

Enabling Lean Water Operations

Transforming *data into information* is critical to success

Chuck Scholpp
Director, Integrated Information Management
Hach Company
(part of Danaher Corporation's Water Quality Platform)

Objectives

1. Introduce concept of how Lean Manufacturing applies to Water and its potential to transform water industry and enable new technologies
2. Encourage support for Lean Water from technologists, engineers, product and service providers, thought leaders, public and private water providers, environmentalists, ...
3. Introduce 4-step approach to enabling Lean using basic concepts
4. Emphasize and reinforce role that data must play in enabling Lean
5. Raise awareness of Hach's role not only in producing data through instruments, but also in transforming data through software

Addressing Water/Wastewater Industry Challenges with “Lean” Concepts

Water Industry Challenges

- Budget constraints
- Changing regulations
- Knowledge retention
- Information overload

Four Steps to Enable Lean

1. Take holistic approach
2. Create lean culture
3. Automate manual processes
4. Achieve sustainability

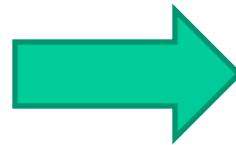
“Lean applies in every business and every process.

It is not a tactic or a cost reduction, but a way of thinking and acting for an entire organization.”

- Lean Institute

Four Steps to Enable Lean Water

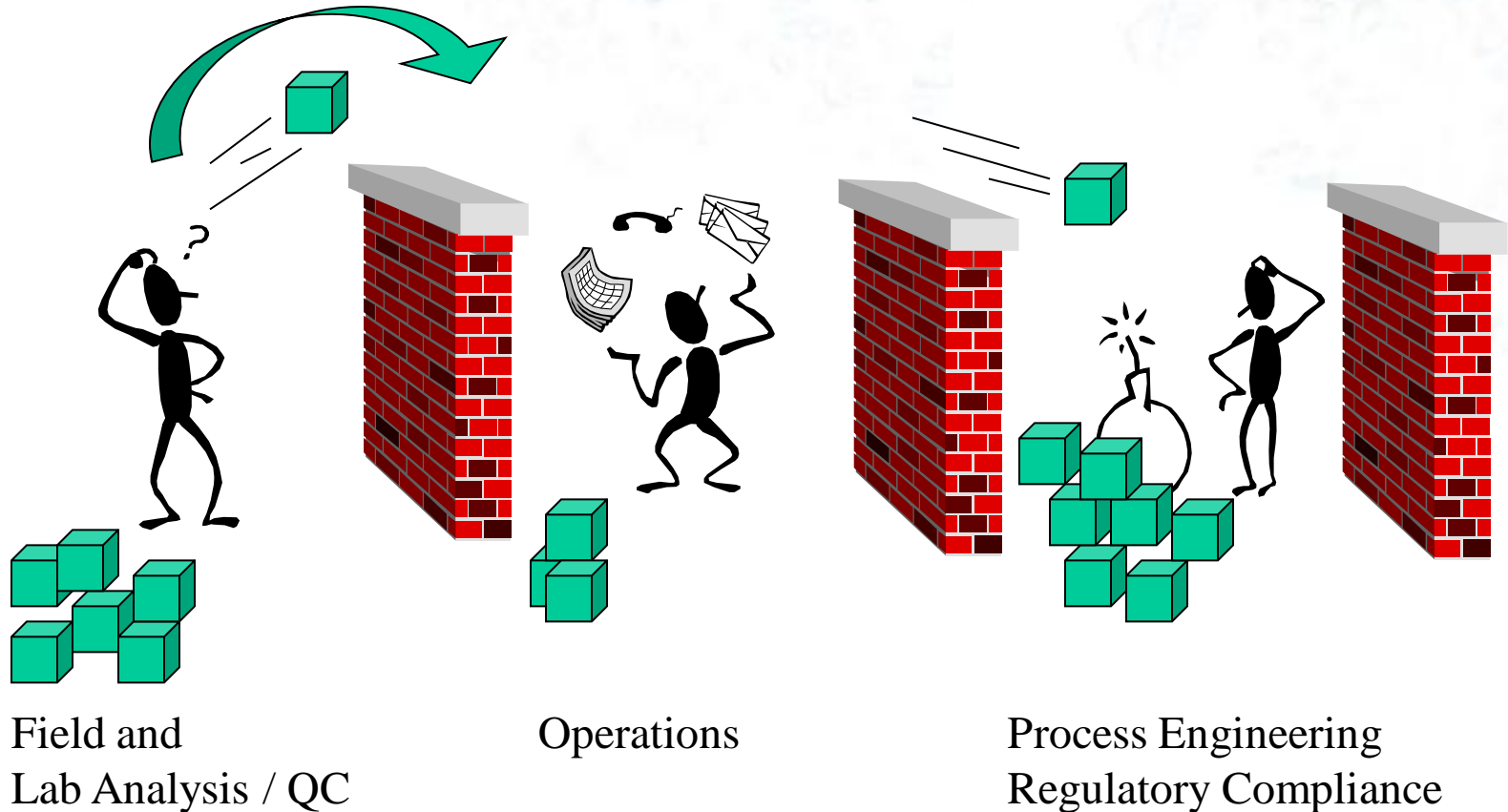
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Step 1: Take a Holistic Approach to Water Operations

