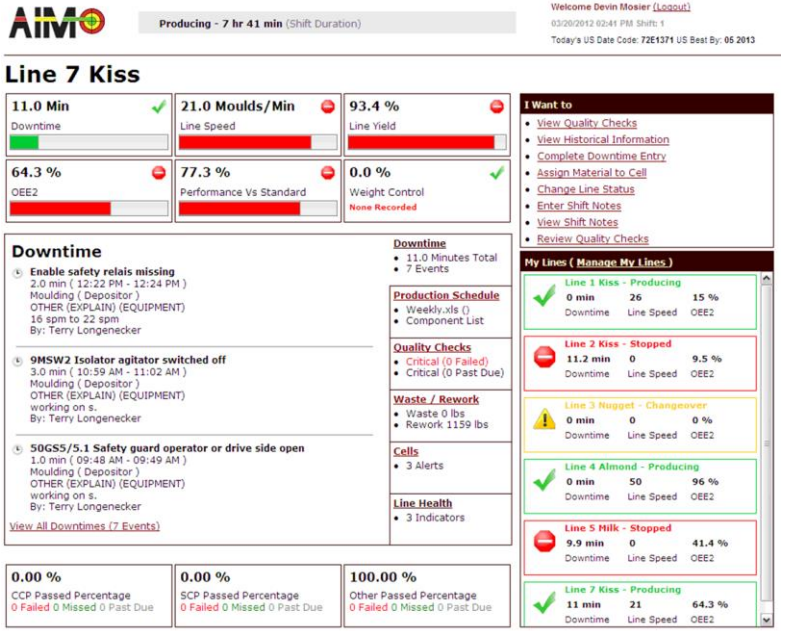
MOM Integration Challenge

Obstacles

- Variability in control data configuration and coding models.
- Wide span of both legacy control systems and newer technologies.
- Inconsistent data definitions and scaling that require data transformations.
- Required minimizing risk of over tasking legacy control systems.
- Need to open up connectivity while retaining security.
- Application layer requires a uniform data model to simplify integration of MOM platforms and SAP MII applications.



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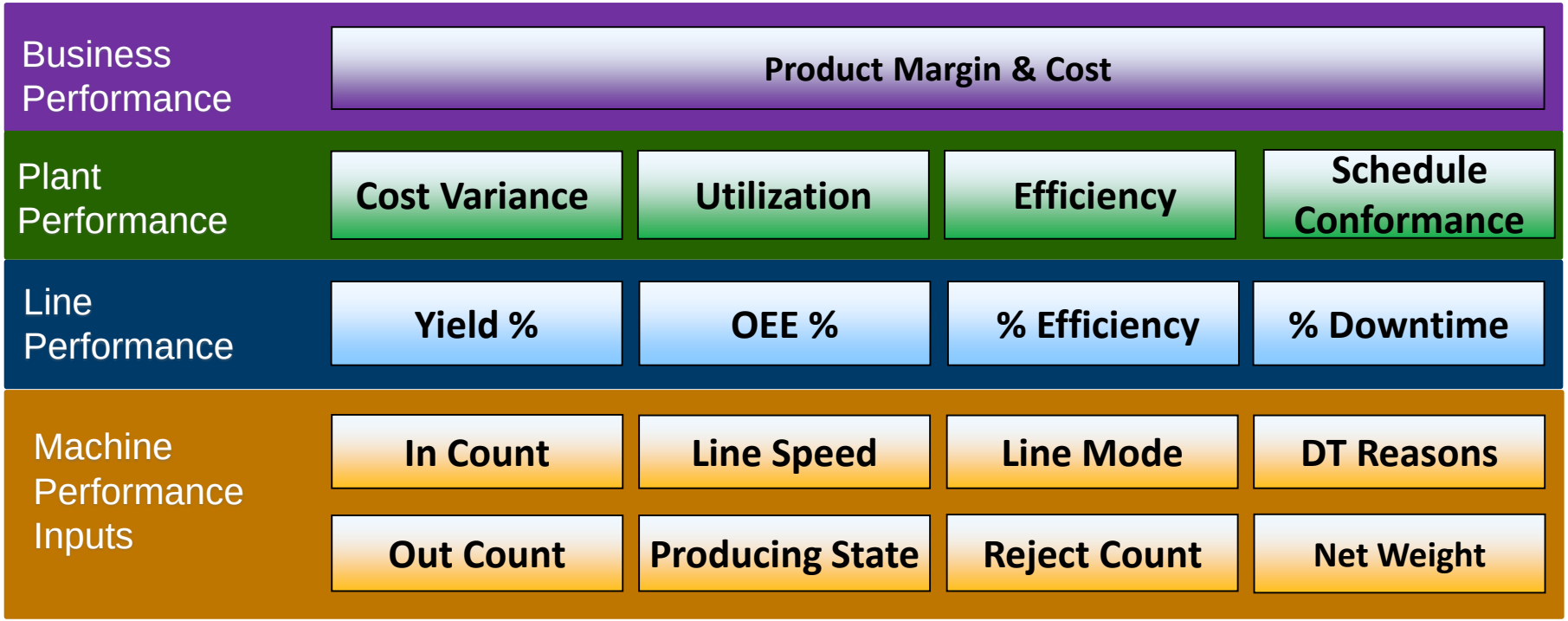
Defining Outcomes and KPI's



