Living the Future of Lab Testing Today: How Henry Ford Health's Clinical Labs and Pathology Department are Delivering More Value to Clinicians and Patients

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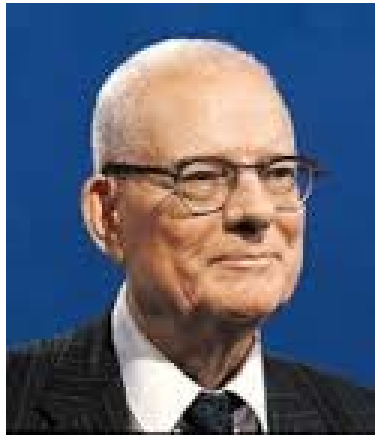
2016 Lab Quality Confab
New Orleans, LA October 18, 2016

The “Old Religion”

“An important obstacle to continuous process improvement is the supposition that improvement of quality and productivity is accomplished suddenly by affirmation of faith”

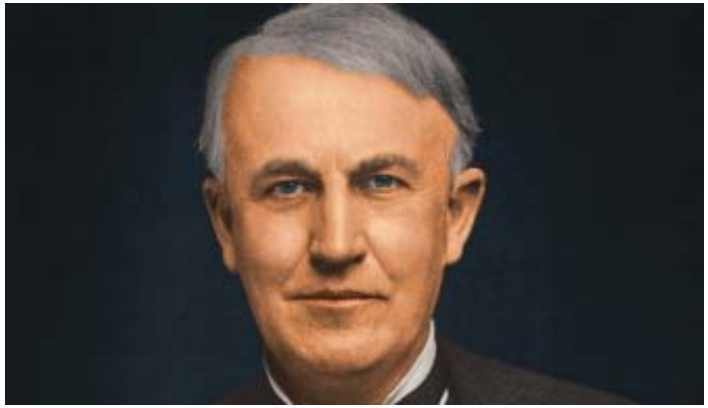


W. Edwards Deming

The “New Religion”

"Opportunity is missed by most people because it comes dressed in overalls and looks like work.”

“There are no rules around here- we are trying to accomplish something”



Thomas Edison

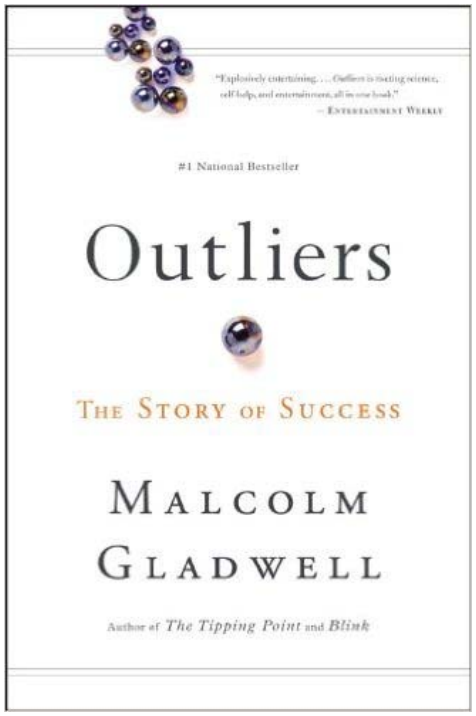
The 10,000-Hour Rule

Key to achieving world class expertise-

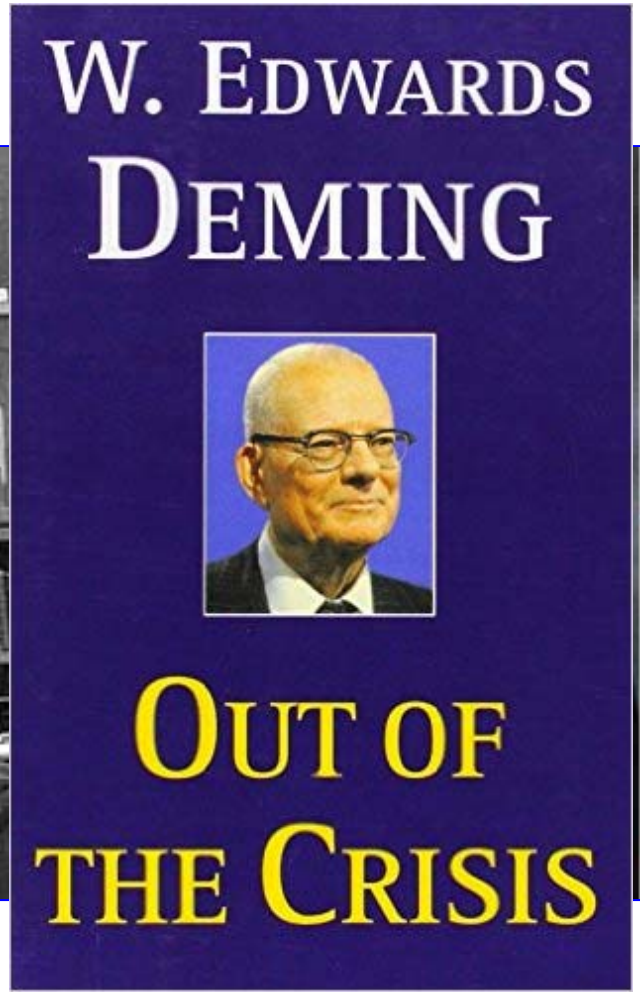
practicing a specific task the correct way,

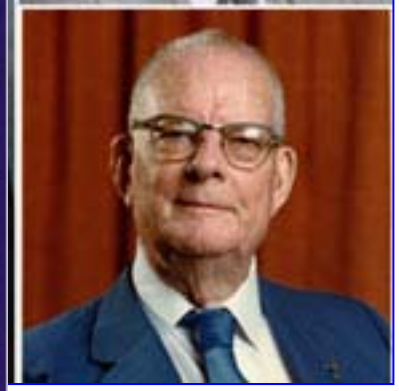
for a total of **10,000 hours**

or 20 hours of work a week for **10 years**



Deming Influence

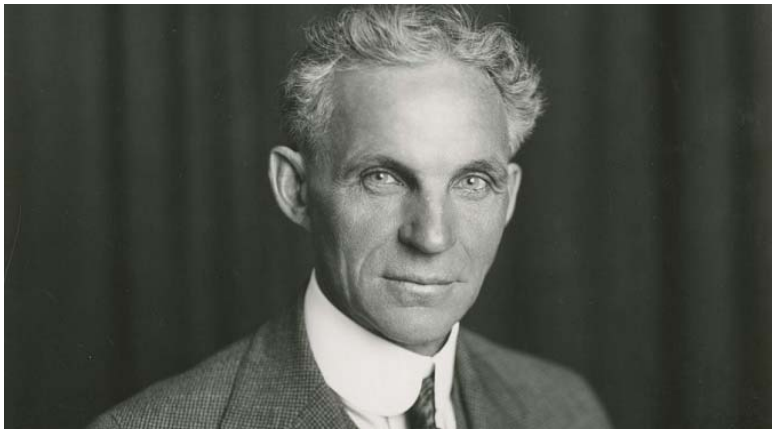




Our Legacy

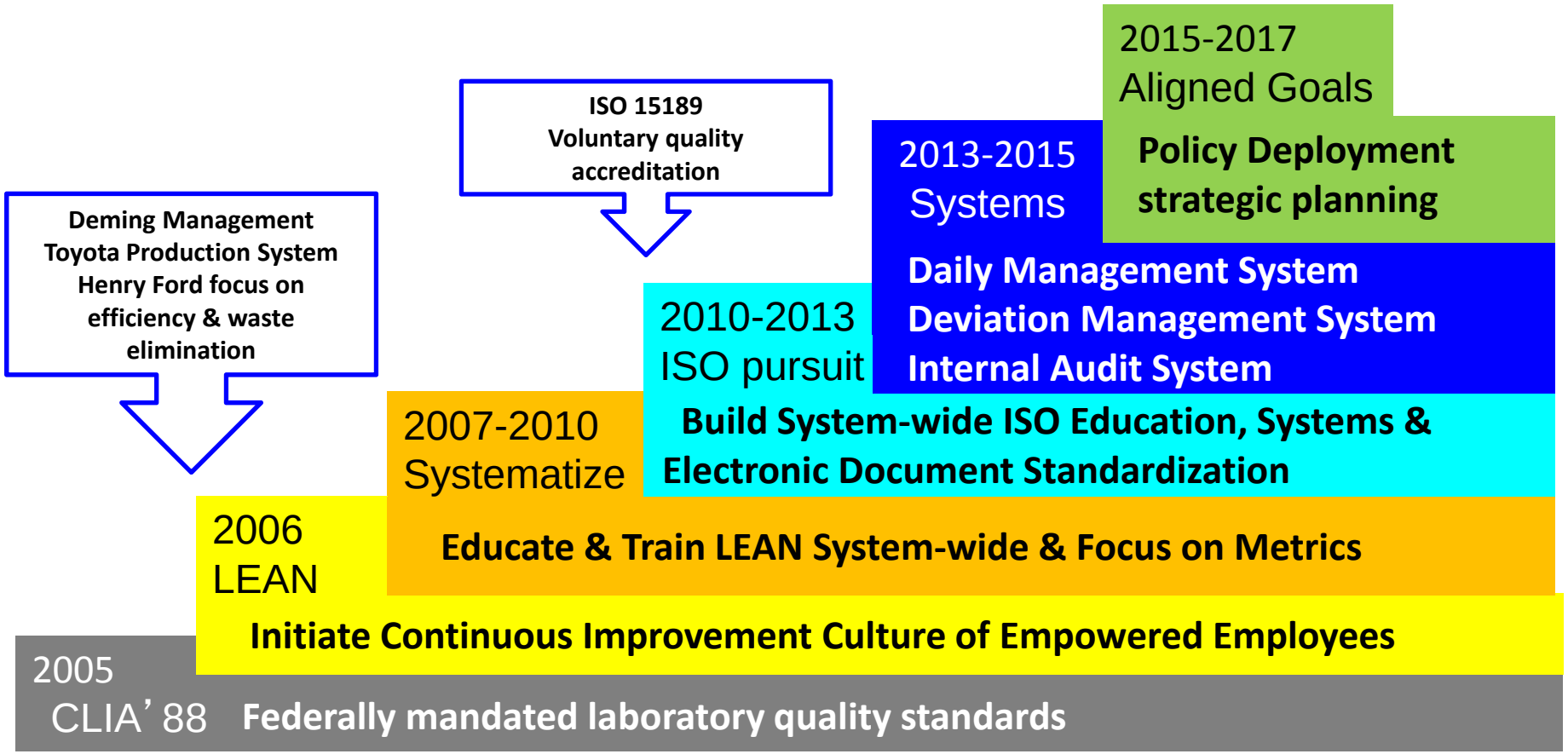
"It's the work, not the man that manages."

"The business of management is to manage. The thing to be managed is the work."



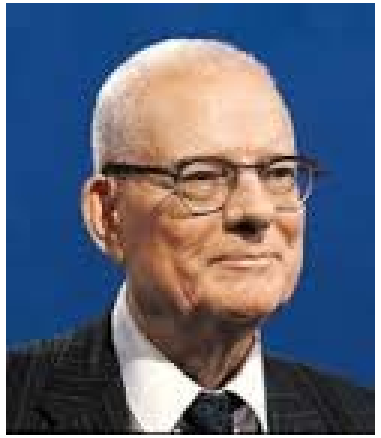
Henry Ford

Progression of Integrated Business Systems to Support Lean & ISO Quality Culture



It’s the System, Stupid ☺

“A bad system will beat a good person every time.”



W. Edwards Deming

Focus on Quality Management System

Leadership defined organizational structure, procedures, processes and resources created to systematically implement quality management with intent to:

- Serve as the system to **proactively achieve total quality management** in all aspects of laboratory practice
- **Manage and monitor activities** to address quality standards
- **Build quality** into the laboratory's processes
- Provide **ongoing assessment** of laboratory performance
- Implement **continuous quality improvements**
- **Consistently achieve** organizational **quality goals**

Basic Intent- Change Human Behavior

HIGH RELIABILITY

In short- a framework of processes and procedures structured to:

Ensure that people do the right and expected thing in performing tasks consistently

1. Fulfill customer expectations

2. Fulfill regulatory expectations

3. Continually seek improvement

Michel's Value Pyramid

World-class by benchmark

Restless innovation and improvement

Customer Value Focus

Deliver value outside lab as perceived by stakeholders

Standardization, Waste Reduction, Problem Solving

Lean/ISO Continuous Improvement Culture

Regulatory Standards

Quality Control & Assurance Culture

LEVEL 1

Achieve normalcy & predicatability

Regulatory Standards

Quality Control & Assurance Culture

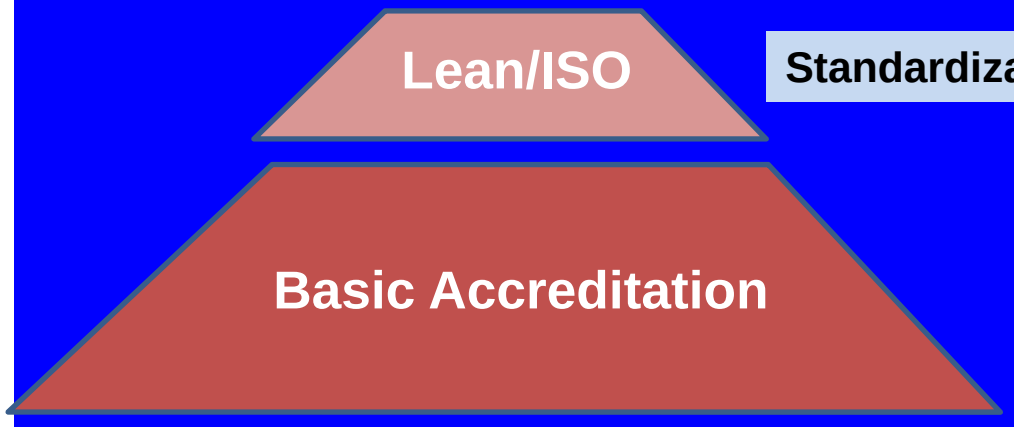
Ground Floor View

“The only things that evolve by themselves in an organization are disorder, friction and malperformance”

