# Effective Ways to Use Metrics to Achieve "Best Practice" Performance in Your Lab

**Lab Quality Confab**

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## Using Metrics for "Best Practice" Performance: Outline

1. Some problems with metrics
2. Lean metrics
3. Using Metrics
   - Benchmarking
   - For Lean process improvement
   - Long range space planning
   - Ongoing metrics to sustain Lean improvements

## Using Metrics for "Best Practice" Performance:

### Some Problems with Metrics

## Using Metrics for "Best Practice" Performance:
### Some Problems with Metrics

- Some of the problems with metrics
  - Not linked to strategic goals
  - People cannot affect the metrics
  - Long delays, not produced in a timely manner
  - Not granular enough – e.g. monthly trends
  - Focused only on downstream outcomes or measure only outputs, not inputs

[1] Portions of this section are adapted from Arnsdorf Associates lecture notes © 2003.

## Using Metrics for "Best Practice" Performance:
### Some Problems with Metrics

- Why have metrics?
  - Analyze and redesign the process
  - Verify and quantify improvement and from process changes
  - Sustain Lean improvements, provide feedback to operators
  - Can help motivate the proper behavior
  - Indicates when the process is out of control limits
  - Helps creates the proper focus on the process – “you measure what you value”
- Metrics test
  - How often are they updated and distributed?
  - Does everyone use the same metrics or are they different for different groups?
  - Can you affect them?
  - Do they affect your actions/performance?

## Using Metrics for "Best Practice" Performance:

**Lean Metrics**

## Using Metrics for "Best Practice" Performance:
### Lean Metrics

- Typical savings from Lean projects:
  - Carrying cost of inventory
  - Reduced material handling cost
  - Less space required
  - Reduced rework – the cost of poor quality is not often measured
  - Lower capital cost – better use of capacity
  - Reduced staffing – often, not always
- Typical benefits
  - Improved cycle times and delivery times
  - Fewer delayed deliveries – TAT outliers
  - Lower cost
  - Improved quality

## Using Metrics for "Best Practice" Performance:
### Lean Metrics

- Typical metrics in Lean projects
  - Takt and cycle times
  - Lead time (turnaround time)
  - Defects, inspection, rework
  - Value added: Non-value added ratio
  - FTEs/productivity, overtime
  - Walking
  - Space
  - Inventory, Work in Process

## Using Metrics for "Best Practice" Performance:

### Using Metrics:
### Benchmarking

## Benchmarking:
### Productivity/Expense Benchmarking

- A number of hospital wide services do not even count tests uniformly. Accept "raw" statistics which may include phlebotomy, indices, etc. Labs are only one department in their database.
  - Solucient
  - Yankee Alliance
  - Mecon
- Far better, are lab specific services. Some have complexity measurements to adjust for test mix.
  - HealthCare Development Services: Lab Trends
  - Chi Solutions
  - CAP LMIP
- Benchmarking will not provide a roadmap to improvement
  - Must "go and see" the process – genchi genbutsu

## Benchmarking:
### Turnaround Time

- From a comparative database 45 M performance measurements of laboratories: from community hospitals to academic medical centers and lean early adopters
- 300 test procedures
- All segments of the value stream

## Using Metrics for "Best Practice" Performance:

**Using Metrics:**
**For Lean Process Improvement**

## Using Metrics for "Best Practice" Performance:
### Using Metrics for Lean Process Improvement

- Process analysis
  - Takt and cycle times, process capacity
  - Lead times (TAT times)
  - Value added, non-value added
  - Staffing analysis, requirements, process capacity
  - Layout, redesign
  - Work cell/operator analysis
  - Queuing theory and staffing
  - Measuring results

## Using Metrics for Lean Process Improvement:
### Definitions

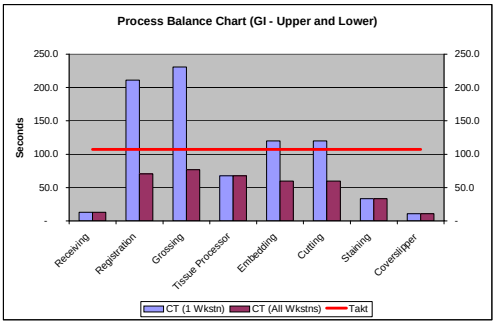
- Some definitions
  - Takt time. The pace of production required to meet customer demand. This is calculated as the available hours divided by the number of specimens. Usually expressed in seconds.
  - Cycle time. How often (in seconds) a specimen is completed by a process. Cycle times for each process must be less than the Takt time or there will be bottleneck in the process and customer demand will not be met.
  - Types of Work/Activity
    - Value Added. An activity that changes the form, fit or function of a product. Value added activities can also be defined as something a customer would be willing to pay for.
    - Non-value Added. The various forms of waste.
    - Non-value Added, but Necessary. Required activities that do not provide value added improvements to the product.