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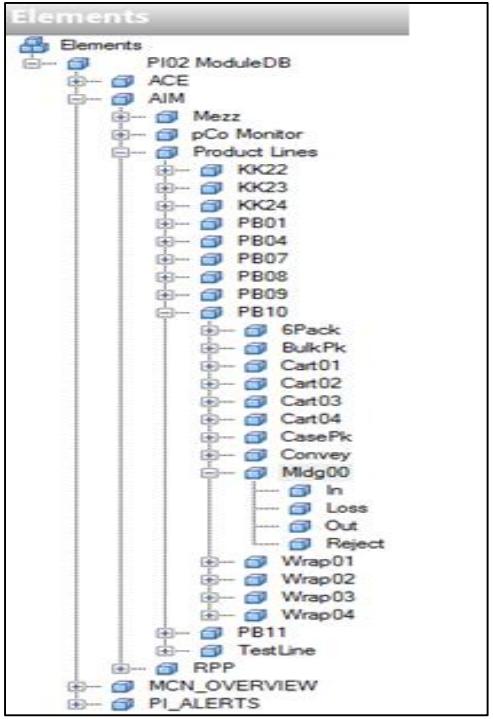
Creating a Modular & Flexible Design

PI AF (Asset Framework)

- Provides flexible hierarchical object structures with *reusable* templates.
- Enables the *standardization* of applications and reporting.
- Supports *real-time*, relational and calculated data elements.
- Supports integrated *event* and *schedule* based *calculations* and rules.
- *Easy to modify and expand* as new requirements arise.
- Easy to create *notifications*.
- Supports *open integration* with a full SDK.
- Ability to *create and track events* with PI Event Frames



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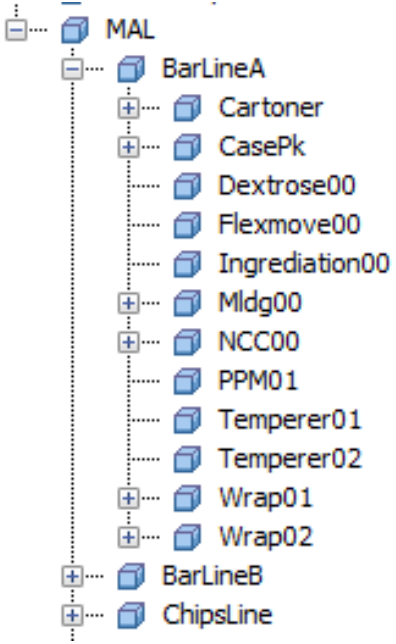
Create Logical Data Structures

PI AF Element Structure

- Multiple PI AF hierarchies can be created to provide views of the same data from different users or use case perspectives.
- PI AF makes it easy to see how the underlaying data, analysis and events fit into the higher level structures.
- It provides an easy way for users to navigate the PI System to find data in the context of the user.
- PI SDK and AF SDK allow programmatic manipulation of PI and PI AF data and objects for custom developed solutions.
- PI DataLink, PI ProcessBook, Web Parts and PI Vision leverage PI AF in their native UI's.

Plant/Line/Cell



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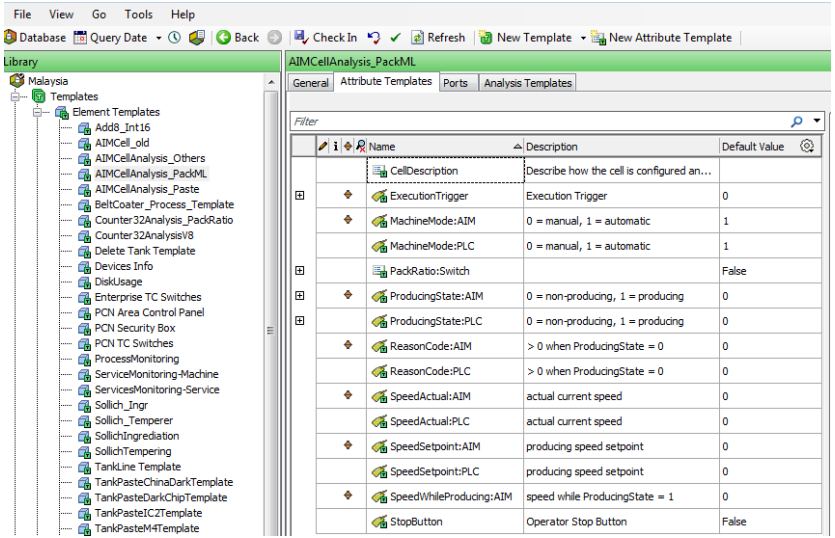
Create Reusable Data Templates

PI AF Templates

- Allow the creation of reusable data models.
- Templates enforce standardization.
- Templates support Parent/Child relationships through Derived Templates or Reference Templates.
- Changes in templates are inherited by each object instance of an element.
- Templates simplify administration, maintenance and changes.
- Templates are recommended for all elements, notifications and event frames. Support a