Peter F. Drucker

LEVEL 2

Establish & meet standards of value



Standardization, Waste Reduction, Problem Solving

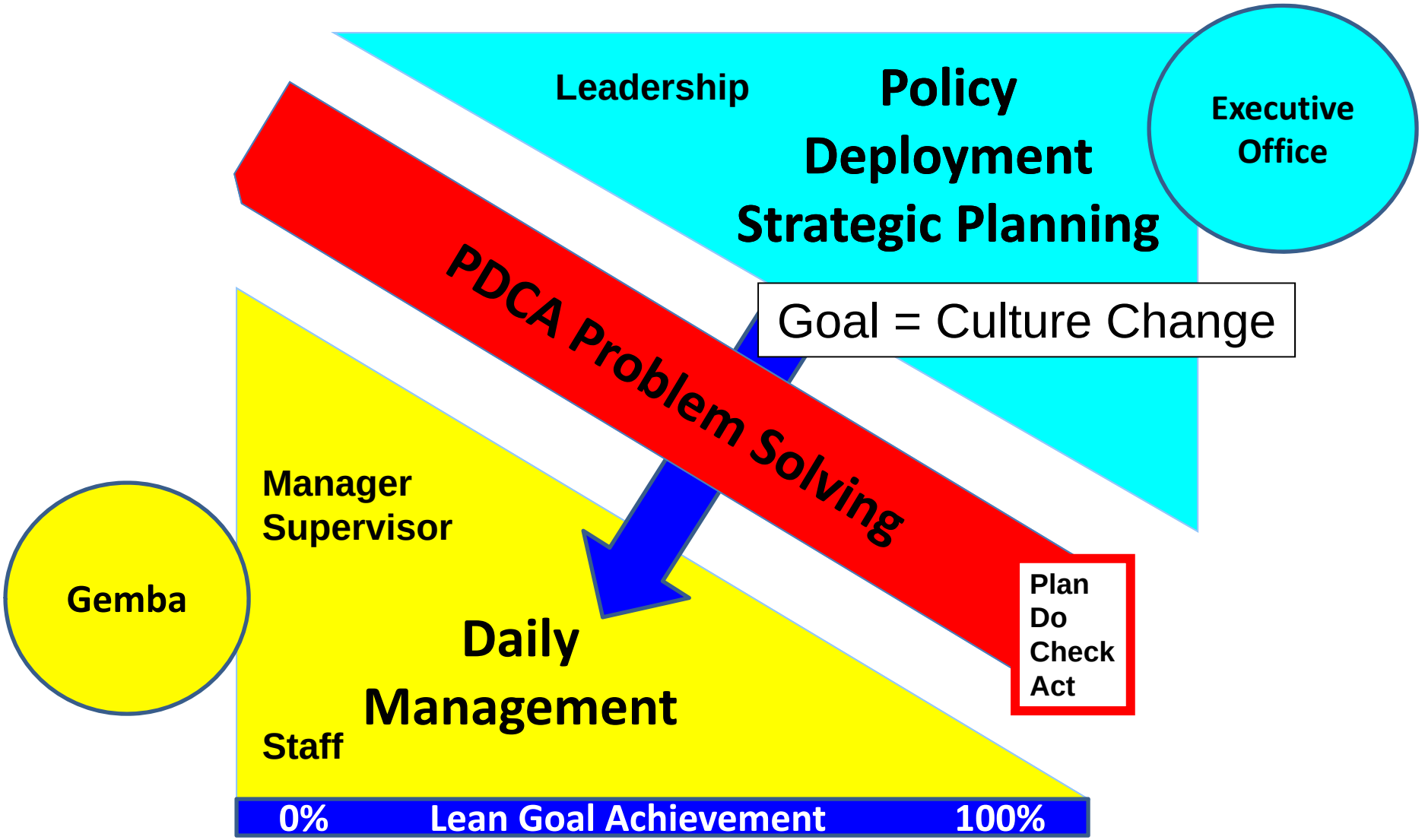
Lean/ISO Continuous Improvement Culture

Transformation Begins Here

“Quality starts in the Boardroom”

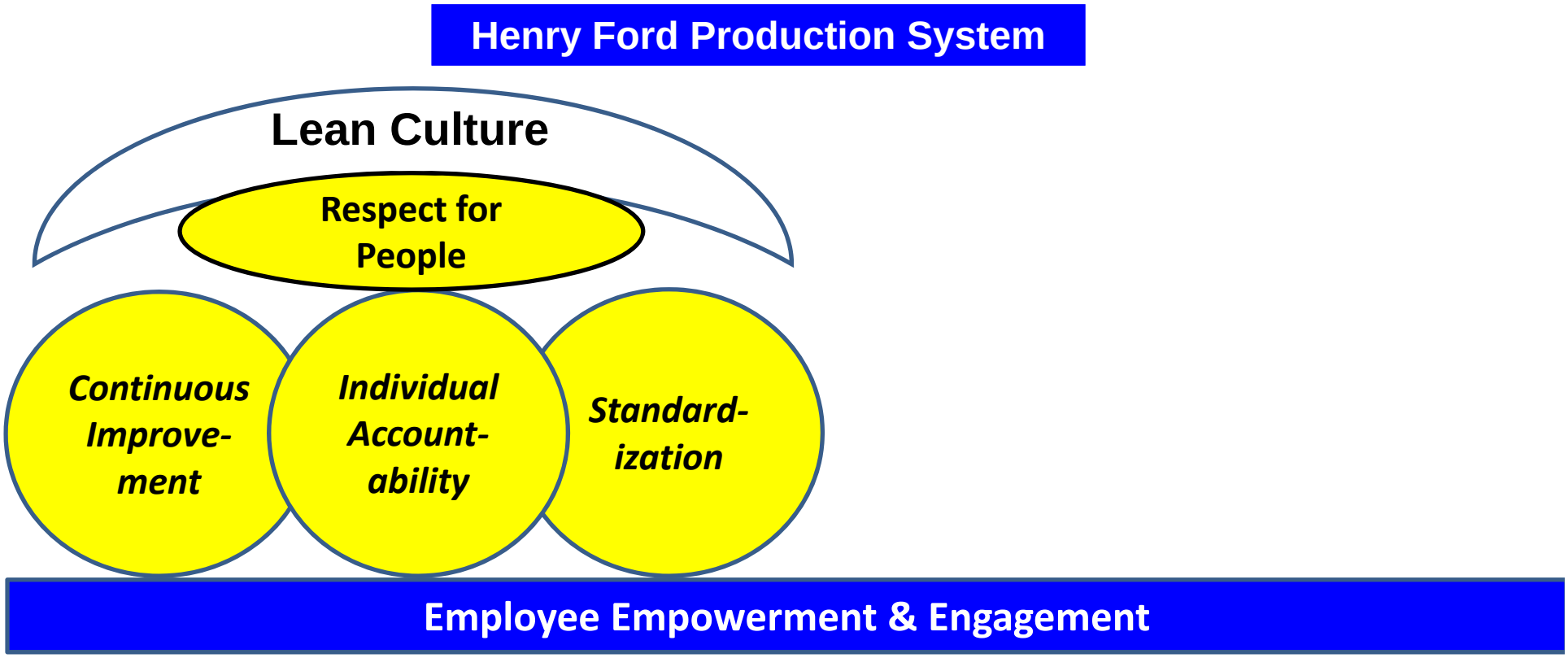
W. Edwards Deming

Improvement by Strategic Plan



Lean with ISO 15189

Pathology and Laboratory Medicine
Henry Ford Health System



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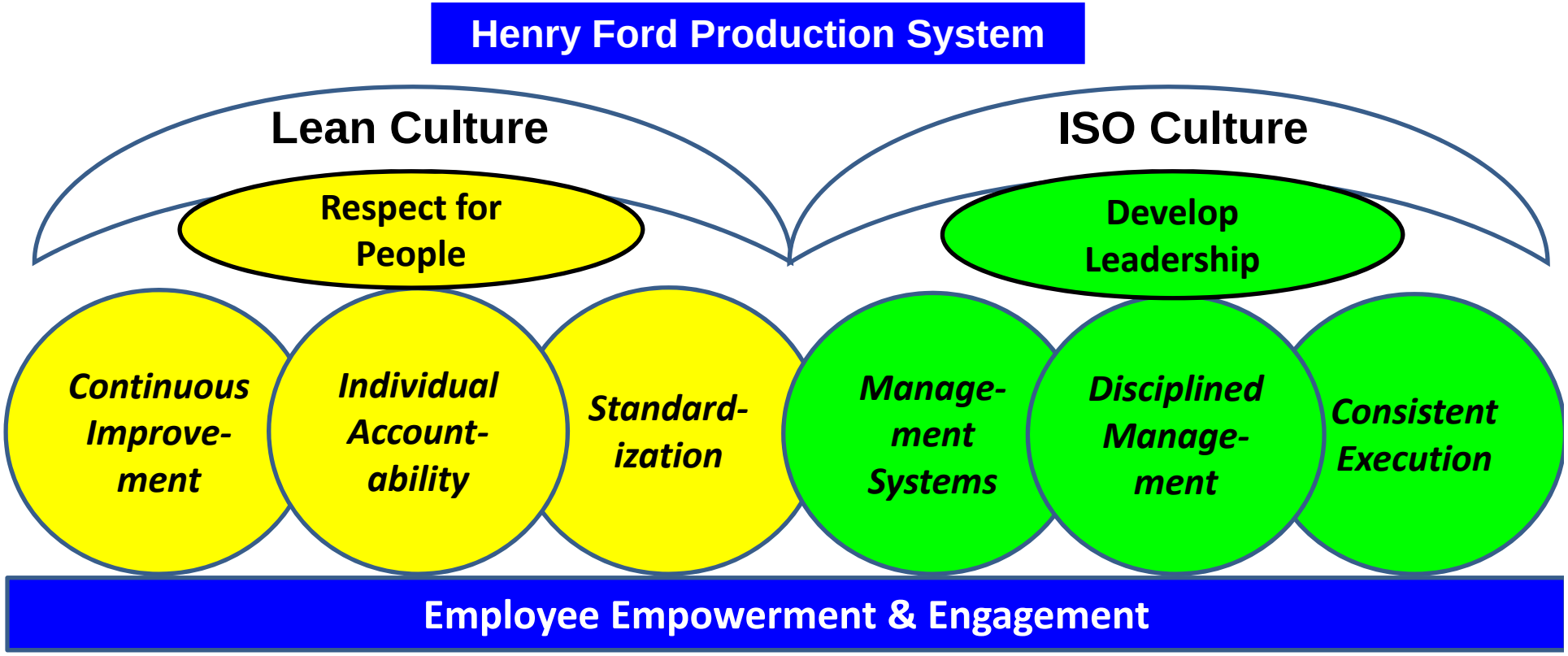


Henry Ford Production System

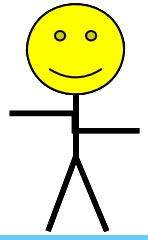
Integrated Systems Achieve Culture of Continuous Improvement

- Standard Work, Connections, Pathways
- 5S
- Visual workplace
- Continuous flow
- Pull production
- Kanban
- Just in Time
- Load leveling
- Batch size
- Mistake proof

1. **Tools of Improvement**

2. **Cultural Philosophy**

- Customer 1st
- Continually develop your most valuable resource, your PEOPLE
- Continuous improvement
- From the level of the work
- Blameless management



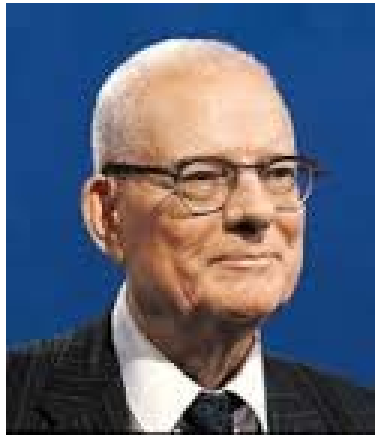
3. **Management SubSystems**

- Hoshin Planning/Policy deployment
- Team leader system
- Improvement management- PDCA (kata)
- Coaching and human development (kata)
- Deviation management
- Daily management
- Document management
- Audit system
- Management review system
- Quality Management System

Profound Knowledge

"To successfully respond to the myriad of changes that shake the world, transformation into a new style of management is required.

The route to take is what I call *profound knowledge*- knowledge for leadership of transformation."



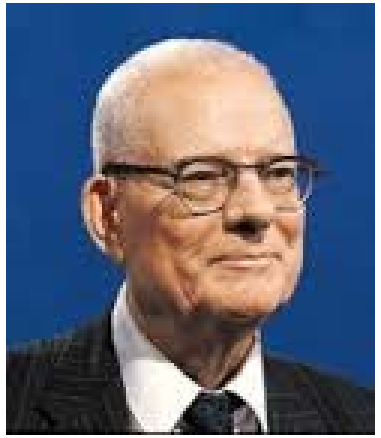
W. Edwards Deming

HFPS Key Cultural Principles

- **Lead with *Humility***
- **Respect every individual**
- **Develop people to be proactive (action plans) and reactive (problem solving)**
- **Empower and engage everyone**
- **Integrate improvement with work in a blame-free culture**
- **Assure quality at the source - never accept, make or pass a defect**
- **Rely on data and facts and direct observation, not opinion**
- **Standardize and stabilize processes**
- **Assure a safe work environment**
- **Relentlessly seek perfection**

Define & Improve Processes Continually

“If you can’t describe what you are doing as a process, you don’t know what you are doing.”



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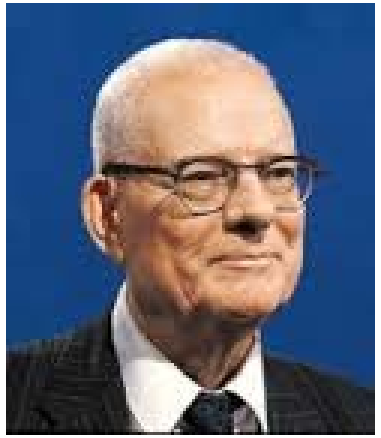
The HFPS Way Forward

- Lean continuous improvement begins with leadership and is owned by managers
- Engage and empower your people to solve problems at the level of the work
- Reduce work variation & waste by standardizing activities, connections and pathways
- Rely on organizational structure and management subsystems to drive continuous change
- Form core teams with strong team leaders and members along the path of workflow
- Break down barriers between silos of control so improvements can occur horizontally
- Foster regular customer-supplier communications within and between work cells
- Integrate people, process, tools, and technology that support the new manner of work
- Implement visual management, with posted daily metrics of value for each work unit reflecting opportunities for change or stability of the process
- Leverage PDCA way of thinking as the operational engine of continual improvement

People Waste

“The greatest waste in America is failure to use the abilities of people.”



