PI Systems and Deliberate Process Improvement

Presented by **Rick Smith**

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Agenda

- About International Paper
- Business and Technical Challenges
- How Did IP Address the Challenges
  - Production Calculation
  - Overall Equipment Efficiency (OEE)
  - Energy Consumption
- Future Plans

About International Paper

- World's Largest Pulp and Paper Company
  - Founded 1898 (116 Years Ago)
  - 70,000 Employees
  - $29 Billion Net Sales (2013)
- OSISoft Installed Base
  - 35 Facilities (70 PI Servers)
    - US, Brazil, France, India, Poland, Russia
  - 1.5+ Million PI Tags
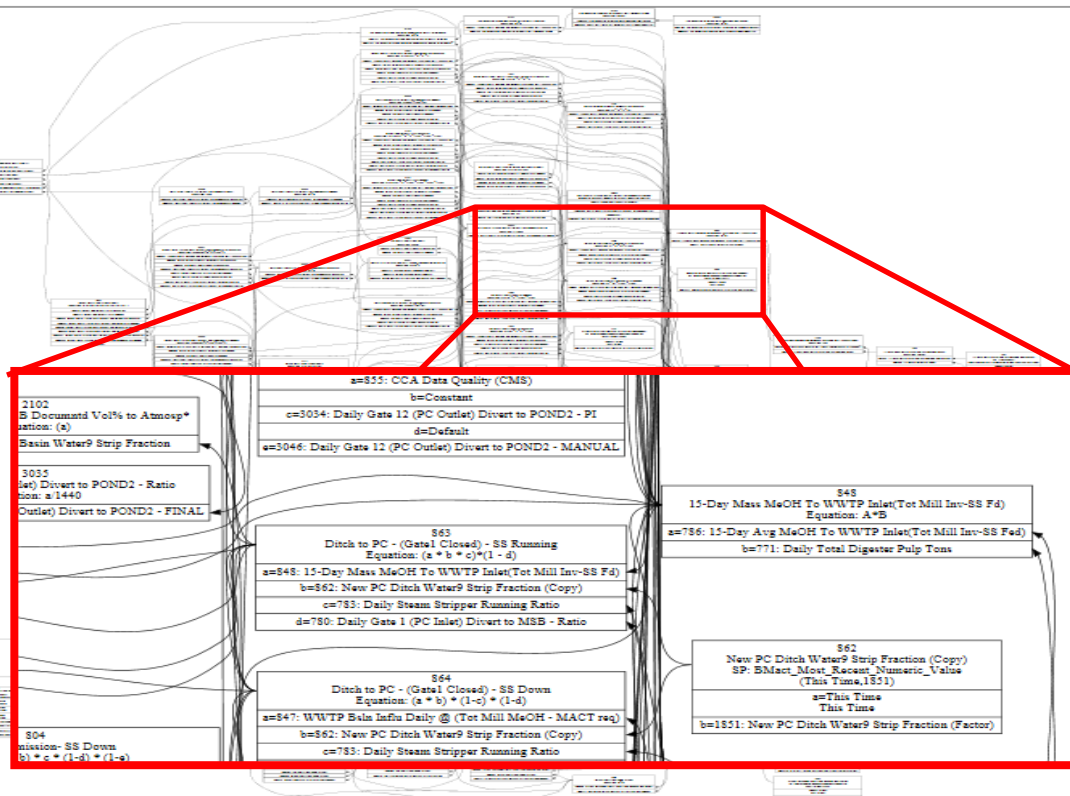
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Challenges

- Business
  - Year-Over-Year Cost Reduction Goals
  - Spend Capital Effectively (Low/No Capital)
  - Retain Historical Cost Reduction Gains
- Technical
  - Single Version of the Truth
  - Manage Through Systems
  - Simplify IT Environment (Configure vs. Develop)
  - Number of Implementations Grows Over Time

I Certify This Calculation is Correct

Single Version of the Truth

- **Question: How Much We Make?**
- The Answer Depends on Who You Ask…
  - What Base-Line Time Period Selected?
  - What PI Tags Were Used?
  - How Was Data Filtered?
  - What Calculations Were Used?

