

# Polishing Lab Core Functions with Lean and Six Sigma Tools

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University of Michigan

Lean Six Sigma Overview

Why Use Consultants

Assessment Overview and Lean Solutions

Implementation Update

Take Home Messages

# Justification for Lean Six Sigma

## Healthcare Environment Pressures

- Patient Safety / Ownership
- Reduced Reimbursement
- Pay for Performance
- Looming Medical Technologist Shortage

## Work Processes Changing

- Automation
- Point of Care Testing
- Electronic Order Entry
- Barcodes / Positive ID Initiatives
- Inspection Ever-readiness
- Paperless or Scanning Initiatives

## Business Culture Changing

- Lean Leaders
  - 5 Who's → 5 Why's
  - Silos → Processes
- Lean Hospitals
- Lean Labs

**Cardiovascular Hospital  
in 9 Months  
NO LAB CAPACITY !!!**

# What Are Lean And Six Sigma?

Operational, industrial and process engineering tools refined by Toyota

Lean focuses on eliminating waste in processes - **NOT PEOPLE !!!**

Six Sigma focuses on reducing variability and eliminating errors in processes

Both

- Focus on what is important to the patient (customer)

- Base decisions on facts and data rather than opinion

- Help transform difficult problems into manageable ones

- Empower / satisfy employees:

  - Owned by the people that do the work

  - Disciplined approach to problem solving

  - Teaches them to see waste, savings and opportunities

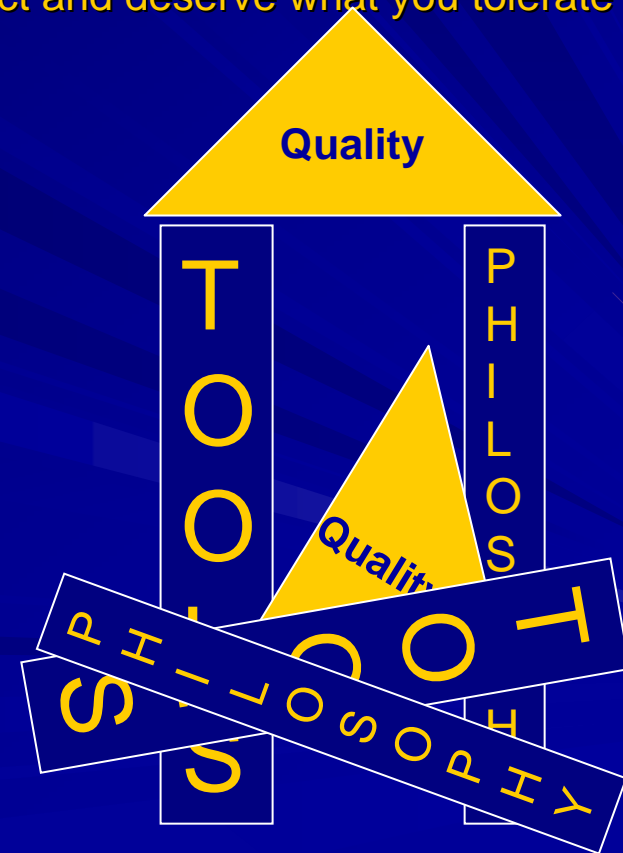
  - Eliminates staffing shortages and overwork

# LEAN - Toolkit & Philosophy

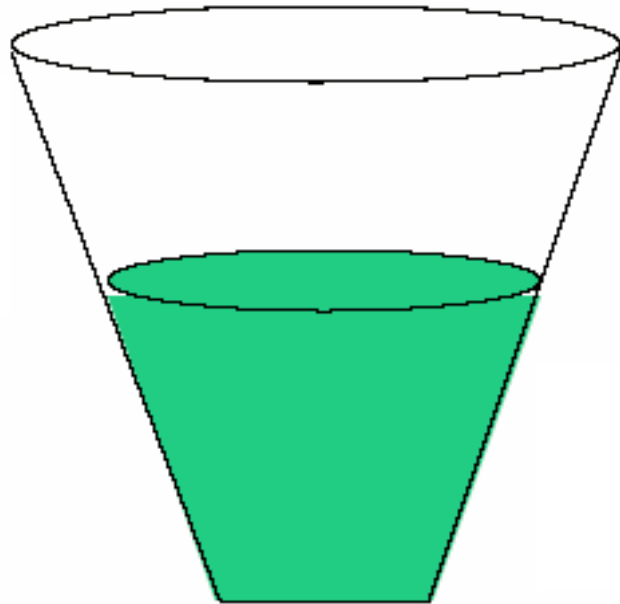
- Standardized Training
- Standardized Problem Solving
- Standardized Work
- Value Stream Mapping
- Kaizen Bursts
- Workload Leveling
- 5S
- Visual Management
- Kanban Systems
- Cellular Design
- Error Proofing (Poka Yoke)
- Value from the patient's perspective
- Pass no defects
- Commitment to continuous learning / improvement
- Standardization is the road to improvement
- Go see for yourself to understand
- Flow where you can
- Pull where you must
- You get what you expect and deserve what you tolerate

## Warning!

**This presentation is rated "PG":** What you are about to see are tools used to CHANGE PEOPLE by TEACHING THEM to identify waste, savings and opportunity. This may be DISTURBING to close-minded individuals and should only be employed with proper Philosophical Guidance.

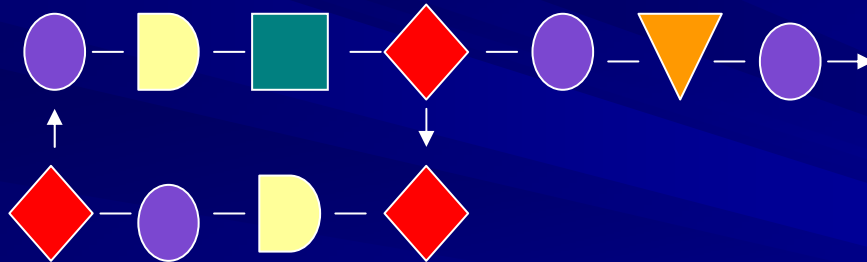


This glass is.....

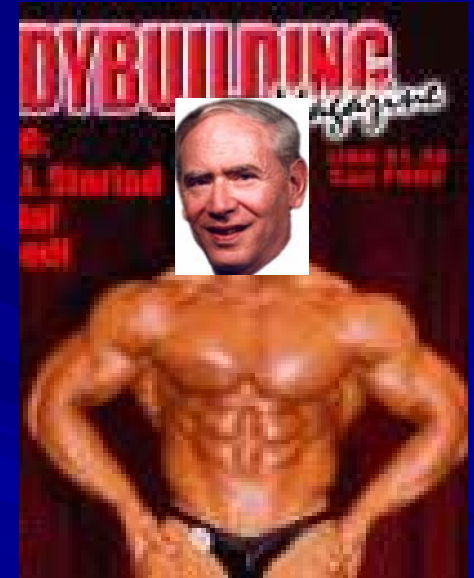


# LEAN Value Stream Mapping

A visual tool for identifying all activities of the planning, design, order, production and delivery processes from the receipt of raw materials to the delivery of the product to the hands of the customer