AIM Cell Analysis PackML Template



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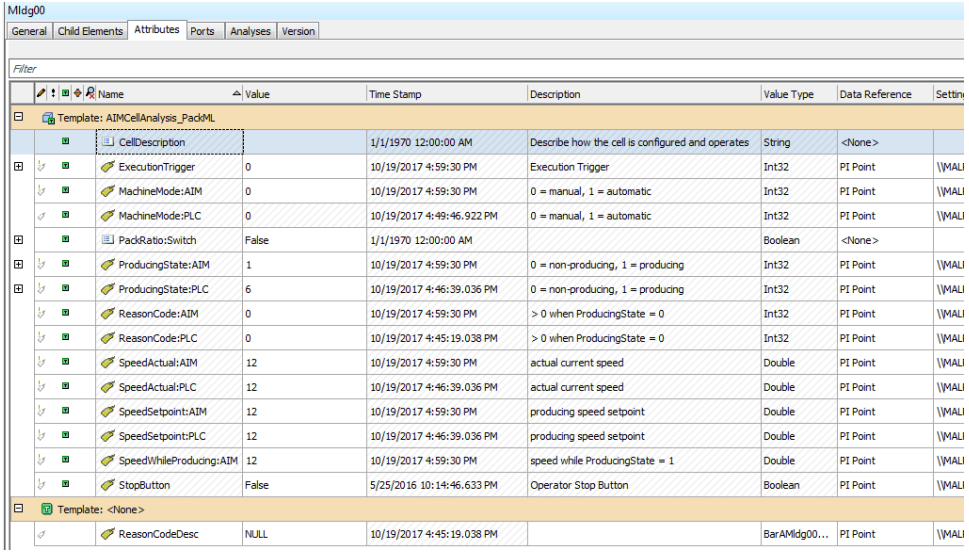
Define Required Data Elements

PI AF Elements

- Elements define the data objects for a specific asset or object.
- Attributes are defined for all required data.
- Attributes have data reference setting that can be relative to elements and/or data sources.

Moulding Cell Element


MIdg00

General | Child Elements | Attributes | Ports | Analyses | Version

Filter

Name	Value	Time Stamp	Description	Value Type	Data Reference	Settin
Template: AIMCellAnalysis_PackML						
CellDescription		1/1/1970 12:00:00 AM	Describe how the cell is configured and operates	String	<None>	
ExecutionTrigger	0	10/19/2017 4:59:30 PM	Execution Trigger	Int32	PI Point	\\MALI
MachineMode:AIM	0	10/19/2017 4:59:30 PM	0 = manual, 1 = automatic	Int32	PI Point	\\MALI
MachineMode:PLC	0	10/19/2017 4:49:46.922 PM	0 = manual, 1 = automatic	Int32	PI Point	\\MALI
PackRatio:Switch	False	1/1/1970 12:00:00 AM		Boolean	<None>	
ProducingState:AIM	1	10/19/2017 4:59:30 PM	0 = non-producing, 1 = producing	Int32	PI Point	\\MALI
ProducingState:PLC	6	10/19/2017 4:46:39.036 PM	0 = non-producing, 1 = producing	Int32	PI Point	\\MALI
ReasonCode:AIM	0	10/19/2017 4:59:30 PM	> 0 when ProducingState = 0	Int32	PI Point	\\MALI
ReasonCode:PLC	0	10/19/2017 4:45:19.038 PM	> 0 when ProducingState = 0	Int32	PI Point	\\MALI
SpeedActual:AIM	12	10/19/2017 4:59:30 PM	actual current speed	Double	PI Point	\\MALI
SpeedActual:PLC	12	10/19/2017 4:46:39.036 PM	actual current speed	Double	PI Point	\\MALI
SpeedSetpoint:AIM	12	10/19/2017 4:59:30 PM	producing speed setpoint	Double	PI Point	\\MALI
SpeedSetpoint:PLC	12	10/19/2017 4:46:39.036 PM	producing speed setpoint	Double	PI Point	\\MALI
SpeedWhileProducing:AIM	12	10/19/2017 4:59:30 PM	speed while ProducingState = 1	Double	PI Point	\\MALI
StopButton	False	5/25/2016 10:14:46.633 PM	Operator Stop Button	Boolean	PI Point	\\MALI
Template: <None>						
ReasonCodeDesc	NULL	10/19/2017 4:45:19.038 PM		BarAMldg00...	PI Point	\\MALI

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Create Required Data Analysis

