



Data Driven Environmental Monitoring: An Automation Journey

Presented by **Rick Smith**

Manufacturing Process Information



Environmental Monitoring: Automation Journey

“The CEMR system allowed us 30 days to analyze data before the EPA’s ICR (Information Collection Request) deadline.”



Emissions Inventory - Source Detail (020912)							
Generated On: 3/5/2012 4:30:25 PM							
Simulation Period: 1/1/2011 12:00:01 AM To 12/31/2011 11:59:59 PM							
Mill - Bleach - Bleach Plant A&B-							
Category	Pollutant	ADBTP-(HWD)					
		Activity	Activity Units	Emission Factor	EF UOM	Control	Emissions Emission UOM
Criteria & PSD	CO	387.170	ADBTP-(HWD)	7.890E-001	LB/ADTBP	0.00 %	154.48 tons
	TPS (Compound Total)						0.95 tons
	YOC (Compound Total)						23.77 tons
	1,1,2-Trichloroethane	387.170	ADBTP-(HWD)	6.850E-005	LB/ADTBP	0.00 %	1.33E-003 tons
	1,2-Dichloroethylene	387.170	ADBTP-(HWD)	3.300E-005	LB/ADTBP	0.00 %	1.80E-003 tons
	Acetaldehyde	387.170	ADBTP-(HWD)	1.520E-003	LB/ADTBP	0.00 %	0.37 tons
	Acetone	387.170	ADBTP-(HWD)	3.700E-003	LB/ADTBP	0.00 %	0.72 tons
	Acrolein	387.170	ADBTP-(HWD)	6.230E-005	LB/ADTBP	0.00 %	0.01 tons
	Benzaldehyde	387.170	ADBTP-(HWD)	6.20E-004	LB/ADTBP	0.00 %	0.12 tons
	Benzene	387.170	ADBTP-(HWD)	5.740E-005	LB/ADTBP	0.00 %	0.01 tons
	Carbon Disulfide	387.170	ADBTP-(HWD)	1.517E-004	LB/ADTBP	0.00 %	0.03 tons
	Carbon Tetrachloride	387.170	ADBTP-(HWD)	5.063E-005	LB/ADTBP	0.00 %	9.80E-004 tons
	Chlorine	387.170	ADBTP-(HWD)	2.330E-003	LB/ADTBP	0.00 %	0.45 tons
	Chlorine Dioxide	387.170	ADBTP-(HWD)	2.218E-003	LB/ADTBP	0.00 %	0.43 tons
	Chlorobenzene	387.170	ADBTP-(HWD)	1.070E-005	LB/ADTBP	0.00 %	2.07E-003 tons
	Chloroform	387.170	ADBTP-(HWD)	4.600E-003	LB/ADTBP	0.00 %	0.89 tons
	Cresols (mixed isomers)	387.170	ADBTP-(HWD)	6.850E-002	LB/ADTBP	0.00 %	1.23 tons
	Chloroacetaldehyde	387.170	ADBTP-(HWD)	4.100E-005	LB/ADTBP	0.00 %	7.94E-003 tons
	Cumene	387.170	ADBTP-(HWD)	2.195E-004	LB/ADTBP	0.00 %	0.04 tons
	Cyclohexanone	387.170	ADBTP-(HWD)	9.400E-005	LB/ADTBP	0.00 %	0.02 tons
	Dimethyl Disulfide	387.170	ADBTP-(HWD)	9.540E-004	LB/ADTBP	0.00 %	0.18 tons
	Dimethyl Sulfide	387.170	ADBTP-(HWD)	2.220E-003	LB/ADTBP	0.00 %	0.43 tons
	Ethanol	387.170	ADBTP-(HWD)	2.500E-003	LB/ADTBP	0.00 %	0.46 tons
	Ethyl Benzene	387.170	ADBTP-(HWD)	1.498E-005	LB/ADTBP	0.00 %	2.90E-003 tons
	Formaldehyde	387.170	ADBTP-(HWD)	7.680E-004	LB/ADTBP	0.00 %	0.15 tons
	Hydrochloric Acid	387.170	ADBTP-(HWD)	2.220E-002	LB/ADTBP	0.00 %	4.21 tons
		387.170	ADBTP-(HWD)	1.490E-003	LB/ADTBP	0.00 %	0.00 tons