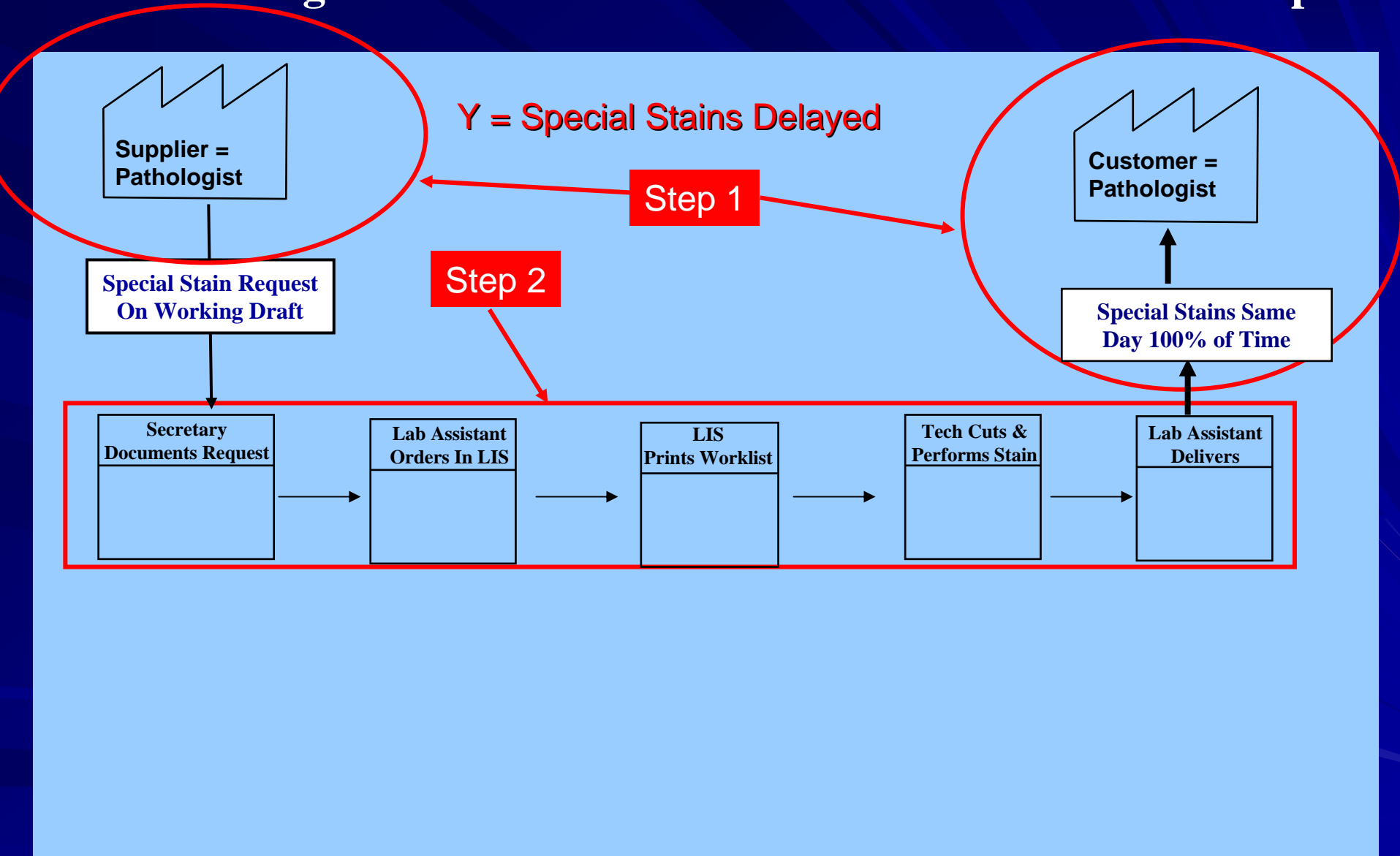


+



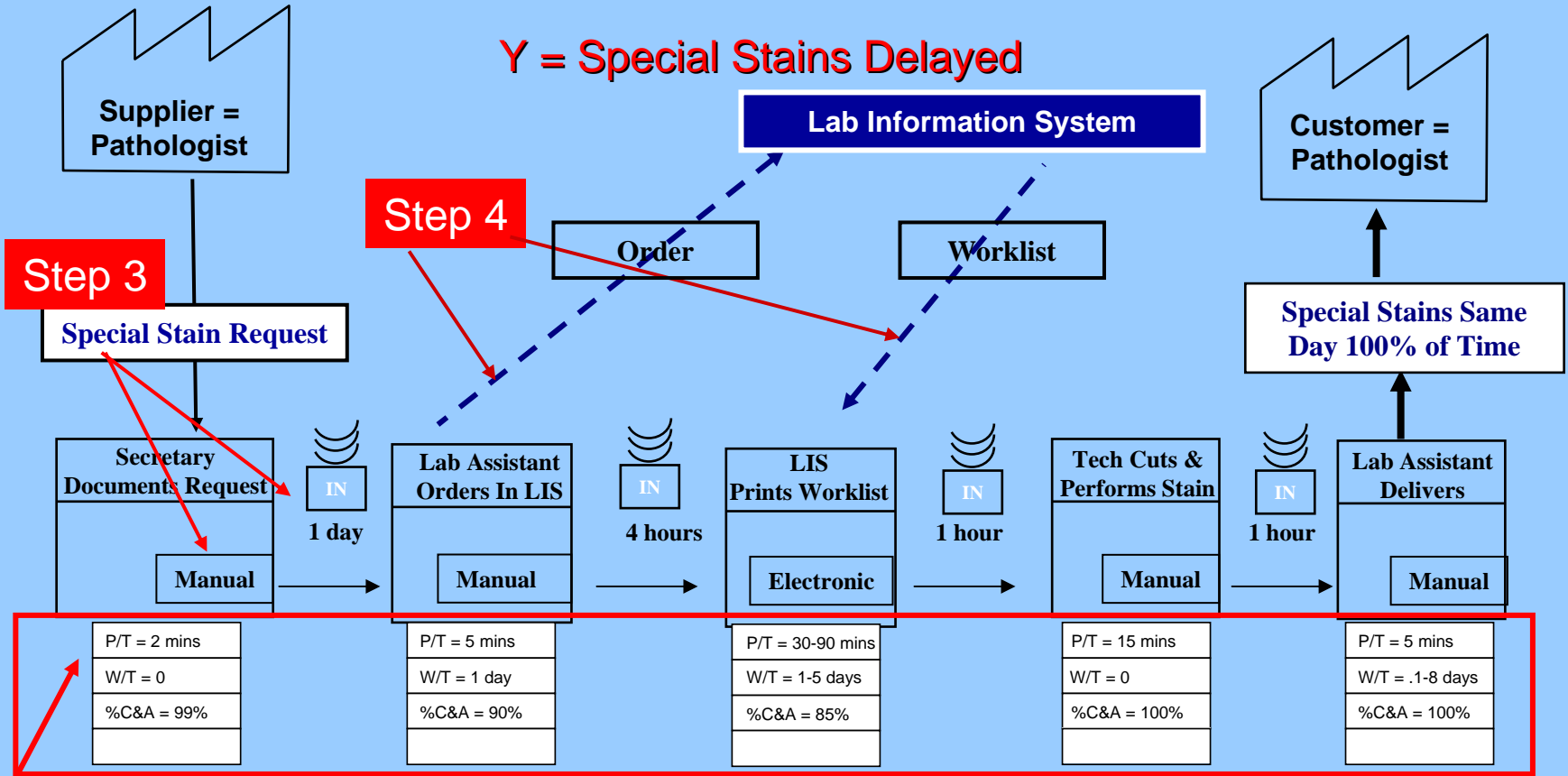
## Process Map on Steroids

# Building a Current State VSM – Start with a Process Map



# Building a Current State VSM – Add the once INVISIBLE!

**Y = Special Stains Delayed**



**Step 5**

NVA:VA is up to 96:1

Customer Demands Met Only 80% of Time

**Step 6**

W/T= 4-69 hours  
P/T=43 min  
%C&A=75%

# Value Added vs. Non-value Added

- **Value added:** transforms the shape, form or function of material and information into parts or products; something the customer is willing to pay for
- **Non-value added:** consumes resources but does not contribute directly to making the product

