Continuous Improvement

COLA Meeting, Temecula

April 27, 2018

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Process Improvement

Bill Oakes

April 27, 2018

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Your Presenter: Bill Oakes

- boakes@qti.qualcomm.com
- Sr Staff Engineer at Qualcomm
- Quality Engineer and Manager in San Diego area 30+ years
- ASQ Certifications –
  - Quality Engineer
  - Reliability Engineer
  - Quality Auditor
  - Manager of Quality/Organizational Excellence
  - Six Sigma Black Belt
- BS in Engineering, MS in Systems Management
- Palomar ASQ Section Leadership Team

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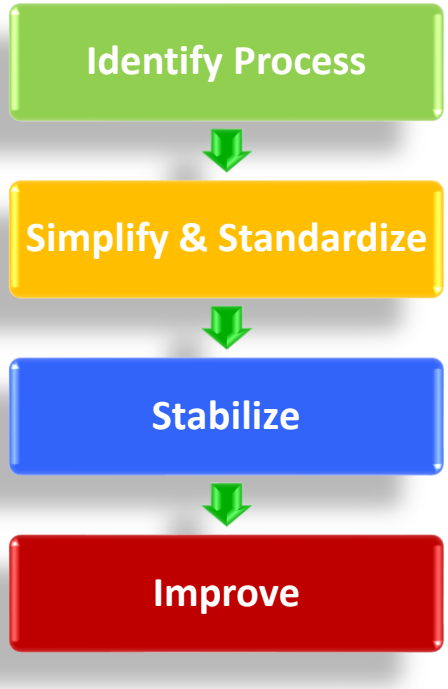
Process Improvement Approach



Process Improvement Basics

1. Reduce Variation

2. Verify Stability

3. Make Changes for Better Performance

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Measuring Results

- Cycle Time
- Delivery Performance
- Scrap Rate
- Yield
- Employee Turnover
- Etc.

Measuring Results

- All these metrics are indicators of process performance
- So, process improvement is monitored through the behavior of the metrics
- There is variation in everything
- How do I tell if the variation is OK?

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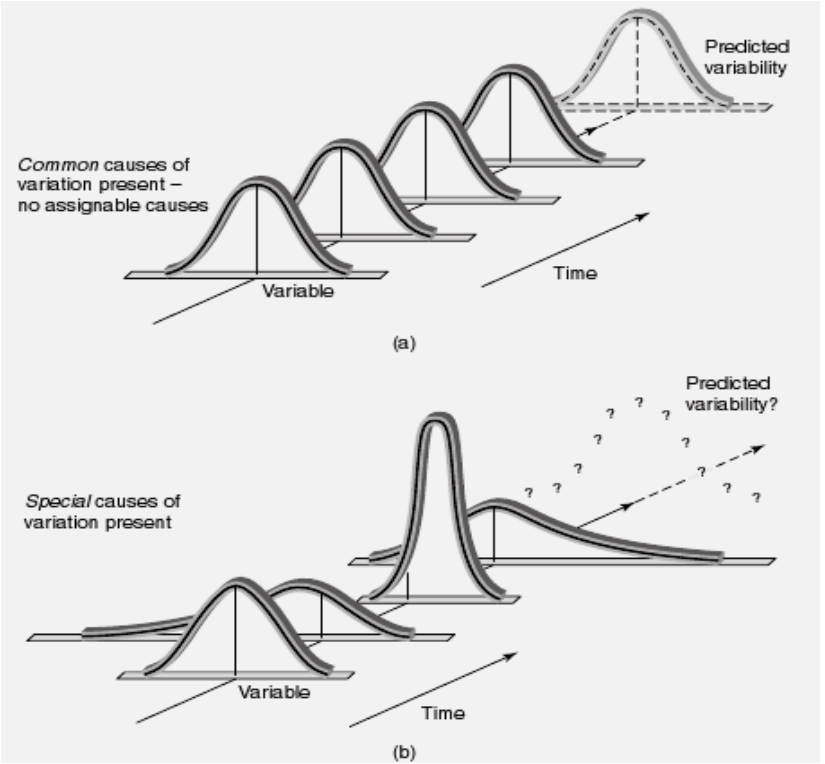
Reducing Variation

Common causes: When only common causes are present in the process, process is called ‘stable’ and ‘in control’.

- Special causes: Relatively large in magnitude, and statistically unlikely to occur if the process is stable.



Process: Getting to Work

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11
Time to Work	45	37	43	50	38	43	44	49	50	37	40
Range		8	6	7	12	5	1	5	1	13	3
Average	43.3										
Avg. range	6.1										
Upper Limit	59.5		= Average + 2.66 x Avg. range								
Lower Limit	25.0		= Average - 2.66 x Avg. range								

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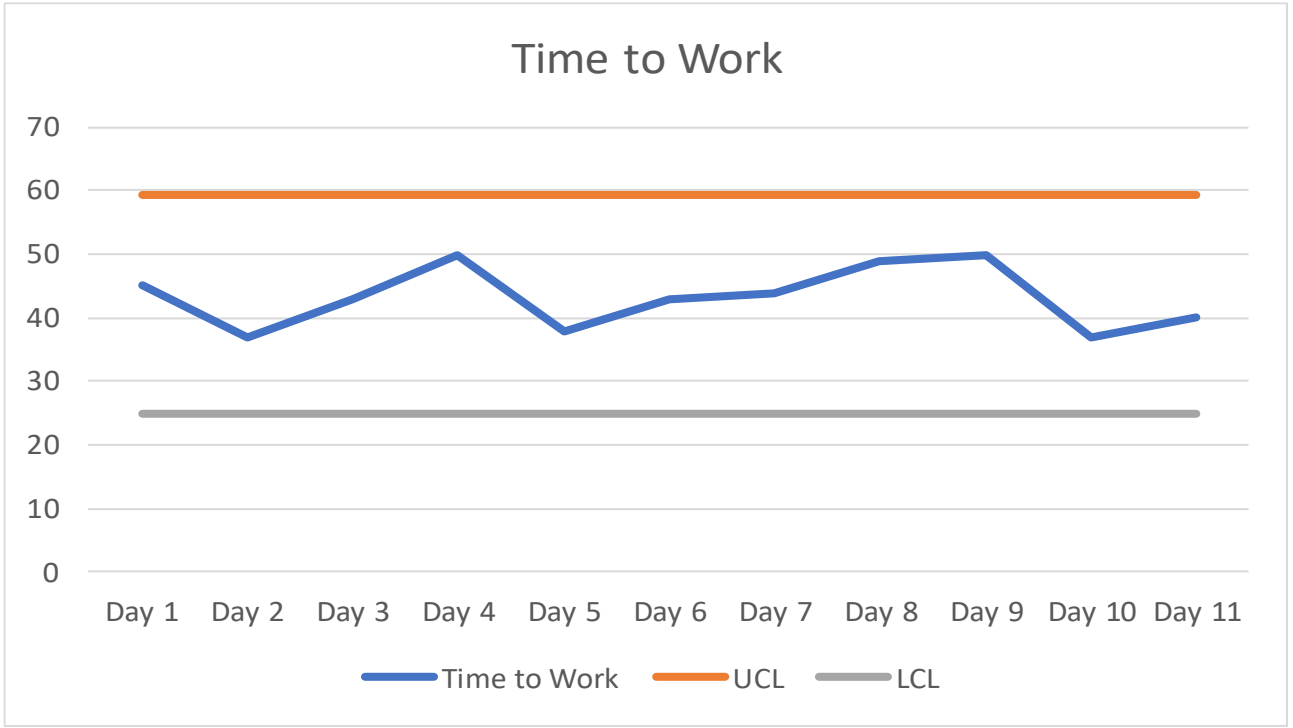
Process: Getting to Work