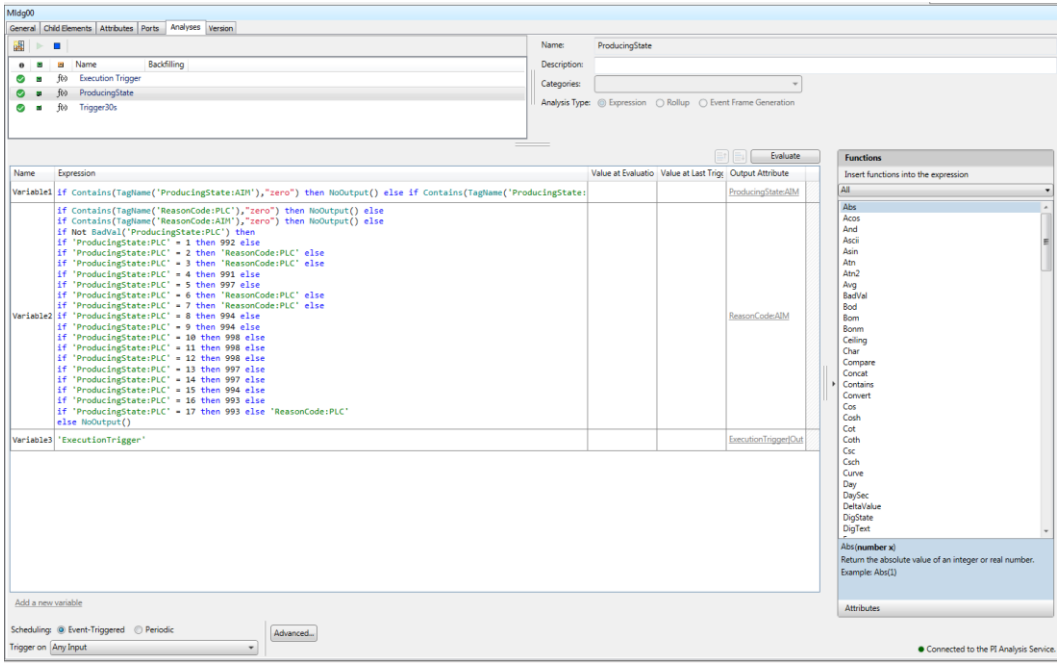
PI AF Analysis

- Manage process logic
- Manage data quality
- Filter data
- Manage data logic/rules
- Aggregate data
- Perform calculations
- Look up values in AF Tables

Solution

- Create Producing State logic
- Assign Reason Codes
- Create trigger tag validation logic

Moulding Cell – Producing State Analysis



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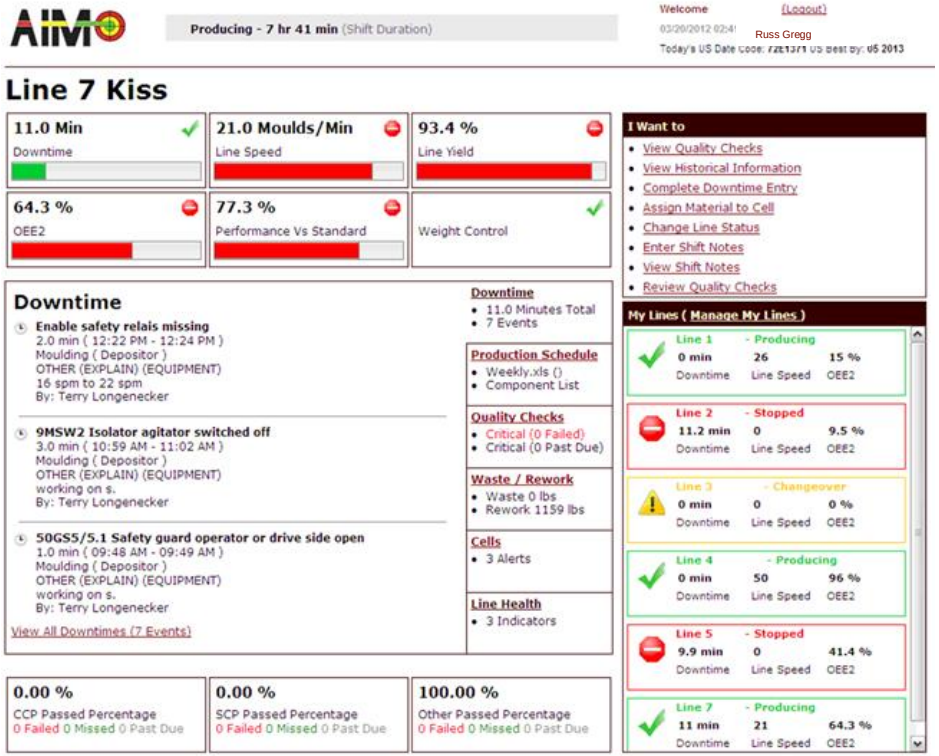
MOM Applications

Operational Awareness

- Visibility
- Data with context
- Real Time Data to Insights
- Actionable



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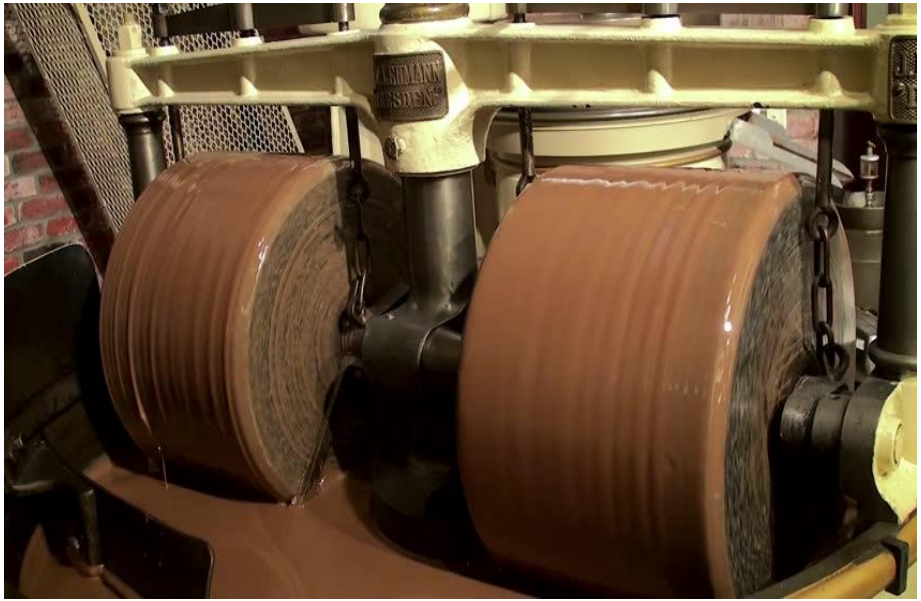
Paste Tracking Challenge

Opportunity

Wei Chong Lai the IS Global Supply Chain Manufacturing Analyst at our Malaysian Plant used the PI System to solve a common production tracking challenge.