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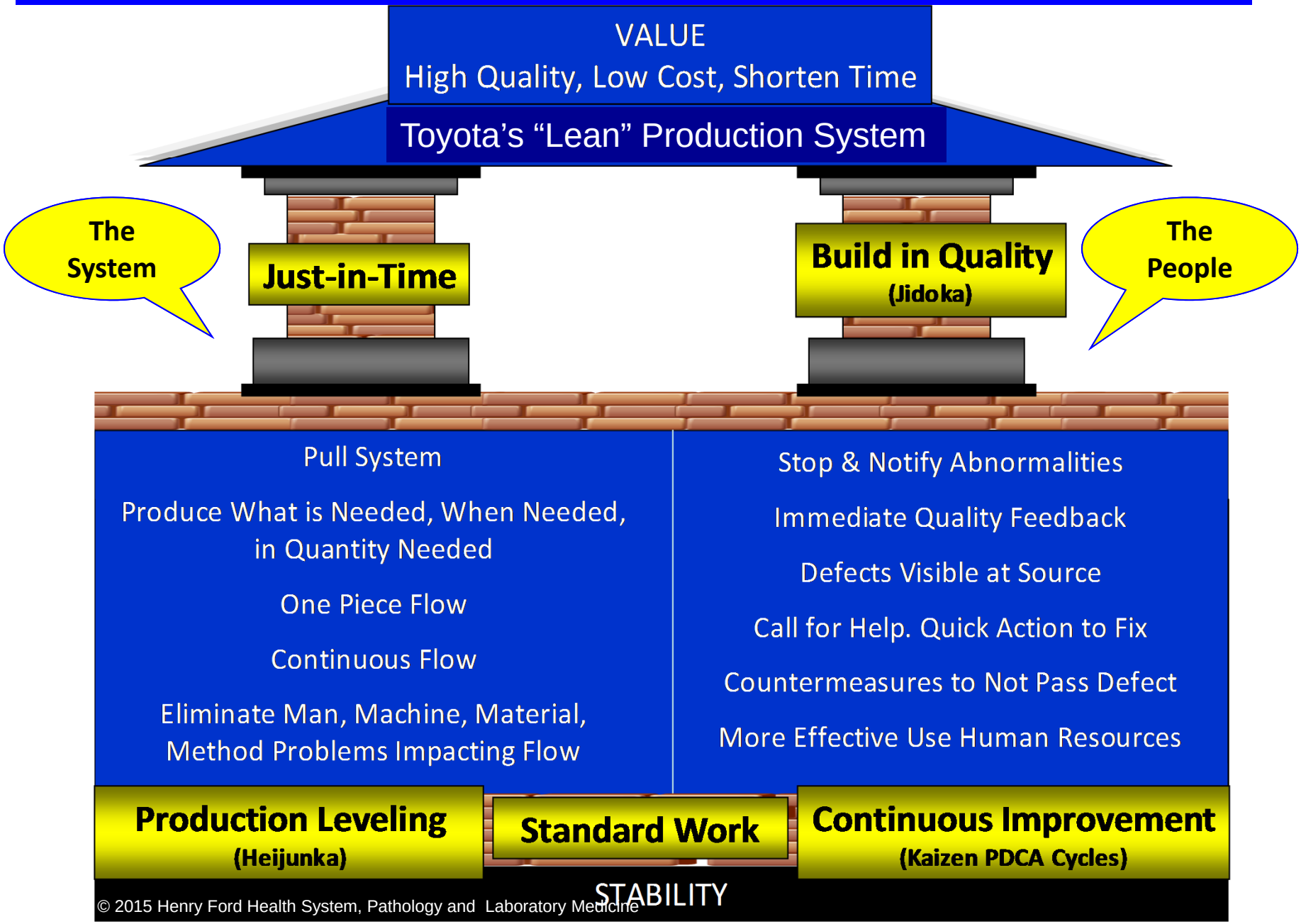
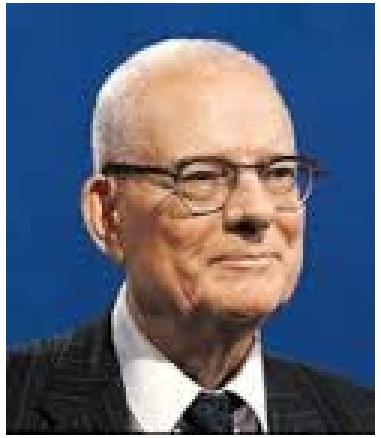
Foundations of Lean Production



Data Rules

**“In God we trust.
All others bring data.”**



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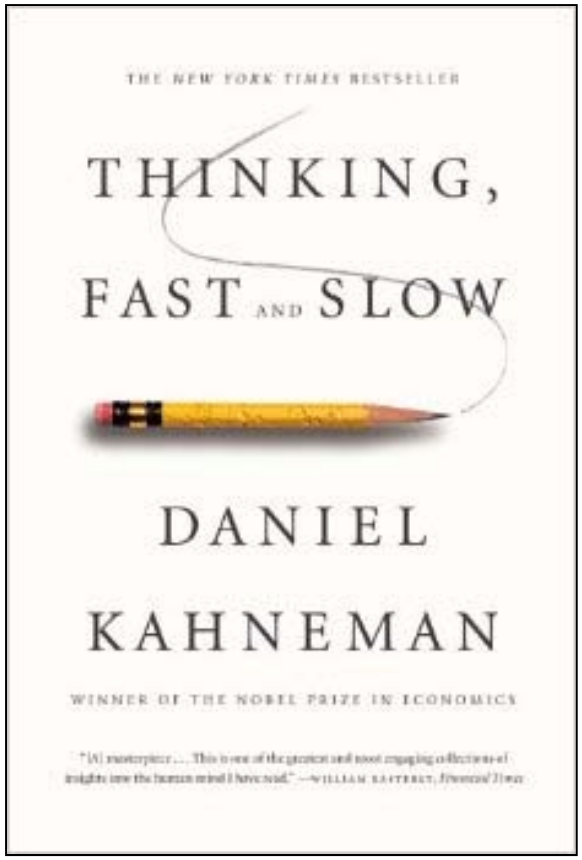
PDCA Problem Solving

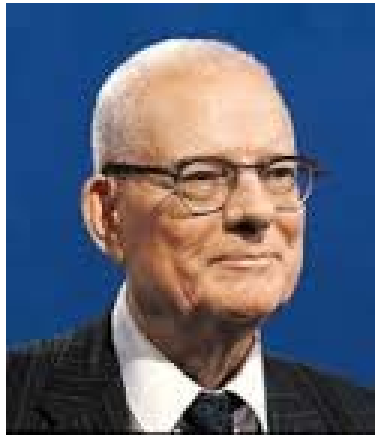


Why so difficult?

FAST System 1	**SLOW** System 2
Fast	Slow
Parallel	Serial
Automatic	Controlled
Effortless	Effortful
Associative	Rule-governed
Slow Learning	Flexible
Emotional	Neutral

Ownership

“Quality is everyone’s responsibility.”



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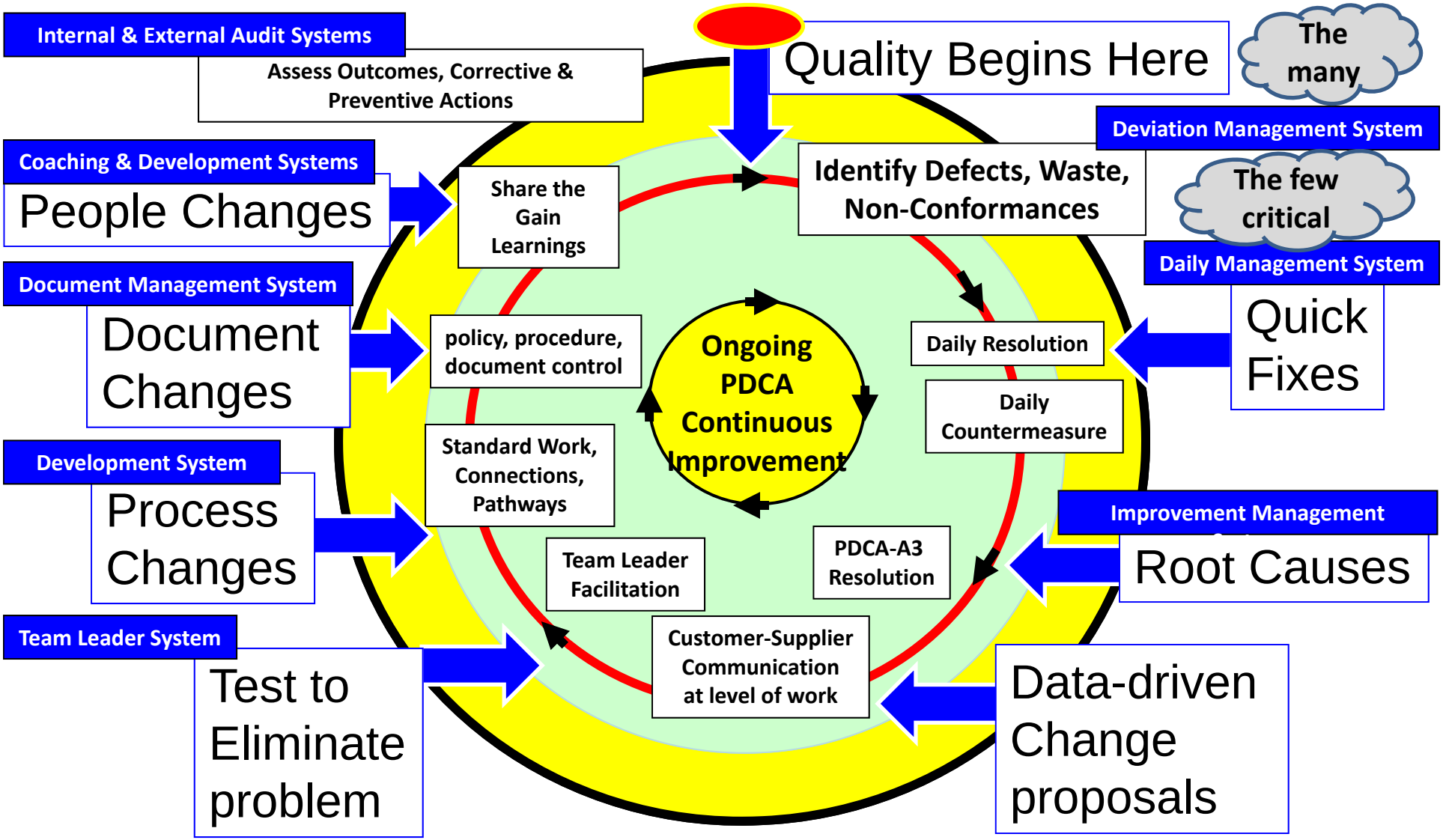
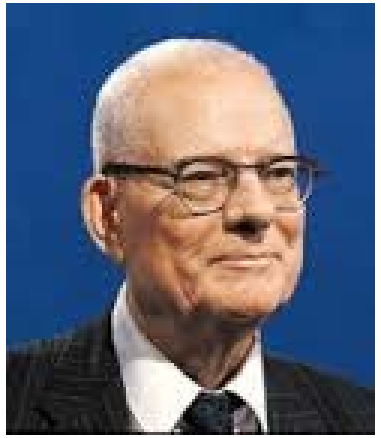
Systems Facilitate Continuous Improvements from Level of the Bench Work



Knowledge is Powerful

“Information is not knowledge. Let’s not confuse the two.”



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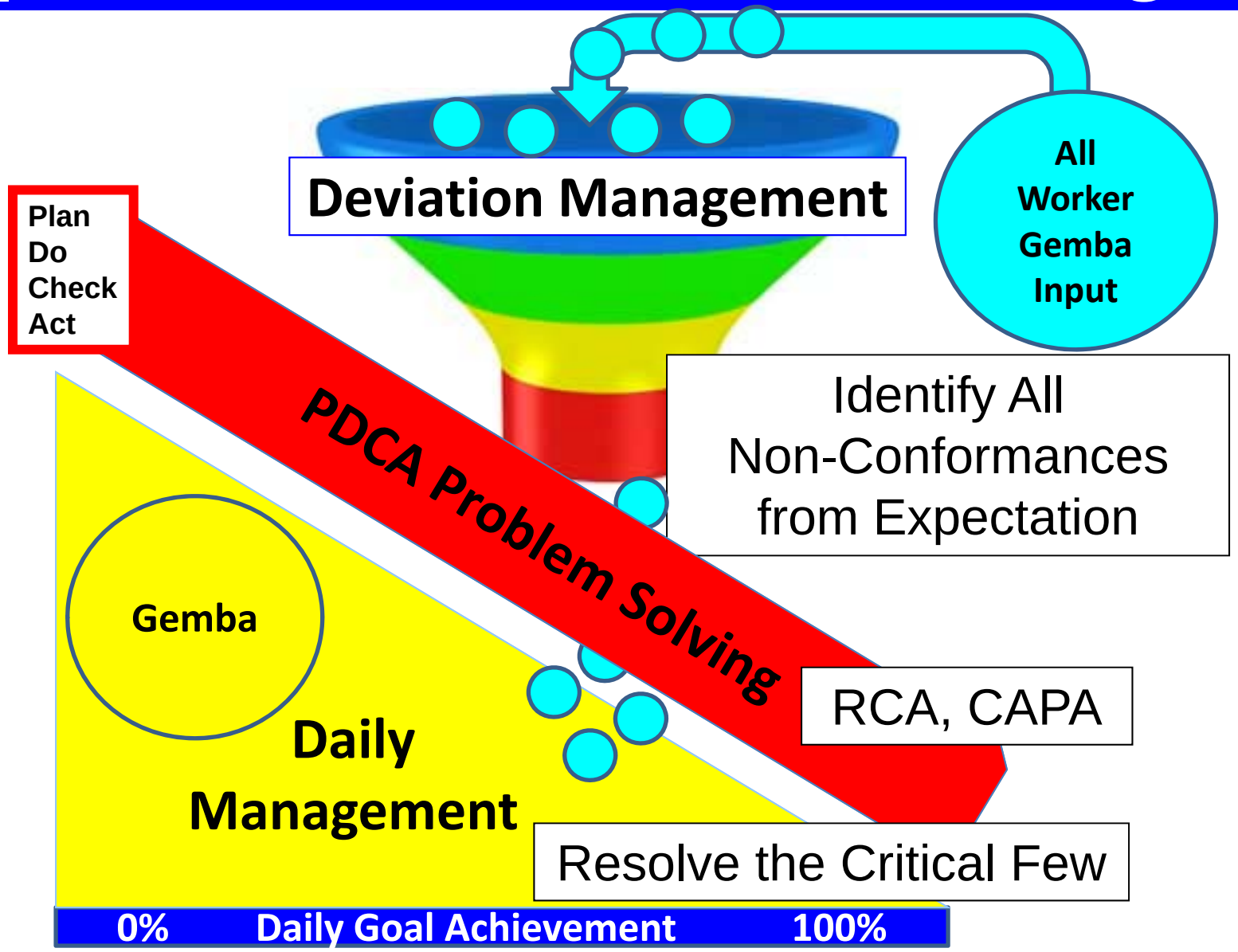
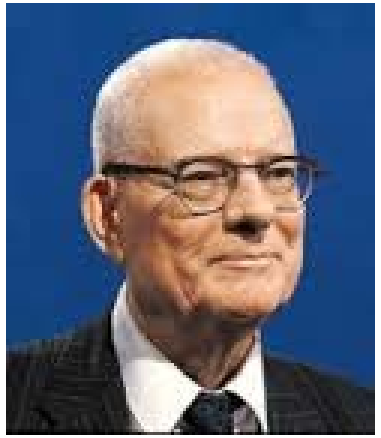
Improvement from Knowledge



DEVIATION MANAGEMENT

Manage by Measure

“You can’t manage what you don’t measure.”



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Answer = 50,000 per year

Q: What is 0.125%
of 40 million lab tests performed?