Process: Getting to Work

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11
M	45	43	40	53	39	51	59	55	42	37	43
T	37	44	42	48	46	36	50	51	47	50	48
W	43	49	35	47	48	38	43	43	56	51	31
T	50	50	38	49	52	39	50	48	46	46	50
F	38	37	43	43	40	43	46	41	41	40	47
Avg	42.6	44.6	39.6	48	45	41.4	49.6	47.6	46.4	44.8	43.8
Range	13	13	8	10	13	15	16	14	15	14	19
Average	44.9										
Avg. range	13.6										
UCL	52.8		= Average + .58 x Avg. weekly range								
LCL	36.9		= Average - .58 x Avg. weekly range								

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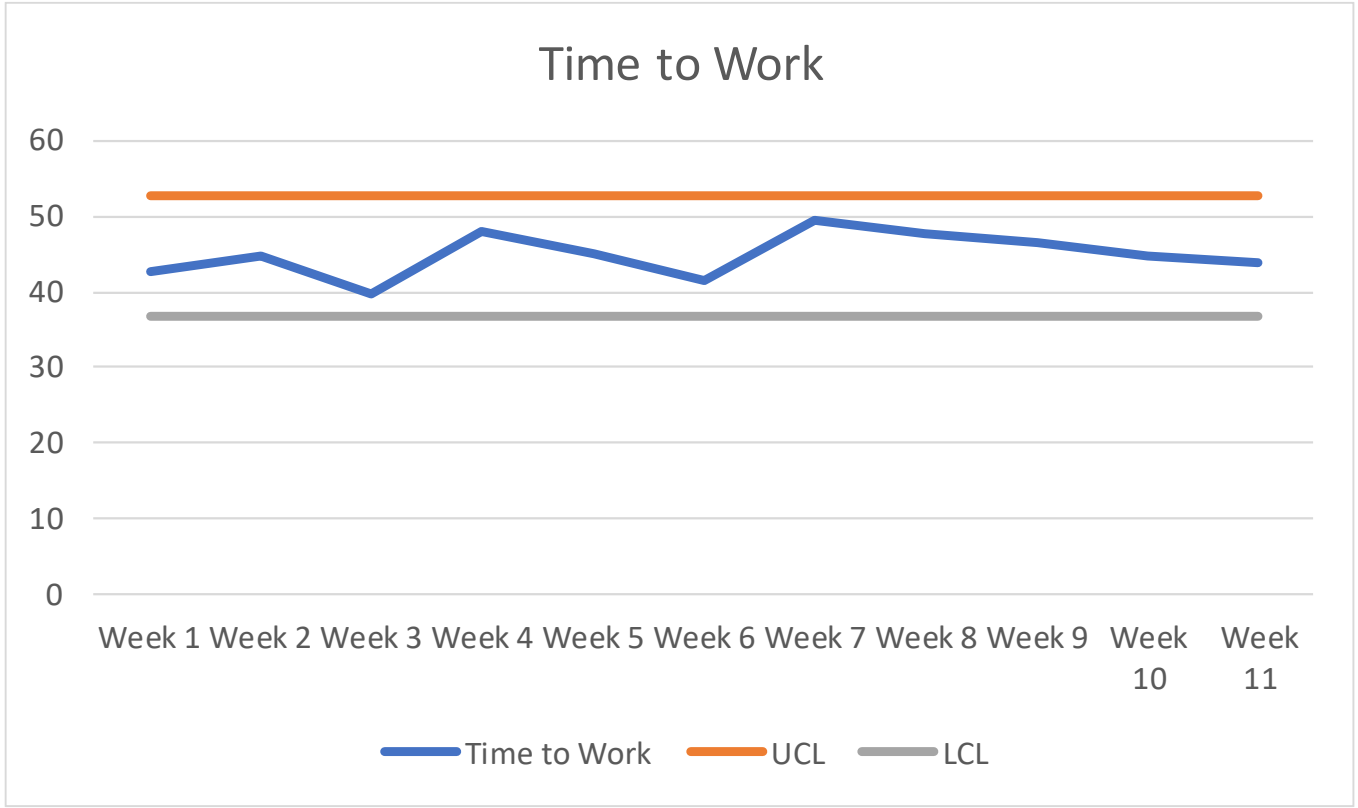
Process: Getting to Work



Process: Getting to Work

- With more data, and using weekly average times, our limits went from 59.5 / 25 to 53 / 37, much tighter
- If a point is outside of the limits, it indicates special cause variation
- Find and fix the special cause so it doesn't happen again

Statistical Process Control (SPC) Basics

- SPC can be applied to many processes to measure their consistency or stability
- The purpose of SPC is to tell if your process has:
  - An ordinary amount of variation (Common Cause) or
  - An unusual amount of variation (Special Cause)Take action when there is unusual variation
- Don’t take action when there is ordinary variation
- Sometimes SPC can tell when a process has changed, before bad product is produced
- SPC is the “Voice of the Process”