# The Process Improvement “Pitfall”

## Typical Value Stream Ratio of Value-Added to Non-Value-Added Activity



Source: C. Fiore; *Lean Strategies for Product Development*, ASQ, 2003

# WASTE

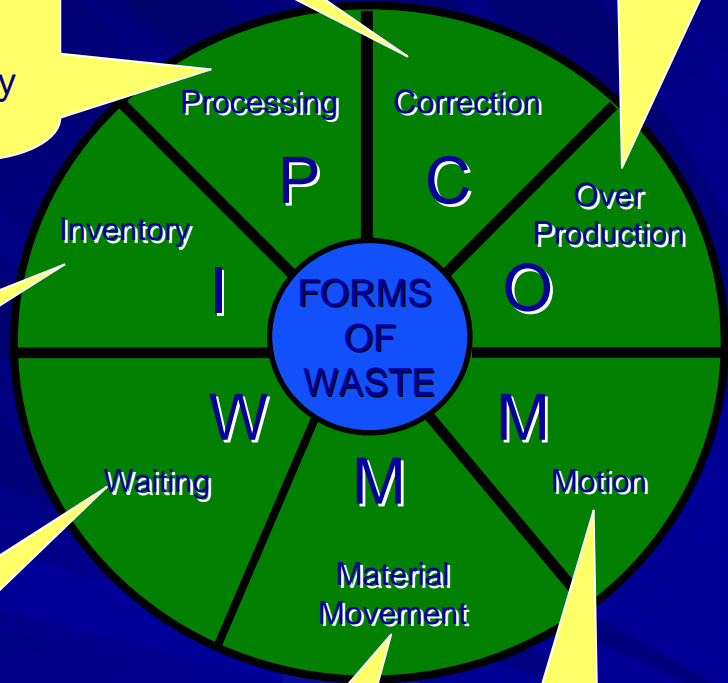
CURRENT THINKING

REQUIRED THINKING

Redundant or unnecessary processing, work that is giving the customer more than he/she is willing to pay for

Rework, work done because of errors in a previous process

Making more than is necessary or making things faster than is necessary, working ahead



Information or material waiting in queue

People waiting for machines or information. Information waiting on people or machines

Unnecessary handoffs, transfers, distances of material & information

Unnecessary people motions, travel, walking, searching

# MANAGEMENT SUMMARY

## PRODUCT PROCESS FLOW ANALYSIS

**Account Name:** University of Michigan  
**Process Location:** Laboratory  
**Process Type:** AutoChem AM List  
**Process Category:** Phlebotomy/CD/Chem

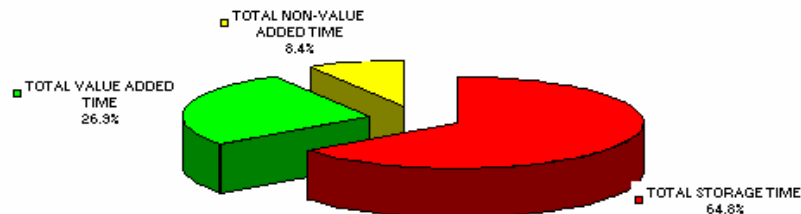
### Current State

|                                   | TIME                       |                   | PERCENT |
|-----------------------------------|----------------------------|-------------------|---------|
|                                   | Time (Seconds)             | Time Hour:Min:Sec | % Total |
|                                   | <b>TOTAL THRU-PUT TIME</b> | <b>10,440</b>     | 2:54:00 |
| <b>TOTAL STORAGE TIME</b>         | <b>6,760</b>               | 1:52:40           | 64.8%   |
| <b>TOTAL VALUE ADDED TIME</b>     | <b>2,808</b>               | 0:46:48           | 26.9%   |
| <b>TOTAL NON-VALUE ADDED TIME</b> | <b>872</b>                 | 0:14:32           | 8.4%    |
| <b>TOTAL TRAVEL DISTANCE</b>      | <b>2,175 feet</b>          |                   |         |

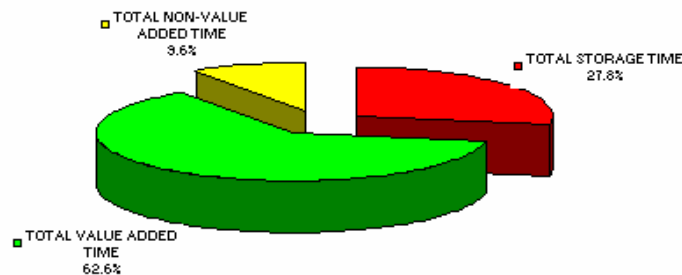
### Estimate of Improvement

|                 | TIME           |                   | PERCENT    | % Change |
|-----------------|----------------|-------------------|------------|----------|
|                 | Time (Seconds) | Time Hour:Min:Sec | % Total    |          |
|                 | <b>4,500</b>   | 1:15:00           | 100.0%     |          |
| <b>1,249</b>    | 0:20:49        | 27.8%             | <b>82%</b> |          |
| <b>2,808</b>    | 0:46:48        | 62.4%             | <b>0%</b>  |          |
| <b>430</b>      | 0:07:10        | 9.6%              | <b>51%</b> |          |
| <b>961 feet</b> |                |                   | <b>56%</b> |          |

