

Smart Sampling Systems: Successes and Challenges

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Process Analytical Systems – A Long History

- Late 1930s: First analyzer implemented at I.G. Farbenindustrie in Germany



- 2014: Annual global process analytical instrumentation business is estimated to be \$7.9 billion*

* PAI/2016, The Process Analytical Instrument Market (2014 to 2020), published by PAI Partners, March 2016



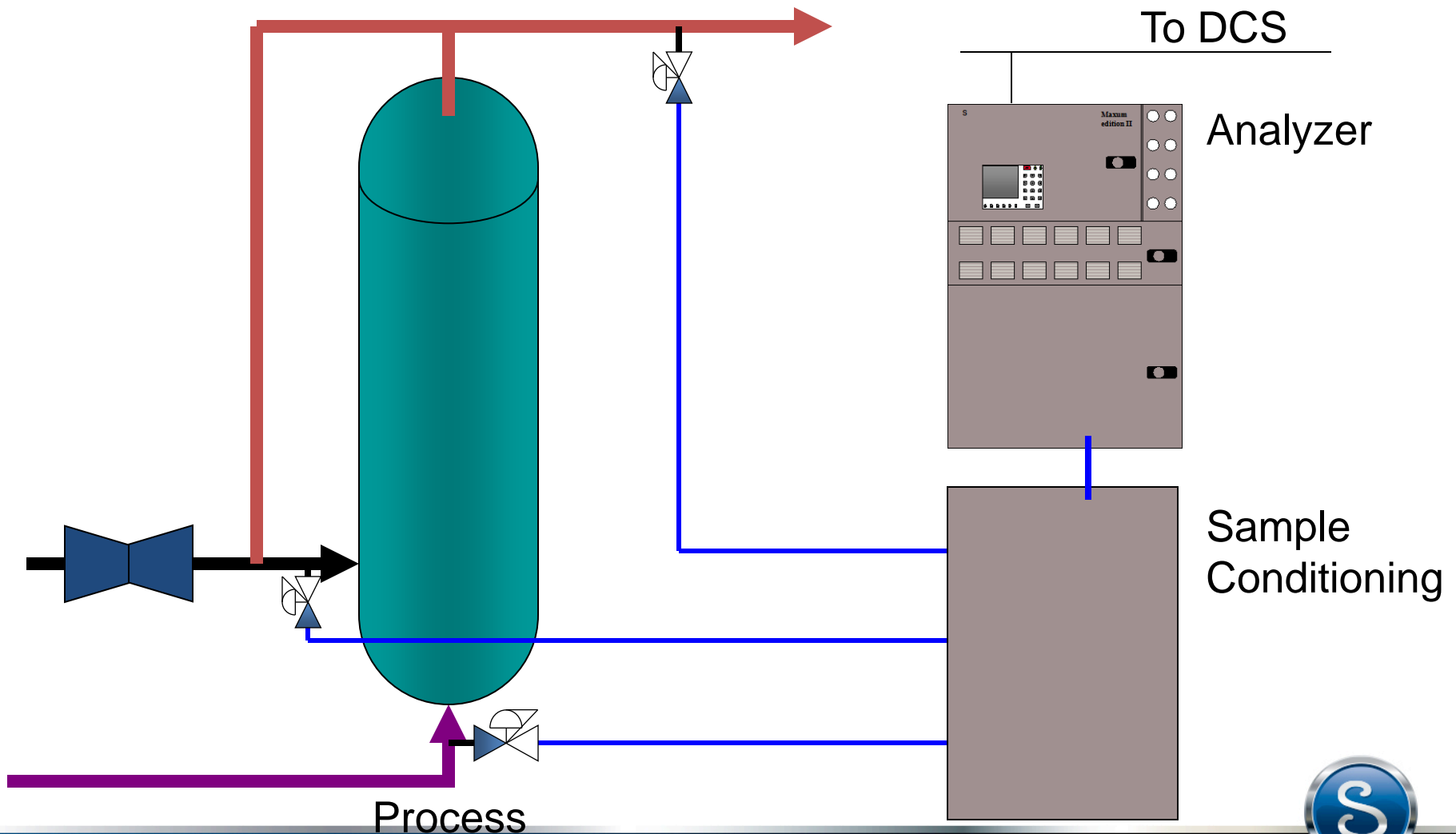


Why Use Process Analyzers?

- Make process operations more profitable
 - Closed loop control to meet product specifications
 - Plant monitoring and alarms
 - Emission control
 - Documentation
- Custody transfer
 - Product quality



Process Analyzer Systems





System Dichotomy

	Amount of Maintenance Required	Diagnostics and Other Tools
Analyzer	Relatively low	Relatively high
Sampling System	Relatively high	Relatively low

As a result, sampling systems represent:

- Least reliable part of the system
- Least predictable part of the system



Sampling Systems 2009 – “An Anachronism”

- In 2009, Rob Dubois (retired Dow Canada), an early leader in the development of NeSSI, stated:
 - “Sampling systems are one of the last bastions of manual operation left in a modern processing facility. Why does process analytical remain an anachronism in a sea of automation?”