Requirements

- Track & Report on paste transfers from conches to the tank farm.
- Track & Report on paste transfers from tank farm to production line feed tanks.



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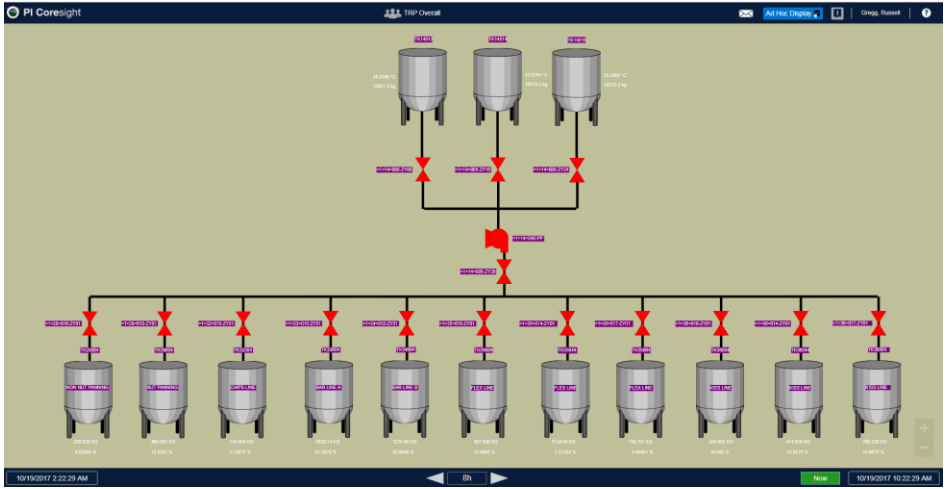
Provide Process Visibility

PI Vision

- The DSC system is connected to the PI Server through the PI Interface Server.
- The DSC system contained data on the current tank levels, valve position states and pump running states.
- This data was all that was required to work out the paste transfer logic that tracks the transfer periods and transferred weight.
- This DCS Screen was easily imported into PI Vision (Coresight) to provide real time visibility of the process states.



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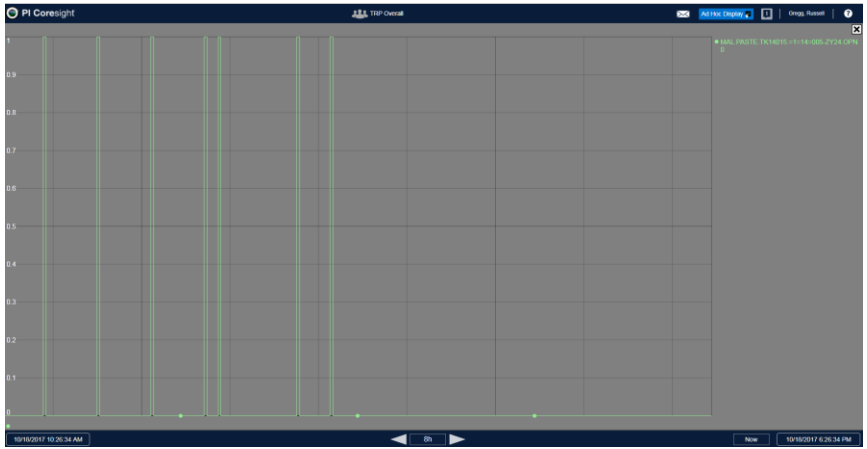
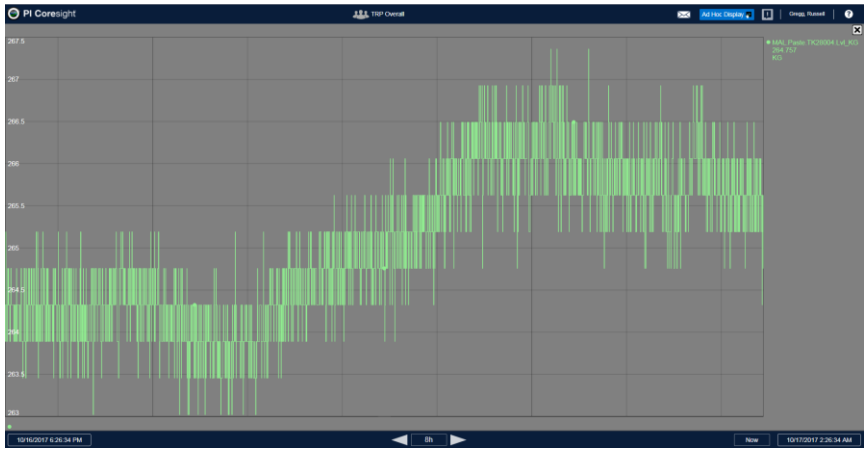
View Data Trends

PI Vision provides functionality to see real time and historical data trends by just clicking on the objects on the display.

Valve Status



Tank Level



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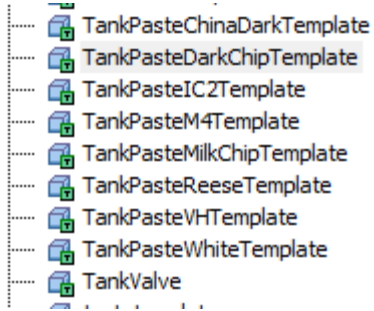
Create Reusable Data Models

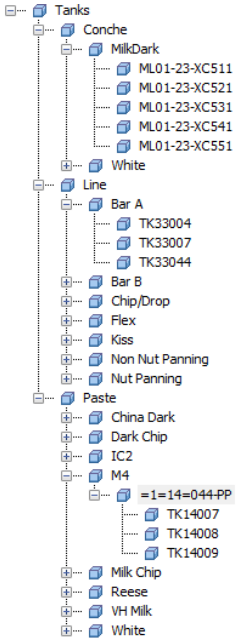
PI AF Element Templates and Elements

- Create tank and valve templates
- Create conch, tank farm and line paste tank elements.