# Using Metrics for Lean Process Improvement:
## Case F: Takt and Cycle Times – Process Capacity

- The various process with very different cycle times. Additional capacity for certain processes will keep the work flowing in an even manner.
- Cycle times for each process must be below the takt time

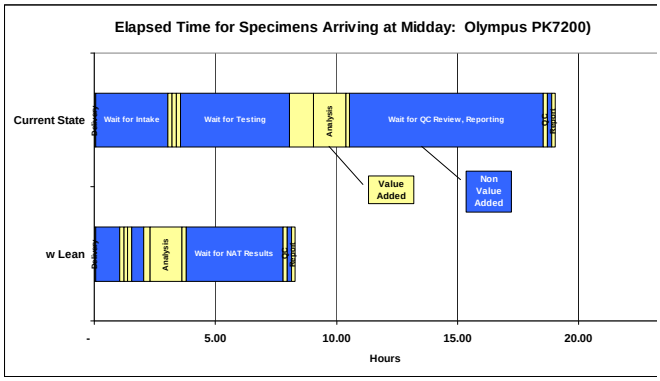
| | GI (Upper, Lower) | | | | |
|---|---|---|---|---|---|
| | Wkstns | CT (1 Wkstn) | CT (All Wkstns) | Lead Time | Takt |
| | | sec | sec | min | sec |
| Receiving | 1 | 13.0 | 13.0 | 1.3 | 107.4 |
| Registration | 3 | 211.2 | 70.4 | 4.1 | 107.4 |
| Grossing | 3 | 231.0 | 77.0 | 7.0 | 107.4 |
| Tissue Processor | 1 | 67.6 | 67.6 | 124.0 | 107.4 |
| Embedding | 2 | 120.0 | 60.0 | 0.6 | 107.4 |
| Cutting | 2 | 120.0 | 60.0 | 2.0 | 107.4 |
| Staining | 1 | 33.4 | 33.4 | | 107.4 |
| Coverslipper | 1 | 11.1 | 11.1 | | 107.4 |
| Total Lead Time | | | | 139.0 | min |
| | | | | 2.32 | hrs |
| | | 583.1 | | | |
| | | 5.43 | | | |



# Using Metrics for Lean Process Improvement:
## Case M: TAT Improvement with Lean

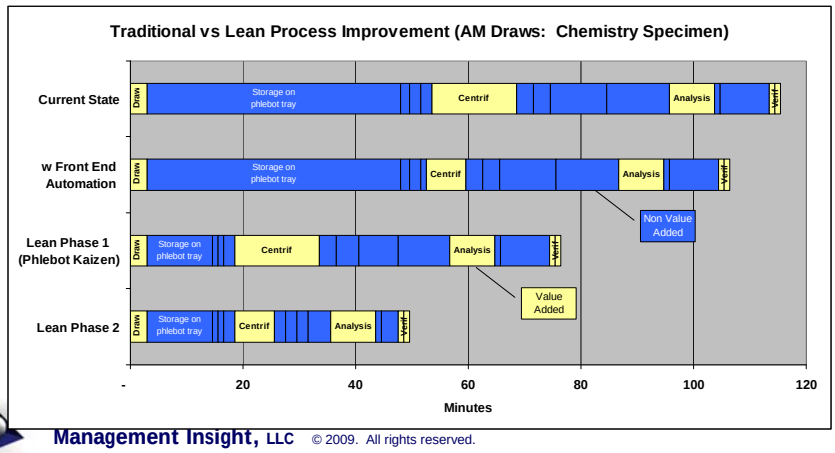
- Potential turnaround time improvement with Lean (midday specimens)
  - Current operations (report at 9AM the following day)
  - w Lean: reduce waiting, earlier instrument QC and run of samples (report at 10PM same day)



# Using Metrics for Lean Process Improvement:
## Case E: TAT Improvement with Lean

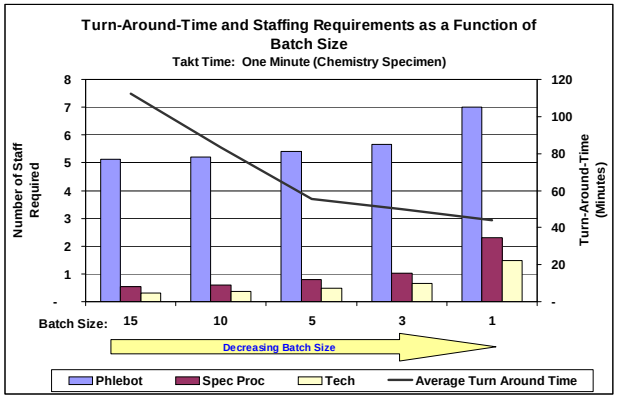
- **TAT projections:**
  - **w/ Front End Automation: 7.5 minute improvement**
  - **w/ Lean (Phase 1): 39 minute improvement**





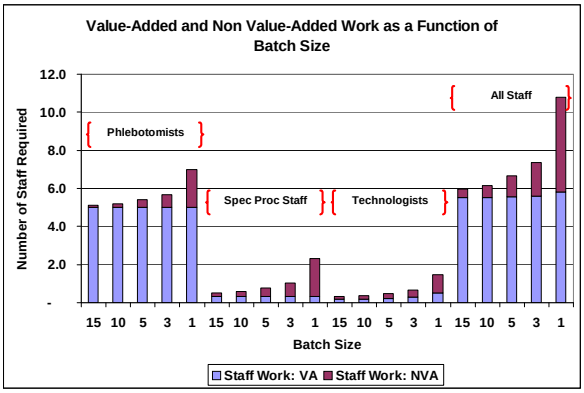

# Using Metrics for Lean Process Improvement:
## Batching, TAT and VA and NVA Time

- **The effect of batch size on TAT and staffing**
  - **92% of TAT reduction benefit from moving from batch of 15 to 3.**