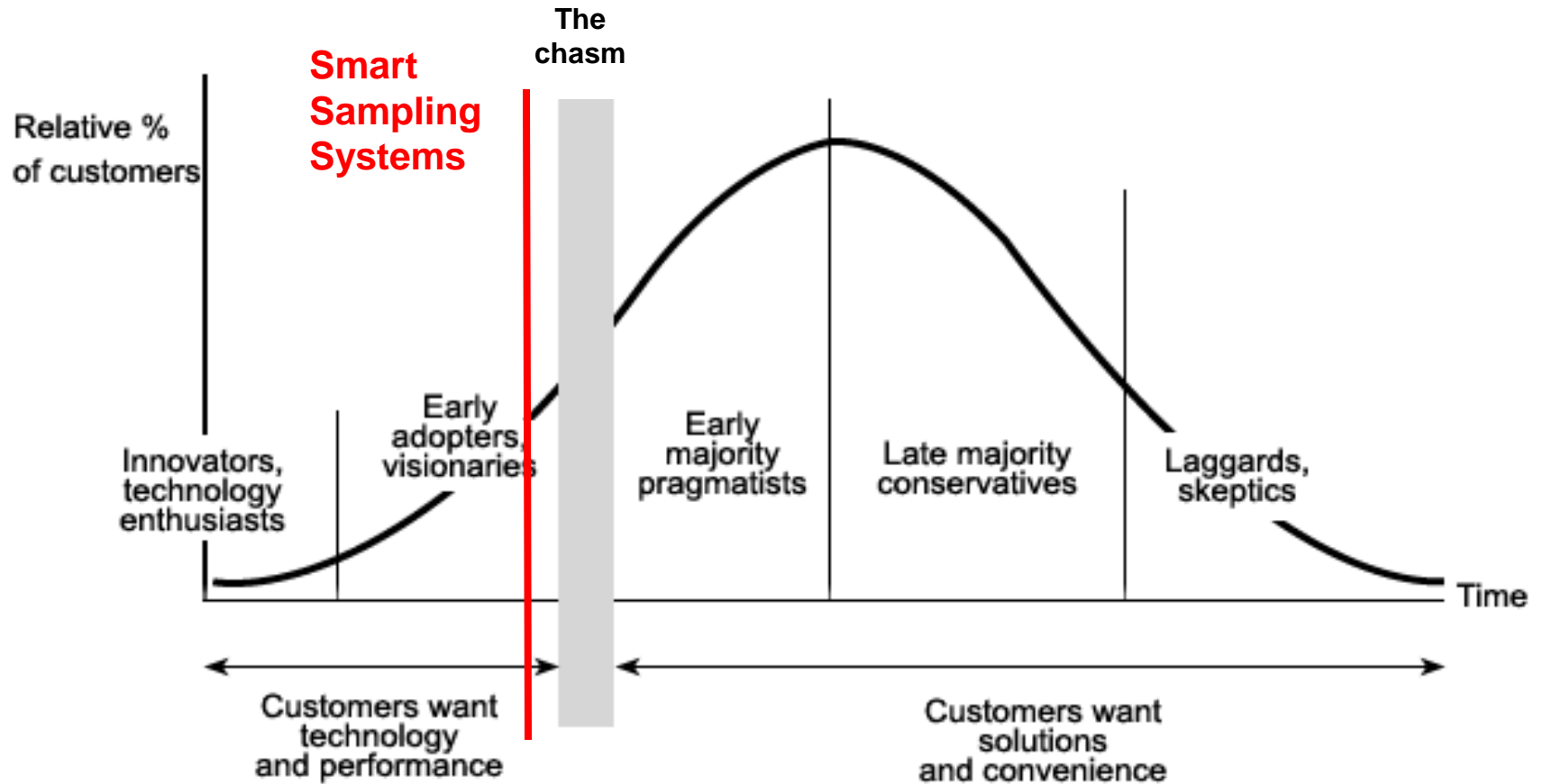
“Rethink Sample System Automation”, Robert N. Dubois, Chemical Processing, May 2, 2009.



Sampling Systems 2016 – Some Progress



Technology Adoption Curve



Moore, G., "Crossing the Chasm: Marketing and Selling High-tech Products to Mainstream Customers", 1991

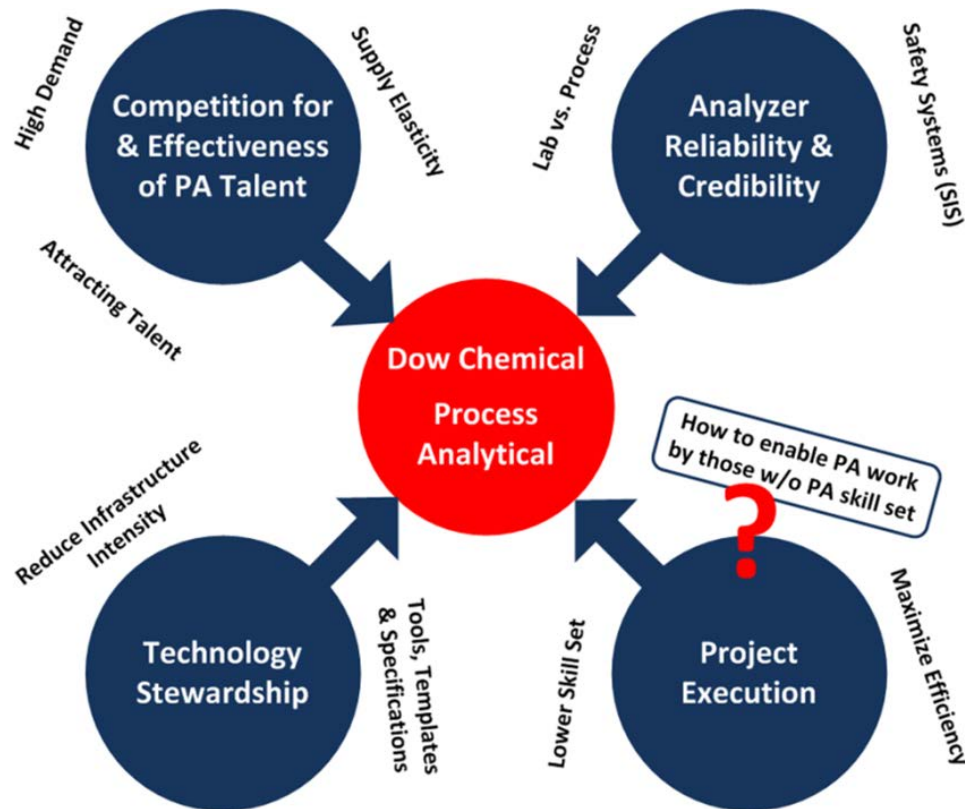


And Yet...