- **Engage cross-functional team**
 - Every person, resource and process are interdependent
 - Gain alignment around processes, process data, and constraints
 - Provide centralized view of progress using visual management
- **Develop process maps** (current and future state)
 - Identify process steps
 - Gather quantifiable data around each step (cycle time, quality, inventory, ...)
 - Identify waste. Consider ways to eliminate steps not creating value
 - Optimize those that add value
- **Improve data accessibility and consistency across enterprise**
 - Complements operator knowledge and observations
 - Increases collaboration and collective mindset

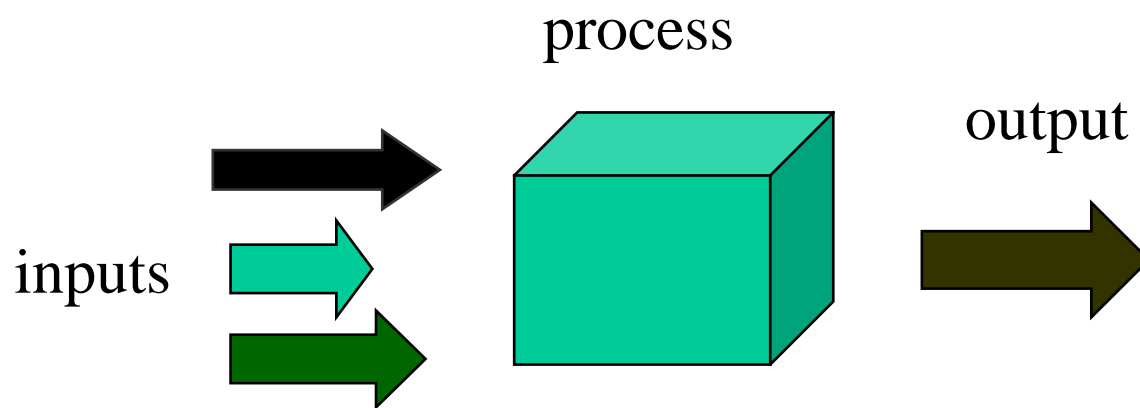
Traditional “Over the Wall” Batch Processing