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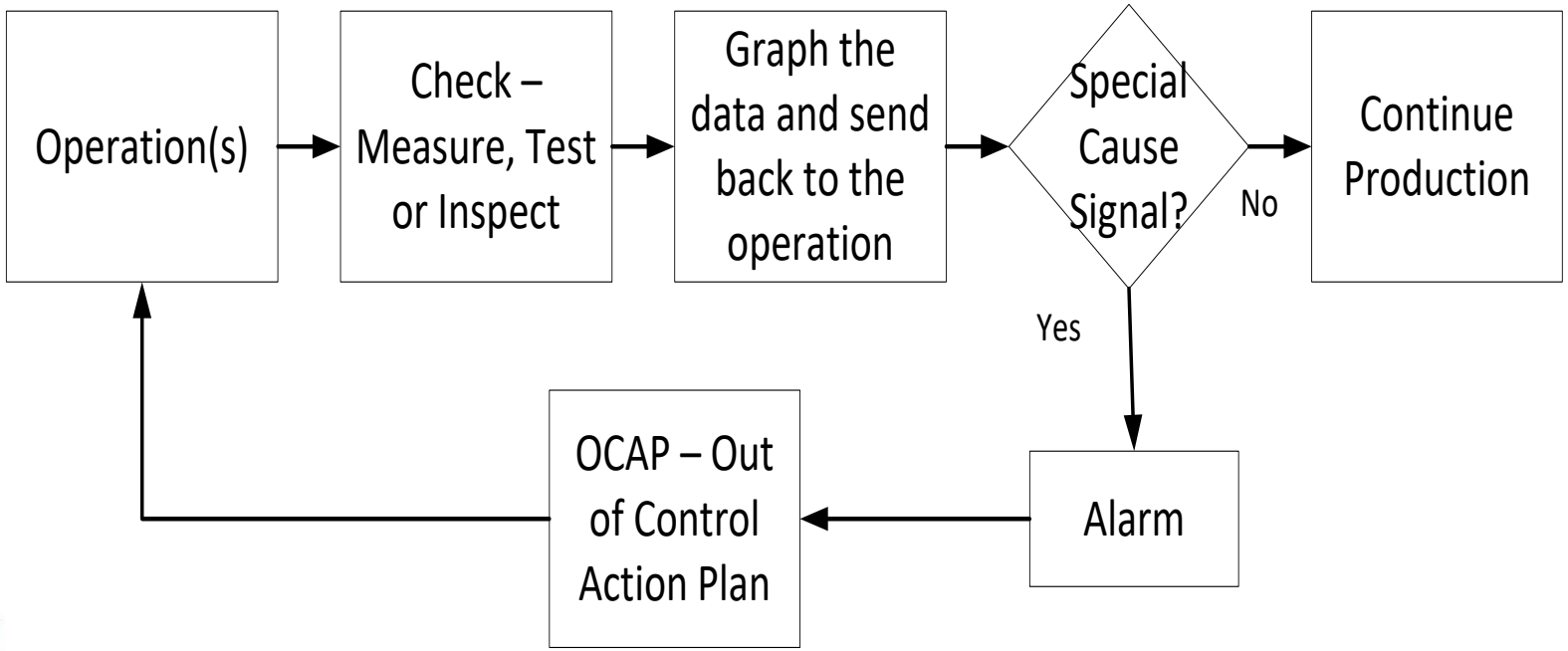
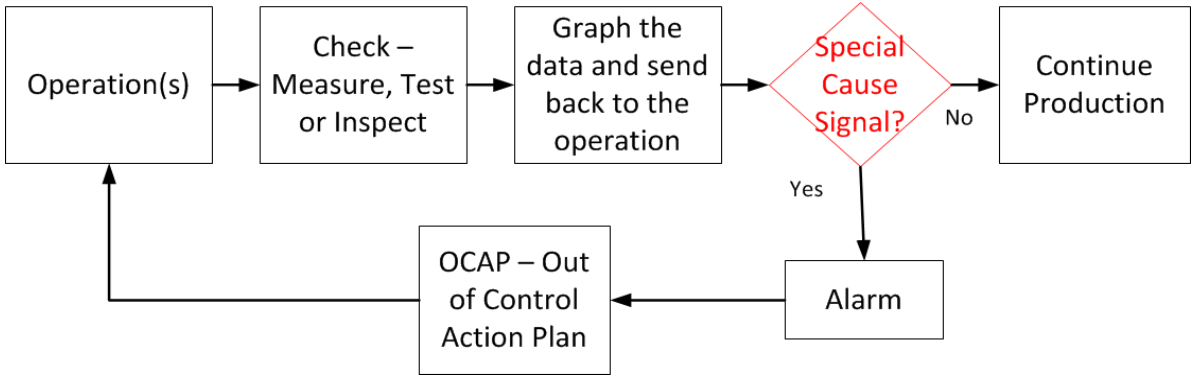
SPC Flow Diagram



SPC Flow Diagram



- Special cause signal: The results are different enough that they are not attributable to random variation
- The signal is often known before the cause
- #1 indicator: A point is beyond the control limit
- Other indicators: Shifts and trends, consult SPC books
- The automated SPC programs allow you to activate various indicators of OOC conditions