- Money is spent to upgrade/replace the analyzer, but the sampling system is often left as is



A Confluence of Challenges & Opportunities



Source: Presented by Rod Spitler of Dow Chemical at ISA-AD Conference, May 2014





Process Analytic Challenge – Analyzer Reliability

- Highly dependent on the sampling system!
- If no flow to analyzer, no feedback to process control system
- How do you know if product is on-spec?
- What would it cost if you have to reprocess that material?





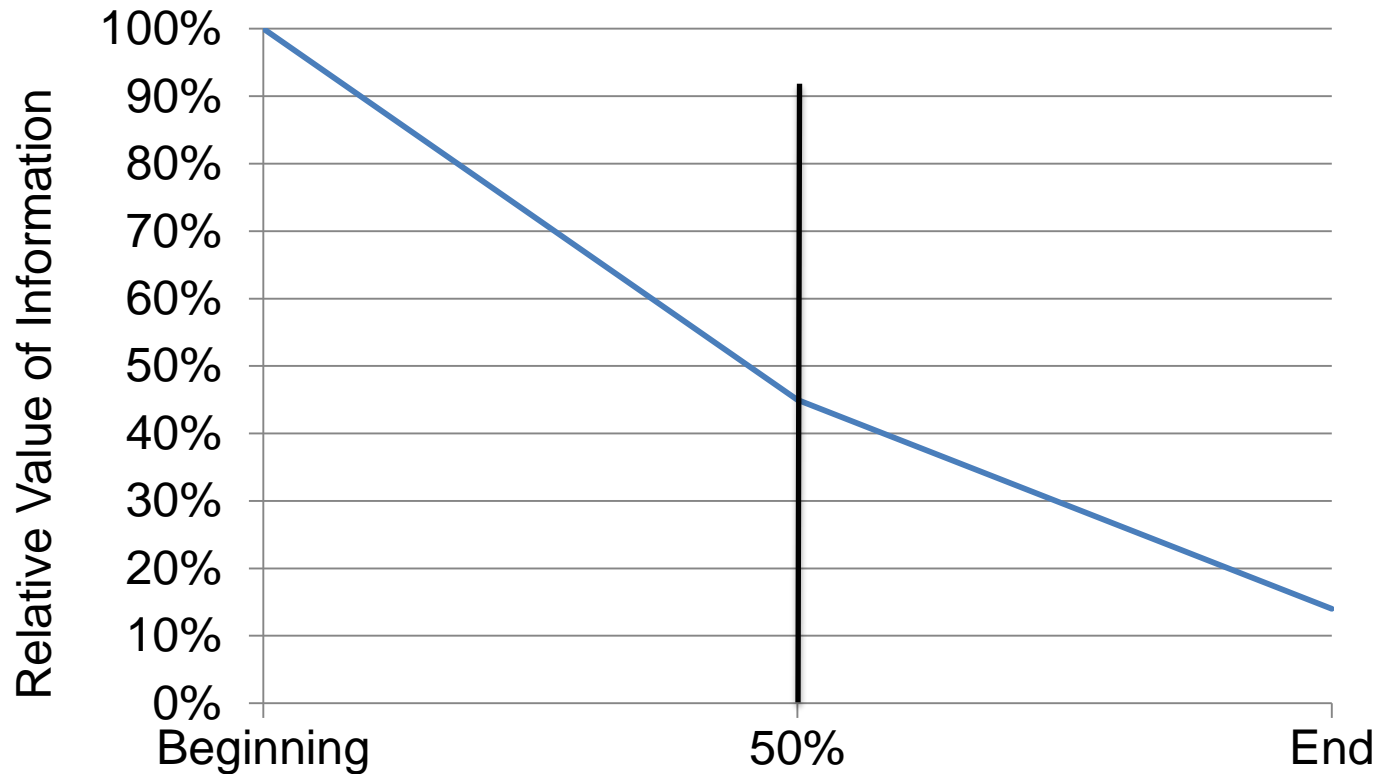
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Real-time!



Time Value of Information



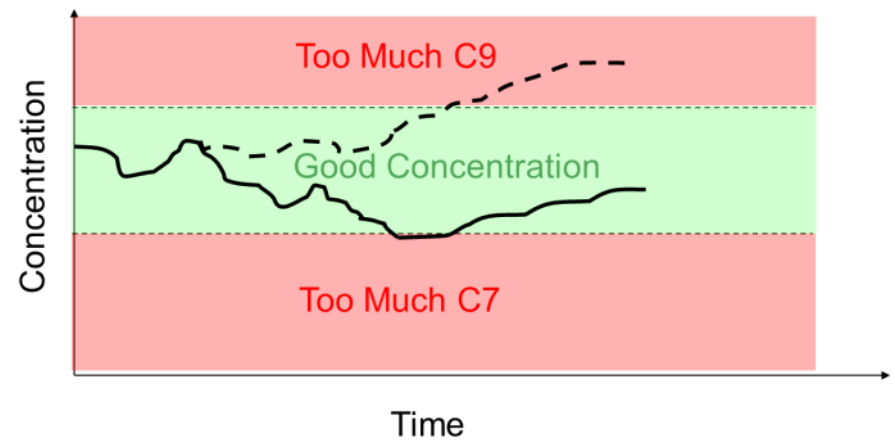
Timing (point at which received during process run time)

Keyes, M.A., "Strategic Process Management", Bailey Controls Technical Paper 88-7, 1989.