Digester Production Calculations

Standardized Calculation Methods

DCS

Raw PI Tags
PI AF (Future)

Environmental
Monitoring

Coefficient
Changes

Excel

Uncontrolled

Decision
Makers

Implementation Timeline
1. Raw PI Tags
2. Excel Calcs From Raw Inputs
3. Daily Env. Calcs Added
4. Convert to PI AF (Future)
5. Convert Excel to PI AF

Digester Production (ADUBTPD)
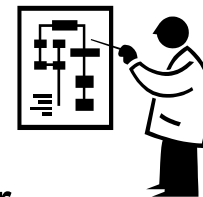
Air-Dried Unbleached Tons per Day =

Chip Meter Speed (rpms) * Bulk Density (lb/ft^3) * Chip Meter Volume (ft^3) *

Chip Meter Fill Factor * **Yield** * [1440 min/day] / [2000 lb/US Ton]

Yield = [A + B*(Kappa) + C * (Kappa)^2]

PI PE -> '03SIC103.PV' * 10.65 * 24.6 * 1.0 *   (0.4198 + 0.00155 * 'K1Kappa.PV' + 0.0 * 'K1Kappa.PV' * 'K1Kappa.PV') * 1440 / 2000

- Yield Coefficients and "Constants" Change

Standard Calculations Via PI AF

PI AF Calculation Conversion Benefits

- Standard Calculation Methodology
  - Controlled By the PI AF Template
  - Therefore, One Version of the Truth
- PI AF Becomes the One Stop Shop for…
  - Enterprise Alias for Calculated Results
  - Time Stamped Coefficient Changes
  - DCS/PI Calculation Comparison

Overall Equipment Efficiency (OEE)

- Overall Equipment Efficiency =
  Availability * Speed Efficiency * Quality
  - **Availability: Downtime/Slowback System (RTS)**
  - Speed Efficiency: Maximum Sustainable Rate
  - Quality: A1 Tons Acceptance
- **Reliability Tracking System (RTS)**
  - Windows Service Reads PI Data and Writes State Information to PI
    - 0=Normal; 1=Slow; 2=Down
    - Event System Triggers Off State Tag
  - Excel Report for Each Unit Operation
  - ~300 Unit Operations Monitored
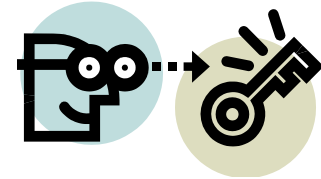
Report Output

Top 15 Reasons Sorted by Equivalent Downtime

YEAR-TO-DATE				
REASON LEVEL 1	**REASON LEVEL 2**	**REASON LEVEL 3**	**# of Incidents**	**Equiv. DT (%)**
Internal Equipment	#1 Lime Kiln	Other	11	0.9%
Internal Equipment	#1 Lime Kiln	ID Fan	1	0.9%
Internal Equipment	#1 Lime Kiln	Precoat Filter	21	0.9%
Internal Equipment	#1 Lime Kiln	Scrubber	4	0.7%
External Upstream	#2 Recovery Boiler	GL Inventory Low	1	0.6%
Internal Process	#1 Lime Kiln	Cool Down	1	0.2%
Internal Equipment	#1 Caustic			
External Utilities	Other			
Internal Process	#1 Lime Ki			
Internal Process	#1 Lime Ki			
Internal Process	#1 Lime Ki			
Internal Process	#1 Lime Ki			
Total				

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RTS Monthly Report Downtime Summary

Date	12/31/10
Mill	Mill-X
Equipment	#1 Lime Kiln

EQUIVALENT DOWNTIME	For Month			Year-To-Date		
	No. of Events	Duration (Hr)	Equival. DT (%)	No. of Events	Duration (Hr)	Equival. DT (%)
Slowback Mode	2	1.1	0.1%	3	3.2	0.0%
Downtime Mode	5	10.5	1.4%	43	1041.2	4.3%
Total			1.4%			4.3%
Overspeed Mode	0	0.0	0.0%	0	0.0	0.0%
Availability (100 - Downtime %)	733.5	98.6%		7718.9	95.7%	
Avg. Time Between DT Events	148.8	hr		203.7	hr	
Average Downtime Event Time	0.0	hr		0.1	hr	

 # EVENTS and RATE CHANGE COUNT

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec YTD

— Slowback — Downtime — Overspeeds — Rate Changes (Right)