AF Element Templates



AF Elements



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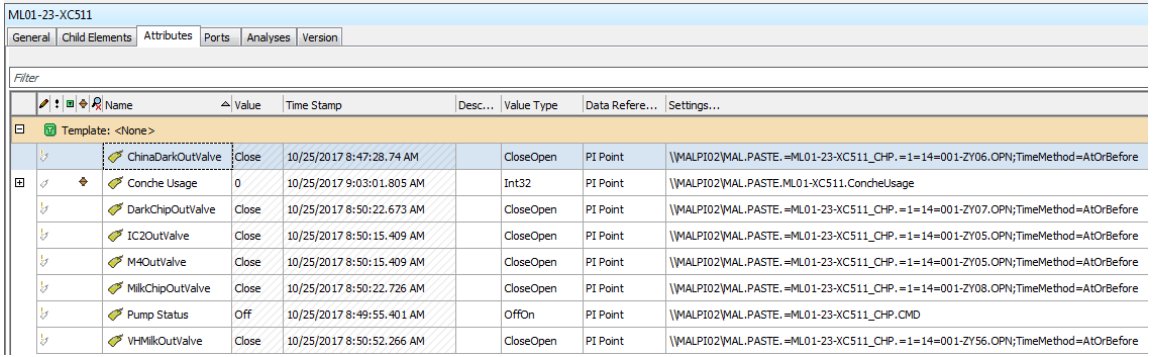
Define Required Attributes

Conche Element Attributes

- Each Out Valve State
- Transfer Pump Status
- Conch Usage.



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Define Required Attributes

Valve Element Attributes

- Valve State
- Vale Position Status

=1=14=040-PP

General | Child Elements | Attributes | Ports | Analyses | Version

Filter

Name	Value	Time Stamp	Desc...	Value Type	Data Refere...	Settings...
Template: <None>						
Output	Off	10/25/2017 8:44:55.439 AM		OffOn	PI Point	\\MALPI02\MAL.PASTE.=1=14=040-PP.CMD
Valve Status	Close	10/25/2017 8:44:55.439 AM		CloseOpen	PI Point	\\MALPI02\MAL.PASTE.=1=14=040-PP.=1=14=005-ZY29.OPN

Tank Element Attributes

- Levels
- Valve Position Status
- Agitator Status
- Temperature

TK14013

General | Child Elements | Attributes | Ports | Analyses | Version

Filter

Name	Value	Time Stamp	Desc...	Value Type	Data Refere...	Settings...
Template: TankPasteIC2Template						
HiHi	1	10/19/2017 11:04:52.393 PM		Int16	PI Point	\\MALPI02\MAL.Paste.TK14013.HiHi
InValve	Close	10/25/2017 8:44:33.208 AM		CloseOpen	PI Point	\\MALPI02\MAL.PASTE.TK14013.=1=14=005-ZY01.OPN
Level_%	70.15...	10/25/2017 9:00:34.915 AM		Single	PI Point	\\MALPI02\MAL.Paste.TK14013.Lvl_%
Level_KG	18385...	10/25/2017 9:00:34.915 AM		Single	PI Point	\\MALPI02\MAL.Paste.TK14013.Lvl_KG
OutValve	Close	10/25/2017 8:50:23.202 AM		CloseOpen	PI Point	\\MALPI02\MAL.PASTE.TK14013.=1=14=005-ZY08.OPN
TA	False	10/25/2017 8:47:15.383 AM	Tank ...	Boolean	PI Point	\\MALPI02\MAL.Paste.TK14013.TA
Temperature	35.47...	10/25/2017 9:00:34.915 AM		Single	PI Point	\\MALPI02\MAL.Paste.TK14013.TT

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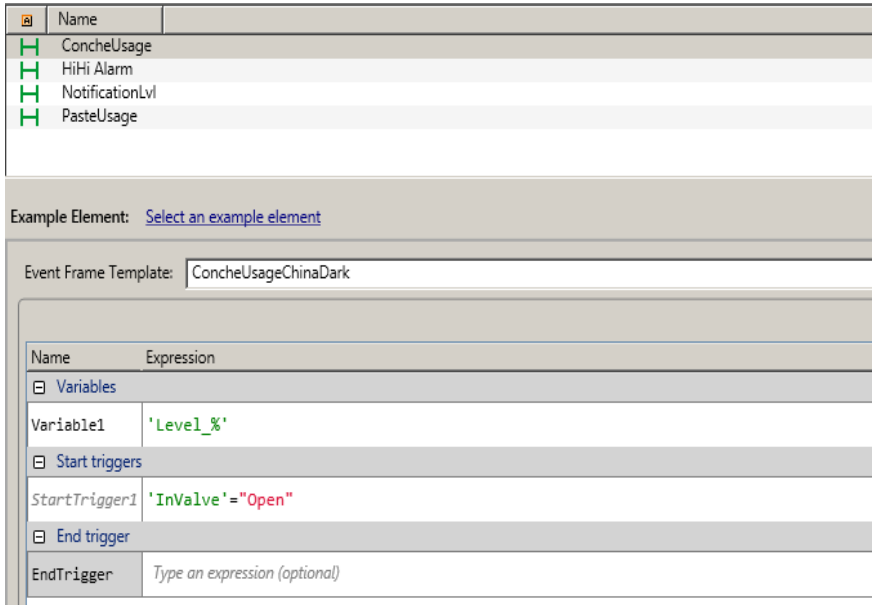
Define Event Templates

Conch to Tank Farm Transfers

- Event Frame Analysis were configured to read the receiving tank level when the tank inlet valve is opened.