Process Analytic Challenge: Analyzer Credibility

- The analyzer is working fine, but not following the process
- Maybe the fast loop flow is not so fast. Do you know?
- How many unnecessary analyzer calibrations could be avoided?
- How much could plant yield be improved?



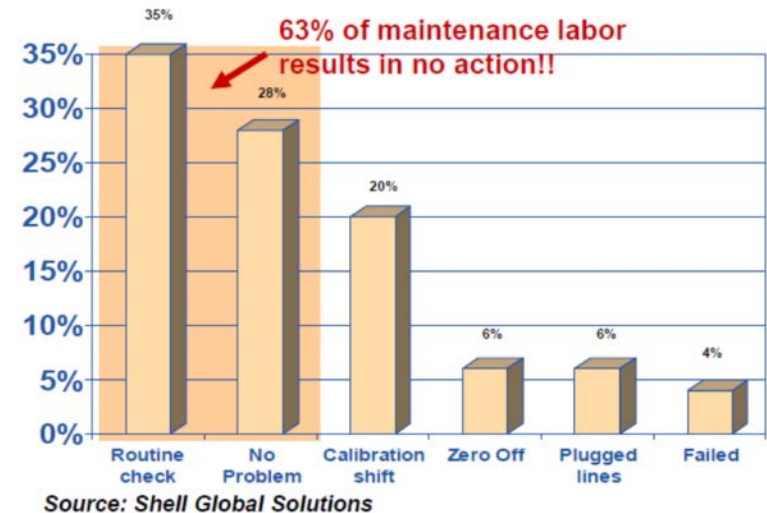
Value of Operability Improvements

- 2016 ISA-AD Presentations
 - Tighter control of a gasoline blending operation, yielding an estimated payback of \$1.6M/year
 - Satisfy operational requirements on an FCCU regenerator flue gas line with only 1.4% RATA downtime
 - “The ability to monitor the blend in real time and to perform closed-loop control trimming of the butane fraction can lead to improved product quality and profitability.”
- Reed, R., Alvarez, M. and Brumfield, L., “Refinery Process Control Applications Using Fast Simulated Distillation Process Chromatography to Enhance Profitability”
- Meeks, J. and Eskridge, D., “Continuous Emission Monitoring on an FCCU Regenerator: A Case Study”
- Arenes, J.C and Simmonds, “A Review of Gasoline Blender Optimization Through Online Analysis of Vapour Pressure”



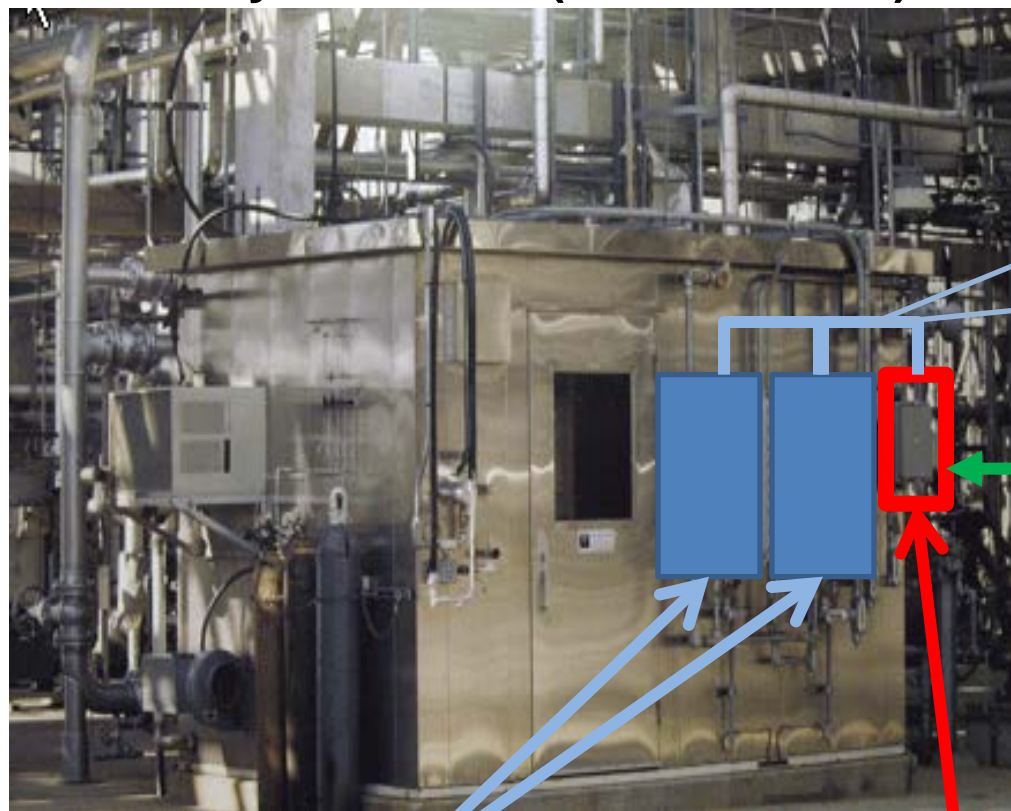
Process Analytic Challenge: Productivity

- Can only identify if a conventional sampling system is working by visual inspection
- No action is needed 63% of the time!
- How much time could be saved if you knew what maintenance action was needed before going to the site?
- What activities could be accomplished using the time savings?
- Could plant safety performance be improved by fewer visits onsite in the process units?