Does that mean 99.875% of the work is without defect

NO

Deviation Management

process => human or machine => product or service

-Deviation from standard

-Defective work product

Anything having to do with a process that can be described as-

- defective, in non-ideal or perfect form,
- not right the first time, or
- not following policy or procedure (root cause

A Structured Management System

- Created by user consensus, System wide quality technical team
- Manager-Supervisor owned process
- Key aspect of managers' standard work, weekly, monthly
- Paper based input documented at Gemba by all 720 employees
- Excel spreadsheet with logic-pivot tables, located on shared drive
- System wide standardization of:
  - ISO compliant process for defect identification, documentation, tracking and trending
  - Classification of defects (taxonomy of 260 types)
  - Documentation of root causes, corrective and preventive actions
  - Elimination by PDCA based resolution, documentation attached to spreadsheet
- System wide analysis by Quality Specialists
- Priority defects reviewed by System Lab Quality Management Committee
- Platform for System-wide standardized resolution of common deviations

Pick List of Deviations

#125 types in 2014

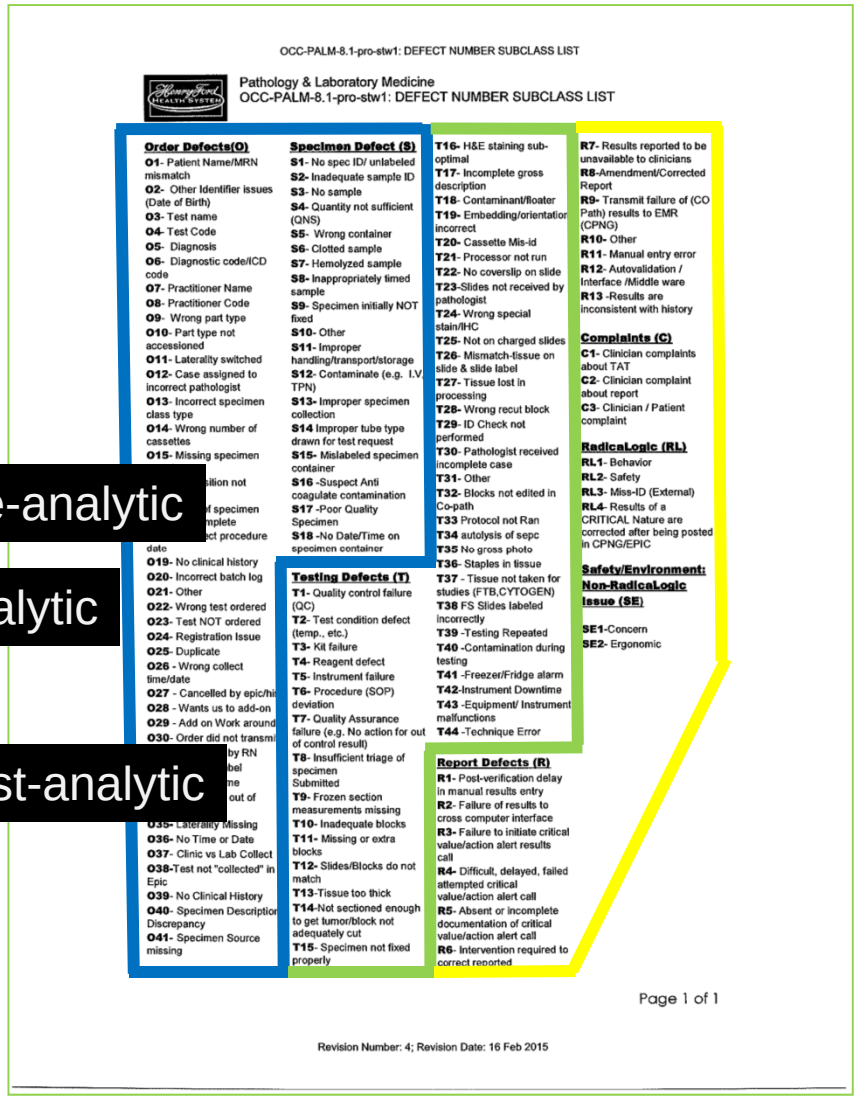
#260 in 2016
and growing

Order
Specimen
Testing
Report
Complaints
RadicaLogic
Safety/
Environmental

47% Pre-analytic

35% Analytic

18% Post-analytic



OCC-PALM-8.1-pro-stw1: DEFECT NUMBER SUBCLASS LIST

Pathology & Laboratory Medicine
OCC-PALM-8.1-pro-stw1: DEFECT NUMBER SUBCLASS LIST

Order Defects(O)
O1- Patient Name/MRN mismatch
O2- Other Identifier issues (Date of Birth)
O3- Test name
O4- Test Code
O5- Diagnosis
O6- Diagnostic code/ICD code
O7- Practitioner Name
O8- Practitioner Code
O9- Wrong part type
O10- Part type not accessioned
O11- Laterality switched
O12- Case assigned to incorrect pathologist
O13- Incorrect specimen class type
O14- Wrong number of cassettes
O15- Missing specimen
O19- No clinical history
O20- Incorrect batch log
O21- Other
O22- Wrong test ordered
O23- Test NOT ordered
O24- Registration Issue
O25- Duplicate
O26 - Wrong collect time/date
O27 - Cancelled by epic/hi
O28 - Wants us to add-on
O29 - Add on Work around
O30- Order did not transmi
O35- Laterality Missing
O36- No Time or Date
O37- Clinic vs Lab Collect
O38-Test not "collected" in Epic
O39- No Clinical History
O40- Specimen Description Discrepancy
O41- Specimen Source missing

Specimen Defect (S)
S1- No spec ID/ unlabeled
S2- Inadequate sample ID
S3- No sample
S4- Quantity not sufficient (QNS)
S5- Wrong container
S6- Clotted sample
S7- Hemolyzed sample
S8- Inappropriately timed sample
S9- Specimen initially NOT fixed
S10- Other
S11- Improper handling/transport/storage
S12- Contaminate (e.g. I.V. TPN)
S13- Improper specimen collection
S14 Improper tube type drawn for test request
S15- Mislabeled specimen container
S16 -Suspect Anti coagulate contamination
S17 -Poor Quality Specimen
S18 -No Date/Time on specimen container

Testing Defects (T)
T1- Quality control failure (QC)
T2- Test condition defect (temp., etc.)
T3- Kit failure
T4- Reagent defect
T5- Instrument failure
T6- Procedure (SOP) deviation
T7- Quality Assurance failure (e.g. No action for out of control result)
T8- Insufficient triage of specimen Submitted
T9- Frozen section measurements missing
T10- Inadequate blocks
T11- Missing or extra blocks
T12- Slides/Blocks do not match
T13-Tissue too thick
T14-Not sectioned enough to get tumor/block not adequately cut
T15- Specimen not fixed properly
T16- H&E staining sub-optimal
T17- Incomplete gross description
T18- Contaminant/floater
T19- Embedding/orientation incorrect
T20- Cassette Mis-id
T21- Processor not run
T22- No coverslip on slide
T23-Slides not received by pathologist
T24- Wrong special stain/IHC
T25- Not on charged slides
T26- Mismatch-tissue on slide & slide label
T27- Tissue lost in processing
T28- Wrong recut block
T29- ID Check not performed
T30- Pathologist received incomplete case
T31- Other
T32- Blocks not edited in Co-path
T33 Protocol not Ran
T34 autolysis of sepc
T35 No gross photo
T36- Staples in tissue
T37 - Tissue not taken for studies (FTB,CYTOGEN)
T38 FS Slides labeled incorrectly
T39 -Testing Repeated
T40 -Contamination during testing
T41 -Freezer/Fridge alarm
T42-Instrument Downtime
T43 -Equipment/ Instrument malfunctions
T44 -Technique Error

Report Defects (R)
R1- Post-verification delay in manual results entry
R2- Failure of results to cross computer interface
R3- Failure to initiate critical value/action alert results call
R4- Difficult, delayed, failed attempted critical value/action alert call
R5- Absent or incomplete documentation of critical value/action alert call
R6- Intervention required to correct reported
R7- Results reported to be unavailable to clinicians
R8-Amendment/Corrected Report
R9- Transmit failure of (CO Path) results to EMR (CPNG)
R10- Other
R11- Manual entry error
R12- Autovalidation / Interface /Middle ware
R13 -Results are inconsistent with history

Complaints (C)
C1- Clinician complaints about TAT
C2- Clinician complaint about report
C3- Clinician / Patient complaint

RadicaLogic (RL)
RL1- Behavior
RL2- Safety
RL3- Miss-ID (External)
RL4- Results of a CRITICAL Nature are corrected after being posted in CPNG/EPIC

Safety/Environment: Non-RadicaLogic Issue (SE)
SE1-Concern
SE2- Ergonomic

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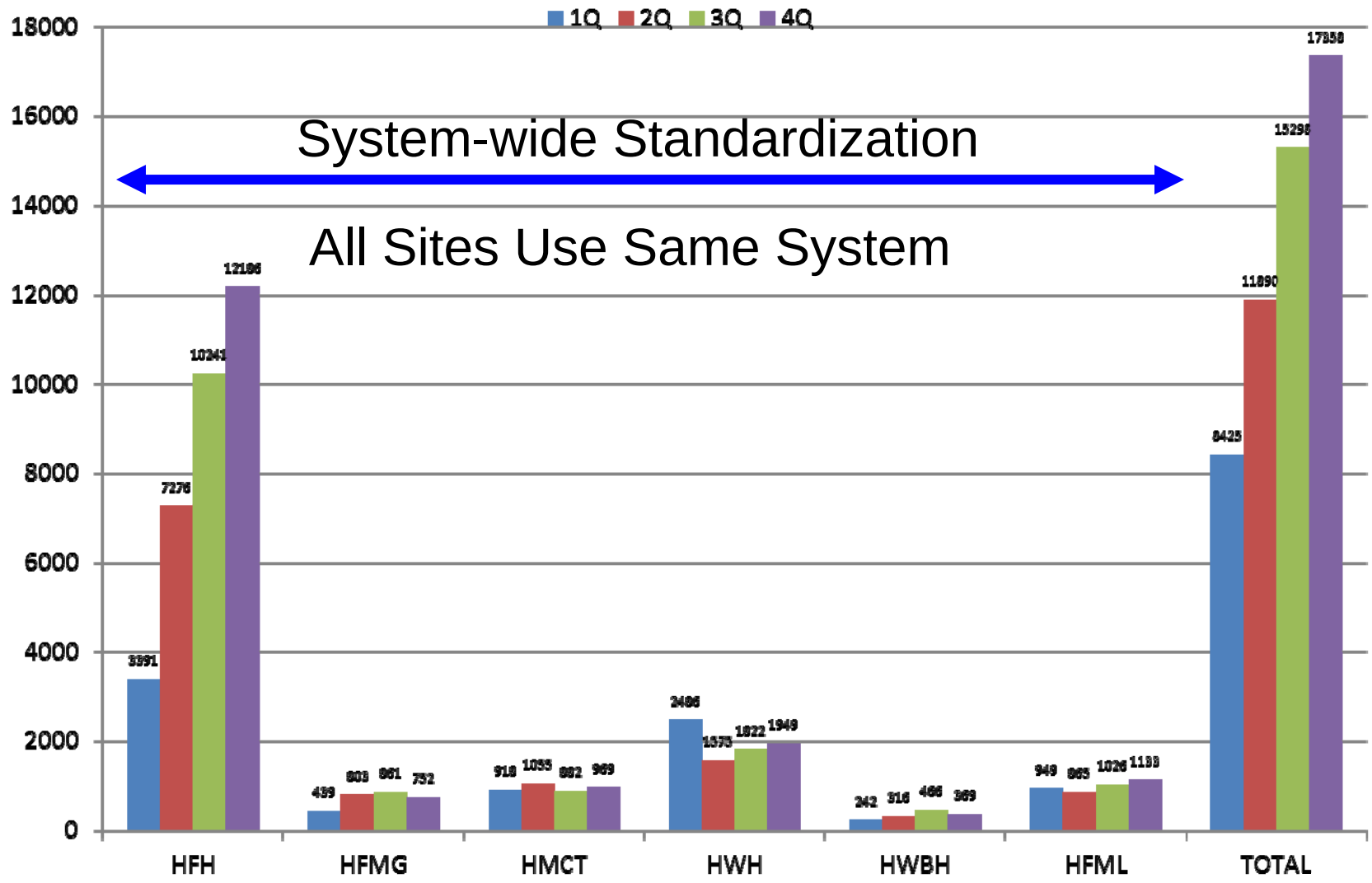
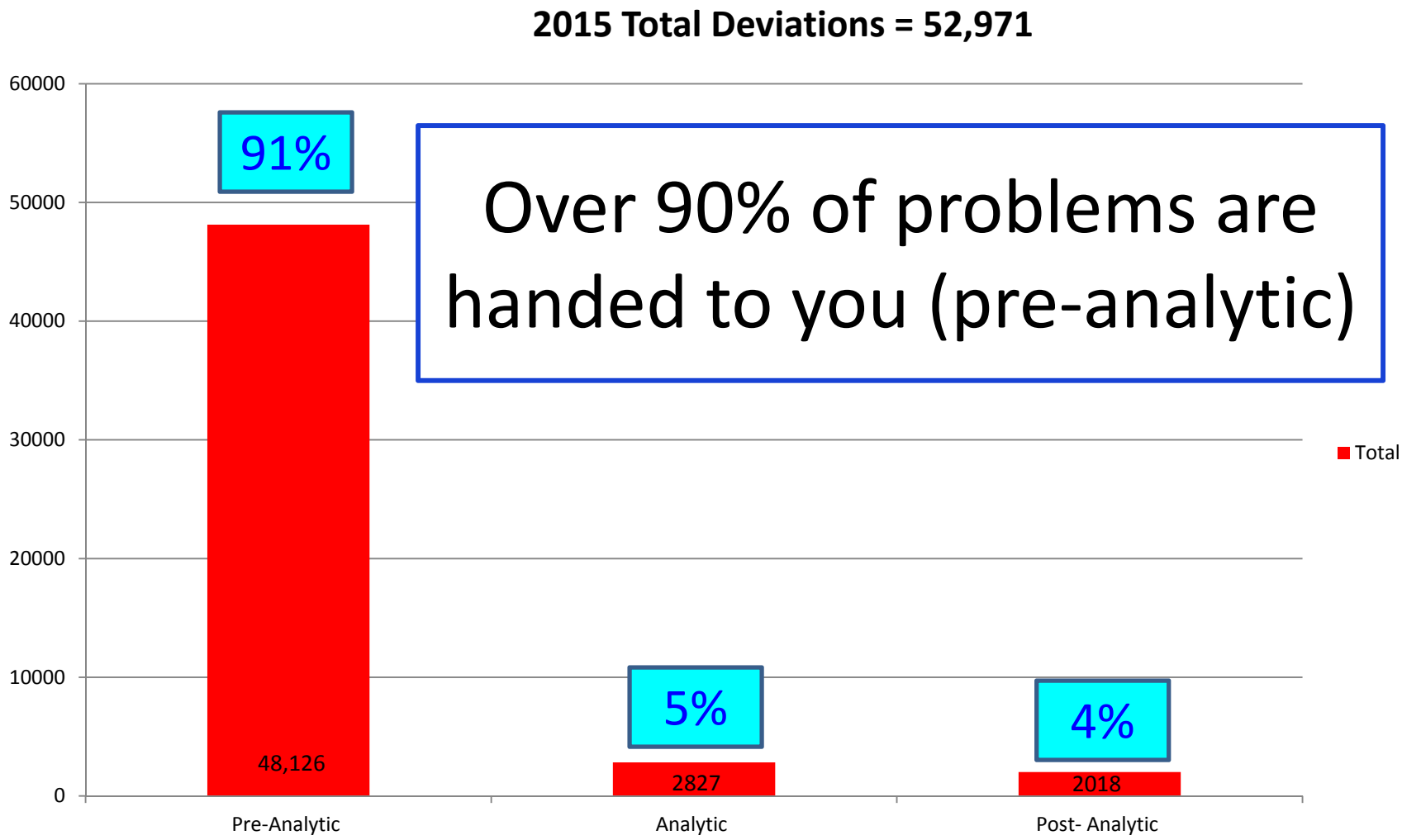
Revision Number: 4; Revision Date: 16 Feb 2015