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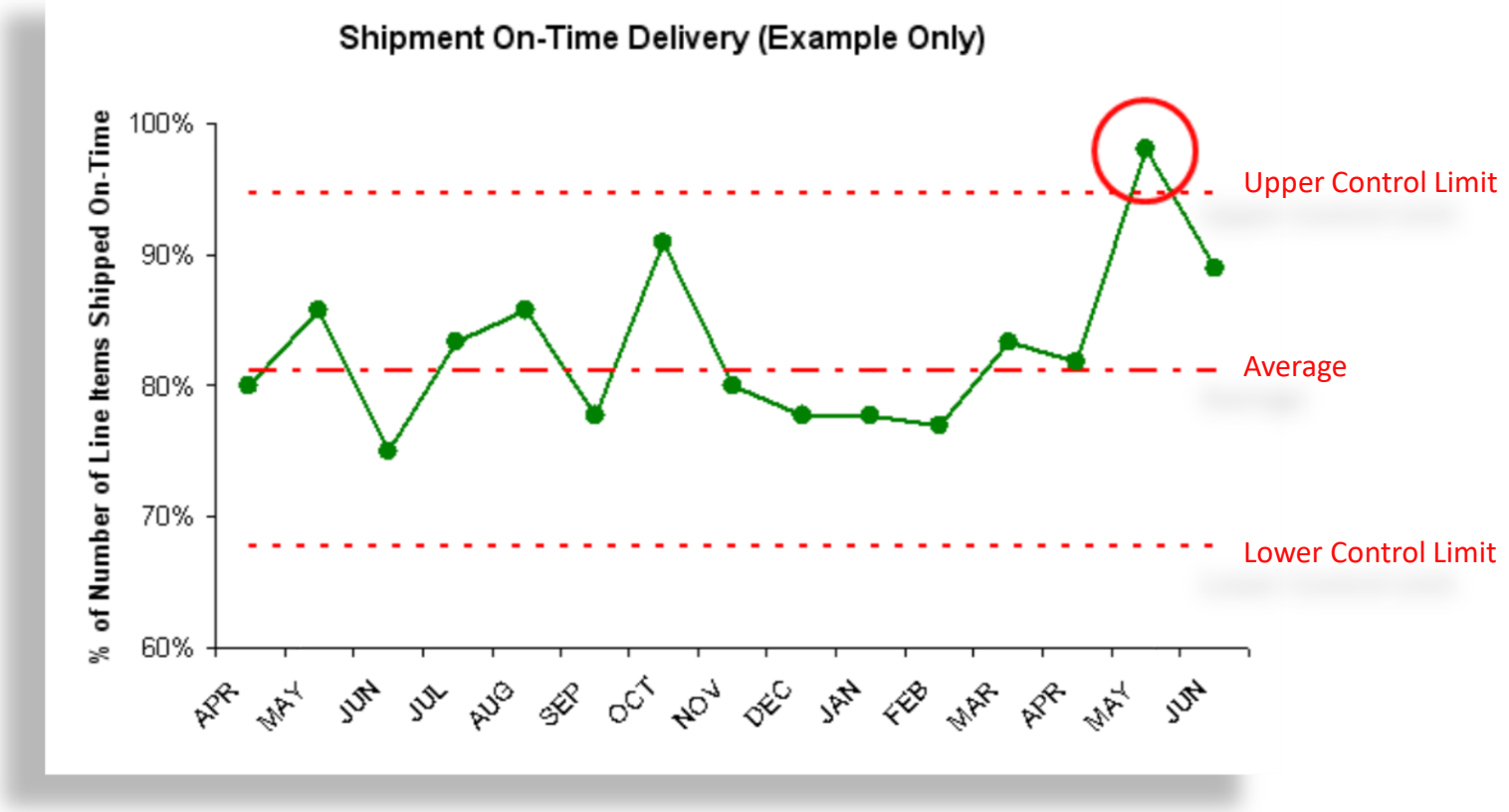
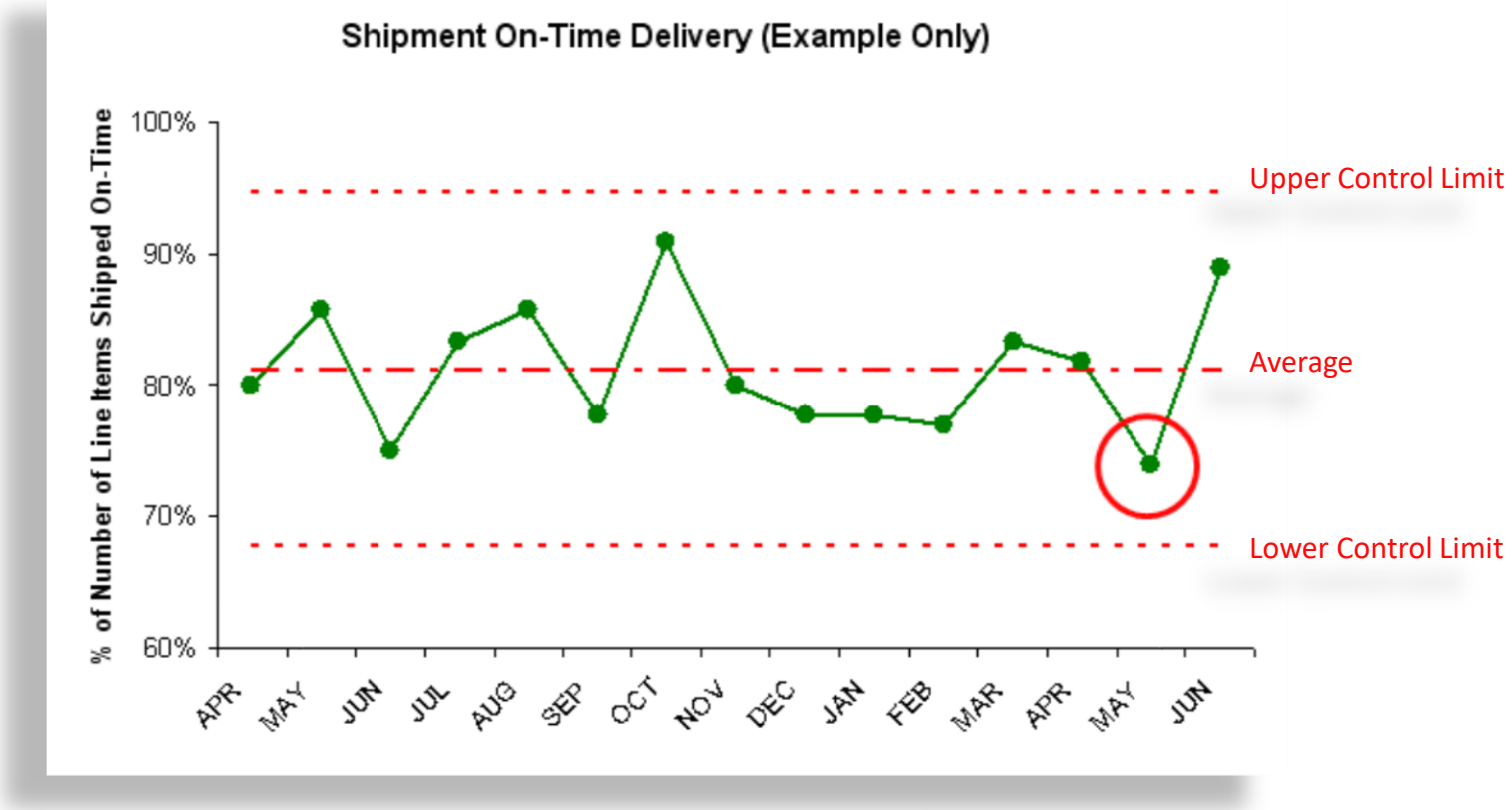
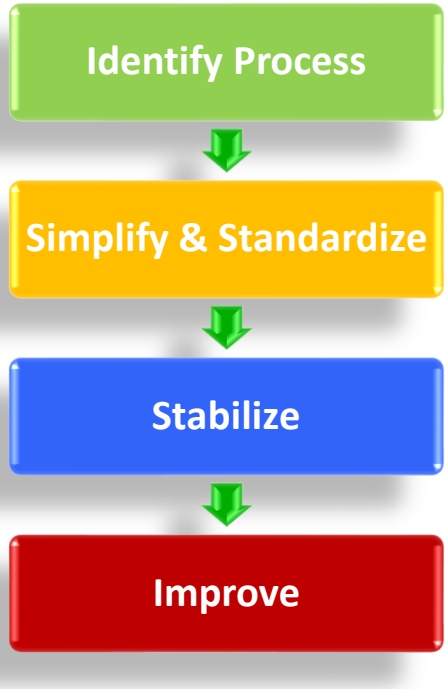
Taking Action from a Special Cause Signal



Taking Action – Tampering, can damage the process



Process Improvement Approach



Process Improvement Basics

1. Reduce Variation

2. Verify Stability

3. Make Changes for better performance

After Stability is Known

- Reducing common-cause variation is more difficult but can be done
- Look for correlations and data trends
- Make changes after verifying improvement