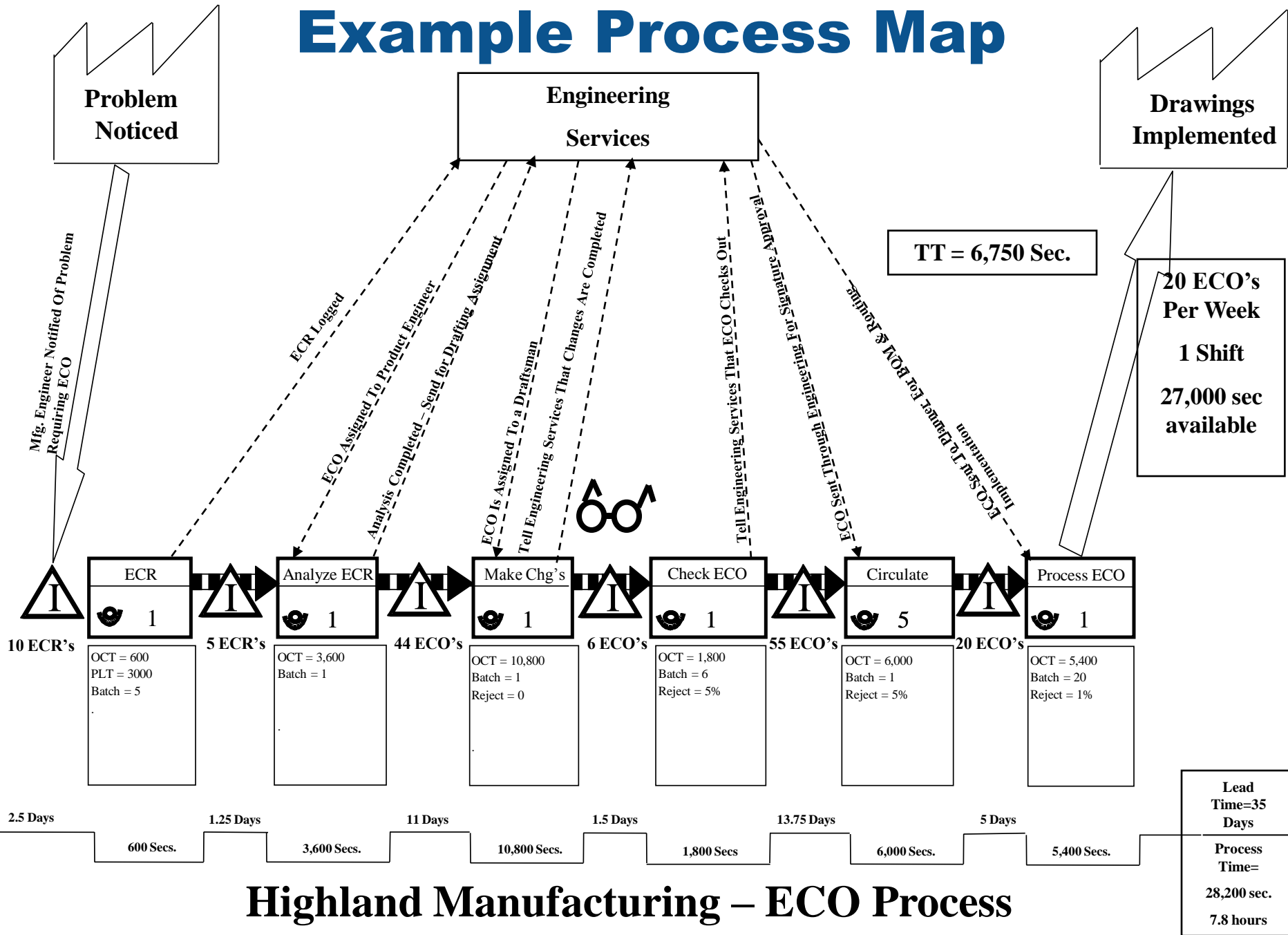
Kaizen = Continuous Improvement = Change

Everything we do is part of a process...