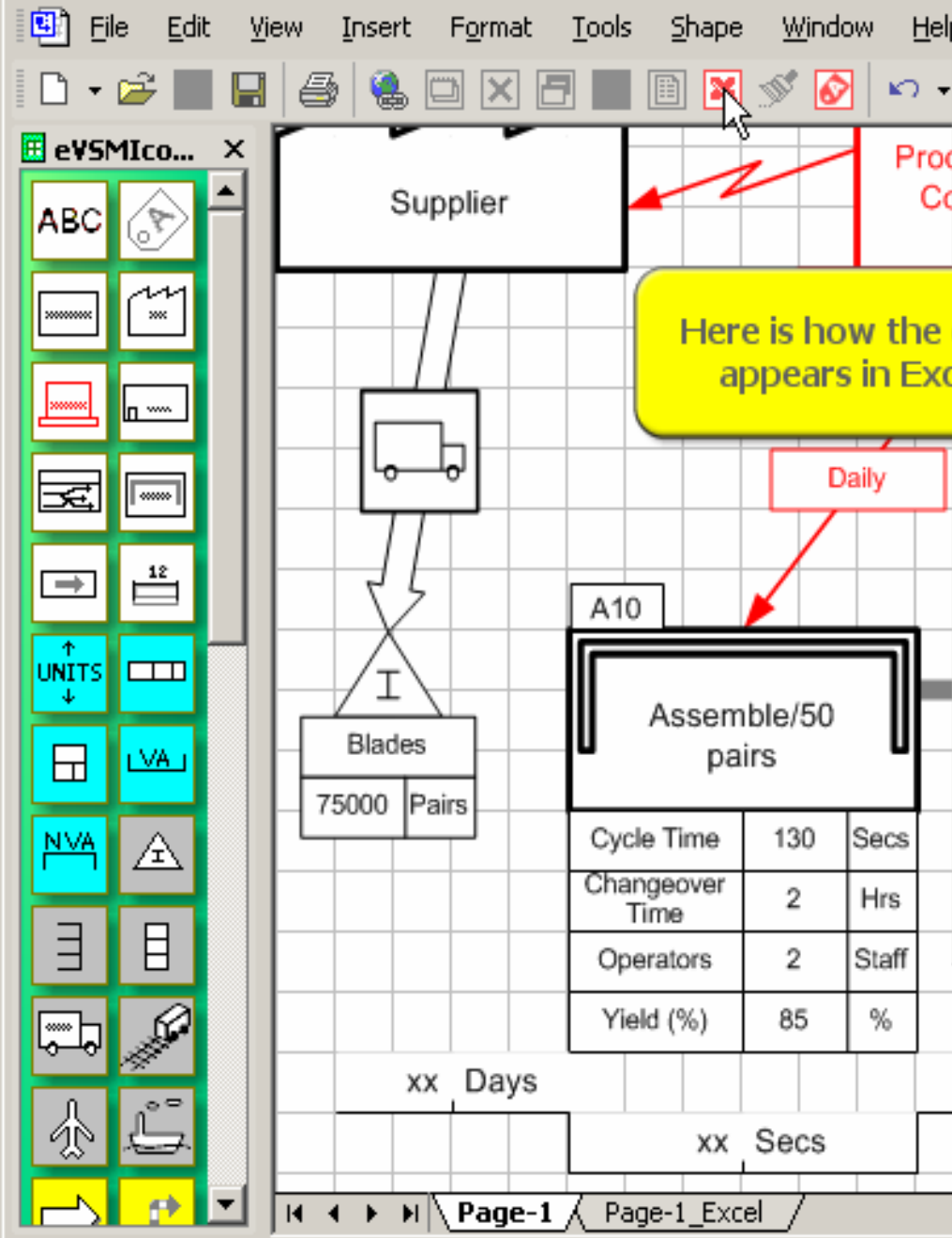
### Current Product Process Flow



### Estimated Product Process Flow







Microsoft Excel - atlas01.xls

|    | B    | C                 | D           | E               | F          | G         | H         |
|----|------|-------------------|-------------|-----------------|------------|-----------|-----------|
| 1  | Tag  | Operation         | VA          | Data            | Data       | Data      | Data      |
| 2  |      |                   | value added | changeover time | cycle time | operators | yield (%) |
| 3  |      |                   | secs        | hrs             | secs       | staff     | %         |
| 4  |      |                   |             |                 |            |           |           |
| 5  | A010 | Assemble/50 pairs | xx          | 2               | 130        | 2         | 85        |
| 6  |      |                   |             |                 |            |           |           |
| 7  | A    | A Series Totals   | 0           | 2               | 130        | 2         | 85        |
| 8  |      |                   |             |                 |            |           |           |
| 9  |      |                   |             |                 |            |           |           |
| 10 |      |                   |             |                 |            |           |           |
| 11 |      |                   |             |                 |            |           |           |
| 12 |      |                   |             |                 |            |           |           |

Page 1 | Sheet1 | Sheet2 | Sheet3


ATLAS Plant Data

|                      |       |      |
|----------------------|-------|------|
| Production Lead Time | Value | Days |
| Processing Time      | Value | Secs |

# Lean Operations Delivered with Video Time and Motion

Timer Pro Video Process Analysis c:\TimerPalm\Video\PARTSPROCESSING.vid....

Video Comparison Data Collection Reporting Line Balancing Std Data Library Export to PDA ToolBox



| Description                              | Subjects | Notes | Rating | +/-S | Time  |
|--|----------|-------|--------|------|-------|
| Place part in fixture, align and tighten |          |       | 100    |      | 2.182 |
| Process Cycle Time                       |          |       | 100    |      | 1.322 |
| Aside to tray                            |          |       | 100    |      | 3.057 |
| Get Part from stack                      |          |       | 100    |      | 4.537 |
| Place part in fixture, align and tighten |          |       | 100    |      | 2.509 |
| Process Cycle Time                       |          | Check | 100    |      | 1.328 |
| Aside to tray                            |          |       | 100    |      | 3.783 |
| Get Part from stack                      |          |       | 100    |      | 6.635 |
| Place part in fixture, align and tighten |          |       | 100    |      | 3.355 |
| Process Cycle Time                       |          |       | 100    |      | 1.856 |
| Aside to tray                            |          |       | 100    |      | 3.766 |
| Restock stack of parts                   | Parts    |       | 100    |      | 7.952 |
| Get Part from stack                      |          |       | 100    |      | 4.877 |
| Place part in fixture, align and tighten |          |       | 100    |      | 2.455 |
| Process Cycle Time                       |          |       | 100    |      | 1.728 |
| Aside to tray                            |          |       | 100    |      | 3.647 |


Start Time: 0.000 Stop Time: 26.396 Elapsed: 26.396

Restart Rewind Cont 5 [Play] Save

Video File: C:\VideoTS\webcast\_2640\_high.wmv

Select File Last Used

Speed: 200% 150% 100% 50% 25% Sound



Snapshot Clipboard Clear

Continuous Timing + to Last Skip 100 Available Activities

Get Part from stack  
**Place part in fixture, align and tighten**  
 Process Cycle Time  
 Aside to tray  
 Restock stack of parts  
 Walk to Next Station

Delete Timing  
 Clear All Timings  
 Delete Activity  
 New Study

Subjects Edit

Notes

Update Every Usage  Apply Now Activity Description

**Place part in fixture, align and tighten**

Info

Current Position: .440 minutes 26.396 seconds Use: Seconds

Total Duration: 4.672 minutes 280.323 seconds Minutes

Open File Save File Exit

Record Temperature

Cycle

Load Parts

Record Batch Number

Get Parts

Inspect surface and Record Temperature

Cycle

Clean and Load Parts

Record Batch Number

Get Parts

Microsoft Excel - ModelMix.xls

File Edit View Insert Format Tools Data Window Help

|   | A             | B             | C                            | D            | E                | F      | G              | H    | I    | J     |
|---|---------------|---------------|------------------------------|--------------|------------------|--------|----------------|------|------|-------|
| 1 | Total         | 284           | Activities (time in minutes) |              |                  |        |                |      |      |       |
| 2 | Product types | Weekly volume | Blow Mold Parts              | Unload Parts | Assemble Housing | Wiring | Cover Assembly | Test | Pack | Total |
| 3 |               |               |                              |              |                  |        |                |      |      |       |
| 4 | 605           | 35            | 20.1                         |              |                  |        | 1.5            | 5.6  | 5.4  | 71.9  |
| 5 | 610           | 4             | 19.2                         |              |                  |        | 1.4            | 5.4  | 5.4  | 74.3  |
| 6 | 610A          | 28            | 8.8                          |              |                  |        | 2.1            | 7.7  | 5.9  | 82.1  |
| 7 | 616           | 15            | 8.8                          |              |                  |        | 2.9            | 9.6  | 7.2  | 89.5  |
| 8 | 625           | 204           | 12.3                         | 14.0         | 33.9             | 15.1   | 2.7            | 9.3  | 7.2  | 94.5  |
| 9 | 655           | 3             | 16.4                         | 18.0         | 46.3             | 15.0   | 2.4            | 9.0  | 8.4  | 115.5 |

Get Parts, 4.87,VA  
Record batch number, 2.37, NVA  
Load Parts, 3.72, VA  
Cycle, 7.00, VA  
Record Temperature, 2.13, NVA

Inspect and aside

Unload parts

Load to molding machine

Get Parts

Aside to rack

Cycle

Get and load parts

Staffing/Equipment By Model

Time Units per Period: 480

|                        |              |         |        |         |         |
|------------------------|--------------|---------|--------|---------|---------|
| Volume                 |              | 35      | 4      | 23      | 15      |
| Total Required         |              | 2516.30 | 297.06 | 1889.41 | 1343.23 |
| Total Staff/Equip      |              | 5.2     | .6     | 3.9     | 2.8     |
| <b>Blow Mold Parts</b> | <b>Total</b> |         |        |         |         |
| Requirement            | 3673.10      | 703.50  | 76.80  | 202.40  | 132.00  |
| Staff/Equip            | 7.65         | 1.5     | .2     | .4      | .3      |
| <b>Unload Parts</b>    | <b>Total</b> |         |        |         |         |
| Requirement            | 3954.00      | 420.00  | 48.00  | 276.00  | 210.00  |

Ok Export Cancel

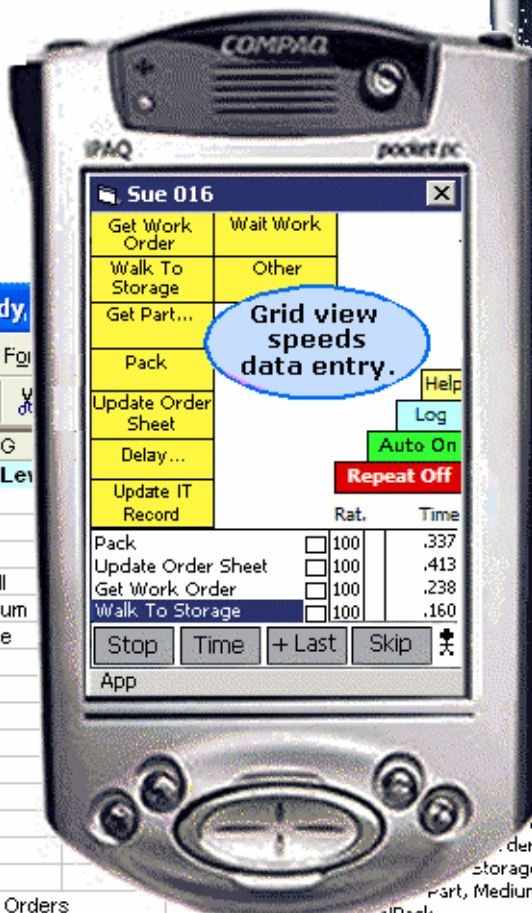
Blow Mold Parts

Time study templates created in Excel are used to configure Timer Pro on the PDA.