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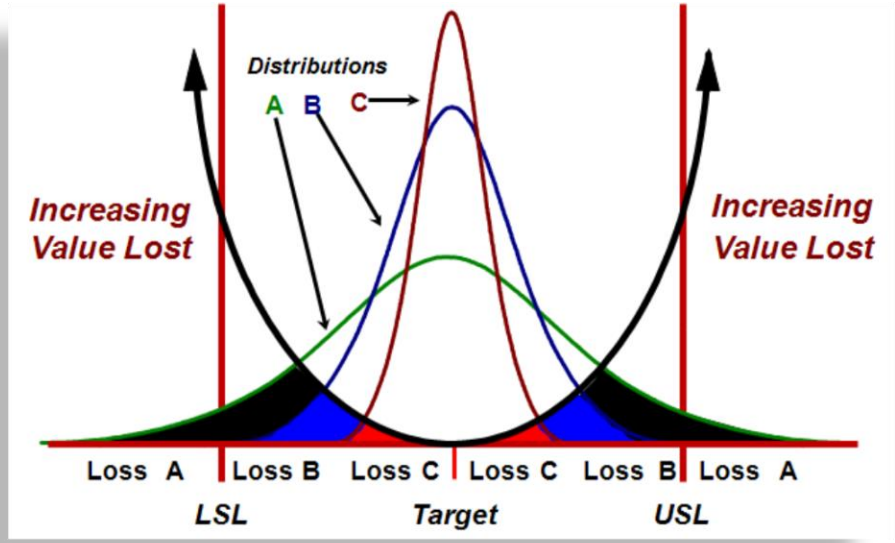
Continual Improvement and the Quality Loss Function



$$L = K (Y - T)^2$$

Where:

L = Loss in Dollars
T = Target Value (normal aim)
K = Cost Coefficient
Y = Actual Quality Value
LSL = Lower Specification
USL = Upper Specification

Why Should We Reduce Process Variation?

Taguchi's Loss Function emphasizes the point that:

- A consistent product minimizes the Total Loss.
- It is better to reduce variation, even within specification.
- Taguchi's definition of Quality is:
  - Quality = Loss inflicted to society after the shipment of product

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Improving Performance

- Better performance only comes through making process changes
- If my time to work is stable, and I want to reduce it, what can I do?
  - Leave earlier when there is less traffic
  - Take a helicopter
  - Move closer to work

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Process Changes

- Brainstorming and team approach
- Segment the process (mapping)
- Identify components that can be reduced or eliminated
- Validate the change before implementing
- Measure effectiveness of the change

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Process Changes

- The Six Sigma methodology is designed to improve process outcomes
- Six Sigma is a collection of statistical and organizational tools
- DMAIC sequence
  - Define, Measure, Analyze, Improve, Control
- Headed by a Six Sigma Black Belt, usually a team project

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Questions
Comments
Smart Remarks

Lead Time Improvement

Sabine Rentschar

April 27, 2018

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About Me

- Industrial Mechanic
- Mechatronic Engineer
- Lean Six Sigma Black Belt
- ASQ Palomar Section Board Member
- Began my career in the Automotive Industry and Machine Engineering
- Somehow ended up in the Optical Industry (Zeiss, Perfect Optics, VSP)
- Currently Manager OpTech at VSP Optics Group
- OpTech is responsible for
  - Quality and CI of our own products and production processes
  - Support with New Product Development and Introduction
  - Best Practices/Standardization of Manufacturing Processes in our lab network
  - Quality of our own products produced by enabled labs
  - Technical product review for category placement

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LSS – SS – CI – QA – QC?

- **Lean manufacturing:**
  - focus on speed, throughput, wastes, time, productivity, process, workflow
- **Six Sigma:**
  - focus on improvement of the product, reduction of variation, quality of the product, defects

- Both have been around for many years.
- Both are proven to show results.
- Both use many of the same tools and complement each other.
- Both use the DMAIC approach.

→ **Lean Six Sigma combines both of them**

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Lean Six Sigma and the Optical Industry

Myths and comments about the use of LSS in our industry:

- "The optical industry is 'different'."
- "We do customized mass manufacturing. LSS doesn't work for customized production, only works for mass manufacturing and commodity products."
- "Takes too much time."
- "It's just a fad."

→ "We cannot use LSS in an optical lab."

Yes, you can.

Example: LSS Black Belt project in one of VSPOne's labs. Project duration 4 months.

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Problem Statement

Improve the average lead time of jobs and reduce the amount of late jobs.

Benefits:

- Reduce overtime/FTEs
- Decrease WIP
- Reduce stress level for staff
- More consistent lead times for customers
- More customer satisfaction

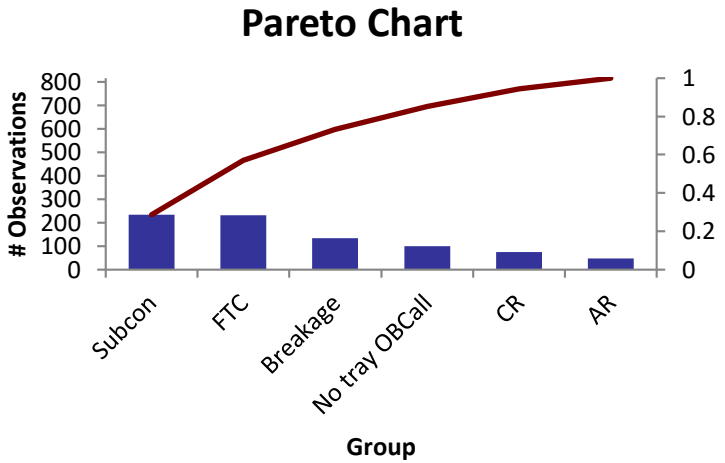
Project Focus

- The initial focus of the project was to reduce the overall lead time. A number of factors contribute to the overall lead time. The scope of the project was limited to optimization of the work flow and the reduction of late jobs over 7 days.
- The main causes for late jobs are:
  - Subcon: Jobs that cannot be produced in-house and have to be sent out to other facilities.
  - FTC: Frame to come. Waiting on the doctor's office to send the frame
  - Breakage: Defects
  - CR: Control room. Area where lenses and frames get paired up.
  - No tray OBCall: In outbound call department.
  - AR: Coating department.

•Subcon, FTC and No tray OBCall are not in our control.

→**The project focus was on multi-breaks and the control room.**

Multi-breaks are jobs that had more than 2 breakages before they can be shipped.