...all processes can be improved

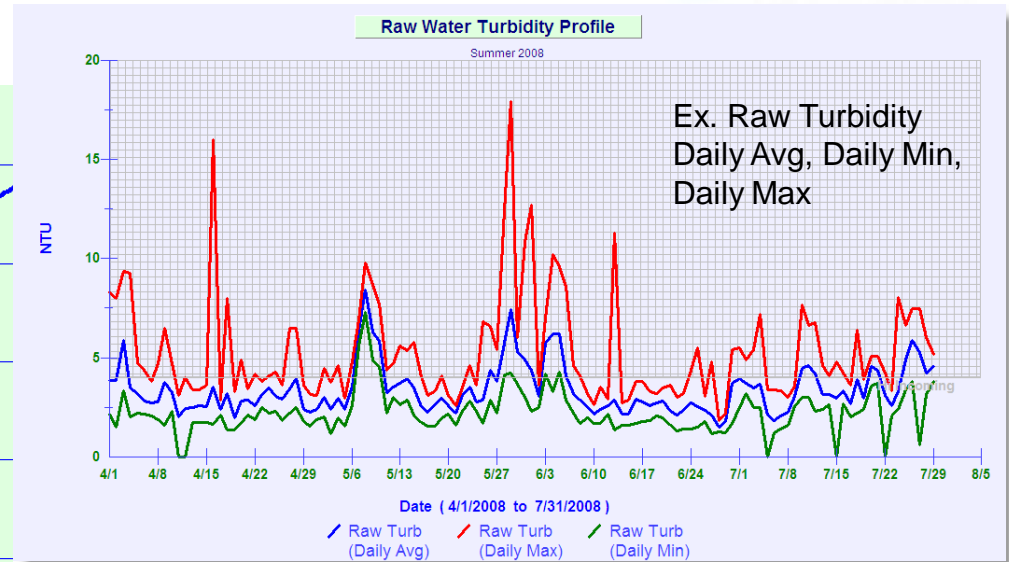
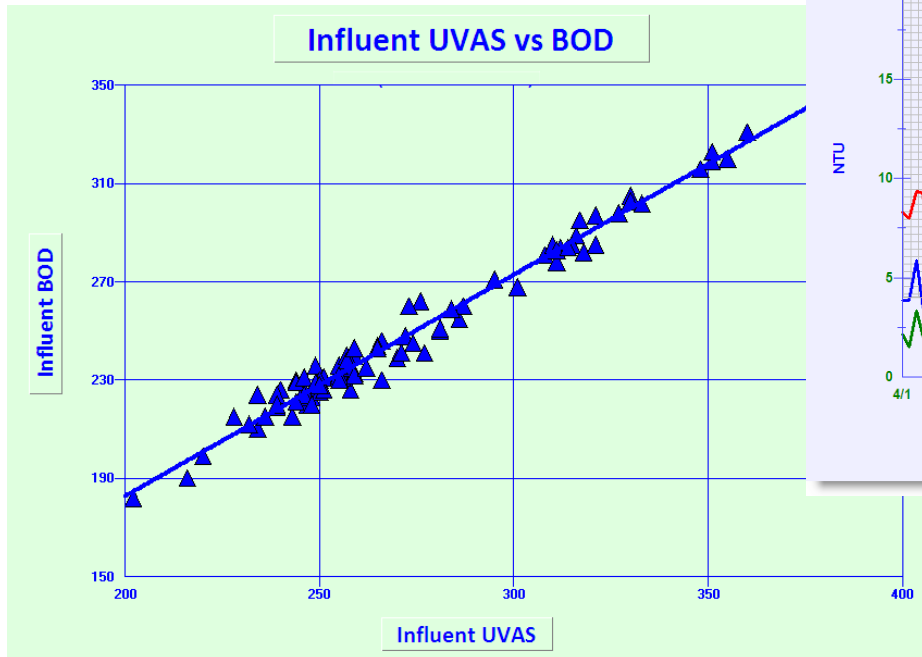


Example Process Map



Combine Data from Field, Lab and Operations

- Enable easy access to cross-functional data
- Configure graphs for trend analysis, correlations, and control charting
- Compare various sets of data to identify cost reduction opportunities



Case Study

Littleton / Englewood - 50MGD WWTP



- Data collected was virtually useless since it was incomplete, difficult to access and lacked tools for easy visualization
- Troubleshooting difficult due to inability of getting accurate picture of the issues
- In the 90's, plant averaged 2 permit violations per year



- Consolidated info from SCADA, LIMS, laboratory, and field instrumentation
- Automated incoming data checks (increases data accuracy)
- Automated and centralized data reporting (drives cross-functional decision making)
- Now correlates information and compare in unique ways to discover excursions, anomalies and important trends



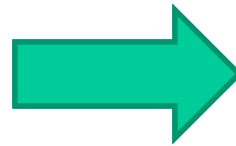
- Zero permit violations = \$0 in fines (formally a budgeted line item)
- 300 hr/yr reduction in budget management time
- 10x more useable data for better decision making
- \$300K annual reduction in energy and methanol cost



Be Right™

Four Steps to Enable Lean Water

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- 2. Create lean culture**
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Step 2: Create a Lean Culture

- Cross-functional “Kaizens” to solve problems
- Monthly cross-functional operations review meetings
- Freedom to question status quo
- Willingness to change
- Teach to “speak with data”

With changing workforce, years of operator experience being the requisite to performing the job must morph into a data-driven approach

Let Software do the Detective Work

- Spend less time gathering and more time analyzing
- Prioritize solving problems over gathering data:
 - System upsets
 - Cost overruns
 - Compliance issues
 - Customer complaints
- Use predictive modeling tools to prevent future issues from occurring
 - Develop "what if" scenarios
- Perform simple or complex search queries
 - Find the exact information you need