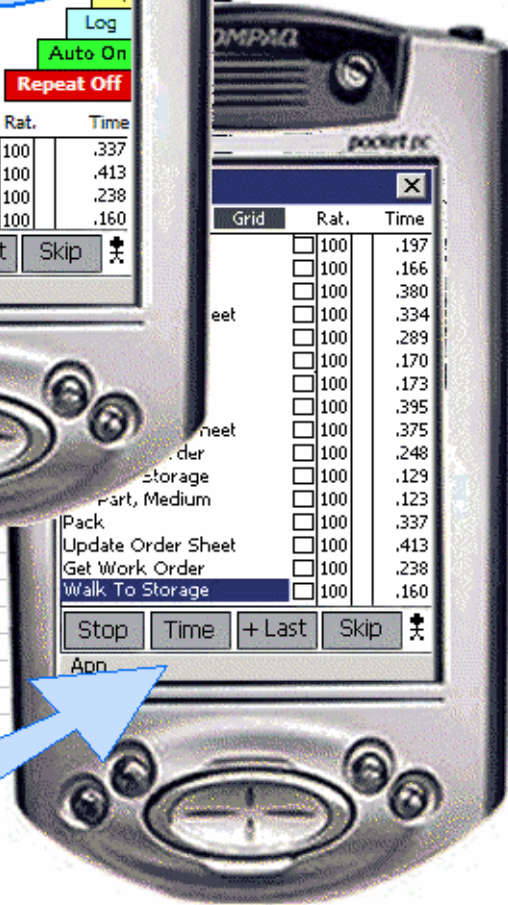
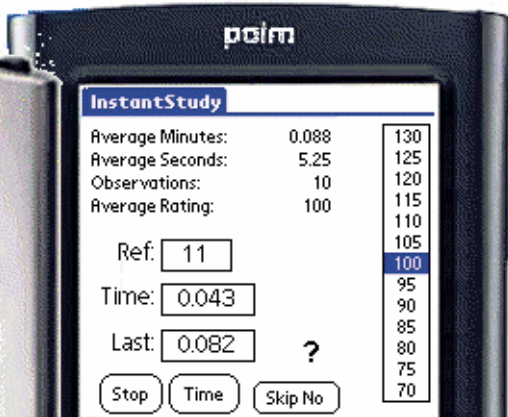
**Customized Time Study**

File Edit View Insert Format

|    | F                  | G           |
|----|--------------------|-------------|
| 1  | 1st Level          | 2nd Level   |
| 2  | Get Work Order     |             |
| 3  | Walk to storage    |             |
| 4  | Get Part           |             |
| 5  |                    | Small       |
| 6  |                    | Medium      |
| 7  |                    | Large       |
| 8  |                    |             |
| 9  |                    |             |
| 10 |                    |             |
| 11 |                    |             |
| 12 |                    |             |
| 13 |                    |             |
| 14 | Pack               |             |
| 15 | Update Order Sheet |             |
| 16 | Delay              |             |
| 17 |                    | Wait Orders |
| 18 |                    | Parts Out   |
| 19 |                    | Conveyor    |
| 20 |                    | Belt        |
| 21 |                    | Shaft       |
| 22 | Update IT Record   |             |
| 23 | Other              |             |
| 24 | Wait Work          |             |
| 25 |                    |             |



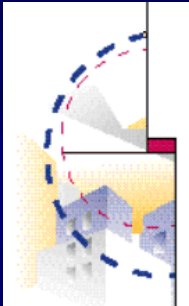
Grid view speeds data entry.



Log view displays time study history.

# Lean Six Sigma Tools

## Lean Video / Timer Pro



**Applied Computer Services, Inc.**

**5445 DTC Parkway**

**Penthouse Four**

**Englewood, Colorado 80111**

<http://www.acsco.com/Video.htm>

Phone (303) 220-0130

US/Toll free(866) 920-0130

E-mail [sales@acsco.com](mailto:sales@acsco.com)

## Lean Value Stream Mapping



Electronic Value Stream Mapping Software

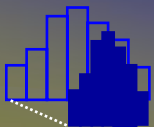
eVSM Support

[support@evsm.com](mailto:support@evsm.com)

<http://www.evsm.com/training>

~ \$350

## Six Sigma Tools



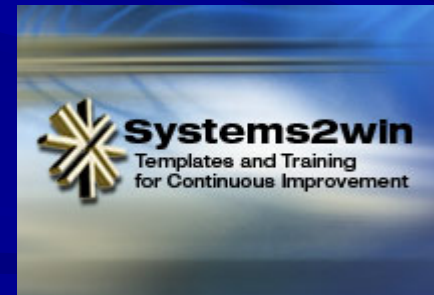
**QE TOOLS**

Patrick Hammett or Steve Geddes

[www.getools.com](http://www.getools.com)

[sales@getools.com](mailto:sales@getools.com)

## Lean Templates and Training



~ \$900 (Lean / Six Sigma Bundle)

<http://systems2win.com>

# Lean Six Sigma Tools



\$500 LeanView™ with AutoDraw™ Technology

Orlando Software Group, Inc.  
<http://www.osgi.com/>

7585 SW Mohawk St.  
Tualatin, OR 97062  
Tel: (503) 404-6050  
[www.igrafx.com](http://www.igrafx.com)



\$250 SigmaFlow VSM

SigmaFlow Headquarters  
5068 West Plano Parkway, Suite 300  
Plano, Texas 75093 USA  
Phone: +1.972.447.8340  
Email: [sales@sigmaflow.com](mailto:sales@sigmaflow.com)