PALM 2015 Deviation Management

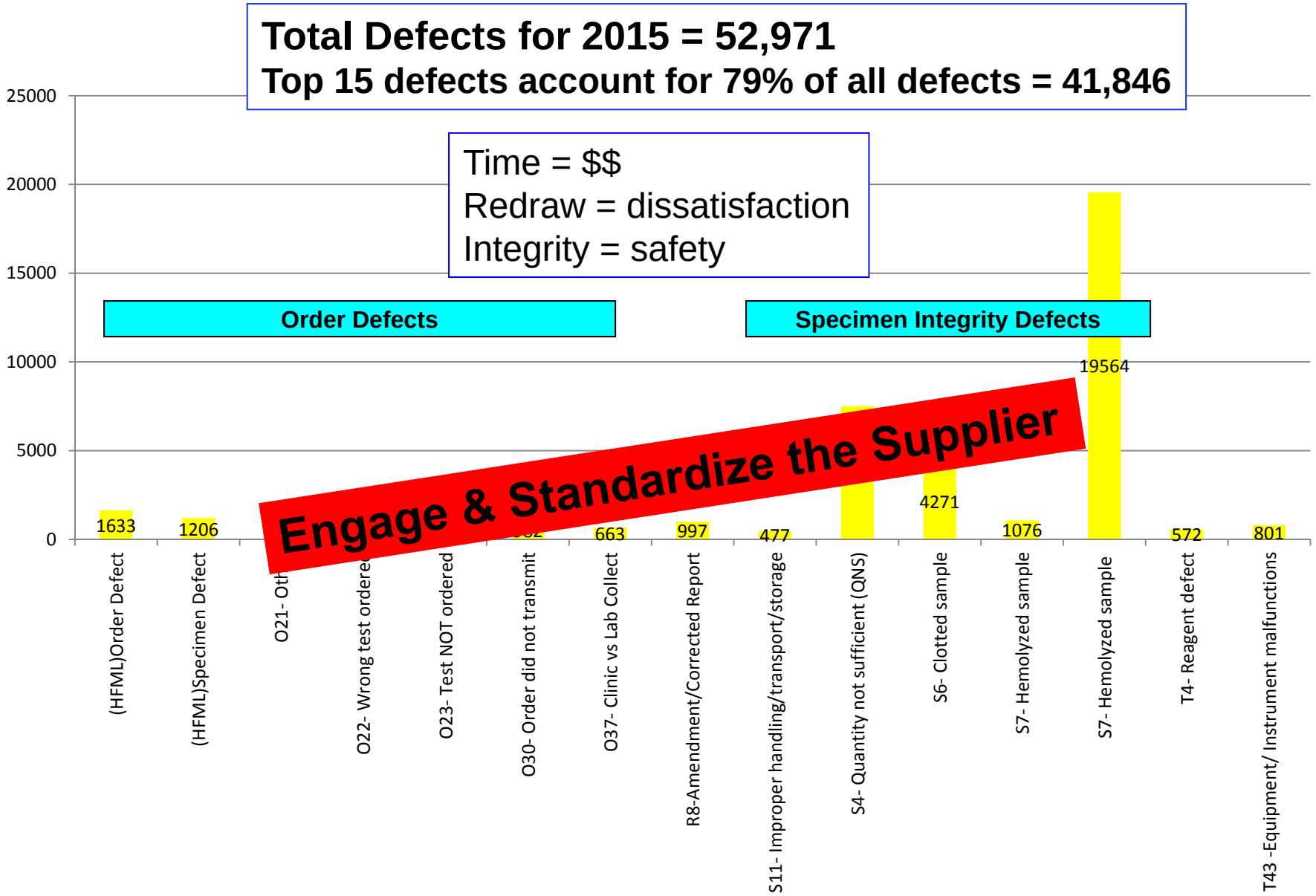
52,971 Deviations



Deviations Classified by Test Cycle Phases

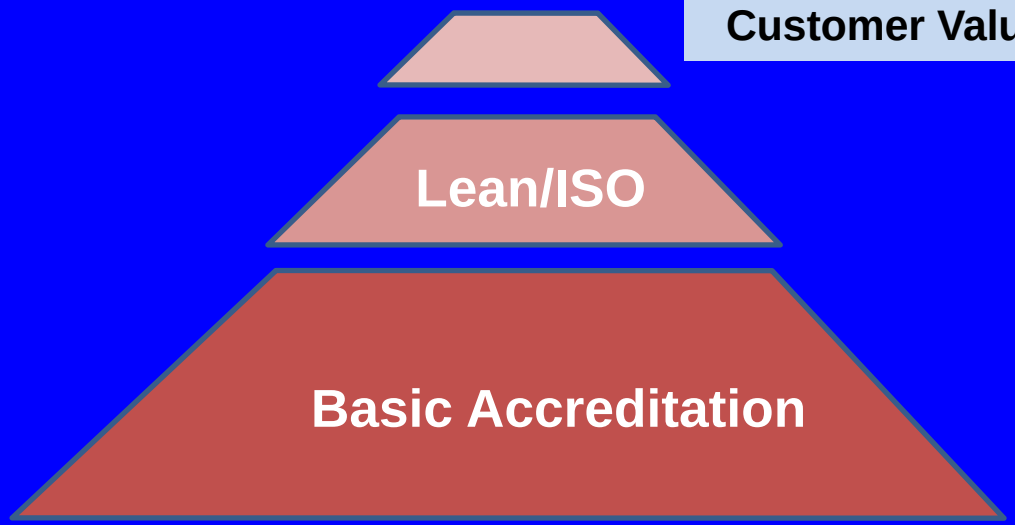


Deviation Management Surveillance Trending



LEVEL 3

Deliver value that Exceeds expectations

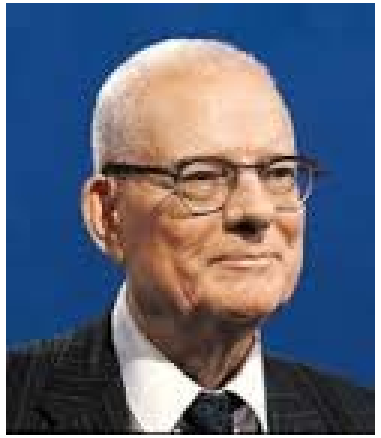


Deliver value outside lab as perceived by stakeholders

Cost of Failures

“No one knows the cost of a defective product – don’t tell me you do.

You know the cost of replacing it, but not the cost of a dissatisfied customer. ”



W. Edwards Deming

Pathology & Laboratory Medicine- All for You

80% **Faster OPD Lab Test Result Times since 2008**

- 98% of Same Day Tests by 6AM
- 90% of Same Day Tests by Midnight vs. 50%
- Epic MyChart test results to patient within 4 hours of OPD visit
- Faster Critical Value notification and timely clinical intervention

55% **Lean Outreach Revenue Growth, last 24 months**

- >$2M in new Net Revenue

50% **Faster IPD Lab Test Result Times since 2008**

- 90% of ER Tests now 30-35 min vs. 90 minutes
- 95% of ER Troponins now in 35 min vs. 70 minutes
- 90% Stats in now 45 min vs. 90 minutes

97% **Pathology O.R. Order Accuracy Post Epic in 2014**

- Error reduction in 1st 6 months

64% **Increased Phlebotomy Patient Satisfaction since 2015**

- 16 draw sites
- Satisfaction rating overall mean 4.8 out of 5
- 10 of 16 sites scoring 5.0
- >600,000 annual phlebotomies

33% **Reduced Phlebotomy Wait Times Since 2014**

- Mean wait time = 7 minutes
- Best performer mean time = 3 minutes
- Worst performer mean time = 14 minutes

Quality Focus is Great

But in the end,
value boils down to

$$

Pathology & Laboratory Medicine- All for You

Faster Micro-organism Identification
Melding New Technologies with Lean Process

Advances in HFHS Microbiology testing using new technologies to identify micro-organisms

- Bacteria & Yeast- Laser Desorption Ionization-Time of Flight (MALDI-TOF)
- Candida sepsis- PCR, nanoparticle hybridization and T2 magnetic resonance signaling

Stakeholder value (**V-metrics**)

- **Faster for caregivers**
  - Decision making while in ER
  - Reduced use of inpatient and ICU beds to isolate while waiting for test results
- **Safer for patients**
  - Lower mortality
  - More immediate and appropriate interventions
- **Cost effective for hospitals and payers**
  - ICU length of stay
  - Appropriate use, overuse and under use of therapies

Faster Micro-organism Identification Maldi-TOF

- Bacterial results improved to 1 day from 2.2 days **55%**
- Yeast results improved to 1.4 days from 4 days **65%**
- Decrease LOS for IPD Seps
- **Annual LOS**

$5,783,287

Yeast & Gram Pos. bacterial sep

$3,230,437

Gram Neg. sepsis

$2,552,850

Pathology & Laboratory Medicine- All for You

Facilitate Appropriate Therapy
Maldi-TOF

Rapid differentiation of pathogenic *Staphylococcus aureus* (coagulase positive) from blood culture contaminant coagulase negative Staphylococci may decrease hospital costs $4000-$6,100/patient (Forrest et al. AAC, 2008, Clin Perform Qual Health Care, 1998)

Approx. 924 patients/year with coagulase negative positive blood cultures at HFH

Reduced **unnecessary antibiotic usage** and **reduced length of stay** in a significant number of patients with coagulase negative positive blood cultures

Annual projected $$ savings

MALDI Summary

- Rapid ID ICU LOS reductions= $5,783,287 per year
- Reagent savings per year = $11,212
- Rapid ID of *S. aureus* from contaminants in blood = $610,000.

Annual overall $$ savings

T2 Candida: Direct from Whole Blood

- Type of Specimen: Whole Blood
- DNA extraction: No
- Sensitivity: 91.1%
- Specificity: 99.4%
- Time to Result: 3-5 hours
- Number of *Candida* Species Detected: 5

MAJOR ARTICLE

T2 Magnetic Resonance Assay for the Rapid Diagnosis of Candidemia in Whole Blood: A Clinical Trial

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Background. Microbiologic cultures, the current gold standard diagnostic method for invasive *Candida* infections, have low sensitivity and take up to 2–5 days to grow. We present the results of the first extensive multicenter clinical trial of a new nanodiagnostic approach, T2 magnetic resonance (T2MR), for diagnosis of candidemia.

Methods. Blood specimens were collected from 1801 hospitalized patients who had a blood culture ordered for routine standard of care; 256 of them were manually supplemented with concentrations from <1 to 100 colony-forming units (CFU)/mL for 5 different *Candida* species.

Results. T2MR demonstrated an overall specificity per assay of 99.4% (95% confidence interval [CI], 99.1%–99.6%) with a mean time to negative result of 4.2 ± 0.9 hours. Subanalysis yielded a specificity of 98.8% (95% CI, 98.3%–99.4%) for *Candida albicans*/*Candida tropicalis*, 99.3% (95% CI, 98.7%–99.6%) for *Candida parapsilosis*, and 99.9% (95% CI, 99.7%–100.0%) for *Candida krusei*/*Candida glabrata*. The overall sensitivity was found to be 91.1% (95% CI, 86.9%–94.2%) with a mean time of 4.4 ± 1.0 hours for detection and species identification. The subgroup analysis showed a sensitivity of 92.3% (95% CI, 85.4%–96.6%) for *C. albicans*/*C. tropicalis*, 94.2% (95% CI, 84.1%–98.8%) for *C. parapsilosis*, and 88.1% (95% CI, 80.2%–93.7%) for *C. krusei*/*C. glabrata*. The limit of detection was 1 CFU/mL for *C. tropicalis* and *C. krusei*, 2 CFU/mL for *C. albicans* and *C. glabrata*, and 1 CFU/mL for *C. parapsilosis*. The negative predictive value was estimated to range from 99.5% to 99.9% in a study population with 5% and 10% prevalence of candidemia, respectively.

Conclusions. T2MR is the first fully automated technology that directly analyzes whole blood specimens to identify species without the need for prior isolation of *Candida* species, and represents a breakthrough shift into a new era of molecular diagnostics.

Clinical Trials Registration. NCT01761266.

Keywords. T2 magnetic resonance; T2MR; *Candida*; fungal infections; clinical trial.

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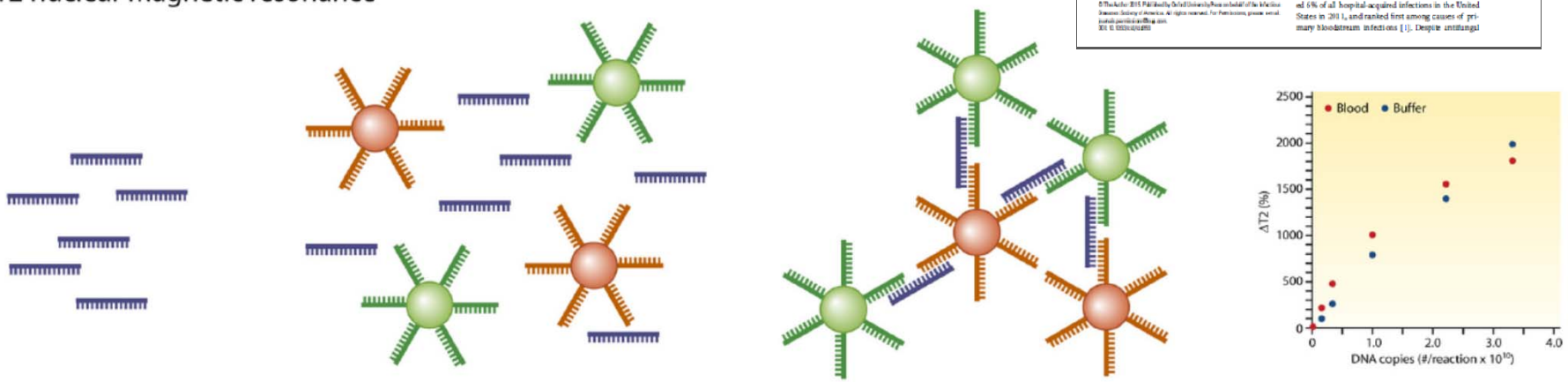
Few advances have occurred in the past decades to adequately address the most severe and costly infectious diseases affecting hospitalized patients, such as invasive fungal infections. *Candida* species infections represented 6% of all hospital-acquired infections in the United States in 2011, and ranked first among causes of primary bloodstream infections [1]. Despite antifungal

D T2 nuclear magnetic resonance



PCR amplifies target sequence on tested sample → DNA probes attached to paramagnetic nanoparticles are added to the sample → The probes bind the amplified DNA → Change in T2 relaxation time is detected via magnetic resonance

Rapid Whole Blood ID Candida Sepsis

- Candidemia mortality 40% despite antifungal therapy
- Mortality triples after 12 hours delay
- Blood culture gold standard takes 1-3 days ☹ T2 detection & speciation = 3-5 hours
- HFH annual send-out cost fungal antigen testing = $244,000, eliminated