Tools Applied

Lean Six Sigma Black Belt - **Project Tollgate**

Project Title: Lead Time Improvement
Black Belt: Sabine Rentschar

Project Start Date: April 28, 2017
Planned Project End Date: August 25, 2017
Actual Project End Date: August 23, 2017

Define	Measure	Analyze	Improve	Control
ID Chartering Manager	Flow - (VSM, IPO, diagram...)	Root cause - C&E, Pareto	Determine solutions	Mistake proofing
Identify Project Team	SIPOC	FMEA (current)	Prioritize solutions	Create new standards
Set meeting schedule	Data collection plan	Waste Walk	Implement future design	Train new standards
Determine project schedule	Measurement System Analysis	Hypothesis test	DOE	Control Plan
Project goals and objectives	Collect baseline data	Scatter plot	FMEA (new process)	Ongoing results monitoring
Initial ROI calculations	Graphic for Y's and critical x's	Control charts	Kaizen events	Training program
Identify project metrics	Std Dev and histogram	5S audit	Validate improvements	Hand off to Process Owner
Communication plan	Sigma Score	Spaghetti diagram	Statistical analysis	Document results
Initial VOC and VOB	Rolled first pass yield	Capacity studies	Kanban, cells, set up times	Audit results
Create Project Charter	Takt time and cycle times	Inventory flow	Smooth demand and flow	Celebrate / communicate
Review with Mentor	**Review with Mentor**	**Review with Mentor**	**Review with Mentor**	**Review with Mentor**
Mentor/Champion	Mentor/Champion	Mentor/Champion	Mentor/Champion	Mentor/Champion

Item is 100% complete
Item is in progress
Item has not started
Does not apply

Note: The tollgate is a guideline, there are many other tools that may be applied as needed

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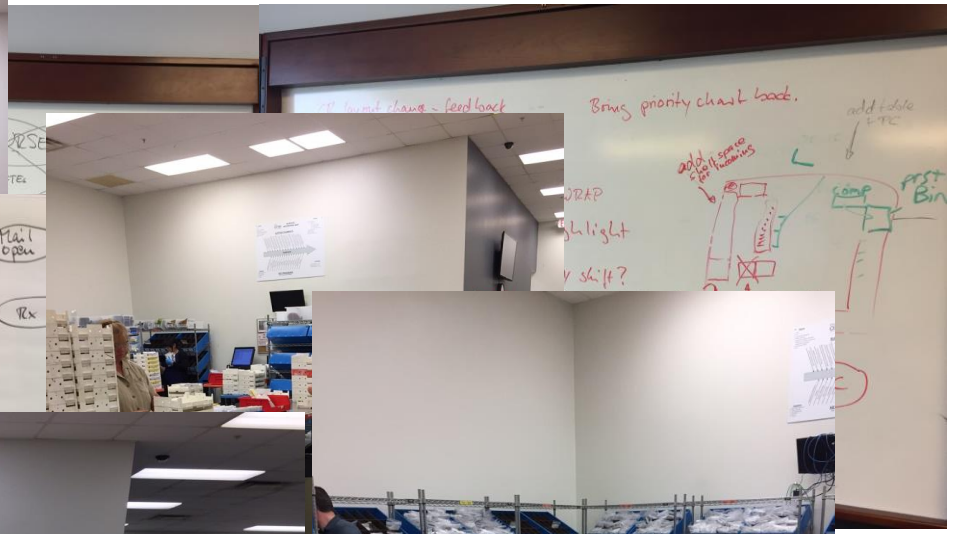

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Actions Taken to Improve Processes

- A lab wide multi-break process was created and implemented to identify and reduce the number of multi-breaks.
- Several sorting steps and inspections were eliminated throughout the lab, reducing the number of times the lenses get handled, sorted and batched.
- Implemented engraving of the job number and designation of left and right lens on all lenses to reduce mix-ups.
- The Finish Sorter position was eliminated in all 3 shifts (3 FTEs).
- The layout of the control room was changed, the area was 5S'd, the new positions and processes were trained out in all 3 shifts.
- The bin locations and bin ranges in the control room were changed to optimize work flow and improve ergonomics for the operators.
- Implemented filters, service codes and routing rules in DVI to automate the routing of jobs through manufacturing, eliminating the need for duplicate inspection and sorting.
- Implemented a pull process for the finishing department to get the work from the control room.