Maximize Confidence in Data with Audit Trails

NPDES Review Form - Monthly Data Entry

File Edit Format

Jan 2009 Thursday, January 08, 2009 Comments Calc Approve

Entry Min Max 50 Daily Limit Min Max > 42 Var Info 4011 Effluent BOD (mg/L) Equation

	Daily Com	Influent		Effluent		Influent		Effluent		4081 - Effluent pH SU
		11 - Influent BOD mg/L	12 - Influent BOD Load LBS/DAY	4011 - Effluent BOD mg/L	4012 - Effluent BOD Load lbs/day	41 - Influent TSS mg/L	42 - Influent TSS Load kg/Da	4041 - Effluent TSS mg/L	4042 - Effluent TSS Load lbs/day	
1 Thu		220	4587	13	284	208	1968	20	436	7.0
2 Fri		228	4982	15	317	223	2211	13	274	7.1
3 Sat		230	5966	10	241	215	2531	9	217	7.2
4 Sun		215	5021	17	385	216	2289	15	339	6.6
5 Mon		260	5920	13	287	238	2459	14	309	6.9
6 Tue		255	7380	25	706	257	3375	28	790	7.0
7 Wed		245	8643	42	1457	264	4227	41	1422	7.1
8 Thu		230	8728	47	1760	306	5270	51		6.9
9 Fri		235	7604	33	1054	540	7930	23	735	7.2
10 Sat		241	6452	27	703	225	2734	18	468	6.4
11 Sun										
12 Mon										
13 Tue										
14 Wed										
15 Thu										
16 Fri										
17 Sat										
18 Sun										
19 Mon										
20 Tue										
21 Wed										
22 Thu										
23 Fri										
24 Sat										
25 Sun										
26 Mon										
27 Tue										
28 Wed										
29 Thu										
30 Fri		283	8922	14	292	206	2947	12	250	7.2
31 Sat		271	8137	28	597	191	2603	23	490	7.0
MIN		215	4,587	10	241	161	1,590	8	183	6.3
MAX		331	12,018	47	1,760	540	7,930	51	1,422	7.7
AVG		271	7,392	22	569	218	2,730	21	499	7.0

Audit Trail

4011 Effluent BOD (mg/L)

Current State of Datapoint
Datapoint Date: 1/8/2009 Value: 47 (47)

History of Actions

Date & Time	User	Action	Value	Approval Level
2/11/2009 1:47:43 PM	SUPER	Data INSERTED	47 (47)	ENTERED
2/11/2009 1:45:33 PM	SUPER	Data DELETED	47 (47)	FINAL APPROVAL
2/9/2009 12:49:43 PM	SUPER	Data MODIFIED to	47 (47)	FINAL APPROVAL
1/13/2009 3:50:24 PM	JAS	Data MODIFIED to	47 (47)	FINAL APPROVAL
1/13/2009 9:36:00 AM	MGM	Data INSERTED	47 (47)	ENTERED

Restore Selected Value Close

Note: Only Super Users and Managers have privileges to restore values from Audit Trail.

Audit trails show who touched the data

Case Study

United Water – 100's of water and waste water plants



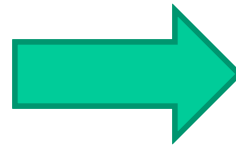
- United Water developed a corporate strategy to improve performance and meet increasingly complex regulations by creating a common platform for use at its over 400 operating locations
- United Water had been using multiple legacy reporting systems which made it difficult to monitor performance in a consistent manner at all of its facilities



- Introduced an enterprise version of Hach WIMS accessible to all of its water and wastewater operations across the country
- WIMS is now serving as United Water's central nervous system, allowing UW to:
 - evaluate the performance of each operation using consistent metrics
 - automatically consolidate data from all facilities
 - produce regulatory & internal compliance and KPI reports
- United Water made the WIMS initiative a corporate priority
- Internal champions were selected
- Significant effort was placed on training

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Step 3: Automate Manual Processes

- Replace manual with software-based data gathering and info reporting
 - Allows increased focus on “holistic” view
 - Improves productivity
 - Reduces errors
 - Maximizes new workforce skills
- EPA moving to on-line reporting in all states
- Frees up time for value-added work
- Efficiently drives collaborative analysis and decisions across business, enterprise, or ecosystem

Empowers the utility to do more with less and simplifies the task of providing state and federal regulators with the reports they need