- Consolidate Environmental Reporting Using Live Process Measurements.
- Build Solution Around the PI System Installed in the '90's.
- Cross Report Consistency
- Respond to “Impossible” Data Requests
- Data Source for Sustainability Goals

Agenda

- Background
- Business Challenge
- Keys to Success
- Conclusions

What Has Changed in 30 Years

1980's

- Few Visual Inspections
- Few Online Measurements
- Periodic Stack Testing
- Discharge Monitoring

2012

- Many Online Measurements
- Periodic Stack Testing
- Parameter Monitoring
- In-Process Monitoring

Technology Has Also Changed

1980's

- Log Sheets
- Single Loop Indicators
- Visual Inspections / Stack Tests
- Factors in Text Publications
- Physical Compliance Reports

2012

- Electronic Log Sheets
- DCS-> PI System
- CEMs-> PI System
- Factors in Spreadsheets/ XML
- Electronic Compliance Databases

Expectations Have Also Changed

- Static Emission (Bubble) Permits
 - Decreased Gap
- Reduced Averaging Periods
 - Annual -> Month -> Day -> Hour
- Customer Expectations
 - Information By Product
- Scorecards
 - Internal (Company)
 - External (Customer)

So What We Are Talking About?

- Emission Calculation: $E_p = SA * EF_p * (1 - CE_p)$
 - P = Pollutant (Compound/Material) Being Evaluated
 - SA = Source/Activity (Production)
 - Hours of Operation, Days in Year, Permit Condition
 - Averaging Methodology May Vary by Regulation
 - EF = Emission Factor (eg. Lb/FuelOil6-MGal)
 - 10 Methodologies for Calculating/Collecting Emission Factor
 - CE = Control Efficiency
 - Removal or Destruction Efficiency

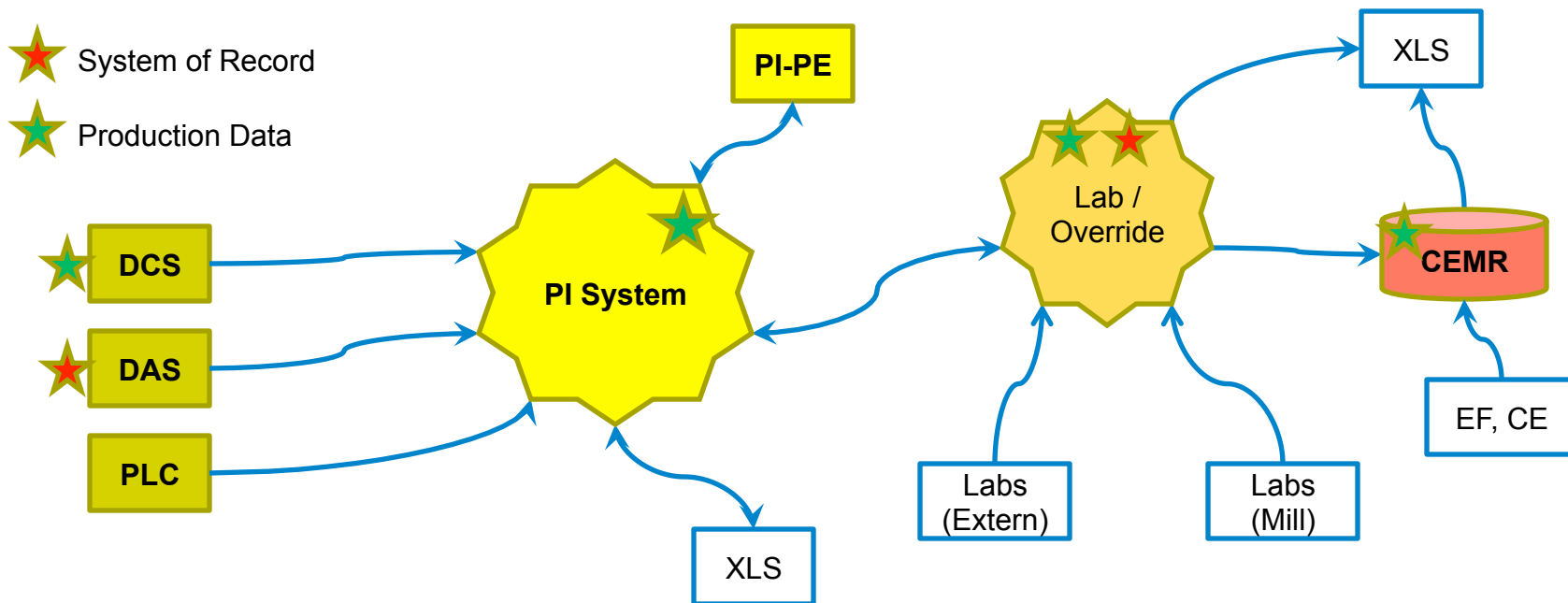
What is So Hard?