EQUIVALENT DOWNTIME

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec YTD

■ Downtime ■ Slow Back □ Overspeed
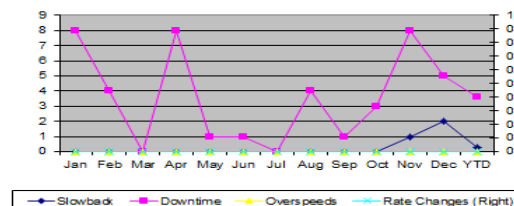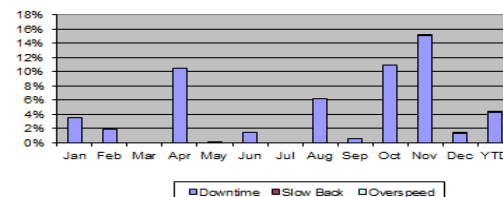
Downtime Data Flow (2002-Present)
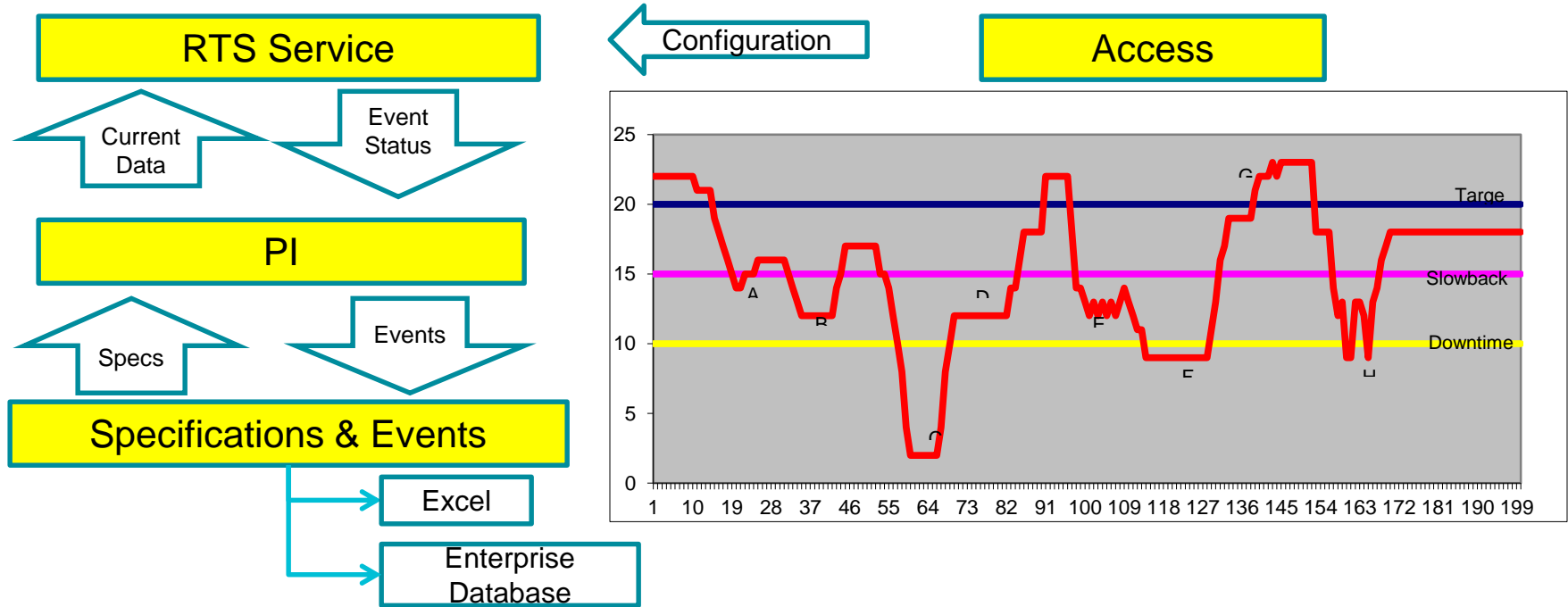
Future Downtime Data Flow
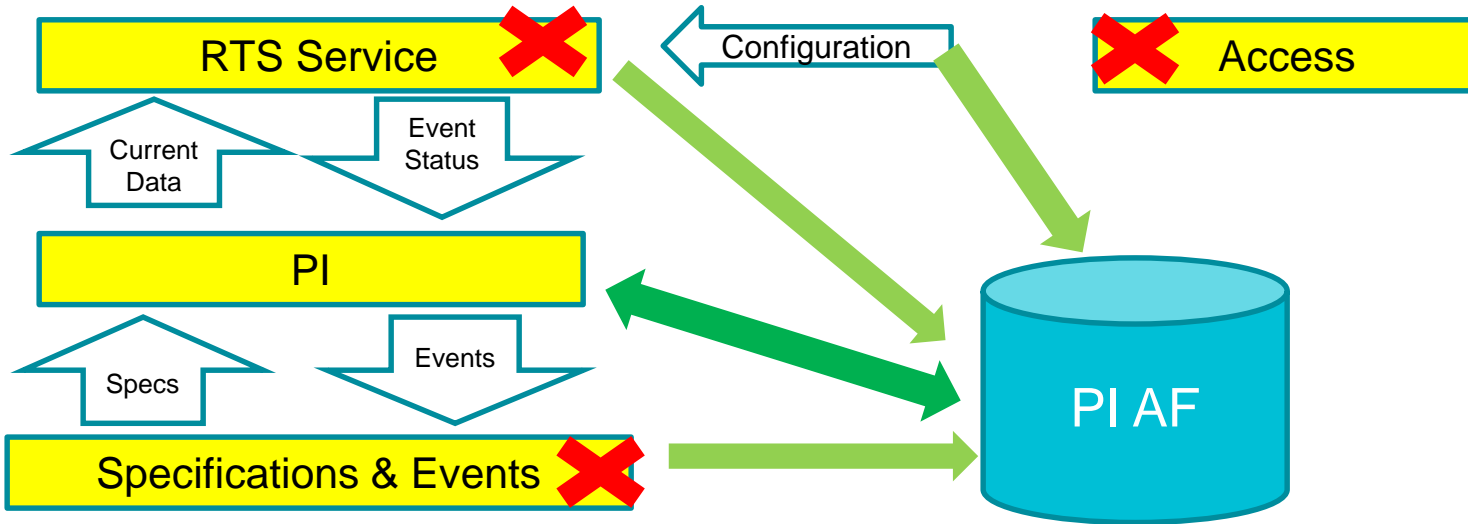
Event name	Start time	End time	Duration	Target.Average	Value.Average
EF_RTS_RTS-Test1_SS_2014-09-12 06:50:00	12-Sep-14 06:50:00			40.00	45.67
EF_RTS_RTS-Test1_SS_2014-09-16 06:20:00	16-Sep-14 06:20:00	16-Sep-14 06:31:00	0 0:11:00	40.00	27.75
EF_RTS_RTS-Test1_SS_2014-09-16 06:50:00	16-Sep-14 06:50:00	16-Sep-14 11:22:00	0 4:32:00	40.00	8.11
EF_RTS_RTS-Test1_SS_2014-09-16 18:32:00	16-Sep-14 18:32:00	16-Sep-14 23:07:00	0 4:35:00	40.00	9.42
EF_RTS_RTS-Test1_SS_2014-09-16 23:11:00	16-Sep-14 23:11:00	16-Sep-14 23:32:00	0 0:21:00	40.00	26.70