\$199

[Suite 890](#)  
151 Bloor St. West  
Toronto, ON M5S 1S4 Canada

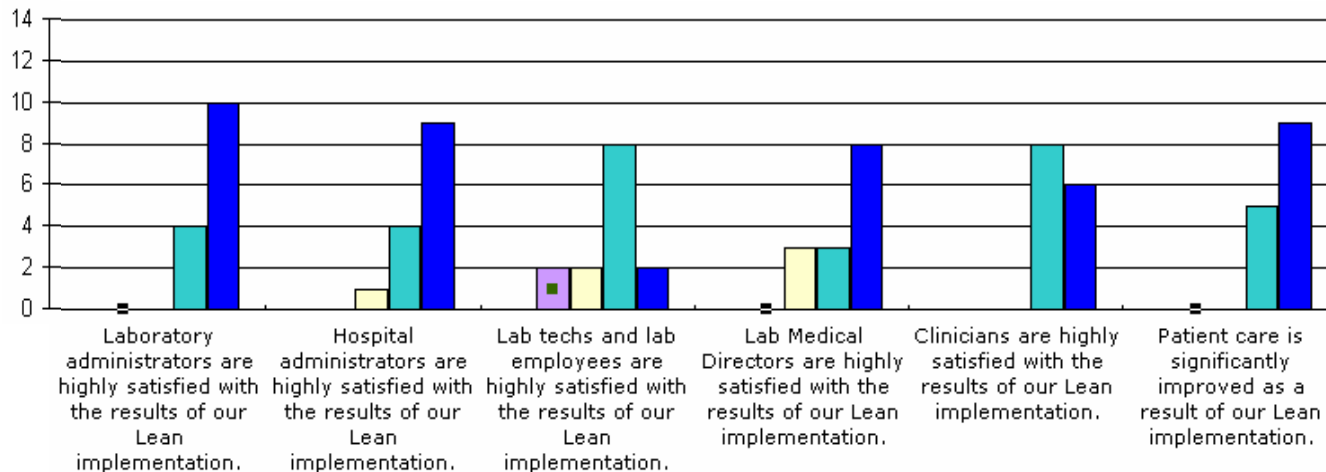
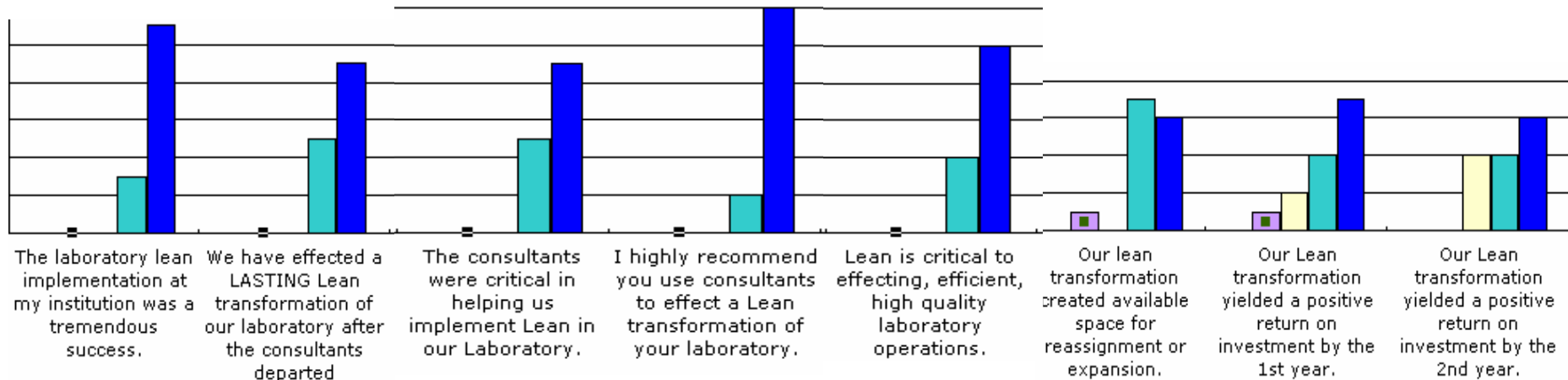
Phone:Sales: 1-888-744-6295

Email:Information: [info@SigmaXL.com](mailto:info@SigmaXL.com)

# Do It Yourself? How Much Time Have You Got?

Please respond to the following with your opinions regarding the following...

Strongly Disagree Disagree No Opinion Agree Strongly Agree



# Consultant's On-Site Evaluation

Are processes standardized to “best” practices and are “best” practices based on data? (Standard Work)

Are unnecessary activities taking place in the testing process? (Product Analysis)

Are motions/actions of individuals performing work over time efficient, purposeful and properly applied to the right task at the right time? (Operator Analysis)

Are inventory and supplies above needs and what are the financial, space and quality costs of maintaining them? (Inventory and Supply Management)

# Improvement Opportunities

Suboptimal processes and poor layout and sizing of equipment force batch processing and unbalanced distribution of work

Excess walking to perform tasks with obstructed paths

Overall lack of organization of tools, parts and equipment

Isolated work islands with no sharing between departments (silos)

Layout and workstation organization, tools, parts and equipment do not facilitate robust and repeatable processes

Excessive buildup of nonproductive inventory and historical records in the work areas

Processes have multiple storage steps and wasted motion and transportation that add variation and time to testing processes

No FIFO (first in, first out)

# Opportunity:

## *Complexity of Product/Operator Motions*

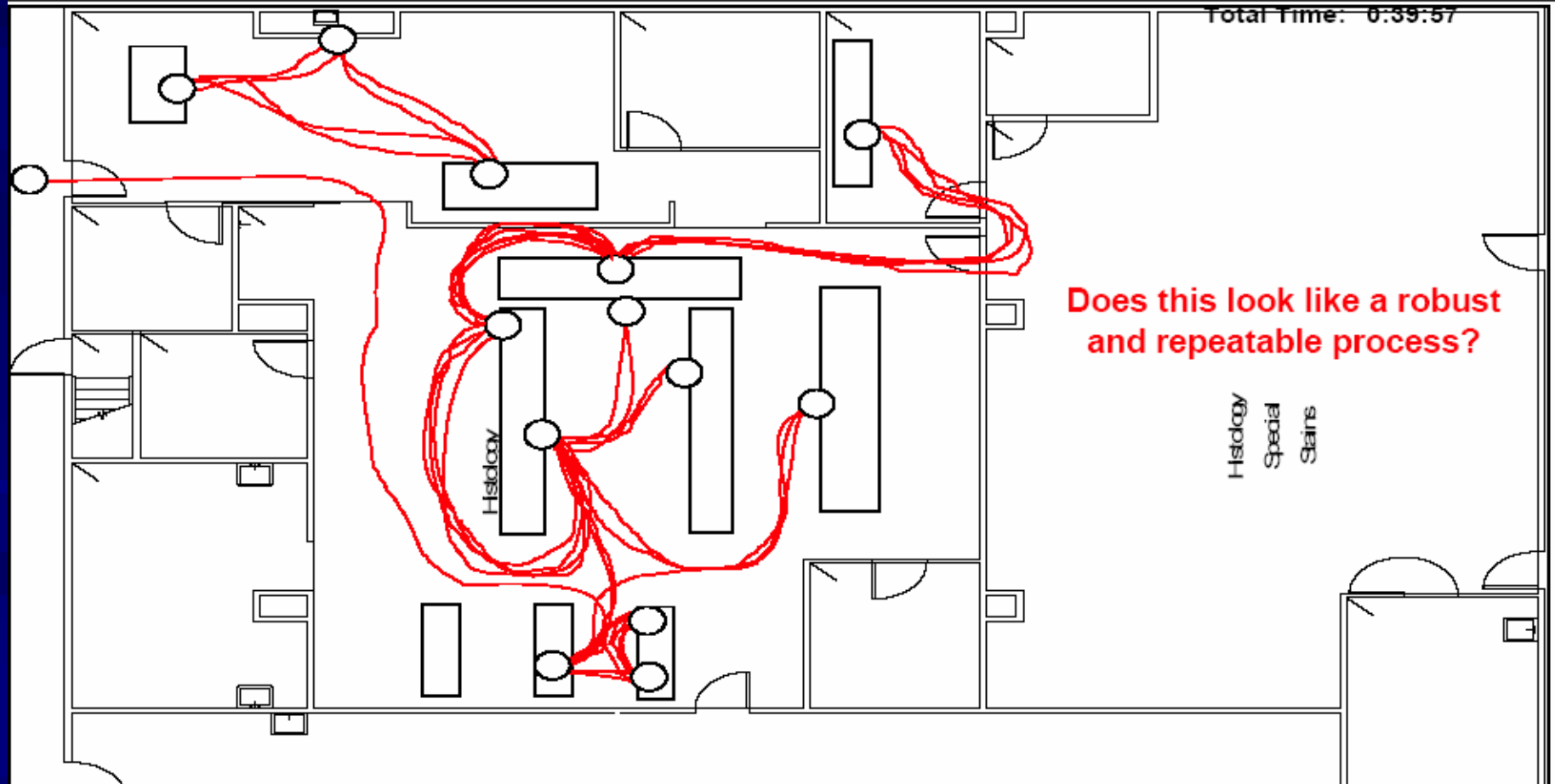
Account Name: U of M Assessment  
Process Location: U of M Hospital - Ann Arbor, MI  
Operator Process Type: Inpatient Histology  
Operator Title: Histology Tech