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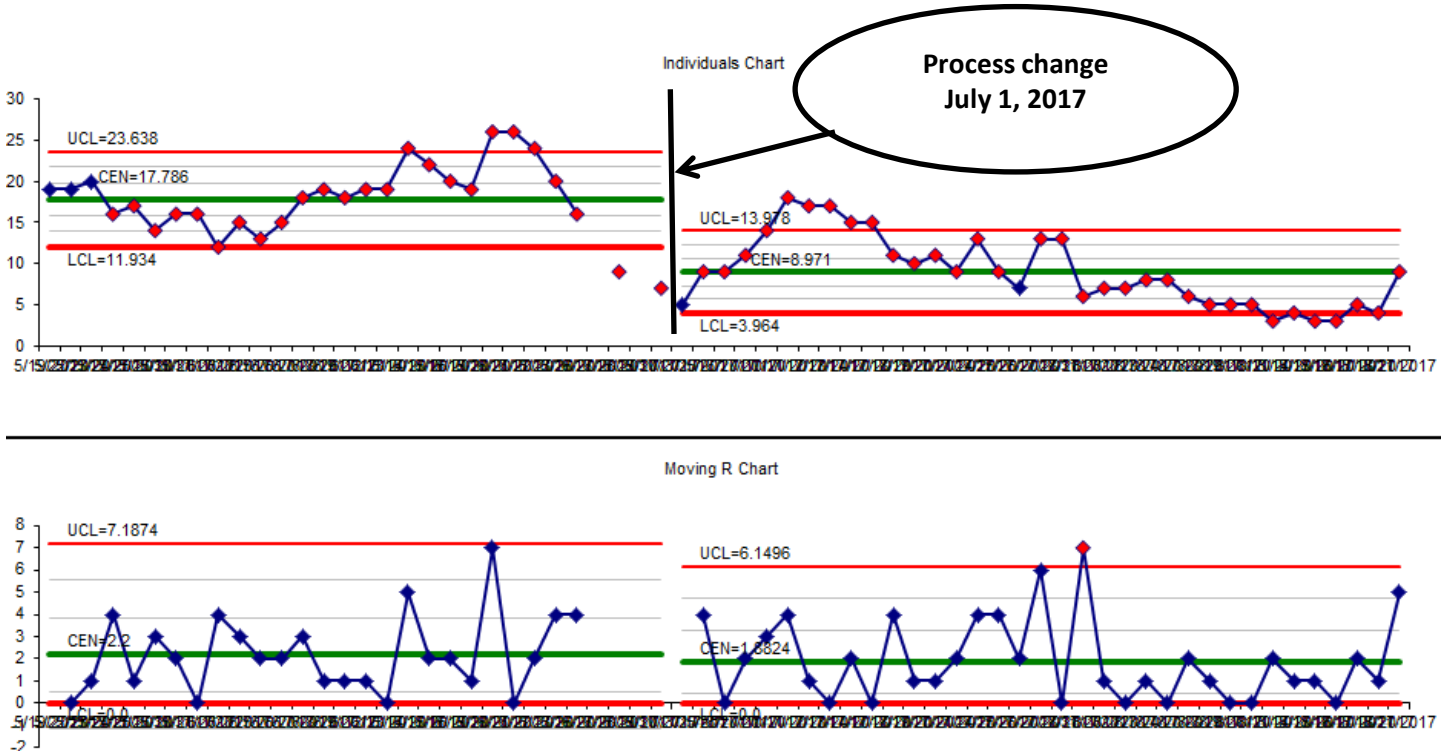
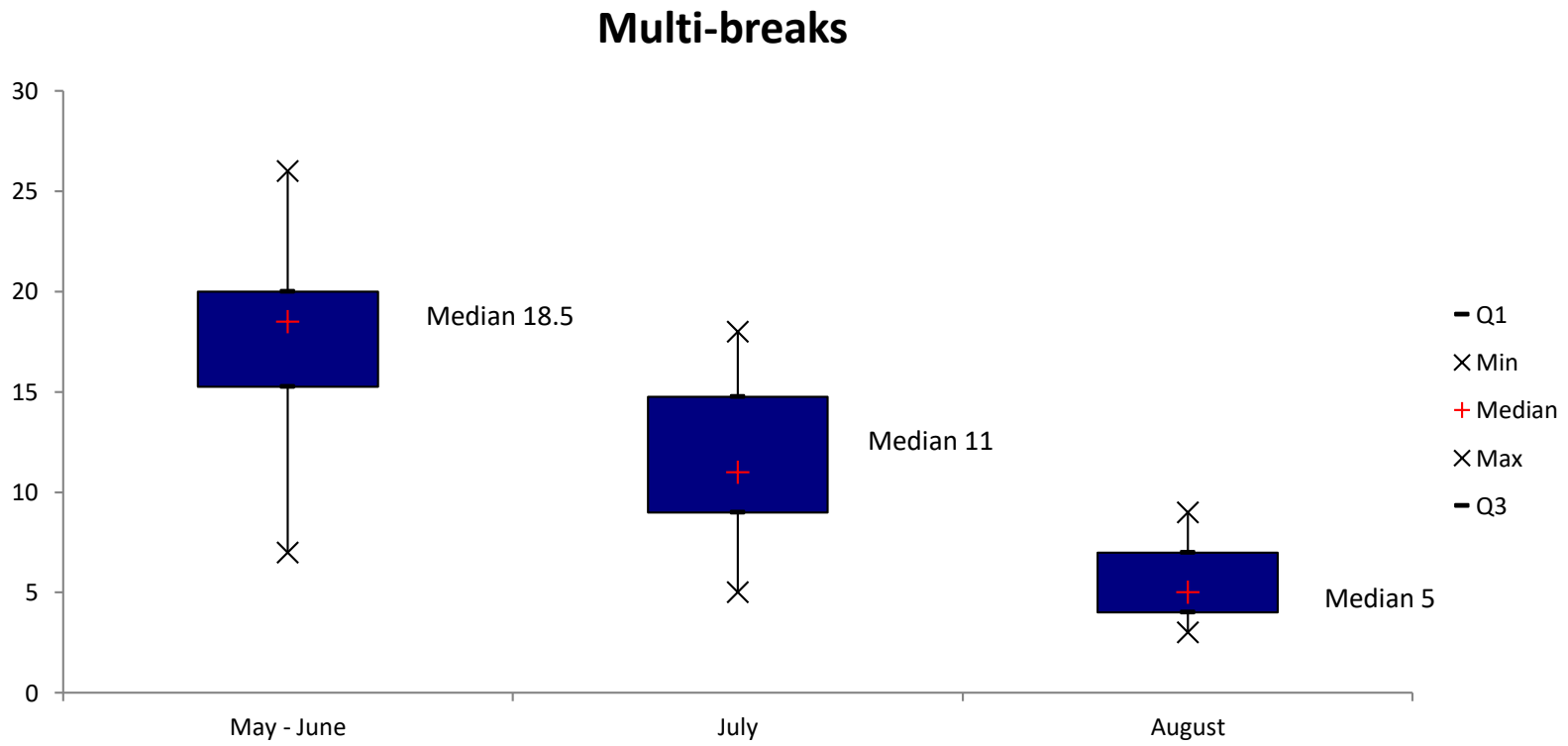
Multi-breaks

Avg # of multi-break jobs before July 1, 2017: 17.8
Avg # of multi-break jobs after July 1, 2017: 9.0
→ **49 % reduction**



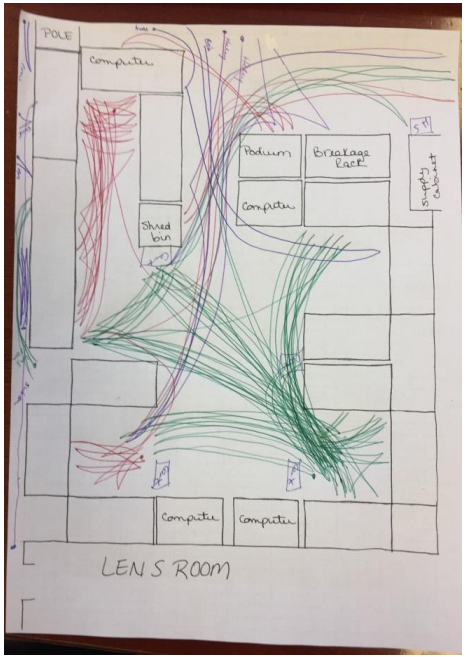
Multi-breaks by Month



Spaghetti Diagram

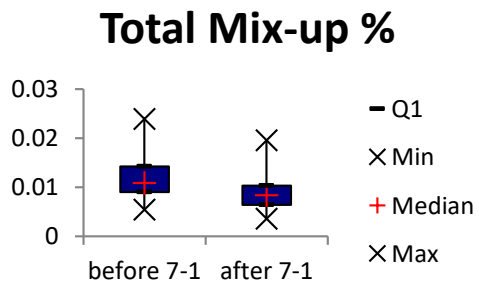
30 minute snap shot of operator traffic in the control room