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PI Event Frame Conversion Benefits

- Simplify Environment
  - Eliminate Distributed Access Databases
  - Eliminate Windows System Service
  - Remove Specification/Event System Requirement
- Configuration with Standard PI Tools
- Will Work at All IP Manufacturing Facilities
- Simplifies Reporting Requirements

Tracking Energy Consumption

- For Each Paper Machine
  - Summarize PI Data for 20-40 PI Tags
    - Retrieve 1-Month of Hourly Averages
    - Remove "Bad Data" (Sheet Break, Downtime, etc.)
    - Allocate/Aggregate Data for "Missing" PI Tags
  - Copy/Paste Values into Enterprise Spreadsheet
- Update Chart Ranges (Enterprise Spreadsheet)
- This Exercise Takes 2+Days/Month

Steam Consumption (lb/Ton) (Low is Good)
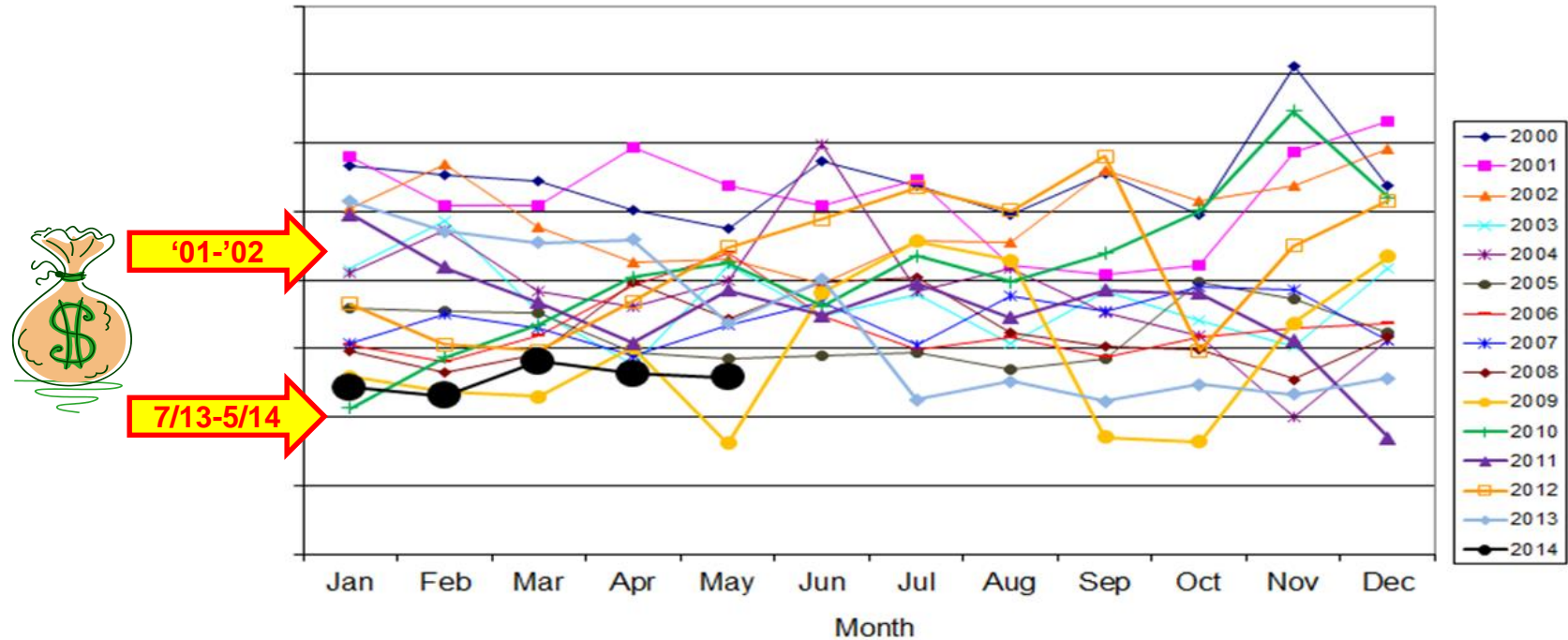
Can We Reduce the Effort?

- OSISoft Paper Machine Demonstration
  - Jim Black (Industry Principal-OSISoft)
  - Gopal Gopalkrishnan (Solutions Architect-OSISoft)
- PI AF Elements
  - Steam, Electricity and Sheet Break Status
- PI Analytics (For Each Element)
  - Value Adjusted For Sheet Break (Event-Triggered)
  - Data Quality Check (Daily Event Frame)

Monthly Summary

Date Range

Monthly Averages

	Start time	End time	ProductionRate	Tons	Electricity_KwhPerTon	Steam_HP_LbsPerTon	Electricity	Steam_HP
PM1_01/2013	01-Jan-13 00:00:00	01-Feb-13 00:00:00	52.99943161	39431.57813	78.89457703	1424.099365	3110937.75	56154.48438
PM1_02/2013	01-Feb-13 00:00:00	01-Mar-13 00:00:00	65.14954376	43780.49219	72.2878418	1326.632324	3164797.25	58080.61719
PM1_03/2013	01-Mar-13 00:00:00	01-Apr-13 00:00:00	63.43252182	47130.36328	67.87601471	1332.900024	3199021.25	62820.0625
PM1_04/2013	01-Apr-13 00:00:00	01-May-13 00:00:00	60.65192032	43669.38281	71.24710846	1341.715454	3111317.25	58591.88672
PM1_01/2014	01-Jan-14 00:00:00	01-Feb-14 00:00:00	45.7202034	34015.83203	82.536026	1544.678101	2807531.5	52543.51172
PM1_02/2014	01-Feb-14 00:00:00	01-Mar-14 00:00:00	67.36373901	45268.43359	75.16860199	1325.387329	3402765	59998.21094
PM1_03/2014	01-Mar-14 00:00:00	01-Apr-14 00:00:00	57.92578125	43038.85547	76.41738892	1475.846313	3288917	63518.73438