- $E_p = SA * EF_p * (1 - CE_p)$
- Typical Paper Mill
 - 40-200 Source/Activities
 - 100-400 Pollutants (Compounds) Per Source/Activity
 - 4500-15,000+ Active Emission Factors
 - Many Reports Share Factors and Calculation Methodology
 - AEI, TRI, PSD, GHG
- Site Test vs. Literature vs. Engineering Estimates for Emission Factors
- Did I Mention Everything is Temporal?

Technology To The Rescue

- 1st Generation Data Driven Monitoring (1990-2008)
 - 80-Tab Excel Spreadsheet and PI Datalink
 - One Spreadsheet per Report per Year
- Generation MACT (2000-Present)
 - IP Developed MACT Reporting System
- 2nd Generation Data Driven Monitoring (2009-Present)
 - Consolidated Environmental Monitoring and Reporting (CEMR)
 - 2009: AEI, TRI (Air-Only), Simplified PSD
 - 2011-2012: GHG (A, C, AA, II, TT)

CEMR High Level Data Flow (Typical)



Keys to Success

- Best Practices
 - Capital Projects
 - Software Development
- PI System for All Real-Time Data
- “Special” PI Tags
- Reconcile Production Data
- Demonstrate New System is Easier

Best Practices: Capital Projects

- Define Scope And Boundaries
 - Clearly Separate “Can Do” from “Will Do”
 - Document Out-Of-Scope
- Multidiscipline Team
 - Accounting, EHS, Process, Process Control, Mfg-IT

Best Practices: Software Development

- Standardize, Standardize, Standardize
- Document Detailed Design
 - If Change Occurs, Must Roll Back to All Facilities
- Generalize Algorithms with Parameters
 - For Example, MACT Average
 - 15-min, 1-hr, 10-day, 15-day, 30-day, 42-day
 - Block Average, Rolling Average
 - With and Without Percent Good
- Generalize with Attributes and Meta-Data
- Implementation Check-List
 - Meter -> PI System -> PI Performance Equations -> Override System -> CEMR -> Reports

What You Need Are...Lots of PI Tags

- All Real-Time Data
 - Process Value, Valve Positions, Setpoints
 - Digital States
 - Open / Close
 - Running / Not Running
 - Potential-to-Emit (PTE/No PTE)
 - Continuous Emission Monitors (CEMs)
 - Final Value and Calculation Inputs
 - Calculated Values
 - Avoid Agglomerated Constants
 - Calculation Parameters (Temporal Components)