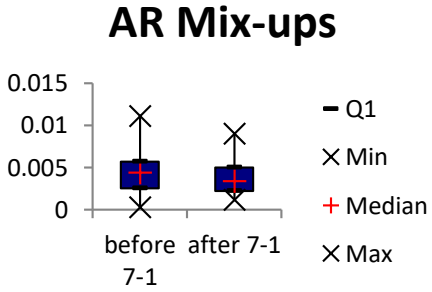
Before layout change



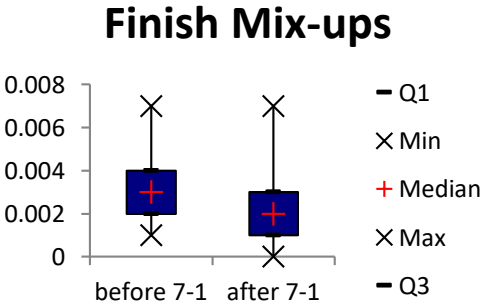
After layout change

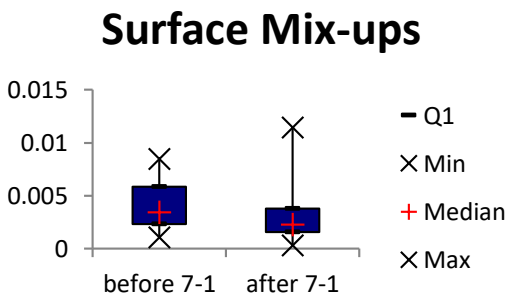
Mix-ups – Total and by Department





Mix-ups/lost before July 1 = 1.2%
Mix-ups/lost after July 1 = 0.9%
→ **25% reduction**





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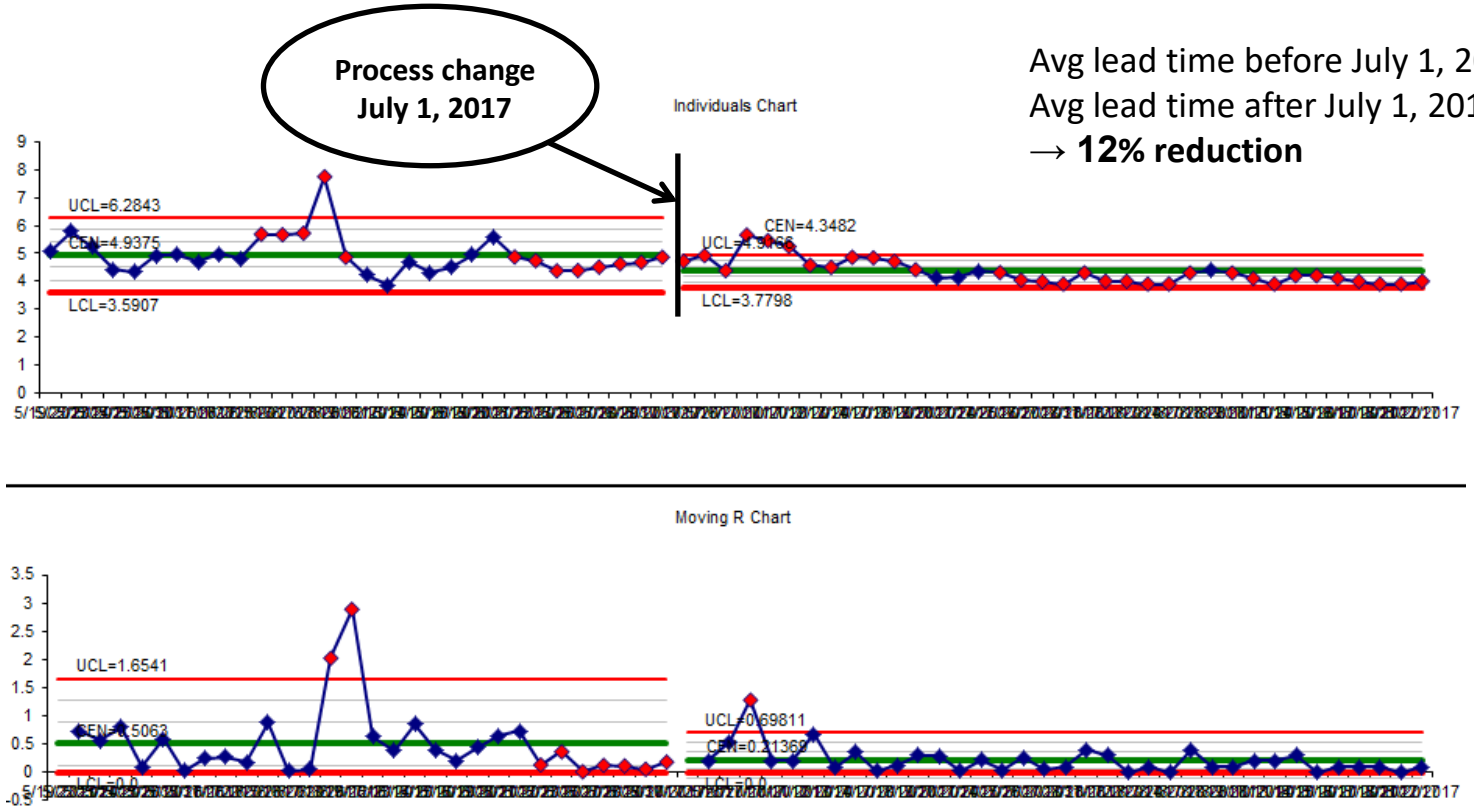
Lead Time Reduction



Avg lead time before July 1, 2017: 4.9 days
Avg lead time after July 1, 2017 : 4.3 days
→ **12% reduction**

Overall Project Benefits

The results of this Project:

- Achieved annualized $332,783 hard savings.
- Improved overall lead time by 12%.
- Reduced amount of late jobs > 7 days by 11%.
- Reduced the amount of multi-breaks by 49%.
- Reduced breakages caused by mix-ups/lost by 25%.
- Improved work flow in the control room.
- Improved ergonomics for employees in the control room in their daily tasks.
- Eliminated several redundant inspections and sorting steps throughout the facility.

Total Savings

- Reduction of mix-up breakage cost: $74,088
- Reduction of multi-break costs: $106,001
- Elimination of 3 FTEs (Finish Sorter position): $152,694

Fully loaded average annual cost of 1 FTE is at $50,898.

Total annualized savings: $332,783

During the project time frame the overall lab yield improved by 1.6%, which equals annualized savings of $297,965. Approximately 40% or $180,089 of that can be directly attributed to the savings in mix-ups and multi-breaks above.

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Summary – Lessons learned

- Numerous opportunities for LSS in an optical lab.
- Key to any successful process change is communication.
- Leadership needs to be actively involved.
- Scope creep has to be immediately controlled to avoid the project getting too large.

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Questions?
Comments?
Concerns?
Hopes?
Wishes?
…
Thank you for your hospitality.