# Using Metrics for Lean Process Improvement:
## Batching, TAT and VA and NVA Time

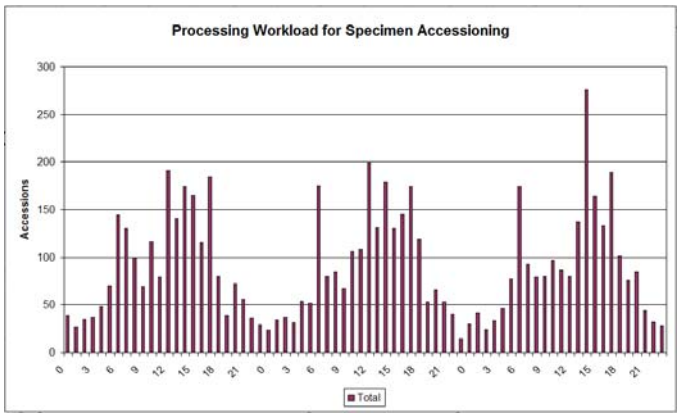
- The effect of batch size on staffing, VA, NVA work
  - Batch size reduction from 3 to 1: a 47% increase in work for an additional 6 minute TAT improvement



# Using Metrics for Lean Process Improvement:
## Case C: Staffing Requirements

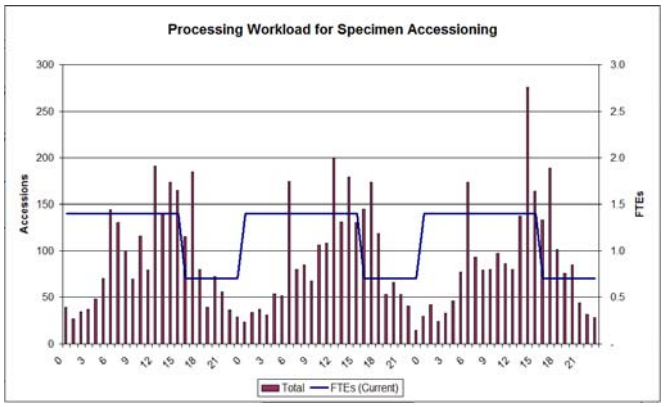
- Begin with analysis of workflow
- First look at opportunities for leveling and eliminating waste



# Using Metrics for Lean Process Improvement:
## Case C: Staffing Requirements

- **Matching workflow with actual staffing provides an incomplete understanding.**

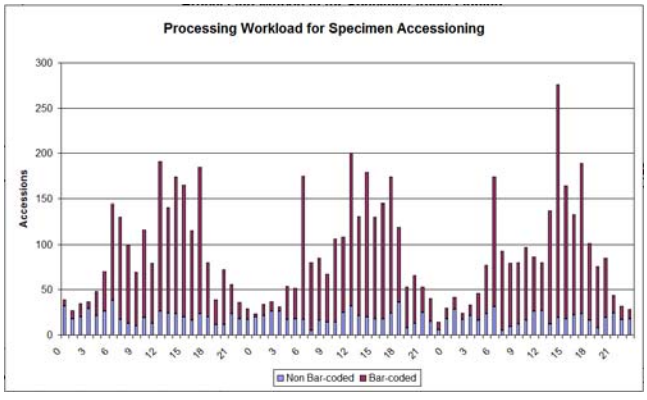





# Using Metrics for Lean Process Improvement:
## Case C: Staffing Requirements

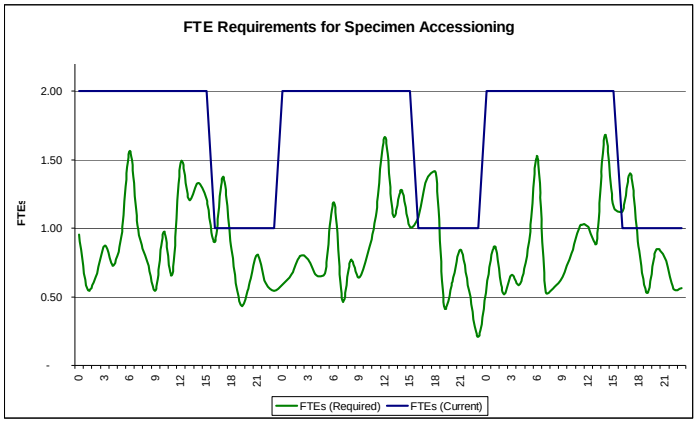
- **Analysis of cycle times for each class of specimen**
- **Usually will need patient location level detail**

| Minutes/Accn | |
|---|---|
| Non Bar-coded | Bar-coded |
| 1.73 | 0.26 |



# Using Metrics for Lean Process Improvement:
## Case C: Staffing Requirements

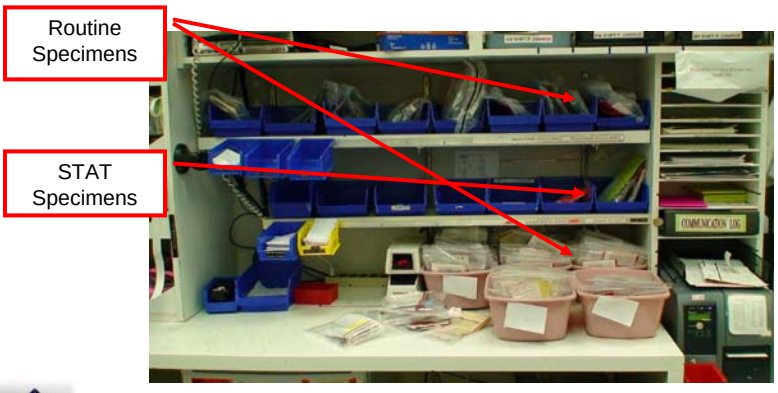
- **Resulting determination of required and actual staffing provides insight.**