Gather and Organize Data for Immediate Access and Analysis

Manual Data Entry:

- If manual data entry is necessary, enter it directly into software thereby eliminating multiple-transcriptions



TSS Benchsheet - Method SM 2540D				
Analyst:	<input type="text"/>	Oven Temperature In:	<input type="text"/>	
Sample Date:	02/08/09 - Sun	Oven Temperature Out:	<input type="text"/>	
Analysis Date/Time:	<input type="text"/>			
	Inf TSS	PE TSS	BAS Conc	MLSS
Sample & Tare	<input type="text"/> g	<input type="text"/> g	<input type="text"/> g	<input type="text"/> g
Tare	<input type="text"/> g	<input type="text"/> g	<input type="text"/> g	<input type="text"/> g
Solids	<input type="text"/> g	<input type="text"/> g	<input type="text"/> g	<input type="text"/> g
Sample Volume	<input type="text"/> ml	<input type="text"/> ml	<input type="text"/> ml	<input type="text"/> ml
Suspended Solids	205 mg/L	62 mg/L	10,000 mg/L	3,780 mg/L

Edit/View Variables

Var # 1

Name: Influent Flow Units: MGD

Track every: Day Type: Parameter Read-Only:

Options: User Defined MDL Rules List Additional Info

Description Limits Optional Print Quality Control **Interface** Qualification

OFF Interface To: iFix_Historian Data Approval Level: To be defined with

Help External Source: ENTERED

TAG: HDW_FIT_INF

Start Time: 00:00 (hh:mm)

Filter Data: Collect data when: Node: Tag.Field F1_ON

Statistic Scale Factor

SUPER (2/9/2009 1:28:50 F)

Automated Data Entry:

- Download data directly from instruments
- SCADA / HMI / Historians
- Dataloggers
- LIMS
- Commercial Lab Reports
- Other Third Party Software

Leverage Tools for Auto-Report Generation

PERMITTEE NAME/ADDRESS (include Facility Name/Location if different)
 Name Rocky Creek WwTP
 Address Rocky Creek, Village of 4020 Froggy Rd SE Rio Rancho, NM 87124
 Facility Rocky Creek Wastewater Treatment Plant
 Location 1234 Lois Lane
 Attn: Clark Kent

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) DISCHARGE MONITORING REPORT (DMR) (2-15) (17-19)
 NM0057493 001 A
 PERMIT NUMBER DISCHARGE NUMBER

COMBINED TREATED PROCESS (SUBR M) Form Approved. F- FINAL OMB No. MAJOR Approval expires MUNICIPAL, NO PRE-TREATMENT *** NO DISCHARGE ***
 NOTE: Read instructions before completing this form.

MONITORING PERIOD
 FROM YEAR MO DAY TO YEAR MO DAY
 (20-31) (22-23) (24-25) (26-27) (28-29) (30-31)

PARAMETER (2-37)	OCCASION (2-43)	QUANTITY OR LOADING (54-61)		UNITS	QUALITY OR CONCENTRATION (62-67)		NO. EX.	PRIORITY OF ANALYSIS	SAMPLE TYPE
		AVERAGE (54-55)	MAXIMUM (56-57)		AVERAGE (62-63)	MAXIMUM (64-65)			
BOD, 5 DAY (20 DEG. C) 00310 1 0 0	SAMPLE MEASUREMENT				205				35
RAW SEW/INFLUENT	PERMIT REQUIREMENT				REPORT DAILY MN				REP DAIL
BOD, 5 DAY (20 DEG. C) 00310 1 0 0	SAMPLE MEASUREMENT	637	2,209	(26)		24			6
EFFLUENT GROSS VALUE PH	PERMIT REQUIREMENT	REPORT	REPORT	LBS./DAY		44.00			45
EFFLUENT GROSS VALUE PH	SAMPLE MEASUREMENT	300A AVG	DAILY MX			300A AVG			DAIL
00400 1 0 0	PERMIT REQUIREMENT					6.0			9
EFFLUENT GROSS VALUE SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT					DAILY MN			DAIL
00530 1 0 0	PERMIT REQUIREMENT					206			26
RAW SEW/INFLUENT	PERMIT REQUIREMENT					612			5
00530 1 0 0	SAMPLE MEASUREMENT	612	1,910	(26)		23			5
EFFLUENT GROSS VALUE FLOW, IN CONDUIT OR THRU TREATMENT PLANT	PERMIT REQUIREMENT	REPORT	REPORT	LBS./DAY		30			4
50050 1	SAMPLE MEASUREMENT	2.96	4.49	(03)		300A AVG			DAIL
EFFLUENT GROSS VALUE REMOVAL	PERMIT REQUIREMENT					74.57			***
BOD, 5-DAY PERCENT REMOVAL	SAMPLE MEASUREMENT					85.00			***
81010 K 0 0	PERMIT REQUIREMENT					DAILY MN			***