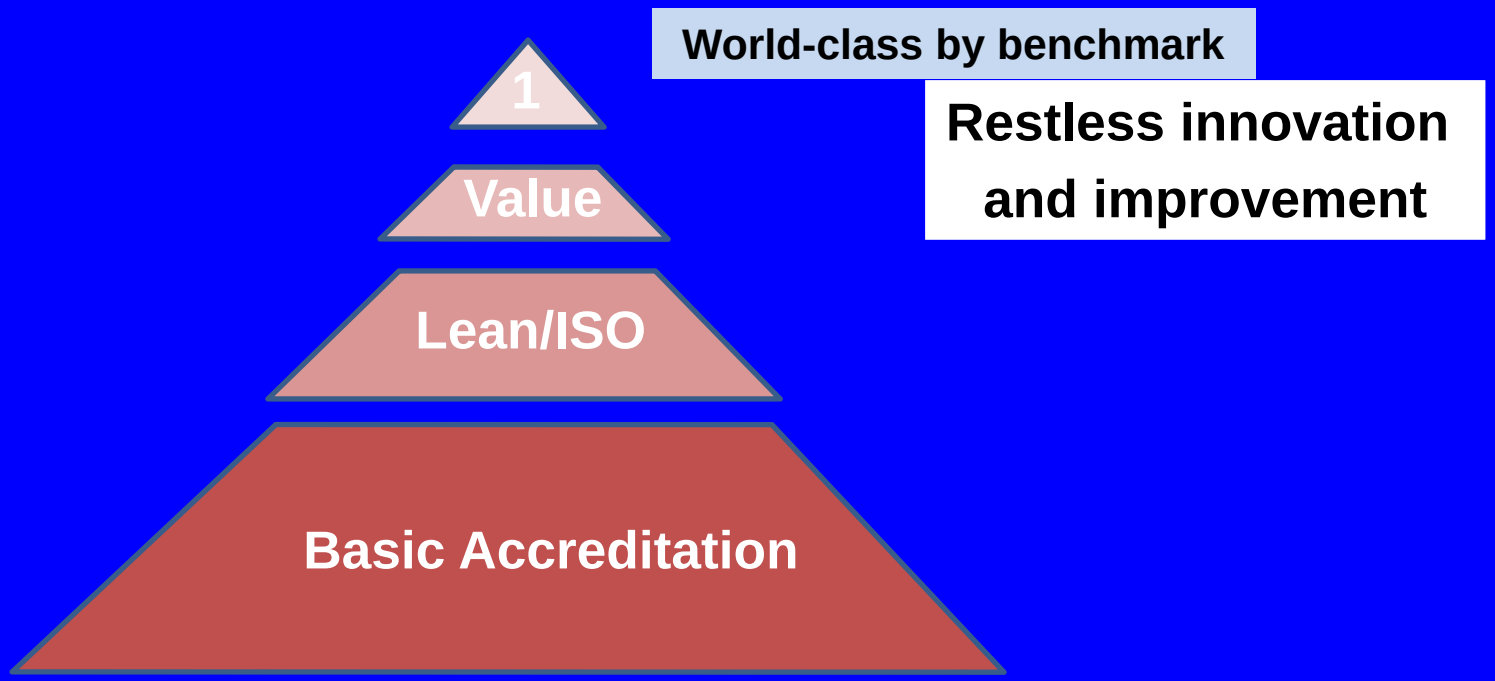
- Candida sepsis episode (1997) = $44,536 per patient
- ICU LOS reduced from 15 to 8 days when rapid identification methods are combined with antimicrobial stewardship (Huang et al. 2013)

- Reduce 1 day ICU LOS + reduced antifungal usage = **$564,000** annual savings
- Minus cost T2 testing $480,000

Overall annual $$ savings

LEVEL 4

Use benchmarks to Achieve Best-in-Class



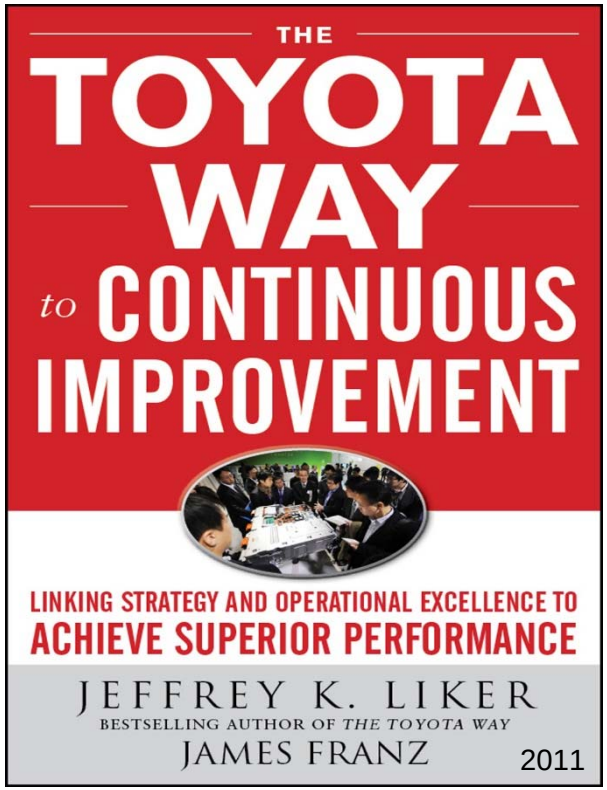
World-class by benchmark

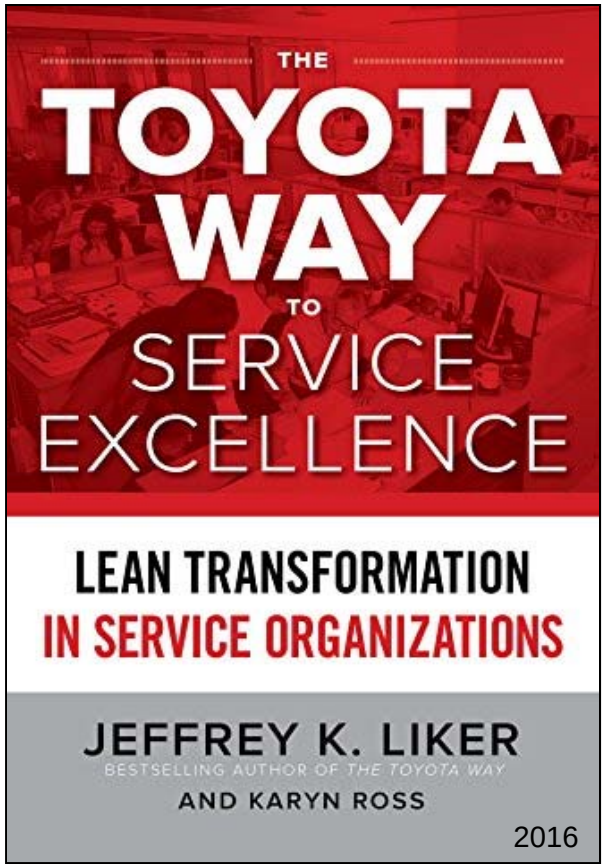
Restless innovation and improvement

Recognition of Culture

"We know from the changes that have already been brought about that far greater changes are to come, and that therefore we are not performing a single operation as well as it ought to be performed."

– Henry Ford





Danaher Business System

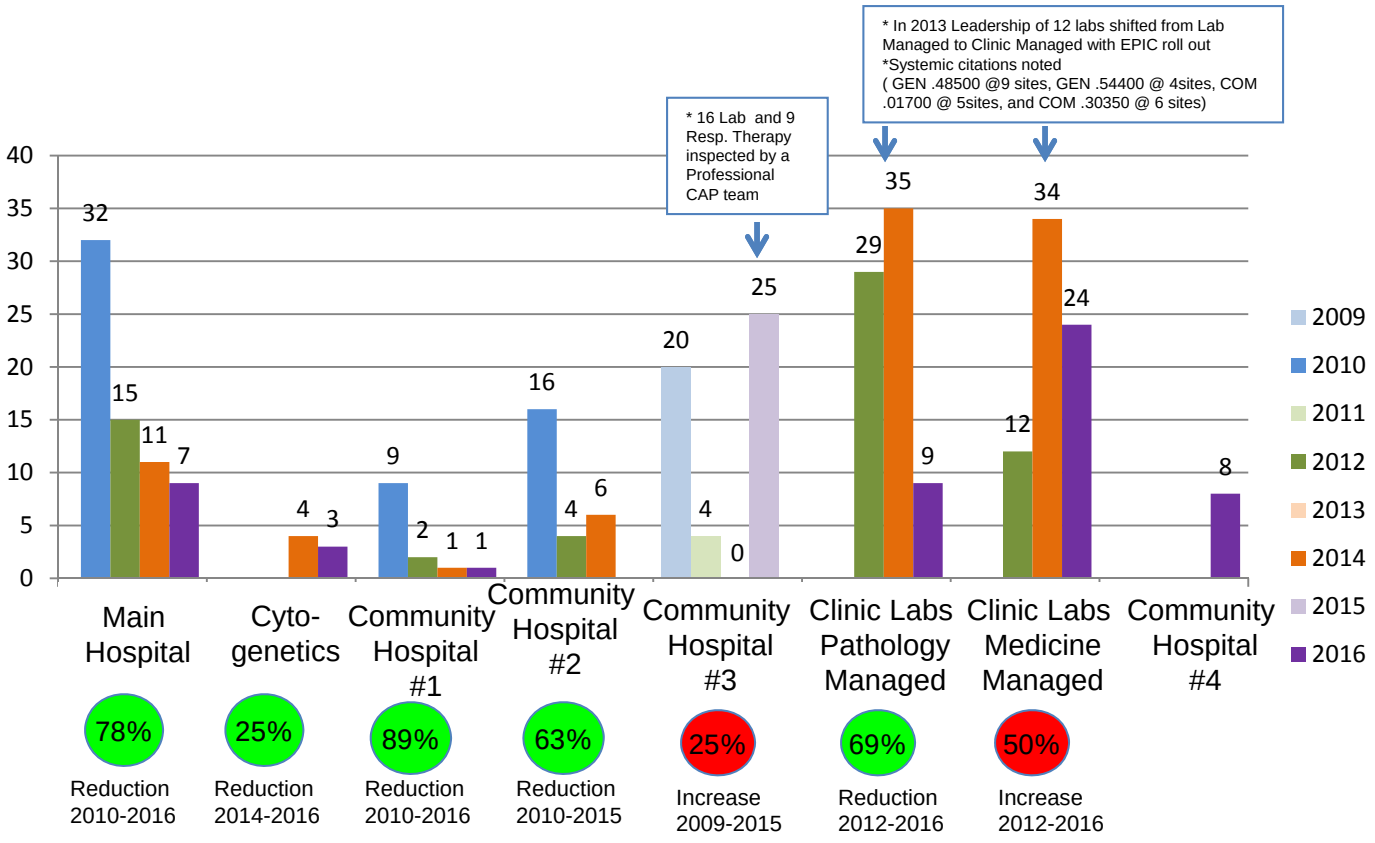
International Center of Excellence

Pathology and Laboratory Medicine

CAP ISO 15189 Center of Excellence and Learning

CAP LAP Citation Trends for PALM

2009-2016



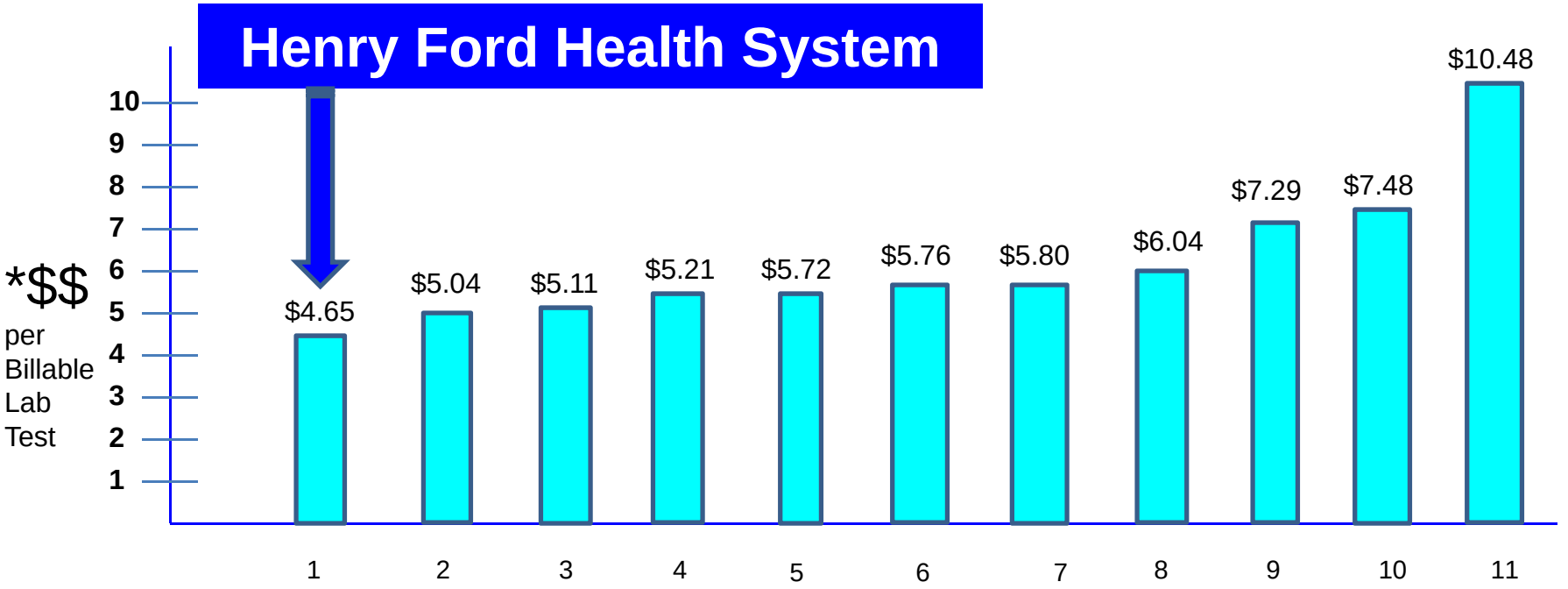
That's All Well and Good

Self praise is No Praise.

Because in the final analysis, to those who control your fate, you are a COST CENTER.