# Using Metrics for Lean Process Improvement:
## Case K: Process Capacity and Staffing

- **At peak times there is a lack of preanalytical processing capacity**
  - **Even the best process will fail to keep pace with demand if there is insufficient capacity**



## Using Metrics for Lean Process Improvement:
### Case K: Process Capacity and Staffing

- **Process capacity for accessioning is not sufficient in the early AM hours and during much of the day shift.**
- **"Call-ins" will almost always result in reduced staffing in this area.**
- **Seven scheduled accessioners are needed to effectively have 6 workstations filled, considering breaks and lunch**



## Using Metrics for Lean Process Improvement:
### Case D: Operator Walking/Layout

- **Workflow for Hgb A1c. Note sequence of processing steps.**


# Using Metrics for Lean Process Improvement:
## Case D: Operator Walking/Layout

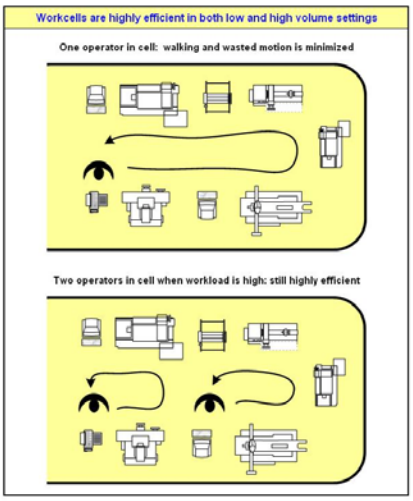
**Flow Cytometry layout.**

**Re-layout in a workcell with an 83% reduction in operator walking.**



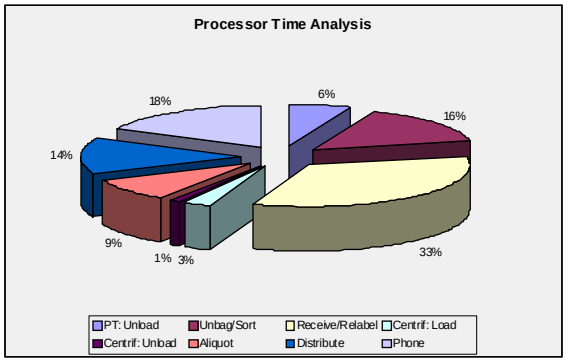
# Using Metrics for Lean Process Improvement:
## Workcell design

**The U shaped workcell is efficient in both low and high volume settings**



# Using Metrics for Lean Process Improvement:
## Case J: Workflow and Performance Analysis

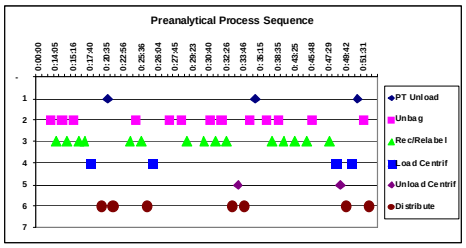
- An analysis of the time spent in processing on various activities. Of primary importance is that phone calls represent a major disruption of workflow. The phone calls during the observation period required 18% of the processor's time.

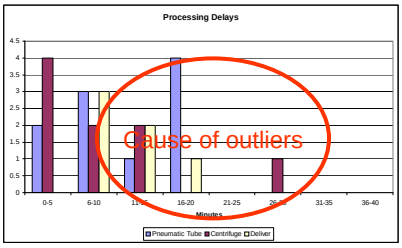


# Using Metrics for Lean Process Improvement:
## Case J: Workflow and Performance Analysis

- The left illustrates the sequence of process steps. It is characterized by a somewhat random organization of the workflow (which is not unusual in the laboratory setting.)
- Phone calls and inadequate staffing also result in processing delays.
- An improved processing design would move specimens from process to process every few minutes.

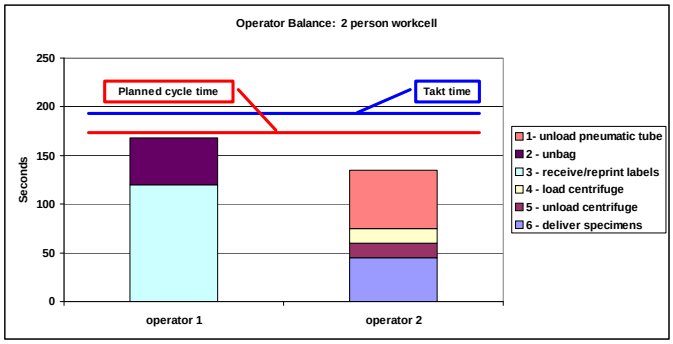


# Using Metrics for Lean Process Improvement:
## Case J: Operator Balance and Cell Design

- A work assignment for two preanalytical operators with a relatively balanced workload based on a 3 minute cycle. This was sufficient to maintain workflow.
- Required operators = total operator cycle time / takt time
  = 310/180 = 1.72