Analyzer House of the Next Decade

Analyzer House (Class 1 Div 2)



Intrinsically
Safe
Comms &
Power

Control Room , Analytical Reliability
Center or Maintenance Center



Plantwide
LAN

Smart Sample System Cabinets
(Class 1 Div 1 inside cabinet)

Power/Com Cabinet,
inside or outside
(Class 1 Div 2)

Historian software such as:

- Siemens ASM
- ABB STAR
- Invensys AMADAS

continuously monitors analyzer and sample system data enabling predictive maintenance.





One Minute of Collected Data

Date	Time	Day/Time	LA_FLOW_SCFH	LA_PTX_UP_P_PSI	LA_PTX_UP_T_C	LA_PTX_DWN_P_PSI	LA_DP_PSI
11/21/2014	12:24:11	11/21 12:24:11	1.30E-41	16.0127	22.1487	15.3118	0.7009
11/21/2014	12:24:16	11/21 12:24:16	6.10E-42	21.3992	25.4079	19.8159	1.58323
11/21/2014	12:24:21	11/21 12:24:21	6.09E-42	21.3799	25.4079	19.8044	1.57553
11/21/2014	12:24:26	11/21 12:24:26	6.08E-42	21.4127	25.4079	19.841	1.57167
11/21/2014	12:24:31	11/21 12:24:31	6.11E-42	21.4242	25.4079	19.8371	1.58708
11/21/2014	12:24:36	11/21 12:24:36	6.12E-42	21.43	25.4079	19.8391	1.59093
11/21/2014	12:24:41	11/21 12:24:41	6.14E-42	21.4261	25.4079	19.8429	1.58323
11/21/2014	12:24:46	11/21 12:24:46	1.35E-41	21.43	25.4079	19.8391	1.59093
11/21/2014	12:24:51	11/21 12:24:51	1.35E-41	21.4454	25.4079	19.8564	1.58901
11/21/2014	12:24:56	11/21 12:24:56	1.35E-41	21.4454	25.4079	19.868	1.57745
11/21/2014	12:25:01	11/21 12:25:01	1.35E-41	21.4146	25.4079	19.8275	1.58708
11/21/2014	12:25:06	11/21 12:25:06	1.35E-41	21.4281	25.4079	19.8468	1.5813