3800-FM-WSFR0006 9/2005

COMMONWEALTH OF PENNSYLVANIA
 DEPARTMENT OF ENVIRONMENTAL PROTECTION
 BUREAU OF WATER STANDARDS AND FACILITY REGULATION

SURFACE WATER SUPPLY MONTHLY TURBIDITY REPORT

FWS Name: Sample Water System
 Address: 100 Water Street

Plant Name: Sandy Beach WTP

DATE	*RAW	*SETTLED	*CFE	COMMENTS
1	8.35	0.74	0.10	
2	8.02	0.87	0.10	
3	9.38	1.10	0.12	
4	9.28	0.62	0.11	
5	4.77	0.43	0.10	
6	4.38	0.42	0.11	
7	3.80	0.44	0.09	
8	4.70	0.37	0.12	
9	6.58	0.35	0.11	

SCOTT MOEHLING
 CHIEF DATA MANAGER
 TYPED OR PRINTED

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

COMMENT AND EXPANATION OF ANY VIOLATIONS (Reference all attachments here)

EPA Form 3320-1 (Rev. 8/05) Previous editions may be used. (REPLACES EPA FORM T-40 WHICH MAY NOT BE USED.)

← Example Discharge Monitoring Report

Example Turbidity Report →

Case Study

City of Gastonia – 16MGD WTP



- Provides regulatory, reporting and business information to many stakeholders across 2 states
- Information tracking and report generating was a huge task
- Basic data entry and reporting took ~ 65 percent of an individual's time
- Complex analysis rarely got done



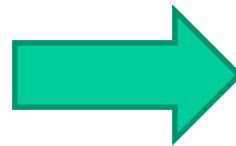
- Monitor KPIs leveraging automated reports and dashboards
- Data is now easily accessible to make meaningful budget and operational decisions



- Reduced basic data entry time from 65% to <10 percent
- >\$60,000 initial cost savings
- 400 hour annual reduction in reporting task time
 - 300 hour annual reduction budget management task time
 - Earned Environmental Stewardship award; maintained ISO 14001 certification

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Step 4: Achieve Sustainability

Changes will continue and demands will increase

- Lean is a systematic approach to entire system
- Continuous improvement mentality
- Data-driven decisions drive optimized solutions
- Visual management of metrics is critical

“There is a water crisis today. But the crisis is not about having too little water to satisfy our needs. It is a crisis of managing water so badly that billions of people - and the environment - suffer badly.”

World Water Council Report 2010

Case Study

City of Boulder 2 WTP – 55MGD



- Custom-built systems and difficult-to-use LIMS solutions made it hard to gather and analyze data for sustained KPI reporting
- Information needed to optimally run operations was missing
- Gathering and reporting data was a time-consuming and cumbersome task



- Automated data gathering
- Automated and centralized KPIs and other reports into visual dashboards
- Leveraged trend & correlation data to drive continual improvement



- Confidence is high that reports have accurate data
- Visualization catches issues before they become problems
- >\$20,000 annual reduction on chemical spend
- Producing higher quality water in an environmentally responsible way

Summary

- Today's reality:
 - Budgets are shrinking
 - Regulations are increasing
 - Workforce is aging
- Water and wastewater utilities must further streamline their processes and improve operational efficiencies
 - Taking a holistic approach to operations
 - Creating a lean culture
 - Automating manual processes
 - Achieving Sustainability
- Using data management software enables Lean Operations and allows better monitoring, reporting and managing of water resources

Contact Information

Chuck Scholpp

Director, Integrated Information Management BU
w.970.663.1377 ext 2547 | c.970.443.1637

Hach Company | www.hach.com/IIM
cscholpp@hach.com



For more information on Hach WIMS, including product overview, needs assessment, success stories, videos, and other resources, please visit:

www.hachwims.com