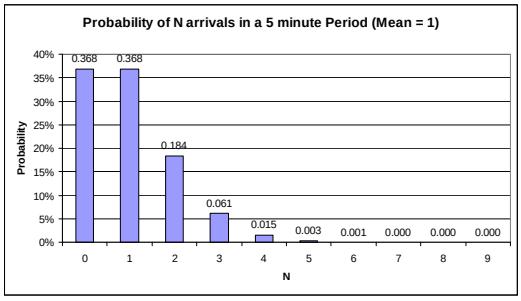

# Using Metrics for Lean Process Improvement:
## Queuing Theory and Phlebotomy Staffing

- Phlebotomy staffing models for: OP clinics, Patient Service Centers
  - To model the staffing requirements *it is preferable to have data on patient arrivals, not data based on collect time - patient may be waiting in queue*
  - Random arrivals follow the Poisson distribution
    - Phone calls to call center, customers arriving at grocery store checkout, patient arriving for blood collection
  - Simple models will help determine required staffing
  - More advanced queuing models (e.g. ProModel/MedModel) can provide comprehensive data on staffing models and patient wait times

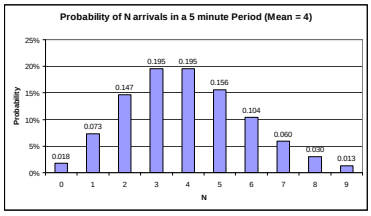
# Using Metrics for Lean Process Improvement:
## Queuing Theory and Phlebotomy Staffing

**Key Principles:**

- **A simple illustration of the Poisson distribution:**
  - **Assume 12 patients arrive per hour and it takes 5 minutes to draw each patient.**
  - **Is one phlebotomist enough?**



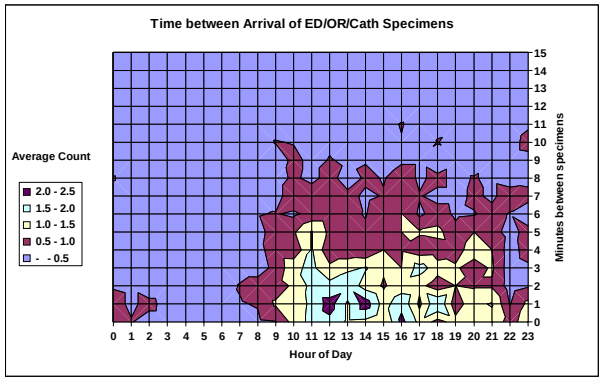

**if 48 patient per hour or 4 per 5 minute period**



# Using Metrics for Lean Process Improvement:
## Case K: Staffing Models: ED/OR Accessioning

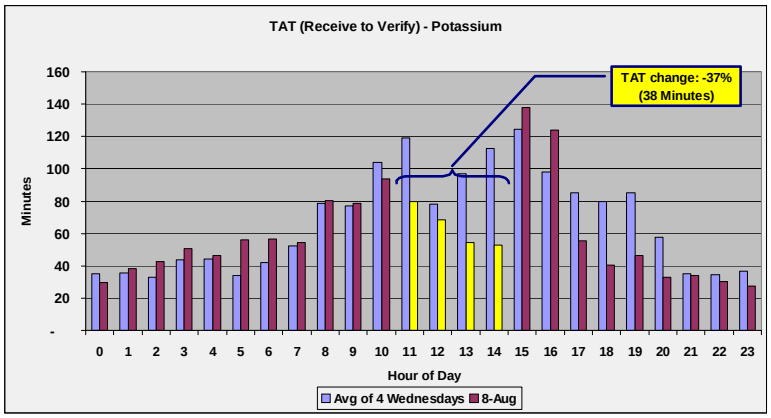
- **Between 10 am and 7 pm ED/OR/CathLab specimens frequently arrive within zero to two minutes of the previous specimen.**
- **A single "ED" accessioning individual will often not be able to process these samples within the expected 6 minute "Receive to Bench" TAT.**



# Using Metrics for Lean Process Improvement:
## Case H: Measuring Results

- The preanalytical processing kaizen reduced chemistry TAT by 38 minutes (a 37% improvement).
- Results of the pilot were available the next day



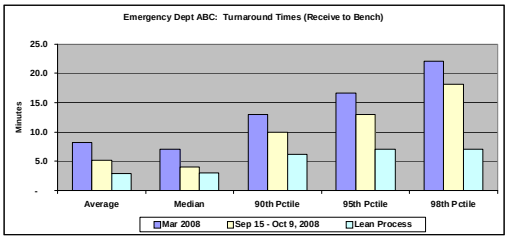



# Using Metrics for Lean Process Improvement:
## Case K: Measuring Results

- The ED preanalytical kaizen improved TAT and eliminated all excessive outliers.
  - The average "Receive to Bench" time was 2.9 minutes, the longest 7 minutes.

ED ABC: Receive to Bench Turnaround Time (Minutes)

| | Mar 2008 | Sep 15 - Oct 9, 2008 | Lean Process | Pct Chg |
|---|---|---|---|---|
| Target | 6.0 | 6.0 | 6.0 | |
| Outliers (Above Target) | 59.4% | 27.1% | 15.4% | -43.3% |
| Average | 8.2 | 5.2 | 2.9 | -43.6% |
| Median | 7.0 | 4.0 | 3.0 | -25.0% |
| 90th Pctile | 13.0 | 10.0 | 6.2 | -38.0% |
| 95th Pctile | 16.6 | 13.0 | 7.0 | -46.2% |
| 98th Pctile | 22.0 | 18.1 | 7.0 | -61.3% |