Lab Cost per Unit of Service

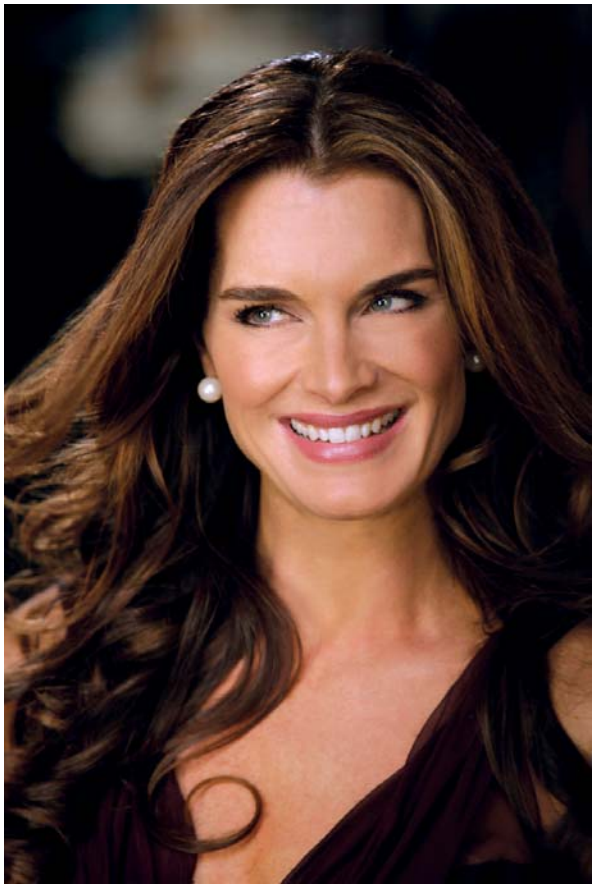
2016 National Peer Laboratory Benchmarking



* Cost = Labor + Agency Labor + Non Labor + Corporate

Someone Will Always Be…

Prettier



Someone Will Always Be…

Smarter

Someone Will Always Be…

Faster

Someone Will Always Be…

Cheaper

Someone Will Always Be That…

But not

High Value to Stakeholders

Dissatisfied with status quo

Anticipating customer needs

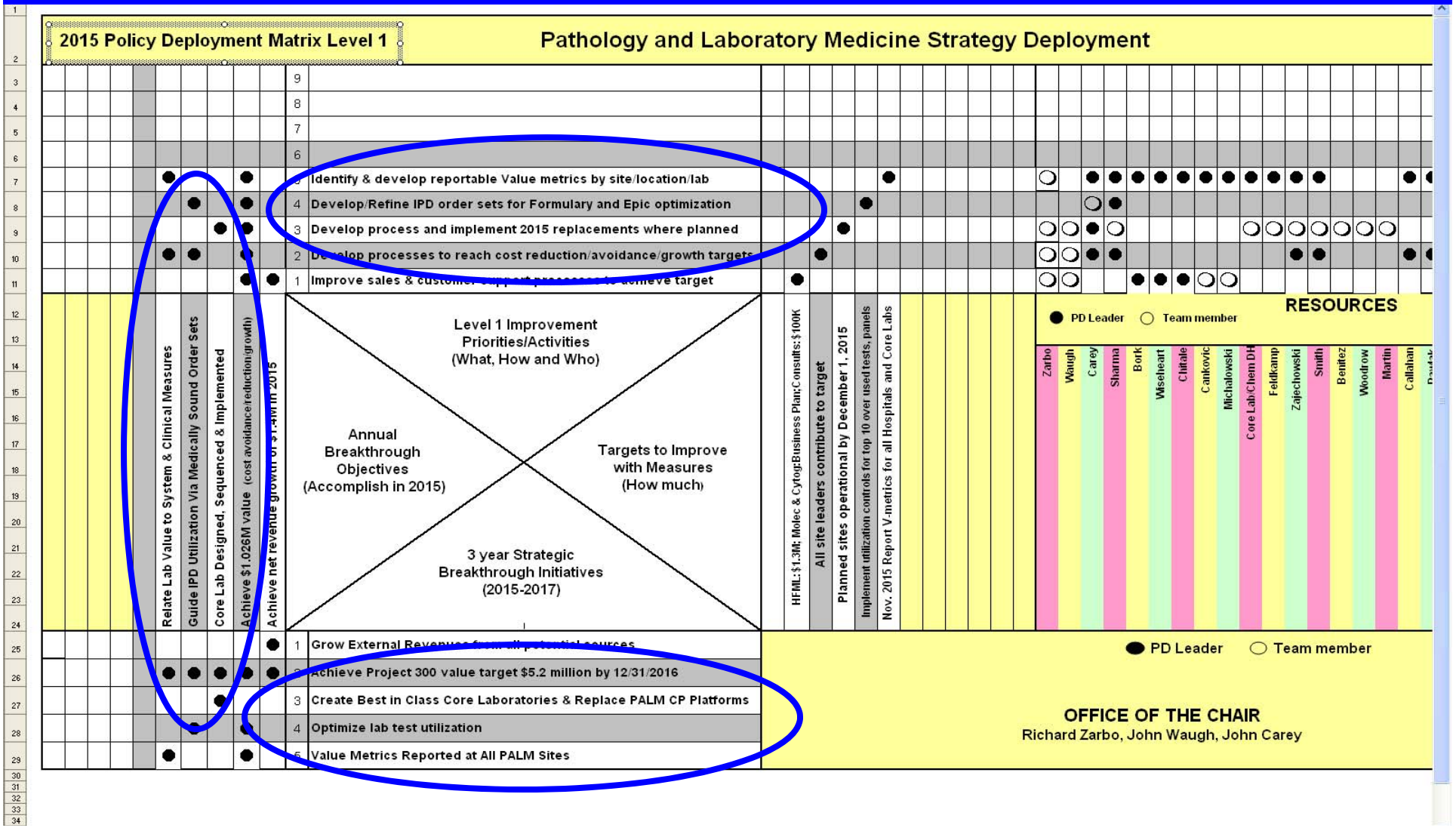
Creative in problem solving

Can do and will do mentality

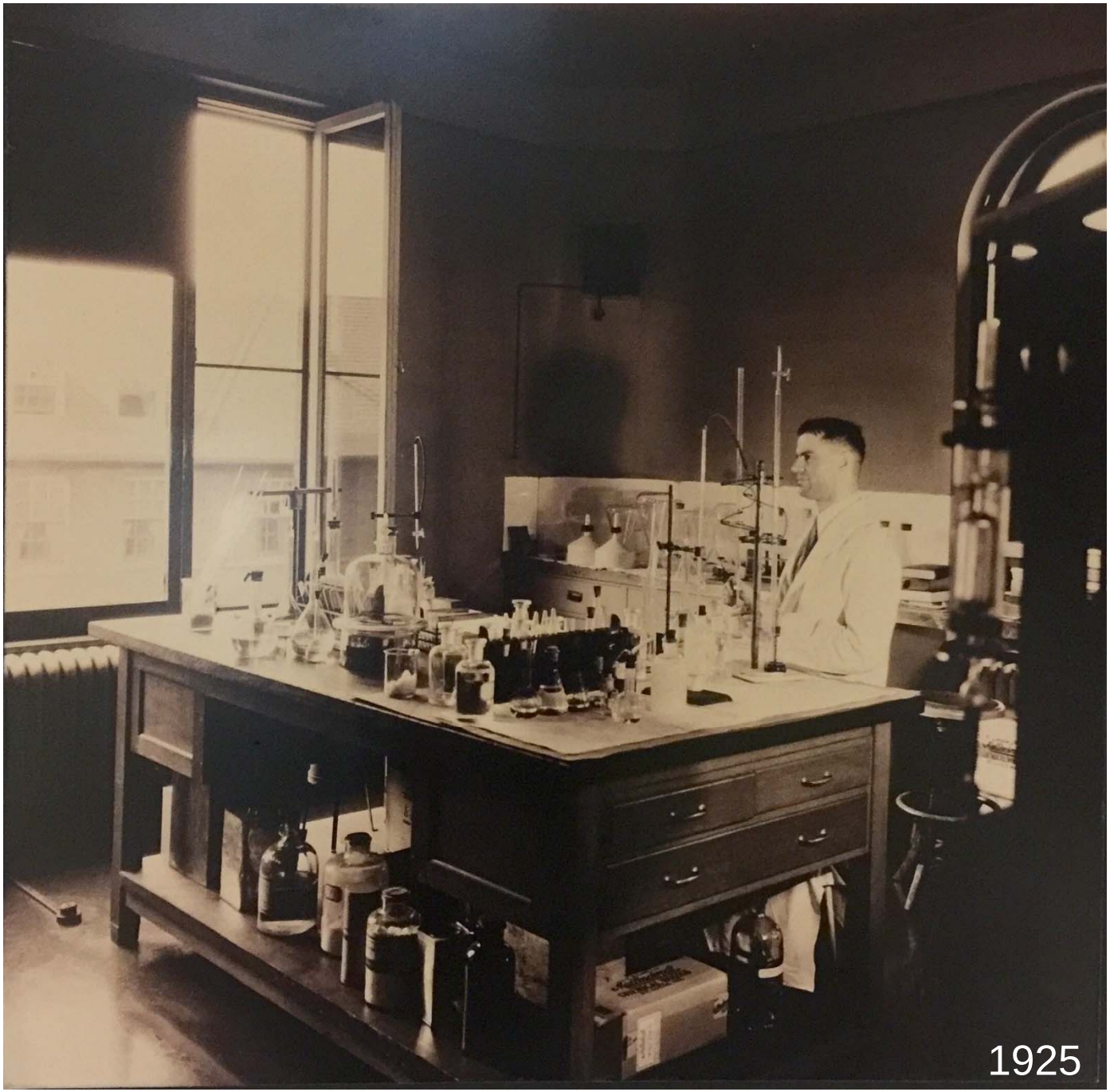
Team-based successes

Because this is what we do!

Value by Design – Policy Deployment



LEAN AUTOMATION

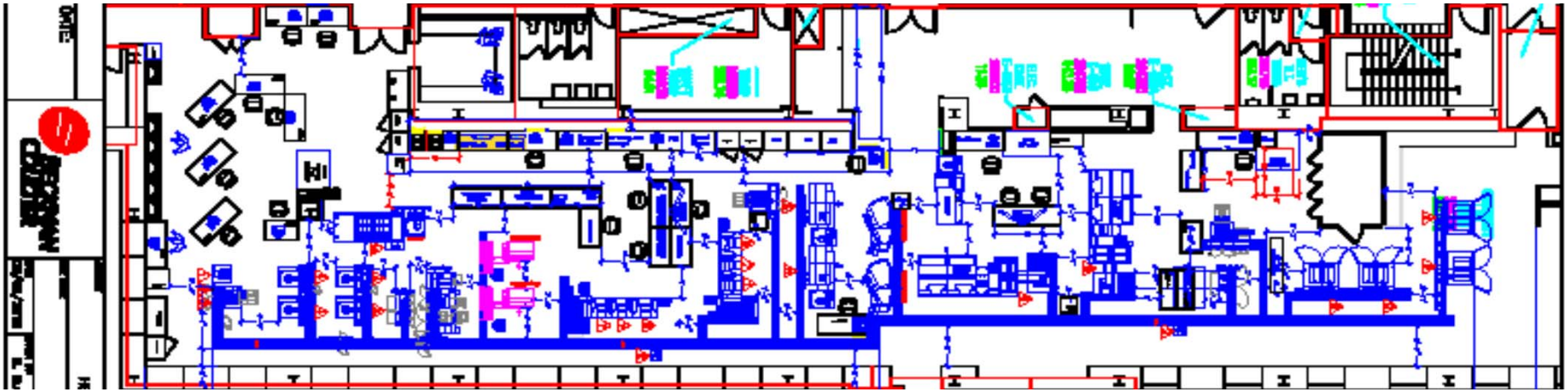


Automation at Henry Ford

Just how BIG is it?

159 feet long

Most comprehensive automation in US

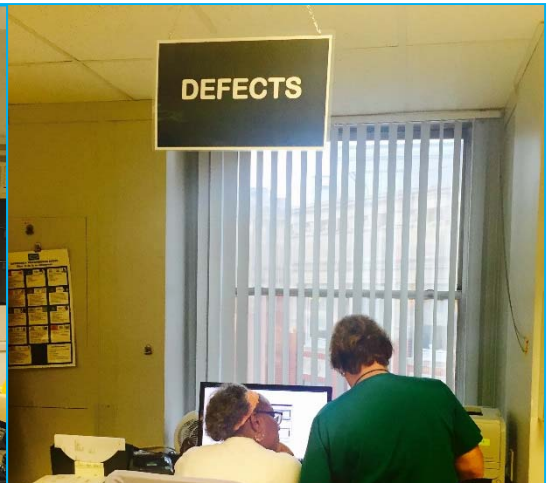


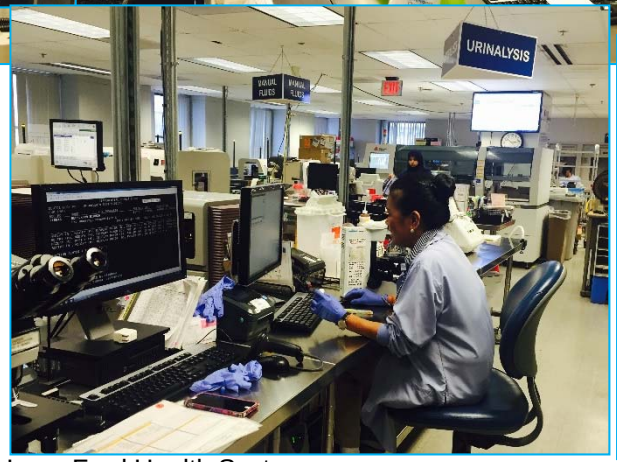
53 yard field goal

8 feet taller than Statue of Liberty

Automation with the "Human Touch"

Technology infused with what humans do better through our Lean problem solving culture is improved !

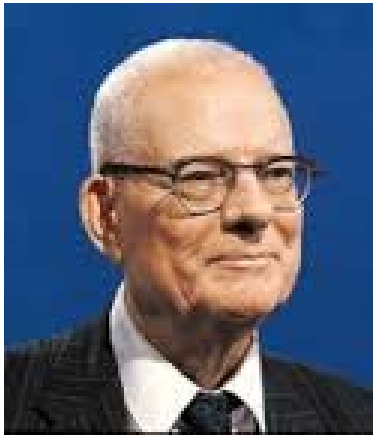




Man & Machine

"If you don't understand how to run an efficient operation, new machinery will just give you new problems of operation and maintenance.

The sure way to increase productivity is to better administrate man and machine."