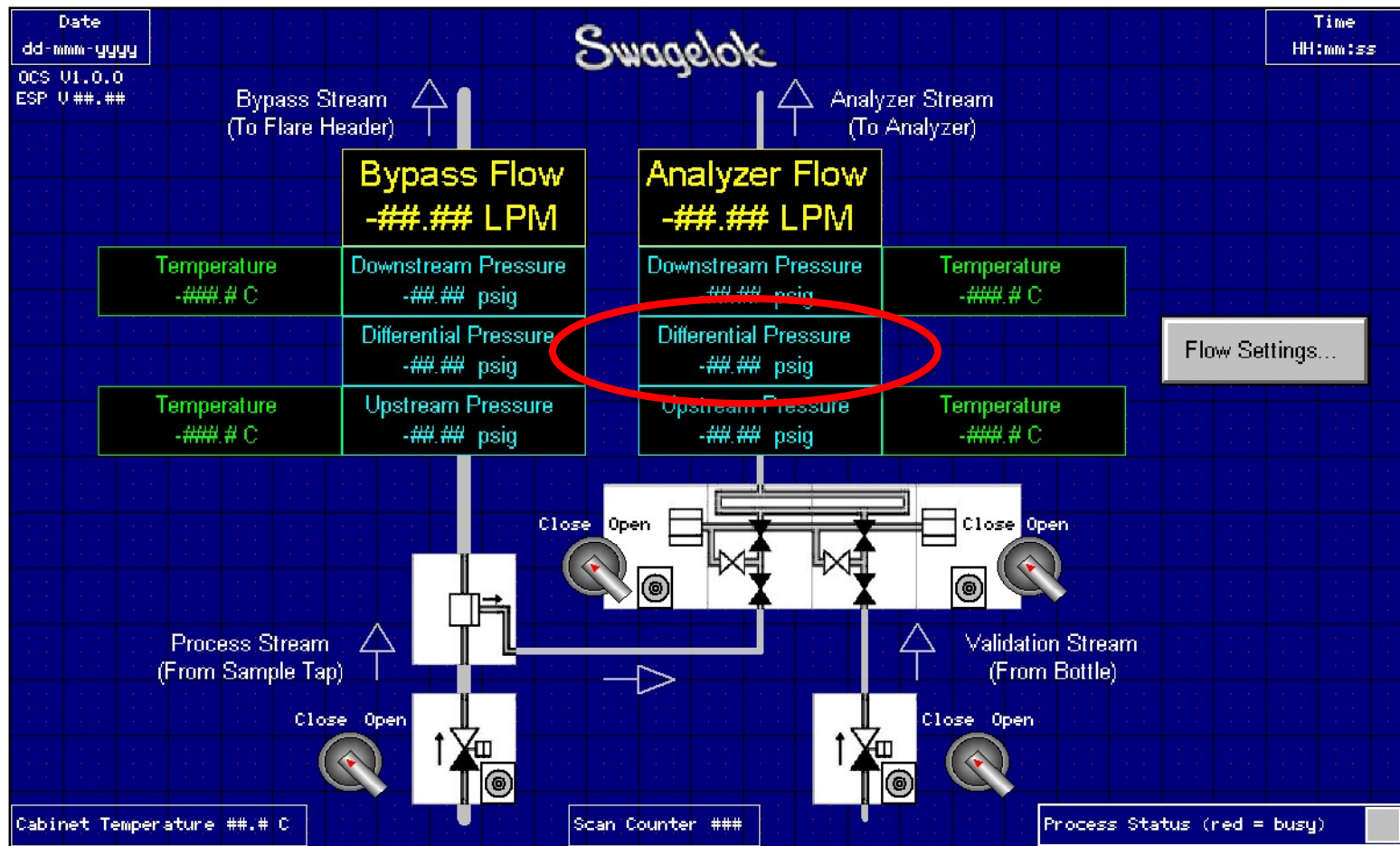


Turn Data Into Information

Sampling Location 1	Sampling Location 2	Sampling Location 3
Sampling Location 4	Sampling Location 5	Sampling Location 6
Sampling Location 7	Sampling Location 8	Sampling Location 9