	Start time	End time	ProductionRate	Tons	Electricity_KwhPerTon	Steam_HP_LbsPerTon	Electricity	Steam_HP
PM2_01/2013	01-Jan-13 00:00:00	01-Feb-13 00:00:00	39.713871	29547.12109	225.8252258	2240.65332	6672485.5	66204.85156
PM2_02/2013	01-Feb-13 00:00:00	01-Mar-13 00:00:00	46.81391907	31458.95313	214.6317444	2141.956787	6752090	67383.71875
PM2_03/2013	01-Mar-13 00:00:00	01-Apr-13 00:00:00	46.71214676	34707.125	211.1295166	2120.703613	7327698.5	73603.52344
PM2_04/2013	01-Apr-13 00:00:00	01-May-13 00:00:00	46.98371887	33828.27734	209.9403076	2136.415771	7101919	72271.26563
PM2_01/2014	01-Jan-14 00:00:00	01-Feb-14 00:00:00	37.06420517	27575.76953	246.0911713	2492.465332	6786153.5	68731.64844
PM2_02/2014	01-Feb-14 00:00:00	01-Mar-14 00:00:00	44.85942459	30145.53125	218.7319183	2245.138916	6593790	67680.90625
PM2_03/2014	01-Mar-14 00:00:00	01-Apr-14 00:00:00	45.86004639	34074.01563	214.614624	2179.784424	7312782	74274.00781
PM2_04/2014	01-Apr-14 00:00:00		35.81909561	23842.70313	208.6723785	2263.317139	4975320	53963.67188

DONE!

1. **15-Second Refresh**
2. **Data Cleaned and Summarized**

Monthly Totals

PI Event Frame Benefits

- Reduce Monthly Task to < 4 Hours (est.)
  - Data Transfer Time Reduced by > 98%
  - Eliminate Data Cleaning Step
  - Eliminate per Ton Calculation Step
- Simplify Reporting
 - Single Version of the Truth

Next Steps and Future Plans

- Switch PI Servers to Domain Security (In Progress)
- PI Asset Framework Projects (Proposed)
  - PI Notifications
    - Replace Home Grown Solution
  - PI Event Frames
    - Replace Home Grown Downtime Solution
    - Daily/Monthly/Grade Analysis
  - Identify and Configure Standard Plant Model
  - … More to Come…
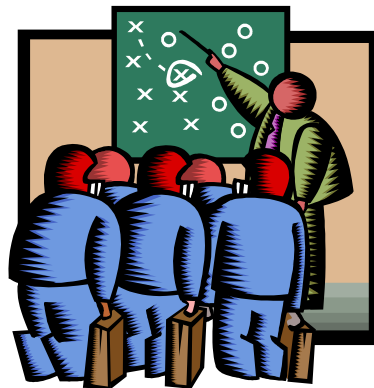
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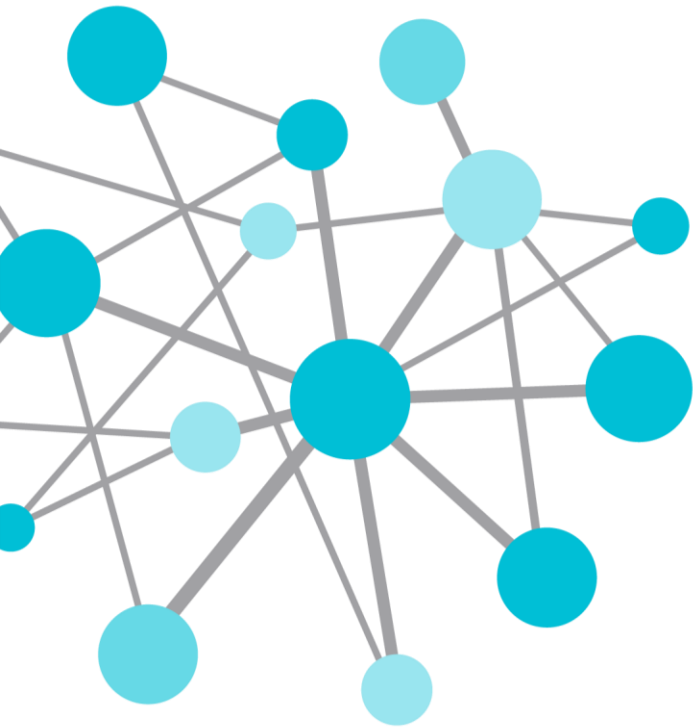
THANK YOU

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