Designing a Lean Laboratory

Decreasing waste and optimizing workflow through lean methodologies.
Overview

Lean manufacturing, lean enterprise, lean production or often simply, "Lean" is a business improvement process centered on preserving value with less work. Lean focuses on streamlining process flow and eliminating waste. Lean methodologies offer a set of "tools" that assist in the identification and continual elimination of waste. As waste is eliminated, quality improves while production time and cost are reduced.

Henry Ford provided the basis for lean manufacturing through standardization of tools and parts. Taiichi Ohno, the father of the Toyota Production System (TPS), refined Ford's system and took it to the next level by focusing on improving the "flow" or smoothness of work. Implementation of smooth workflows exposes existing quality problems—waste reduction happens as a natural consequence.

Eliminating waste along entire value streams, instead of at isolated points, creates processes that require less human effort, less space, less capital and less time to produce products and services; and at a far lower cost and with fewer defects than with traditional business systems. Lean departments and hospitals, like their corporate brethren, are able to respond to changing demands with higher quality, lower cost and faster throughput.

Identifying Waste in Labs

According to BSM, an international healthcare consulting firm, every laboratory is different. There are seven original wastes:

1. Transport – movement not actually required to perform the processing
2. Excess inventory – all components, work-in-process and finished product not being processed
3. Motion – more movement of people or equipment than is required to perform the processing
4. Waiting – waiting for the next production step
5. Overproduction – production ahead of demand
6. Overprocessing – extra activity resulting from poor tool or process design
7. Defects – extra effort resulting from the need to inspect for and fix defects

In addition, there are five related wastes common to the lab:

1. Lack of focus – technicians are often dedicated to specific tests with little or no control of the progress of individual samples through a variable system
2. Long and variable lead times – batching or queuing samples before performing a run
3. Ineffective fast-track systems – this sequence, developed to address urgent samples, often becomes too large to be effective
4. High levels of work-in-progress (WIP) – this “batching” often results in extra non-value-added effort to control, track and prioritize samples
5. Volatile incoming workload – peaks and troughs of specimen deliveries cause low productivity during slow times and poor lead time during peaks
Laboratories are often considered one of a hospital's profit centers, so they must operate as lean as possible to be efficient and drive revenue. To overcome these wastes, consider the lab's procedures and layout—is its workflow optimized for operational efficiency? Is the lab prepared to support growth? Is the staff being used to the best of their abilities? An efficient lab design and workflow greatly improves turnaround times and increases volumes produced in less space and with fewer full-time employees (FTE).

When evaluating a lab for improvement, it is important to have a thorough understanding of the current operations in the space. Begin by testing current state: measuring specimen arrivals from various business segments (inpatient, outpatient and outreach) and evaluating actual turnaround times and requirements.

There are a number of laboratory activities to evaluate for waste, including:

**Compare value- and non-value-added tasks.**
It is important to distinguish between value-added and non-value-added tasks to increase efficiency. By focusing the staff on higher value tasks, it is possible to increase efficiency and generate cost savings. Within the lab, value-added work may include: specimen collection, centrifugation, analysis, review and reporting of a result. Non-value-added work may include: sorting, moving or storing specimens, loading/unloading instruments, and quality and specimen integrity checks.

**Review workspace layout.**
Many factors influence an efficient laboratory design, including: the number and type of work stations, workflow, operational business models, and automated instruments and robotics. The most effective way to achieve maximum flexibility, adaptability and expandability is thought to be through an open laboratory plan with workstations on wheels where possible.

**Conduct value-stream mapping.**
Value-stream mapping can improve the space plan and identify opportunities for waste elimination. Steps may include an evaluation of workflow—cycle time, lead time, takt time (the available production time divided by demand), and the identification of process bottlenecks and non-value added tasks.

**Evaluate workflow.**
A thorough workflow analysis evaluates distance walked by the operator or traveled by the specimen, work-in-progress (samples waiting), number of operators and peak-period demand.

According to the National Institute of Building Sciences, "An increasing number of research institutions are creating “open” labs to support team-based work. The open lab concept is significantly different from that of the "closed" lab of the past, which was based on accommodating the individual principle investigator." Open plans enhance staff utilization, communications, supervision and offer the ability to share equipment and instruments.

**Optimizing Workflow**

Once the sources of waste within a lab have been identified, simple changes can have significant impact on eliminating waste and improving workflow. Among the most common lean initiatives to optimize laboratory workflow are:

**Create work cells.**
A work cell is an arrangement of equipment and manual workstations that follows the sequence of processes for a given product. A lean work cell minimizes handling distance (walking), improves visual management and communication, and reduces work-in-progress (samples sitting in racks waiting for processing).

**Consider operation-based versus process-based layouts.**
Lean labs group equipment based on process and operation-based layout groups equipment based on function. A process-based layout provides increased efficiencies by:

- Designing around processing steps, which reduces space requirements, number of workstations and walking; while improving visual management
- Automating processes where appropriate and not assigning technicians to a specific machine, which causes unproductive waiting
- Replenishing supplies from the perimeter in high-volume lab cells, reducing disruptive workflow
- Reducing batch sizes and aiming for single piece flow, minimizing wait times
Incorporate “U” shaped cells.

U-shaped cells are common in lean labs because they provide improvements for continuous flow, allowing an operator to finish work in the same location that they started. This also eliminates the waste of walking back from the end of the line to the beginning. The flow is set up counterclockwise as most people are right-handed, which keeps the dominant hand where the work arrives from as you progress through the line. Benefits to a U-shaped lab setup include:

- Locating entrances and exits close to each other to eliminate unnecessary walking
- Improving transport turnaround times
- Reducing floor space requirements
- Creating demand-based and flexible workflows
- Increasing communication by placing workers in close proximity

Evaluate automated material transport options.

Automation maximizes operations and decreases cost. In budget-conscious environments, pneumatic tube systems and autonomous mobile robots support workflow efficiencies by automating blood and specimen transport, providing the following benefits:

- Offering continuous workflow improvements by eliminating unnecessary transport, motion and waiting—allowing technicians and processors to focus on higher value, patient-related tasks
- Optimizing resources and minimizing distractions from non-value-added tasks
- Supporting just-in-time processing and eliminating over production and work-in-process
- Allowing for faster sample transport and smaller batches

Summary

A core belief in lean is that people are an organizations’ most important asset. This is even more critical in hospitals and clinical settings where patients’ lives depend on the work that its employees perform. Properly engaged and leveraged, these employees are a competitive advantage – delivering a better patient experience. Keeping employees safe and providing them with excellent working conditions demonstrates their value to the organization. True lean process improvement doesn’t eliminate FTEs, but reallocates them to work that adds value both to the organization and the employee.

Automated transport systems reduce three types of waste (transport, unnecessary motion and waiting) in laboratories and contribute to continuous flow and faster turnaround times. This frees up valuable staff time for higher-value, patient-focused tasks. By decreasing waste and optimizing laboratory layouts, workflow becomes cleaner and more efficient. Additional benefits include increased productivity, reduced costs, more predictable performance, reduced levels of work in progress, greater empowerment of lab personnel and improved patient satisfaction.