Event Frame Template



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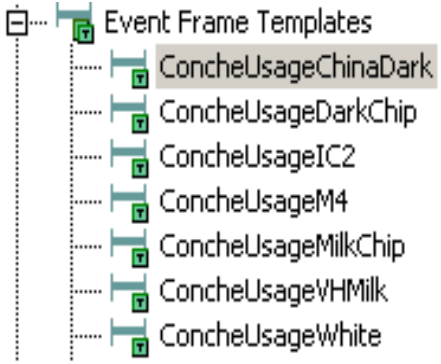
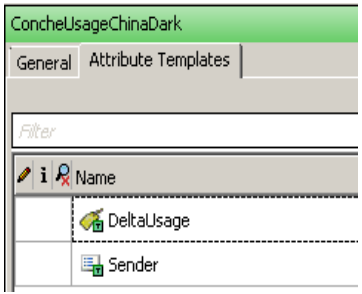
Define Event Attributes

Conche Usage

- PI AF Event Frames were created to track each transfer event from the individual Conches.
- Each event creates an event name and collects the start and end times. Additional data are captured as attributes of the Event.





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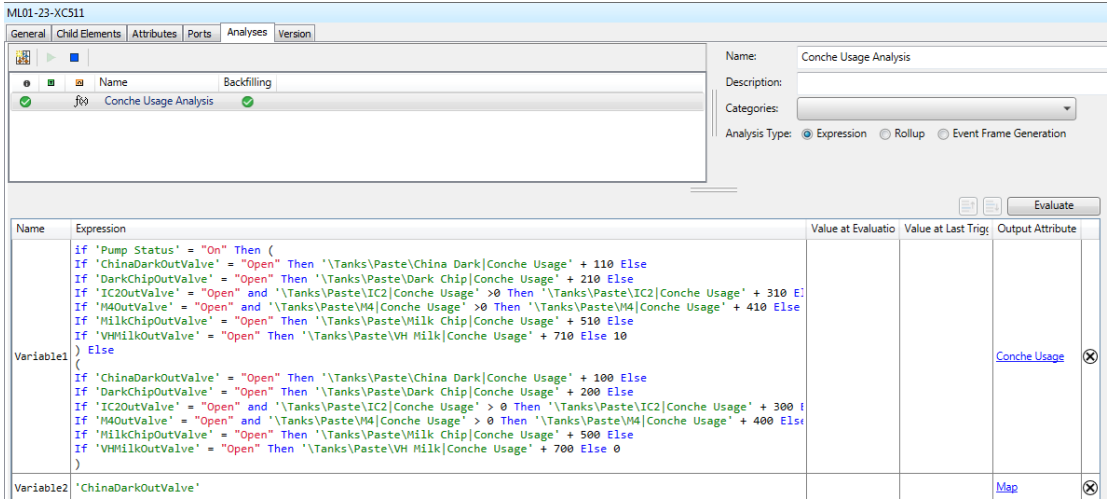
Define Required Analysis

- PI AF Element Analysis is used to create the logic for determining which Conche is transferring product when the transfer pump is “On”.



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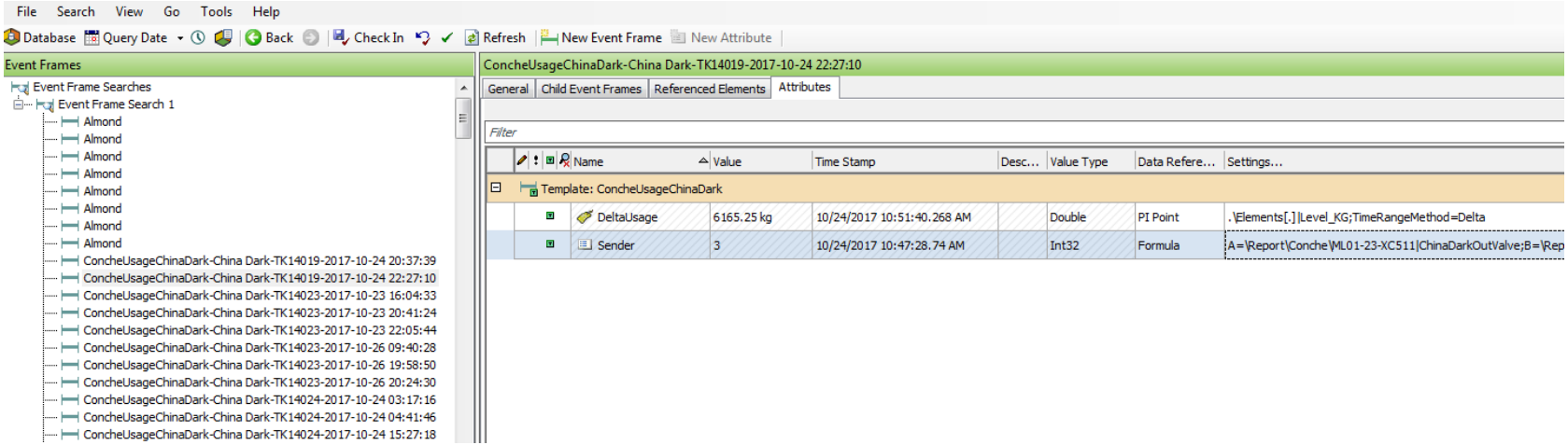
PI System Explorer

Searching and viewing Event Frames

- PI System Explorer is used to create, edit and view PI AF Elements, Event Frames,Tables and Notifications,.