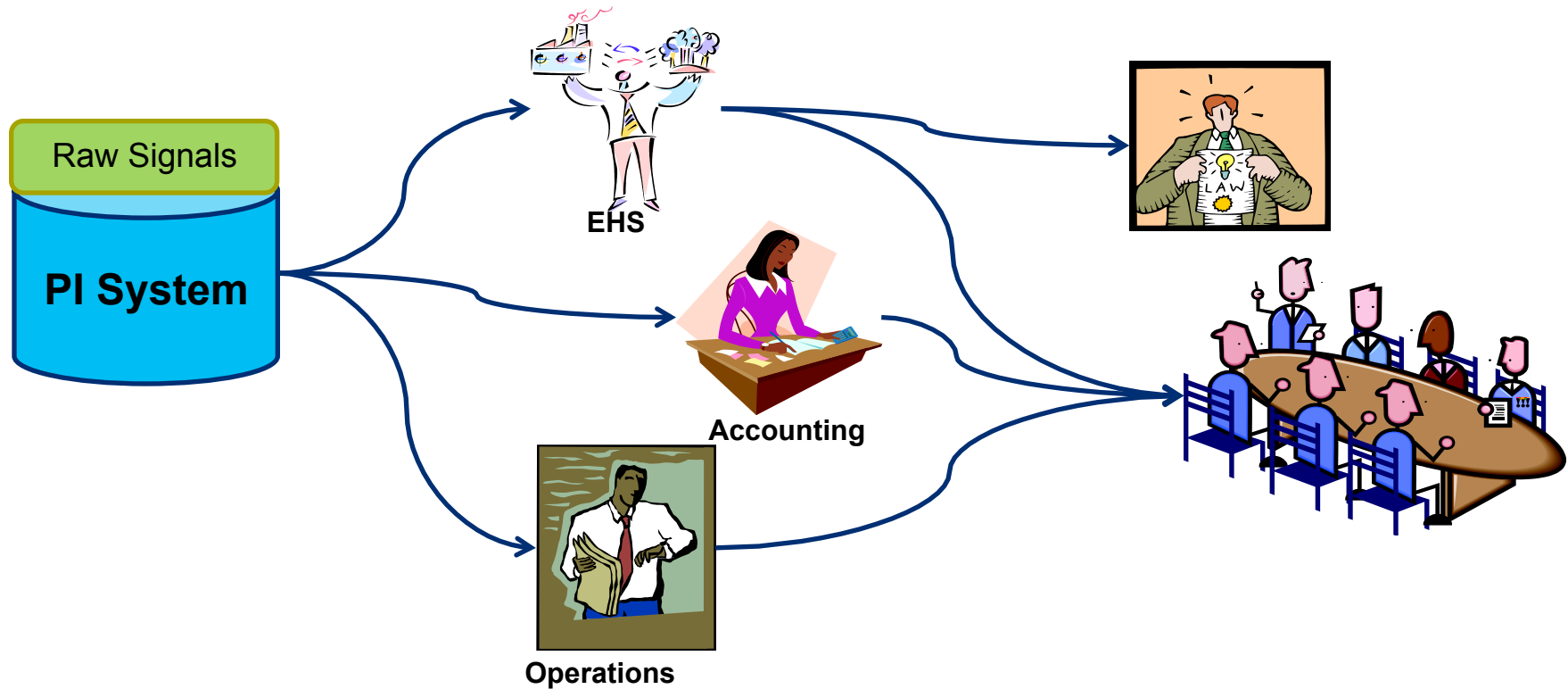
... and Special PI Tags

- Raw Input (Field Measurements)
- Filtered Input (PI-Performance Equations)
 - aka “.Filt” Tags
- Potential-to-Emit (More than Run Status)
 - aka “PTE” Tags
- Final Aggregated Value (Hourly/Daily/Monthly)
 - aka “.HR”, “.DAY” or “.MTH” Tags
- Golden (Gospel) PI Tags