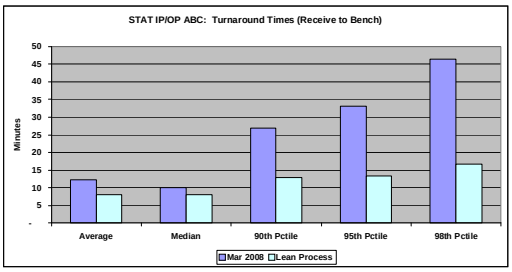


# Using Metrics for Lean Process Improvement:
## Case K: Measuring Results

- **The STAT preanalytical kaizen reduced outliers by 84% and eliminated all excessive outliers.**

**STAT ABC: Receive to Bench Turnaround Time (Minutes)**

| | Mar 2008 | Lean Process | Pct Chg |
|---|---|---|---|
| Target | 15.0 | 15.0 | |
| Outliers (Above Target) | 31.5% | 5.0% | -84.1% |
| Average | 12.2 | 8.0 | -34.5% |
| Median | 10.0 | 8.0 | -20.0% |
| 90th Pctile | 27.0 | 13.0 | -51.9% |
| 95th Pctile | 33.0 | 13.3 | -59.7% |
| 98th Pctile | 46.3 | 16.7 | -63.9% |






# Using Metrics for "Best Practice" Performance:

## Using Metrics:
## Long Range Space Planning

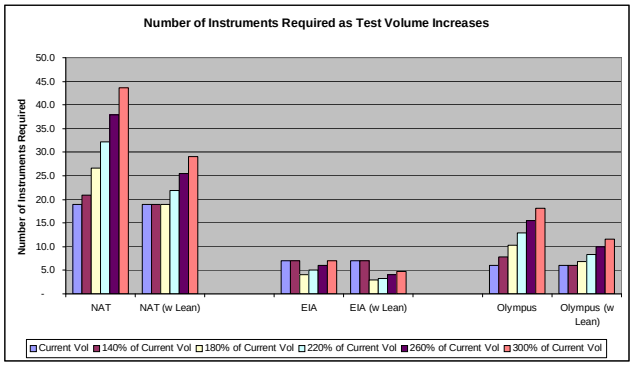
# Using Metrics for Long Range Space Planning:
## Case M: Instrument Requirements for Growth

- **Detailed projections for each category and instrument (with Lean and extended operating hours)**
- **Use machine cycle times and include setup time for a run**



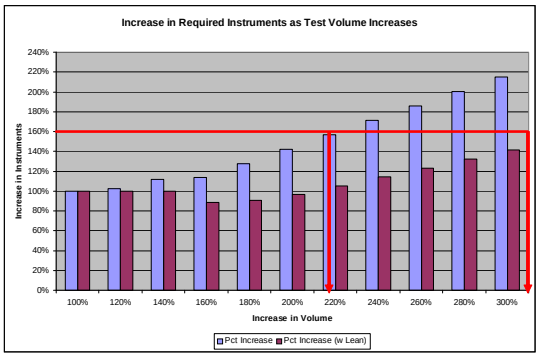
# Using Metrics for Long Range Space Planning:
## Case M: Instrument Requirements for Growth

- **Instrument requirements as a category are shown below.**
- **EIA projections assume HIV will be moved from the Commander to the Prism in the near term, reducing required number of instruments.**
- **Lean strategies will reduce instrument requirements.**



# Using Metrics for Long Range Space Planning:
## Case M: Instrument Requirements for Growth

- Significant growth in test volume can be accommodated with the new space. The additional 60% increase in space should roughly accommodate a 60% increase in instrumentation.
- The 120% increase in volume (and 200+% with Lean) may not be fully realized due to changes in test mix, and importantly, the time of arrival of additional client specimens. If these new arrivals occur late in the evening, there will be less effective capacity for growth.






# Using Metrics for "Best Practice" Performance:

## Using Metrics:

## Ongoing Metrics to Sustain Lean Improvements

# Using Metrics for "Best Practice" Performance:
## Ongoing Metrics to Sustain Lean Improvements

- Focus should be on the process and maintaining standard work.
- Metrics are after the fact, "you cannot inspect quality into a product"
  - Harold F. Dodge, Bell Labs

# Using Metrics for "Best Practice" Performance:
## Ongoing Metrics to Sustain Lean Improvements

- Ongoing metrics can help sustain process improvement
- Who considers this of value?
  - Toyota follows the *Plan, Do, Check, Act* cycle. Provides daily metrics as feedback to workgroups.
  - Six Sigma DMAIC: *Define, Measure, Analyze, Improve, Control*
  - Survey of early adopter Lean labs:

| | Level of detail/granularity | | | | |
|---|---|---|---|---|---|
| Frequency | Monthly | Weekly | Daily | Hourly | By Spec |
| Daily | 0% | 0% | 67% | 17% | 0% |
| Weekly | 0% | 33% | 0% | 0% | 0% |
| Monthly | 67% | 0% | 0% | 0% | 0% |

| How Important are ongoing metrics? (scale: 1-5) | Average |
|---|---|
| Sustaining Lean improvements | 4.7 |
| Feedback on current process improvements | 4.3 |
| Maintaining standard work | 3.8 |

| How are metrics used? | Pct |
|---|---|
| Discussed in daily huddle meetings | 50% |
| Posted | 100% |
| Distributed/eMailed | 67% |

## Using Metrics for "Best Practice" Performance:
### Ongoing Metrics to Sustain Lean Improvements

- Toyota practices the Floor Management Development System that includes group visual control board, daily workgroup meetings and daily performance feedback[1].
  - "Find the key processes and control items that will drive the results."