PREPARED BY: Ken LePage  
Analysis Date: 1/0/1900  
Videotaped on Date: 2/7/2006

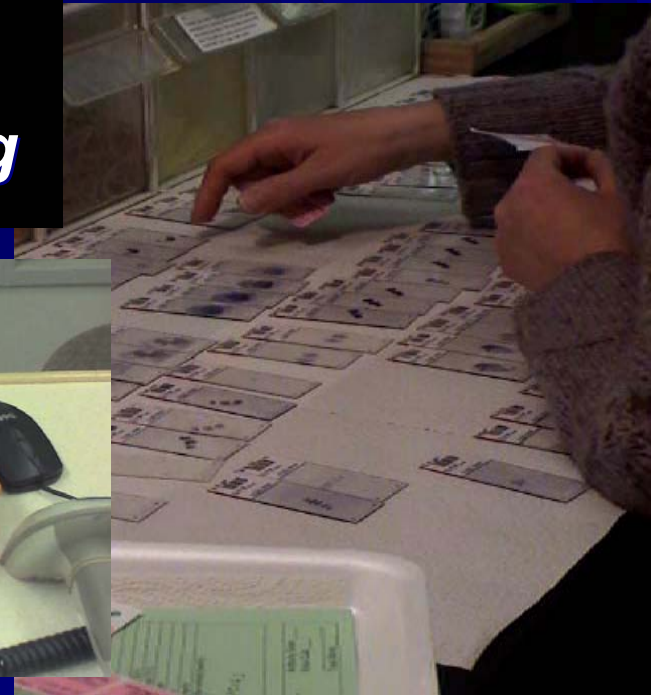
NOTE: Depict rough scale of equipment layout; and, draw a point to point diagram of the complete product flow