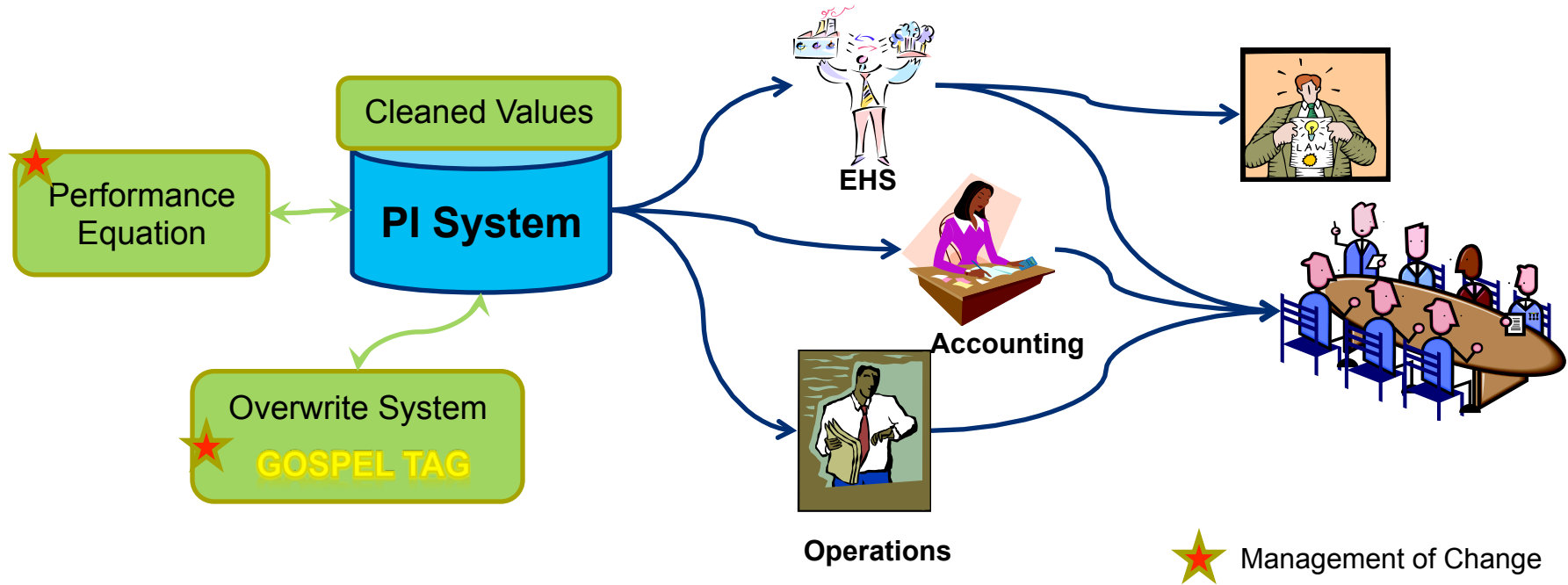
... Units of Measure

- Does the Unit of Measure Match the PI Tag?
 - PB1.NatGas.MMSCF.MTH w/ Units = MMSCF
 - PB1.NatGas.MMBTU.MTH w/ Units = MMSCF (?)
- Wet vs. Dry Measurement - Be Specific
 - Ambiguous: PB1.Bark.Tons.MTH w/ Units = Tons (?)
 - Specific: PB1.Bark.GTons.MTH w/ Units = GTons
- Abbreviation Standards – Be Consistent
 - Does MLbs Mean Thousands or Millions of Pounds?

Reconciling Data (Before)



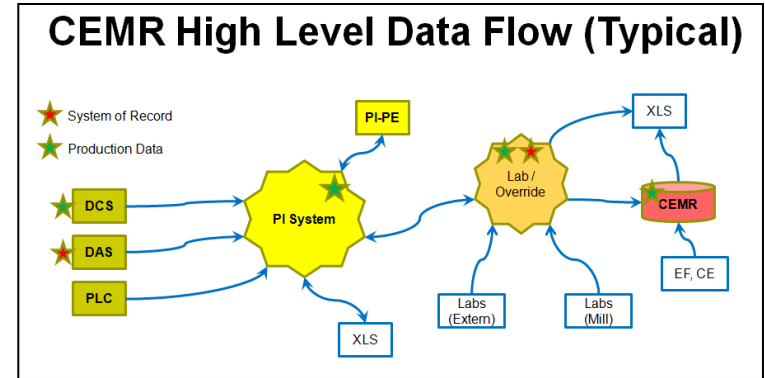
Reconciling Data (Today)