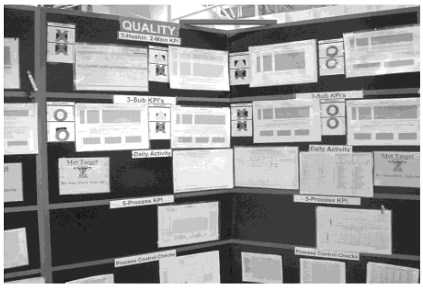



**Figure 15.11** Quality Section of Group Board for Floor Management Development System

[1]Toyota Culture, Jeffery Liker and Michael Hoseus, Ch 15. © 2008. McGraw-Hill.

## Using Metrics for "Best Practice" Performance:
### Ongoing Metrics to Sustain Lean Improvements

- Monthly, weekly not granular to provide any insight into what went wrong or well.
  - Real time displays can be valuable, but do not provide a daily summary of overall performance
  - Daily metrics and feedback much more valuable

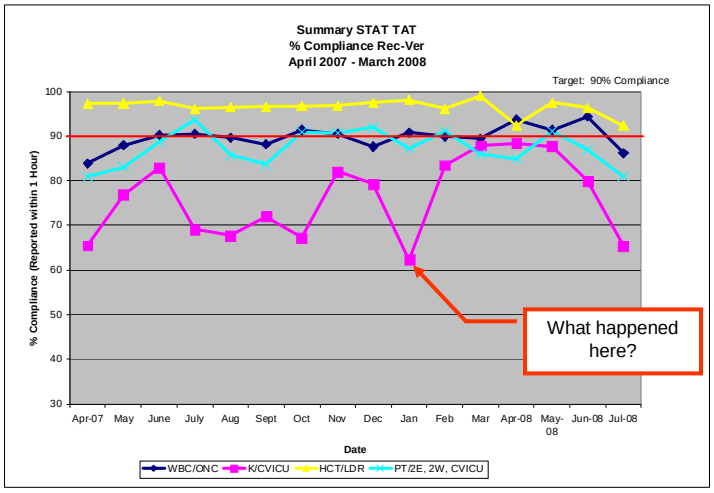
# Using Metrics for "Best Practice" Performance:
## Ongoing Metrics to Sustain Lean Improvements

- **A common approach: daily reports with many pages of accession/test level detail**