Distance Traveled (feet): **529**

Total Time: **0:39:57**

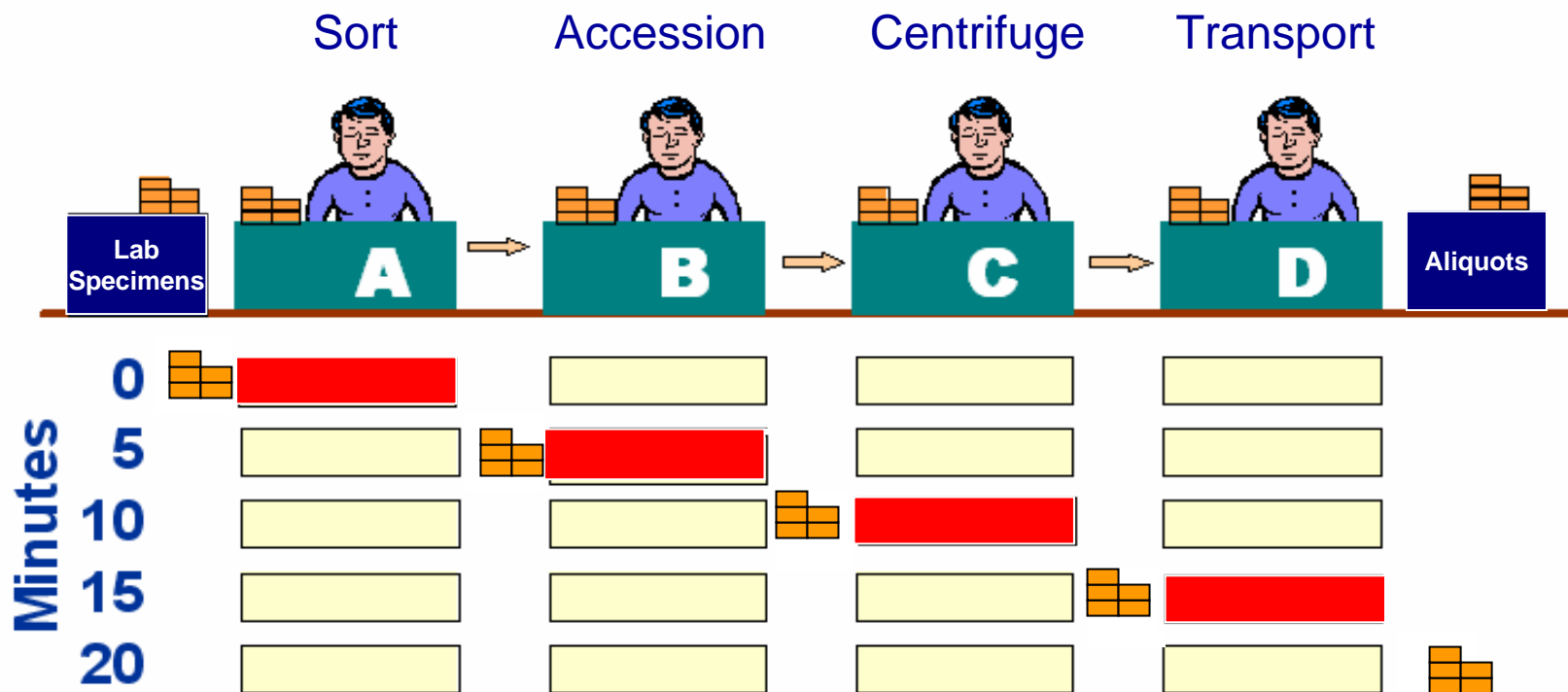


# Opportunity: Batch Processing



# Opportunity:

## *Batch Processing*



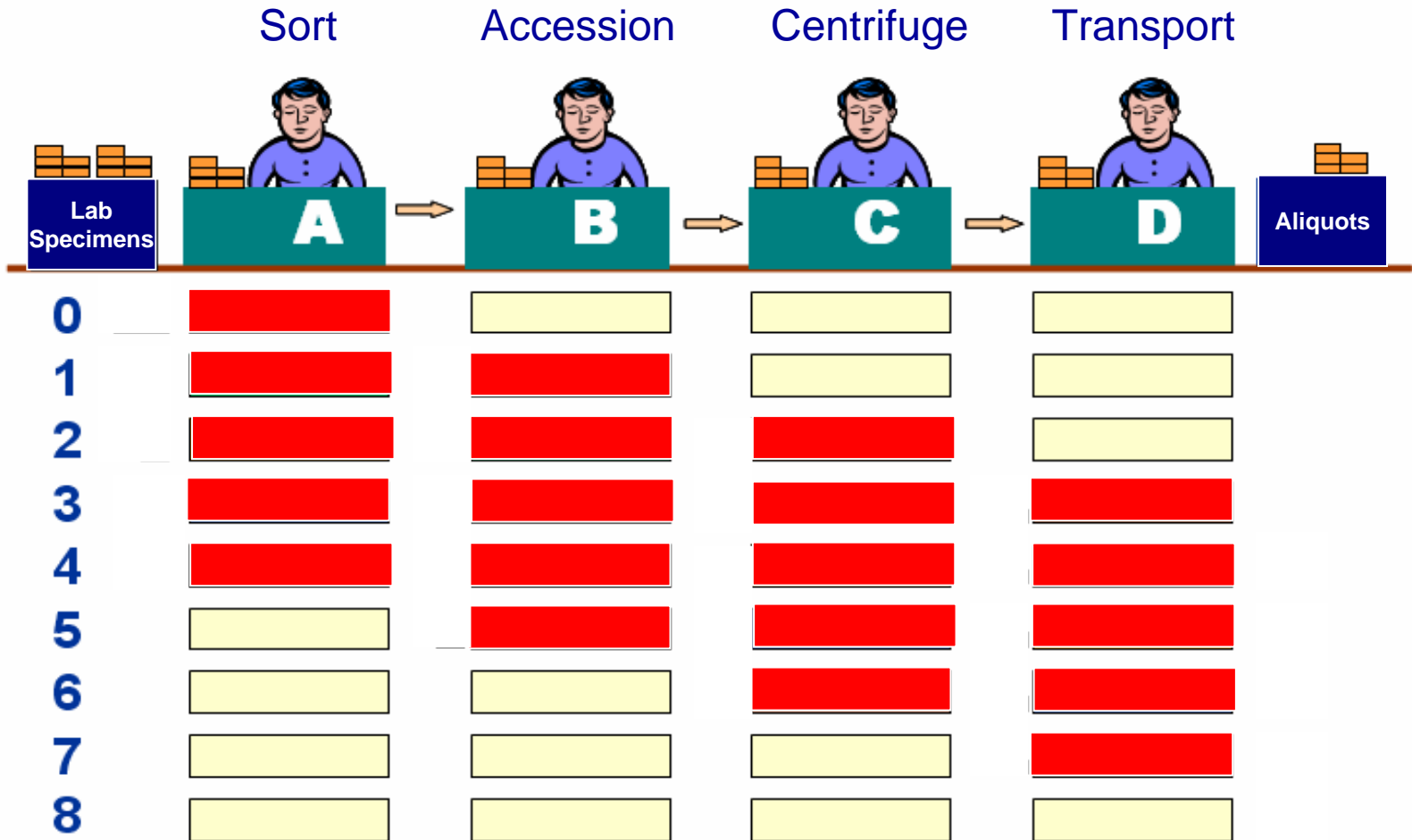
Processing time  
= 1 minute per unit

# Problems with Large Batch Sizes

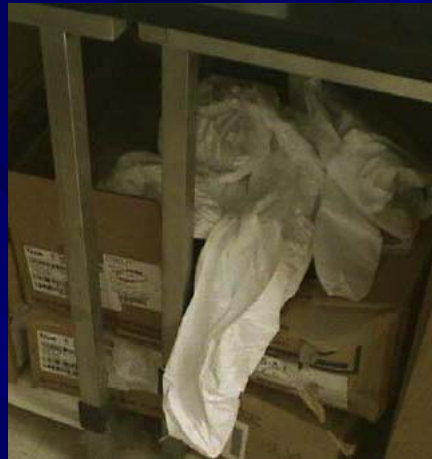
- Increases inventory
  - More storage space
  - Problems are less apparent
  - More rework if there are problems
- Decreases product flexibility
- More difficult to balance operations

# Solution:

## *Implement Single-Piece Flow*

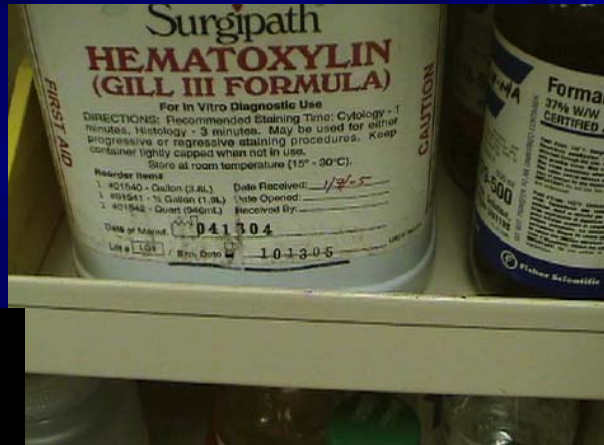


**Opportunity:**  
**Excessive/Disorganized Inventory and Supplies**





**Opportunity:**  
***Excessive/Disorganized  
Inventory and Supplies***



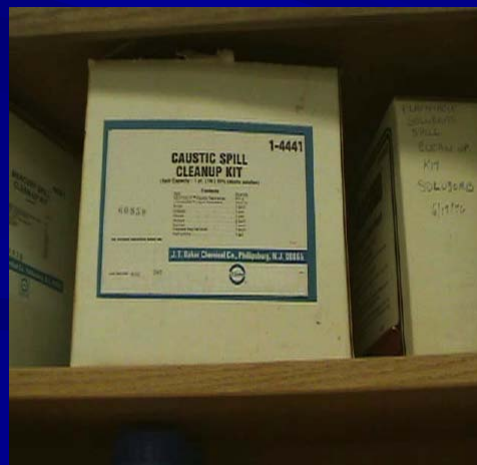
**Expired 10-13-05**



**Expired Jan 2006**



**Older supplies in behind new**



**Expired March 1981**



**Expired Nov 05**

# Solution:

## *Inventory Management and Control with Kanban Systems*



Organization of Supplies



When removing supplies, pull card when you get to it



Place re-order card in proper location for re-stocking process

|  |  |   |
|--|--|---|
| Inventory number                             | JJ10342  | Stock in OR Specimen Closet   |
| Storage conditions                           | Room Temp  | Part sketch   |
| Re-stock number                              | PO-34279   |  |
| Contact # for problems                       | 54532  |   |
| Replenish                                    | 4 Gal Jugs                                       |   |
| Item warehouse location                      | Hang Tag on Inventory Hook When This Item Opened |   |
| Path Store Room<br>2F322, Row 6,<br>Shelf 46 |  |   |

# Opportunity: *Workstation Clutter*



**Solution:**

***Visual Factory & 5s***

**Sort, Set in Order, Shine, Standardize, Sustain**

***Seiri, Seiton, Seiso, Seiketsu, Shitsuke***

Shelves without doors

Nothing in drawers

A place for everything

And everything in its place

Don't just know – SHOW!



# After 5s

Three numbers in the range of 1-50 are missing. Ready? GO!

## Numbers from 1 to 49

|           |           |    |    |    |           |           |           |    |           |
|-----------|-----------|----|----|----|-----------|-----------|-----------|----|-----------|
| 1         | 2         | 3  | 4  | 5  | 6         | 7         | 8         | 9  | 10        |
| 11        | 12        | 13 | 14 | 15 | <b>16</b> | 17        |           | 19 | <b>20</b> |
| 21        | 22        | 23 | 24 | 25 | 26        | 27        | <b>28</b> | 29 | 30        |
| 31        | <b>32</b> | 33 | 34 | 35 | 36        | 37        | 38        | 39 | 40        |
| <b>41</b> |           | 43 | 44 | 45 | 46        | <b>47</b> | 48        | 49 |           |

# Solution: *Visual Factory*



Consultant:

# Core Lab Lean Assessment

Reduce throughput time for testing by 30-50%

Increase productivity 30-40%

Reduce space required for testing by >20%

Reduce supply inventory by 40-50%

Permit redeployment of up to 6 FTE's

Eliminate overtime expense \$400,000 / year

**Total 12 Month Project Cost**

**~ \$650,000**

**11 Month**

**Return on Initial Investment**

**2012 Lean Design for Six Sigma**

**~ \$20 million**

**3 Year ROI**

**\$2.28 million**

**After Year 3**

**\$1.04 million / yr**

# Lean Lab Initiatives

## FTE Redeployment Targets



# Pre-Consultation Experiments

## Incident reports up 2000%, time to resolution improved by 98%

Value stream mapping  
Standard work

## Requisition standardization and redesign for clinics

Standard work  
Root cause analysis  
Error-proofing

# Facilitated Discoveries

## A.M. phlebotomy test TAT down by 57%

Single piece flow  
Workload balancing  
Inventory management and resupply

## Central processing work down by 20% for key labs

Product flow mapping

## Chemistry lab frees up 300 sq ft.

Technology grouping  
Cellular workstation design

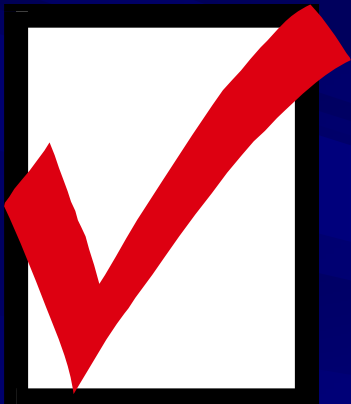
## Delta 4 FTE's

Elimination of waste, rework and duplicate processes (silos)  
Workcell redesign

## 6 lab resources facile with LSS tools, change leadership & project management!

**1st four weeks!!!**

# Take Home Messages



- Lean Six Sigma is MANDATORY, NOT OPTIONAL
- The tools work; leadership and dealing with the human responses to change are the keys to success
- Specimen Flow, Value Stream Mapping, 5-S, Standardization and Root Cause Analysis form the foundations
- Learn as you go, develop a model line and tools/software
- Implementing Lean may be costly but is financially rewarding - let the success of each project pay for the next
- Do not automate bad or unnecessary processes - get Lean first!
- Consultants may help smooth and shorten the transformation
- Implementing Lean Six Sigma may seem daunting but it is the fastest and most effective way to impact customer satisfaction and employee satisfaction while at the same time generating in employees enthusiasm (joy, pride), a clear sense of purpose, and ownership of quality

*“Learning to See” by John Shook and Mike Rother*

*“The Complete Lean Enterprise” by Beau Keyte and Drew Locher*

<http://cpd.engin.umich.edu/> *Lean Six Sigma for Healthcare Online and Live Training*