★ Management of Change

Take the IT Out of the Process

- Help Users Help IT
- Automate Repetitive Tasks
- Troubleshooting Tools
- Standard Report Templates
 - Dump Report So Users Can Build Own Reports
 - Include Meta-Data for Grouping/Filtering



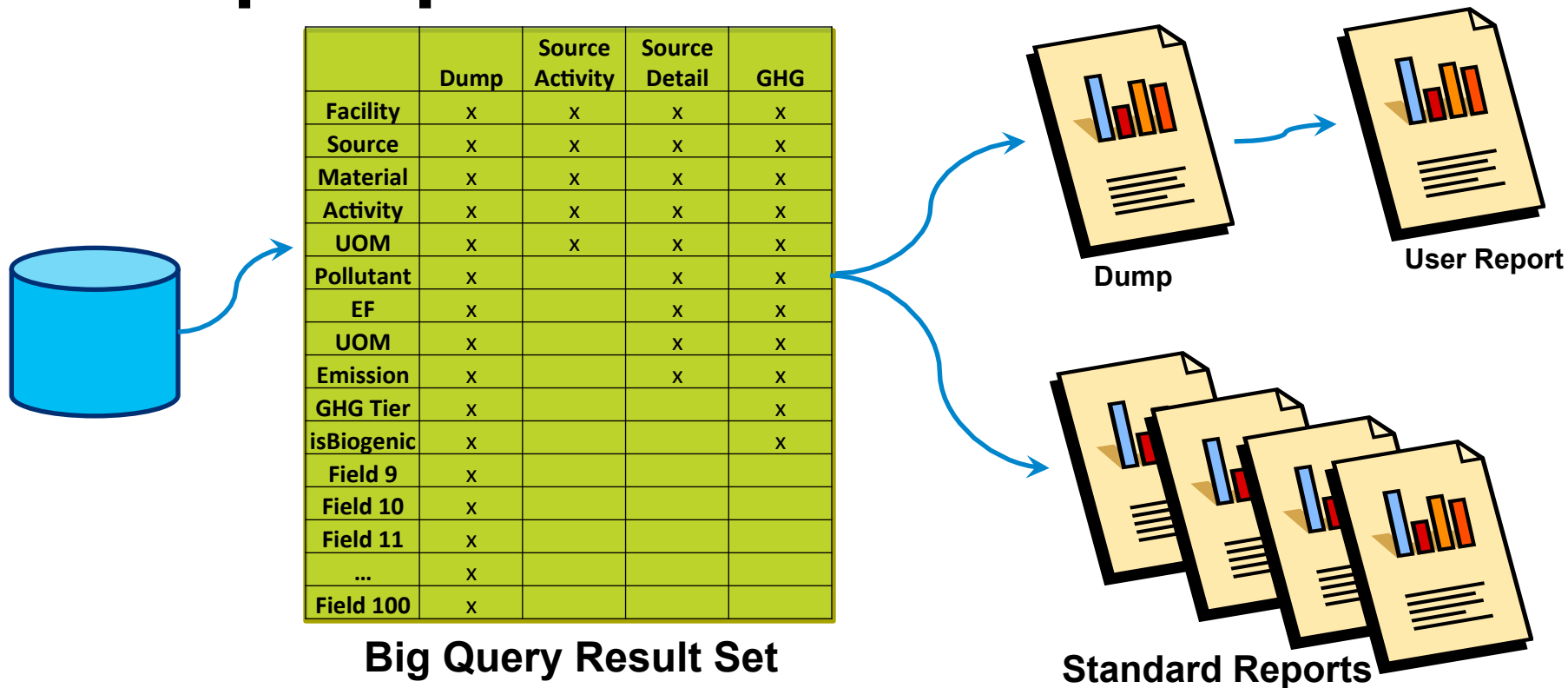
Gap Calculations Aid Check-Out

Variable Description	Year Total	January
Mill Total NatGas- Meters- MMSCF Calc	1419.968	112.253
LK Monthly Nat Gas Fuel Usage	388.064	30.44
RB Monthly Nat Gas Fuel Usage	118.1	7.7
PB-X Monthly Nat Gas Fuel Usage	652.25	49.3
PB2-Y Monthly Nat Gas Fuel Usage	200.1	19.4
Therm Oxid Monthly Nat Gas Fuel Usage	61.454	5.413
Misc NatGas (Diff + Vendor 2) MMSCF	11.3113	1.3311
Difference (Intercon Invoice- Metered) NatGas MMSCF	0.0866	0.0148
Vendor 2 NatGas- MMSCF	11.2247	1.3163

How Was That PI Tag Calculated?

Level	Level 1 ID	Level 2 ID	Level 3 ID	Level 4 ID	Level 5 ID								
1	CR-COND_SYS_DOWN.DAY	Condensate Coll. Sys Daily Downtime											
						METHOD=>TimeEq('CR-COND_SYS_PTE.STAT','Y+7h','T+7h',"CanNotEmit")/60							
						METHOD (Explained)=>TimeEq('CR-COND_SYS_PTE.STAT','Y+7h','T+7h',"CanNotEmit")/60							
2		CR-COND_SYS_PTE.	Condensate Coll. System PTE										
						METHOD=>if 'CR-MAIN_FOUL_COND_PTE.STAT'="CanNotEmit" and 'CR-TURP_SYS_PTE.STAT'="CanNotEmit"							
						METHOD (Explained)=>if [Main Foul Condensate tank PTE] ="CanNotEmit" and 'CR-TURP_SYS_PTE.STAT'="CanNotEmit"							