| Pt Num | Pt Ord Lo | Pt Loc | CID | Acc Num | Prty Co | Ord Tes | Ord Co | Rec Tes | Outlier | Ord-Col | Coll-Rec | Ord-Res | Coll-Ver | Ord-Ver | Rec-Ver | Res Tech | Phleb Code | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LDLP | LDLP | E192006 | 08 | S | 2999 | ABC | 569 | Y | 14 | 13 | 27 | 75 | 89 | 62 | 911 | 2592 | |
| | RADON | RADON | E192006 | 64 | S | 105 | ABC | 569 | | 8 | 7 | 15 | 15 | 23 | 8 | 00200-A | 1208 | |
| | ED | ED | E192006 | 95 | S | 2999 | ABC | 1098 | | 96 | 2 | 98 | 8 | 104 | 6 | 00200-A | | |
| | WBNLP | WBNLR | E192006 | 78 | S | 2999 | ABC | 569 | Y | 9 | 8 | 17 | 69 | 78 | 61 | 969-378 | 2591 | |
| | WBNLP | WBNLR | E192006 | 03 | S | 2999 | ABC | 569 | Y | 81 | 11 | 92 | 64 | 145 | 53 | 448-911 | 8888 | |
| | ED | ED | E192006 | 02 | S | 2999 | ABC | 1042 | | 1 | 13 | 14 | 20 | 21 | 7 | 00200-A | 8888 | |
| | ONC | ONC | E192006 | 13 | S | 105 | ABC | 1727 | | 11 | 7 | 18 | 19 | 30 | 12 | 00200-A | 2598 | |
| | HEM | HEM | E192006 | 19 | S | 105 | ABC | 1727 | | 3 | 9 | 12 | 59 | 62 | 50 | 378 | 1208 | |
| | SAU | SAU | E192006 | 60 | S | 1098 | ABC | 1098 | | | 14 | | 27 | 9 | 13 | 00200-A | 8888 | |
| | ONCIN | ONCIN | E192006 | 11 | S | 1727 | ABC | 1727 | | | 5 | | 15 | 7 | 10 | 00200-A | 8888 | |
| | RADON | RADON | E192006 | 93 | S | 652 | ABC | 1727 | | 11 | 6 | 17 | 26 | 37 | 20 | 00200-A | 1208 | |
| | ED | ED | E192006 | 18 | S | 2999 | ABC | 1098 | | 15 | 12 | 27 | 19 | 34 | 7 | 00200-A | 2774 | |
| | ONCIN | ONCIN | E192006 | 85 | S | 1587 | ABC | 1587 | | | 16 | | 37 | 17 | 21 | 00200-A | 8888 | |
| | C3 | C3 | E192006 | 16 | S | 1098 | ABC | 1098 | | | 11 | | 25 | 13 | 14 | 00200-A | 8888 | |
| | LDLP | LDLP | E192006 | 17 | S | 2999 | ABC | 1727 | | 29 | 15 | 44 | 29 | 58 | 14 | 00200-A | 2592 | |
| | ED | ED | E192006 | 00 | S | 2999 | ABC | 1098 | | 14 | 6 | 20 | 13 | 27 | 7 | 00200-A | 2774 | |
| | LDRLP | LDRLP | E192006 | 89 | S | 2999 | ABC | 1587 | Y | 71 | 66 | 137 | 87 | 158 | 21 | 00200-A | 8888 | |
| | ED | ED | E192006 | 19 | S | 2999 | ABC | 1042 | | 20 | 4 | 24 | 10 | 30 | 6 | 00200-A | 2774 | |
| | LDLP | LDLP | E192006 | 31 | S | 2999 | ABC | 1727 | | 14 | 7 | 21 | 14 | 28 | 7 | 00200-A | 2591 | |
| | FGR | FGR | E192006 | 39 | S | 2999 | ABC | 1727 | | 10 | 12 | 22 | 25 | 35 | 13 | 00200-A | | |
| | C2 | C2 | E192006 | 08 | S | 2999 | ABC | 1727 | | 46 | 4 | 50 | 24 | 70 | 20 | 00200-A | 2593 | |
| | ED | ED | E192006 | 41 | S | 2999 | ABC | 1098 | | 2 | 8 | 10 | 14 | 16 | 6 | 378 | | |
| | ED | ED | E192006 | 98 | S | 2999 | ABC | 1098 | | 21 | 13 | 34 | 22 | 43 | 9 | 00200-A | | |
| | ED | ED | E192006 | 86 | S | 2999 | ABC | 1098 | | 47 | 3 | 50 | 13 | 60 | 10 | 00200-A | 879 | |
| | ED | ED | E192006 | 08 | S | 2999 | ABC | 1098 | | 17 | 3 | 20 | 15 | 32 | 12 | 00200-A | 879 | |
| | ED | ED | E192006 | 25 | S | 2999 | ABC | 1098 | | 24 | 8 | 32 | 21 | 45 | 13 | 911 | | |
| | ORC | ORC | E192007 | 13 | S | 1098 | ABC | 1098 | | | 6 | | 14 | 5 | 8 | 00200-A | 8888 | |
| | ED | ED | E192007 | 42 | S | 2999 | ABC | 559 | | 57 | 14 | 71 | 24 | 81 | 10 | 00200-A | 8888 | |
| | ED | ED | E192007 | 47 | S | 2999 | ABC | 1098 | | 27 | 21 | 48 | 30 | 57 | 9 | 00200-A | 897 | |
| | ED | ED | E192007 | 01 | S | 2999 | ABC | 771 | | 21 | 3 | 24 | 11 | 32 | 8 | 00200-A | 879 | |
| | LDRLP | LDRLP | E192007 | 27 | S | 2999 | ABC | 569 | | 25 | 10 | 35 | 21 | 46 | 11 | 00200-A | 8888 | |
| | ED | ED | E192007 | 23 | S | 2999 | ABC | 1098 | | | 15 | 14 | 23 | 22 | 8 | 00200-A | | |
| | LDLP | LDLP | E192007 | 51 | S | 2999 | ABC | 1587 | | | 11 | 5 | 18 | 13 | 7 | 00200-A | | |
| | ED | ED | E192007 | 78 | S | 2999 | ABC | 559 | | 5 | 23 | 28 | 29 | 34 | 6 | 00200-A | 8888 | |
| | ED | ED | E192007 | 77 | S | 2999 | ABC | 2773 | | 15 | 1 | 16 | 9 | 24 | 8 | 00200-A | 8888 | |
| | ED | ED | E192007 | 66 | S | 2999 | ABC | 559 | | 16 | 5 | 21 | 9 | 25 | 4 | 00200-A | 8888 | |
| | LDRLP | LDRLP | E192007 | 01 | S | 2999 | ABC | 507 | | | 40 | 28 | 57 | 45 | 17 | 00200-A | 8888 | |
| | ED | ED | E192007 | 47 | S | 2999 | ABC | 559 | | 12 | 7 | 19 | 18 | 30 | 11 | 00200-A | 8888 | |
| | ED | ED | E192007 | 93 | S | 2999 | ABC | 559 | | 22 | 4 | 26 | 16 | 38 | 12 | 00200-A | 879 | |
| S | | ABC | 313 | 313 | 54 | | | | | | | | | | | | | |

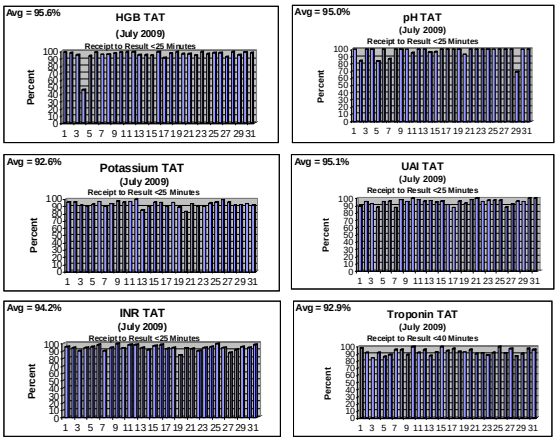


# Using Metrics for "Best Practice" Performance:
## Ongoing Metrics to Sustain Lean Improvements



# Using Metrics for "Best Practice" Performance:
## Ongoing Metrics to Sustain Lean Improvements

- Daily metrics may still not provide adequate granularity



# Using Metrics for "Best Practice" Performance:
## Ongoing Metrics to Sustain Lean Improvements

- Concluding thoughts:
  - Metrics can be a powerful tool to achieve best practice performance
  - "You measure what you value"
- Comments, questions?
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