W. Edwards Deming

Our Approach to Automation

Process Automation - Machines doing work at the Gemba previously done by people

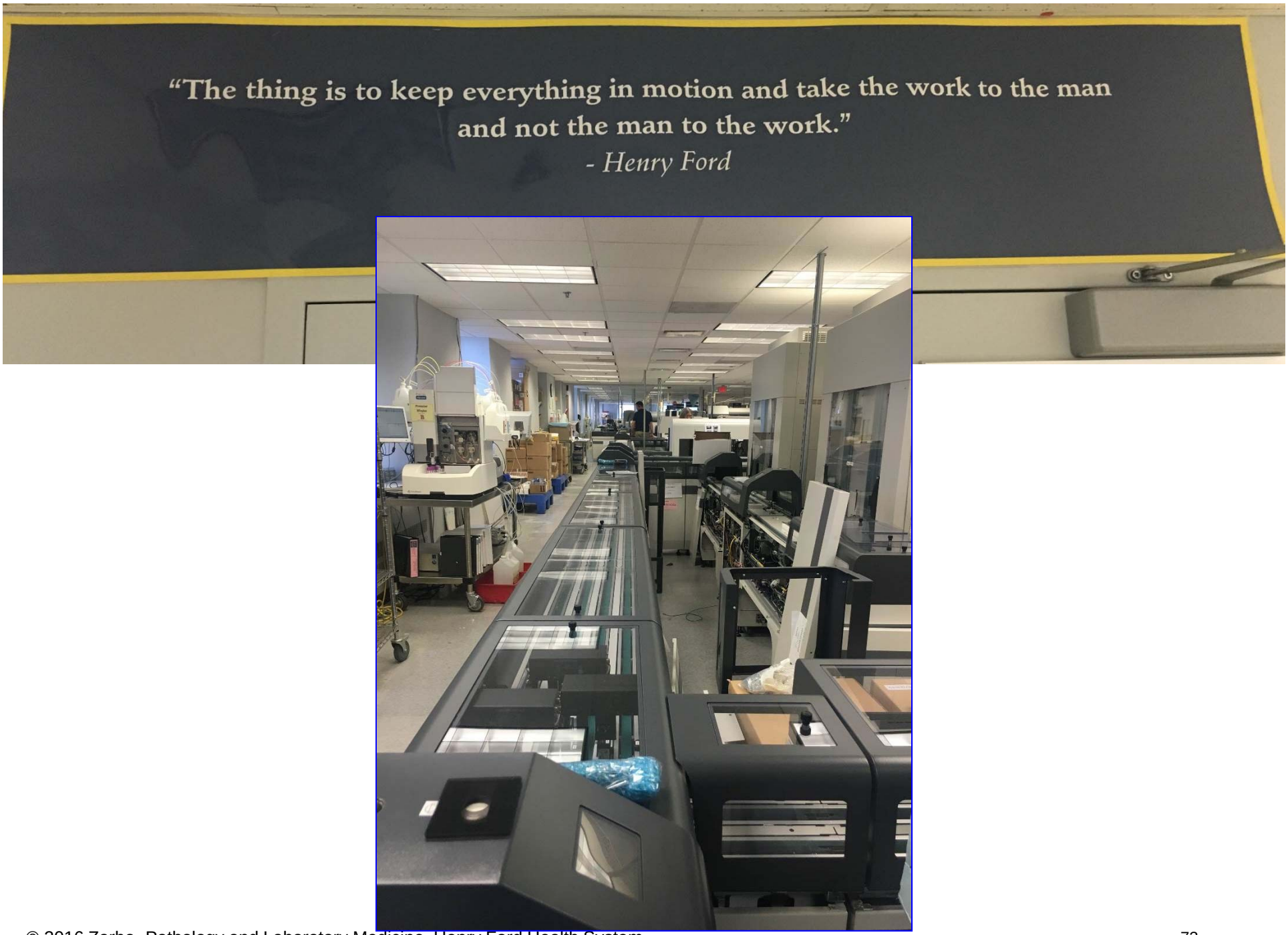
The Advantage - Machines increase standardization, capacity, productivity and economics of the process

Lean - Engaged people continuously solving work problems from the level of the Gemba

The Advantage – Constantly learning from problems, parsing unique differences and improving the process

3P - Production Preparation Process

An event-driven process for developing a new product
concurrently with the operation (process)
that will produce it,
by the people who will interact with it



51 Days of Kaizens Over 2 Years

2014

October 28, 2014 (1 day)
3P modeling and design of automation layout, sample delivery, metrics (current vs future process steps, load leveling strategies, staffing vs. volume)

2015

January 12-15, 2015 (4 days)
Revise automated instrument locations & outlets Chem vs. Heme/Coag to optimize manual stations, cross coverage, upfront processing, sendout testing

January 28-29, 2015 (2 days)
External site visit OSU

March 10-13, 2015 (4 days)
Redesign manual workstations to reduce motion, specimen transport, touch points, lead and cycle times in the flow of specimens from receipt to testing area

April 28- May 1, 2015 (4 days)
Reduce touches points to line for cooler specimens, redesign handoff & tracking from Specimen Receipt to Cytology and Serology, reduce specimen hold time after testing and devise validation plan for new UA and Heme analyzers

July 14-17, 2015 (4 days)
Design just-in-time reagent inventory & storage requirements for Instruments & manual testing, reduce specimen touches from Specimen Receipt to Micro/ Serology

August 19-21, 2015 (3 days)
Develop and try-storm Lean designs for Specimen Receipt and Delivery area

October 6-8, 2015 (3 days)
Finalize Lean design for Specimen Receipt and Delivery area

2016

January 13-15, 2016 (3 days)
Design processes to support installation of automated line and achieve continuous flow of specimens from delivery to Core Lab to respective testing sites

April 26-29, 2016 (4 days)
Design processes to support the outlets -aliquots, sendouts, manual testing in Heme/Coag, Chem, Wets, UA and specimens sent to Micro/Serology/HLA

June 14-16, 2016 (3 days)
Design reporting by Client Services rather than bench techs to Medical Centers for defective/inadequate samples by 12 noon next business day, Design notification of Core Lab critical values by Client Services.

August 16-19, 2016 4 days)
Design processes to support downtime of Power Express and Automate to continue to achieve ER TAT of <30min for Heme, Coag, UA, Lyt7 and CTNI

September 13-16, 2016 (4 days)
Standardize and optimize Remisol for Chemistry, Heme and Coag. Design specimen delivery rolling band conveyer to inlet.

November 7-18, 2016 (8 days)
Line Go-Live

Kaizen Fueled Change

Action Items

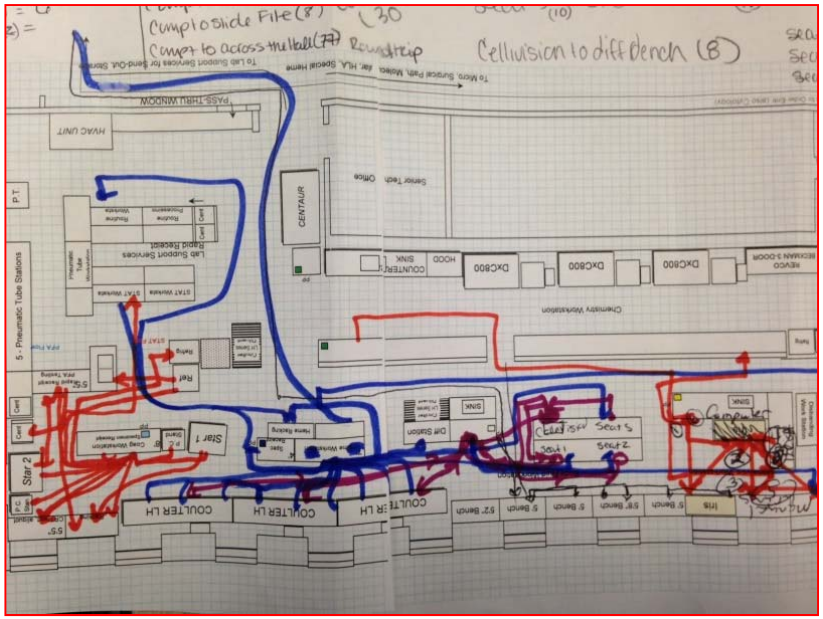
Oct 2014 – Aug 2016

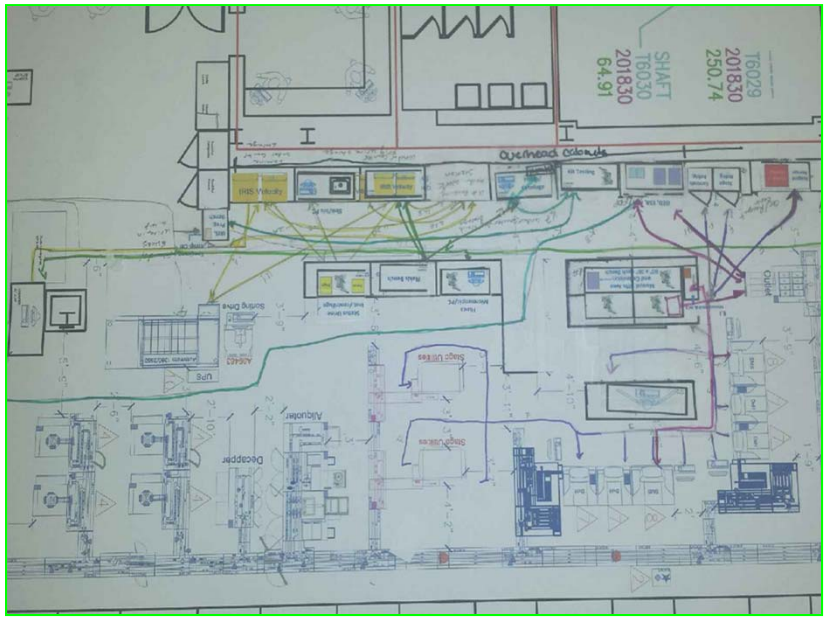
- 141 action items
- 101 complete (72%)
- 40 open
  - 7: open (past due)
  - 11: upcoming due date
  - 22: new as of August 19th

Motion Reduction Kaizen

69 FTE's throughout 24 hours

Motion	Before Automation	After Automation
Steps	72,405	27,051
Miles	41.1	15.4
Time in Motion	20.1 hours	7.5 hours

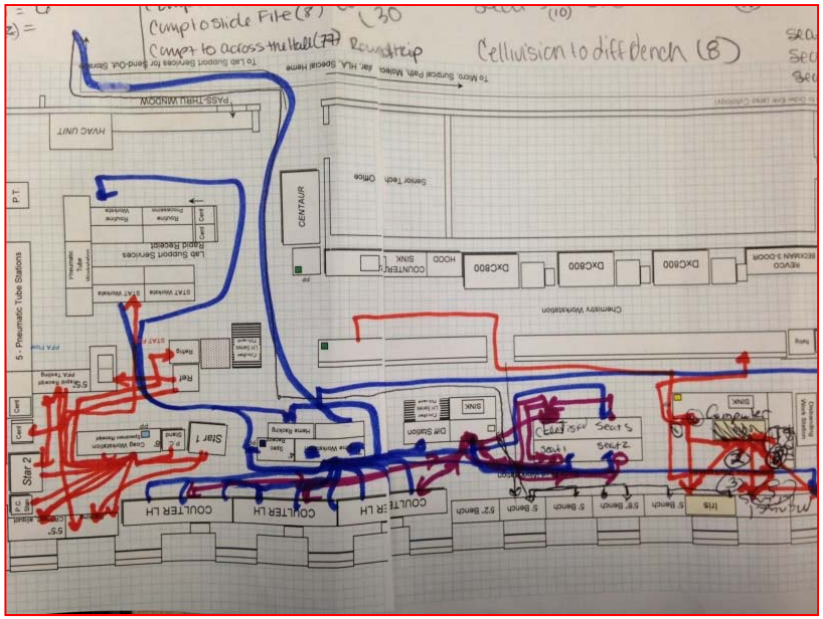


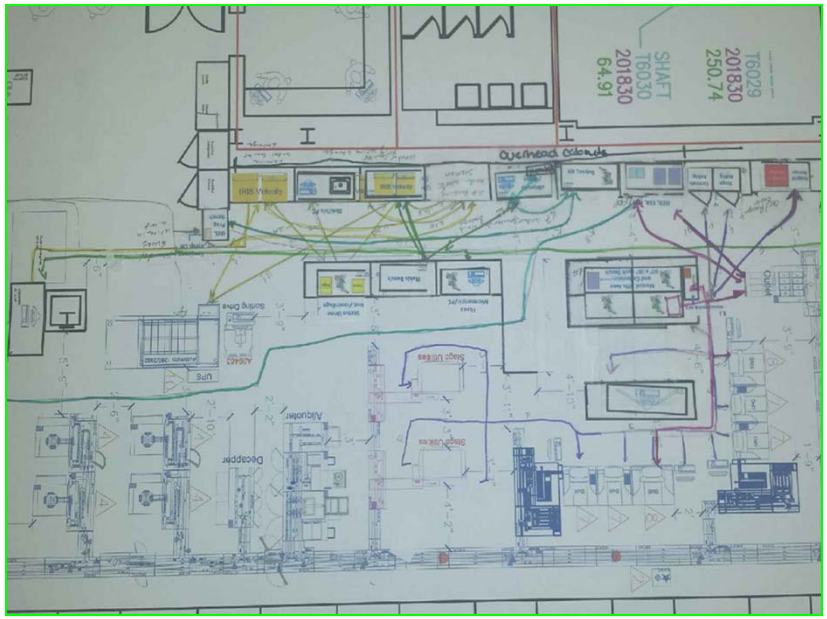


Motion Reduction Kaizen

69 FTE's throughout 24 hours

Motion	Before Automation	After Automation	63% Savings
Steps	72,405	27,051	45,345 steps
Miles	41.1	15.4	25.8 miles
Time in Motion	20.1 hours	7.5 hours	12.6 hours =~1.5 FTE





Specimen Handling "Touches" Kaizen

	# Touches Barcode Ready	# Touches Non-Barcode Ready
Pre-Automation-Hematology	26	28
Post-Automation-Hematology	2	6
Improvement	**92%**	**78%**
Pre-Automation-Basic Chemistry		
Post-Automation-Basic Chemistry		
Improvement		**81%**
Pre-Automation Basic Chemistry Shared between 2 analyzers	34	36
Post-Automation-Basic Chemistry Shared between 2 analyzers	2	6
Improvement	**94%**	**83%**

Almost There

Opportunity

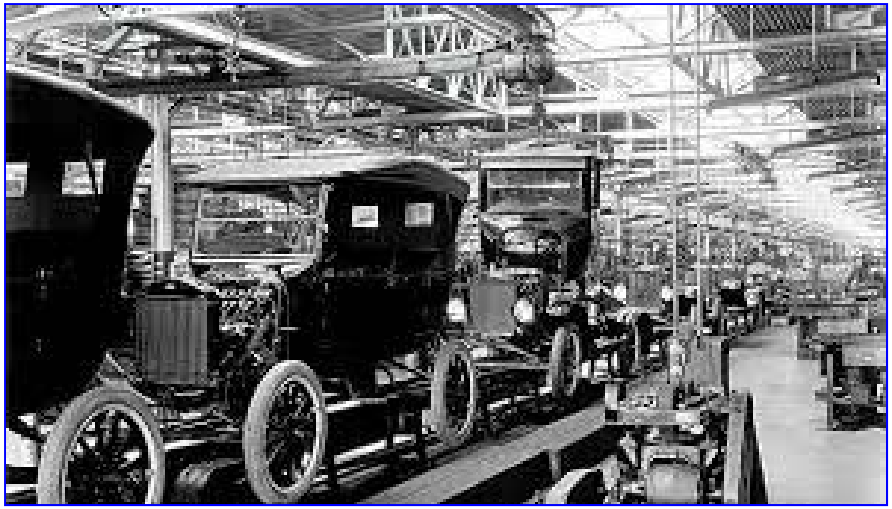
The Lean Solutions

1. **Culture of people empowerment & structures that authorize action and accountability & proficiency in tools that solve problems**

2. **Minimal “touches”**

3. **Real-time metrics related to the “line” to promote human interaction and problem solving**

4. **Authority to standardize the “suppliers” to eliminate problems at the source representing over 90% of quality defects**



Why Bother?

Essentially, many of the leading laboratories around the world all have access to the same technology and hardware.

Based on our laboratory culture, we strive to be different, to achieve higher levels of performance for our clinicians.

Because its more than a lab test,
it's a patient waiting for a medical decision.

BENEFIT OF LEAN MANAGEMENT

At the End of the Day

“We get brilliant results from average people managing brilliant processes-

while our competitors get average or worse results from brilliant people managing broken processes.”

Fujio Cho
Honorary Chairman
Toyota Motor Corp

IMPROVEMENT

As Leader,
this is your
JOB #1

"Our system of management is not a system at all; it consists of planning the methods of doing the work as well as the work." ***-Henry Ford***