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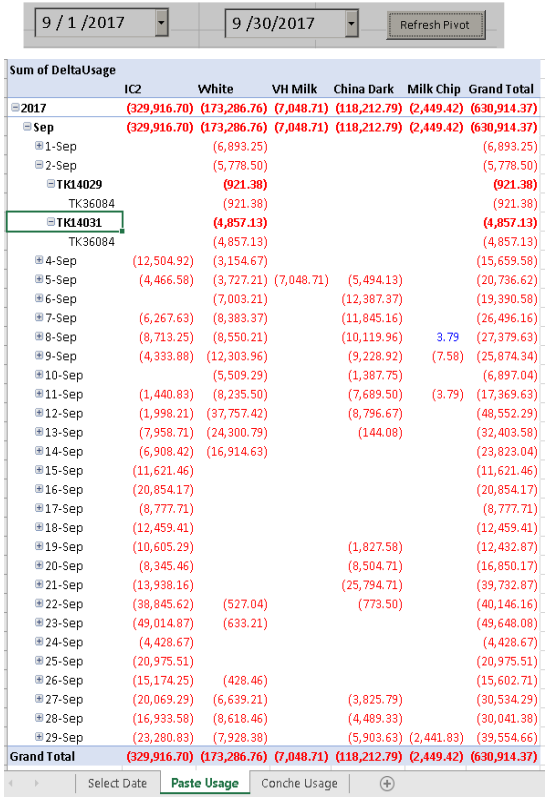
Paste Usage Reporting

PI DataLink

- Excel with PI DataLink was used to create the paste and conche usage report.
- Events are returned based on the date range entered.
- Using Excel Pivot Table functionality the data was arranged and summarized by the sending and receiving tank ID's.



Sum of DeltaUsage	IC2	White	VH Milk	China Dark	Milk Chip	Grand Total
2017	(329,916.70)	(173,286.76)	(7,048.71)	(118,212.79)	(2,449.42)	(630,914.37)
Sep	(329,916.70)	(173,286.76)	(7,048.71)	(118,212.79)	(2,449.42)	(630,914.37)
1-Sep		(6,893.25)				(6,893.25)
2-Sep		(5,778.50)				(5,778.50)
TK14029		(921.38)				(921.38)
TK36084		(921.38)				(921.38)
TK14031		(4,857.13)				(4,857.13)
TK36084		(4,857.13)				(4,857.13)
4-Sep	(12,504.92)	(3,154.67)				(15,659.58)
5-Sep	(4,466.58)	(3,727.21)	(7,048.71)	(5,494.13)		(20,736.62)
6-Sep		(7,003.21)		(12,387.37)		(19,390.58)
7-Sep	(6,267.63)	(8,383.37)		(11,845.16)		(26,496.16)
8-Sep	(8,713.25)	(8,550.21)		(10,119.96)	3.79	(27,379.63)
9-Sep	(4,333.88)	(12,303.96)		(9,228.92)	(7.58)	(25,874.34)
10-Sep		(5,509.29)		(1,387.75)		(6,897.04)
11-Sep	(1,440.83)	(8,235.50)		(7,689.50)	(3.79)	(17,369.63)
12-Sep	(1,998.21)	(37,757.42)		(8,796.67)		(48,552.29)
13-Sep	(7,958.71)	(24,300.79)		(144.08)		(32,403.58)
14-Sep	(6,908.42)	(16,914.63)				(23,823.04)
15-Sep	(11,621.46)					(11,621.46)
16-Sep	(20,854.17)					(20,854.17)
17-Sep	(8,777.71)					(8,777.71)
18-Sep	(12,459.41)					(12,459.41)
19-Sep	(10,605.29)			(1,827.58)		(12,432.87)
20-Sep	(8,345.46)			(8,504.71)		(16,850.17)
21-Sep	(13,938.16)			(25,794.71)		(39,732.87)
22-Sep	(38,845.62)	(527.04)		(773.50)		(40,146.16)
23-Sep	(49,014.87)	(633.21)				(49,648.08)
24-Sep	(4,428.67)					(4,428.67)
25-Sep	(20,975.51)					(20,975.51)
26-Sep	(15,174.25)	(428.46)				(15,602.71)
27-Sep	(20,069.29)	(6,639.21)		(3,825.79)		(30,534.29)
28-Sep	(16,933.58)	(8,618.46)		(4,489.33)		(30,041.38)
29-Sep	(23,280.83)	(7,928.38)		(5,903.63)	(2,441.83)	(39,554.66)
Grand Total	(329,916.70)	(173,286.76)	(7,048.71)	(118,212.79)	(2,449.42)	(630,914.37)

Select Date | Paste Usage | Conche Usage

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감사합니다

谢谢

Danke

Gracias

Merci

Thank You

ありがとう

Спасибо

Obrigado

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