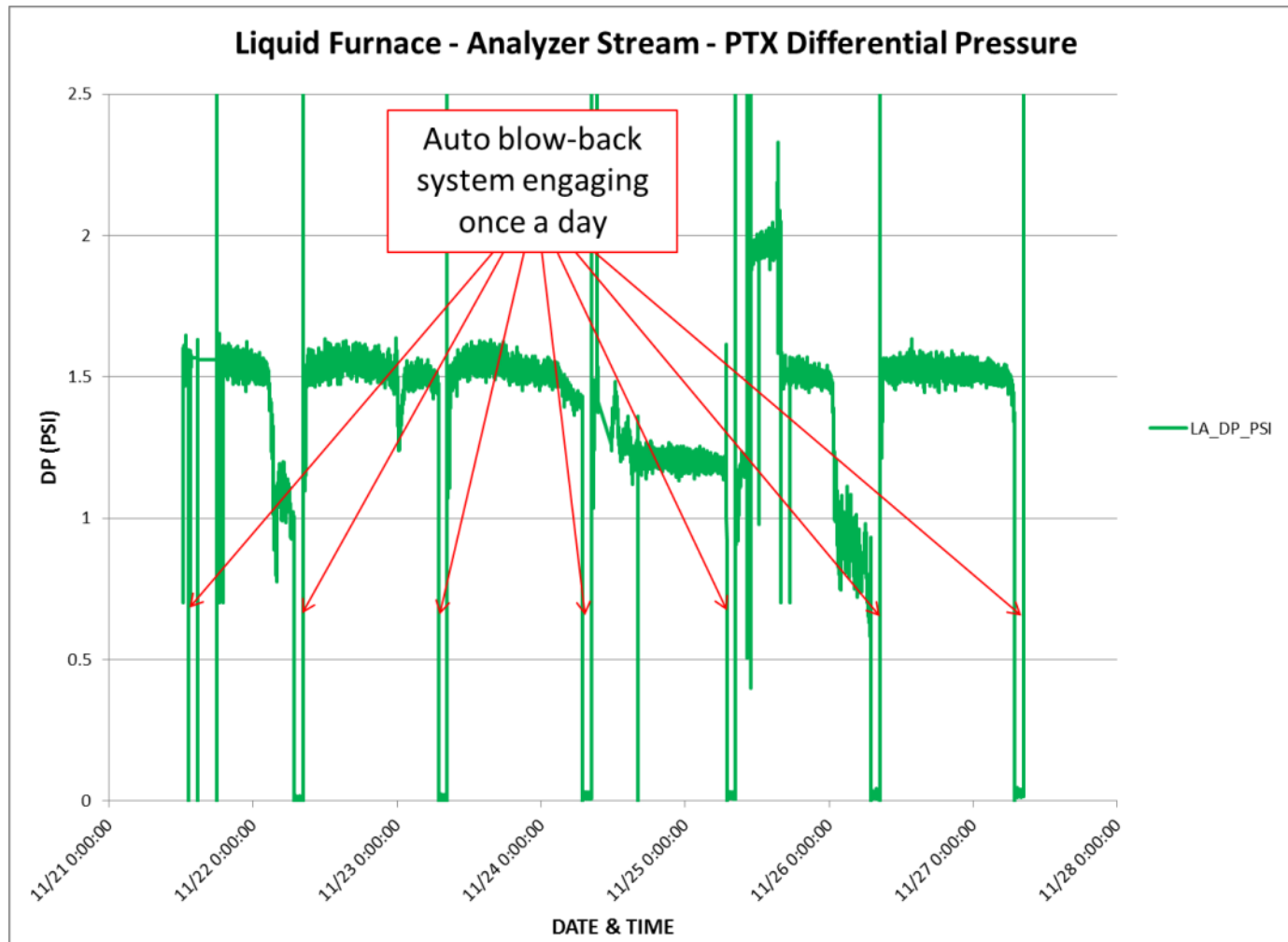


Go Directly To The Issue

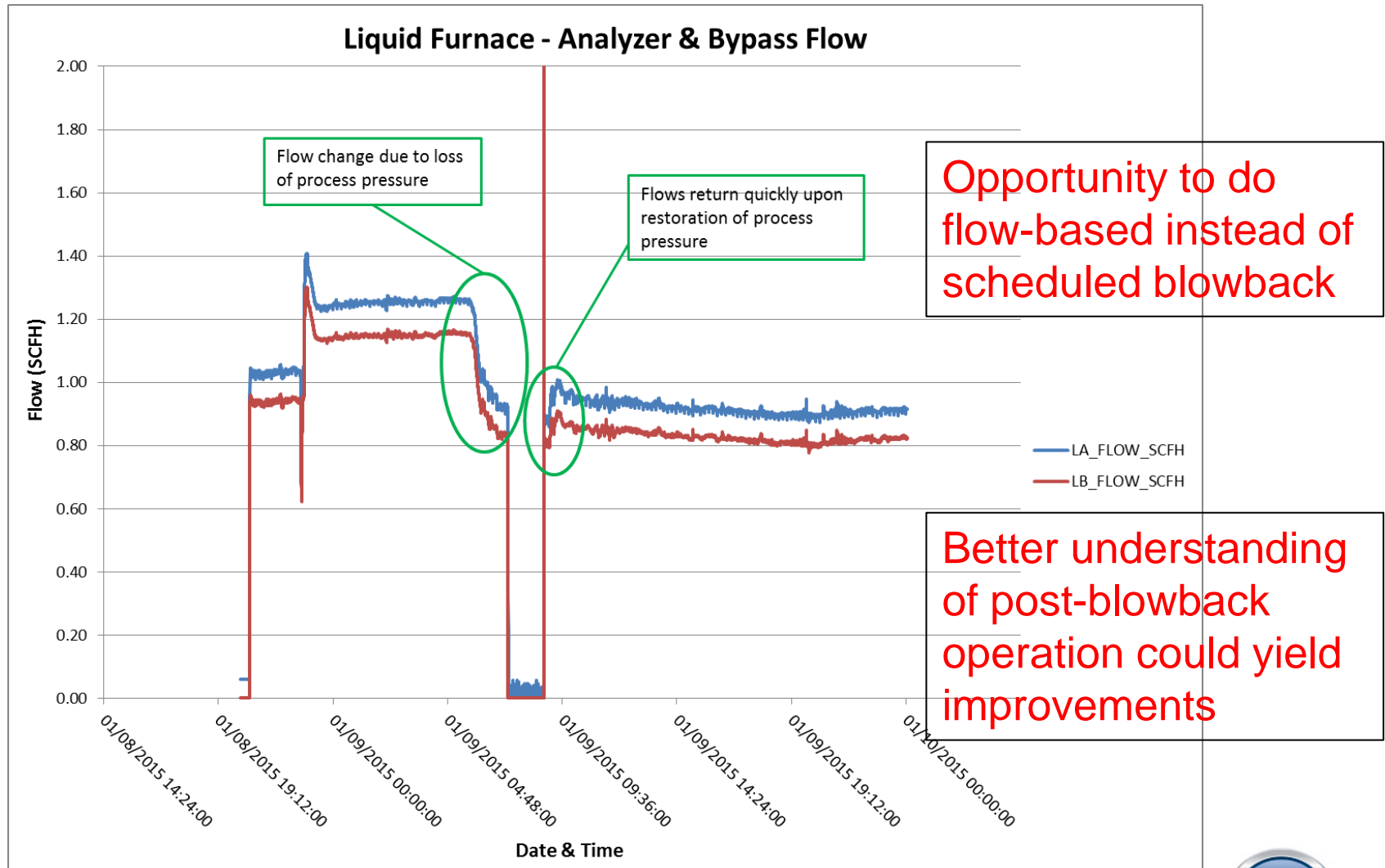




Trends Tell A Story



Insights Into Operational Improvements



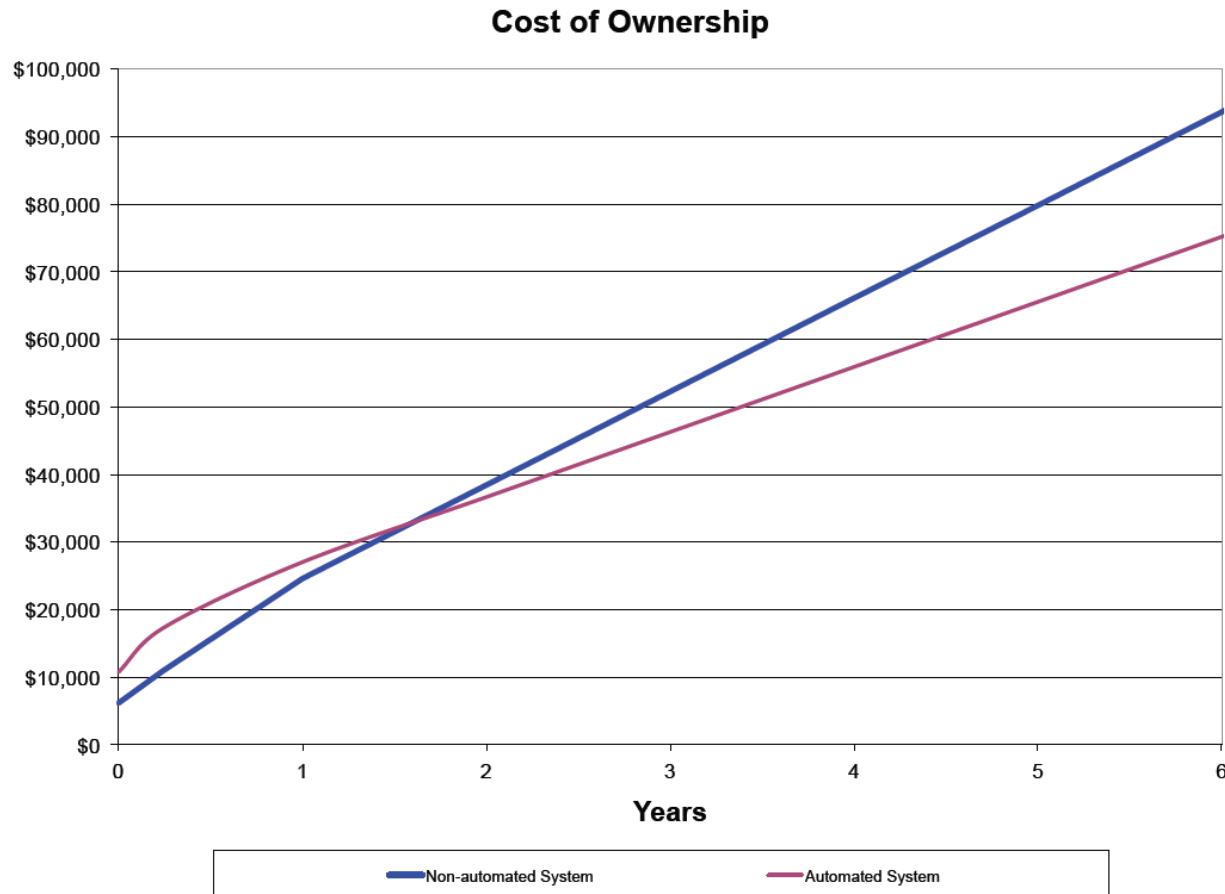


Long-Term Benefits

- Improved measurement validity and reliability
 - Validity assured during upsets, bad weather or storm conditions, holidays and other times of lowered maintenance
 - Increases analyzer uptime and credibility
- Maintenance cost reduction
 - Continuous monitoring of system automatically vs. periodic check by human walk-by
 - When maintenance is required, personnel know maintenance situation, parts and tools required before going out to system
- Personnel safety
 - Fewer visits to sampling locations



Lower Total Cost of Ownership



“The Benefits of an Automated, Networked Approach to Sampling Systems”, Swagelok, 2015



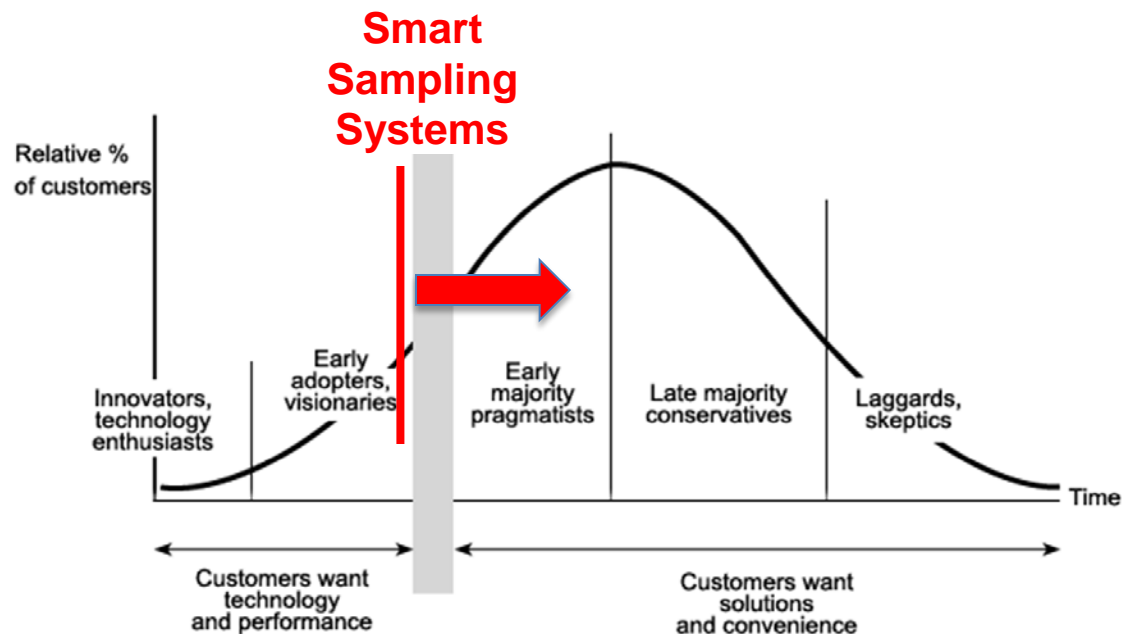
What is Hampering Adoption?

- Payback period is less than 2 years, but...
- Procurement is rewarded for savings on the initial purchase price
 - Do not really care about total cost of ownership
 - 'Soft benefits' do not matter
 - Must show tangible cost savings
- We must show how smart sampling systems can improve plant profitability
 - Constant flow to analyzer (increase analyzer uptime)
 - Analyzers follow the process (tighter control)
 - Fewer visual inspections (better use of technician time; improved safety)



Our Role

- We all (end users, EPCs, integrators, suppliers) must look for the “better way” and proactively sponsor change



Summary & Conclusions

- We have made some progress toward smarter sampling systems – but not mainstream yet
- Smart sampling systems provide an opportunity to increase end user profitability
- Challenges remain in adopting smart sampling technology
- We can overcome these challenges through our collective energy, creativity and enthusiasm
- Let's not allow sampling systems to be an “anachronism”



Thank you for your attention!

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