3			CR-MAIN_FOUL_C	Main Foul Condensate tank PTE									
						METHOD=>IF ('CR-Evap_PTE.STAT' = "CanNotEmit") then "CanNotEmit" else "CanEmit"							
						METHOD (Explained)=>IF ('CR-Evap_PTE.STAT' = "CanNotEmit") then "CanNotEmit" else "CanEmit"							
4				CR-Evap_PTE.	Evap run status - PTE.STAT								
						METHOD=>IF ('FL15305' <= 10) or (TimeNE('CR-evap_feed_stat','*-45m','*',"							
						METHOD (Explained)=>IF ([Description Not Found] <= 10) or (TimeNE([De							
5					fl15305	60# stm to evaps. Flw. (fl15305)							
5					CR-Evap_Feed_	Evap Feed Status - Water or Liquor (CR-Evap_Feed_Stat)							
5					fl15805	total liquor flow to evaps. (fl15805)							
3				CR-TURP_SYS_PTE	Turpentine system PTE								
						METHOD=>IF (('CR-Pri_chip_Meter_PTE.STAT' = "CanNotEmit") and ('CR-HDWD_chip_Meter							
						METHOD (Explained)=>IF ([Primary Chip Meter PTE.STAT] = "CanNotEmit") and ([HDWD C							
4				CR-Pri_chip_M	Primary Chip Meter PTE.STAT (CR-Pri_chip_Meter_PTE.STAT)								
4				CR-HDWD_chi	HDWD Chip Meter PTE.STAT (CR-HDWD_chip_Meter_PTE.STAT)								
4				CR-M_13114_0	Main Foul Cond. Pump to ASB (CR-M_13114_03.stat)								

Dump Report



Conclusion

- Build a Good Cross-Functional Team...
- Use Best Practices...
- ... and You Too Can Build a Compliance Monitoring System with Real-Time Data

Rick Smith

Richard.SmithJr@ipaper.com



THANK YOU

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