

Implications

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Applying Lean Production in Healthcare Facilities

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Escalating healthcare costs and a sense of urgency to decrease medical errors and improve quality have increased efforts to improve efficiency in the delivery of healthcare services. One strategy to address these problems began many years ago in an unlikely place. The Toyota Production System (also known as Lean Production), originally inspired by Henry Ford's assembly line approach to manufacturing, is being successfully applied in the healthcare setting today.

A Case Study with Park Nicollet Health Services

Park Nicollet Health Services, a nonprofit, integrated care system located in suburban Minneapolis, Minnesota, has recently undertaken a major initiative to implement Lean production practices. The Toyota Production System tools and management concepts are used to improve patient services and internal processes. Lean concepts now form a common language that is used to obtain continuous improvement across the organization. A strong organizational infrastructure has been developed to support Lean practices.

A case study of Lean processes and production methods applied to Park Nicollet Health Services is the focus of this issue of *Implications*. Specifically, the design and construction of Park Nicollet's new Heart and Vascular Center is discussed. We, at Ellerbe Becket, worked closely with Park Nicollet and the lean concepts, to maximize the physical infrastructure. Let's take a look at the Lean process, then we'll discuss how we applied it to a healthcare setting via design.

What is Lean?

Lean Production (also known as The Toyota Production System) is a set of operating philosophies and methods designed to improve production quality and efficiency. The key concepts underlying Lean Production (e.g., flow or assembly line production) were first used by Henry Ford. Faced with limited resources following World War II, Toyota Motor Company executives Kiichiro Toyoda and Taiichi Ohno built upon Ford's original concepts in an attempt to gain a competitive edge and to create security for their workers. Ford's emphasis on individual machine output was refocused on product flow from a holistic systems perspective. When applied to healthcare, the goal of Lean Production is to create maximum value for patients by reducing waste through improved quality, efficiency and safety.



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Fundamental Philosophies of Lean

In a Lean Production System, products and services are produced only as they are needed by downstream customers. One product or process is completed before another begins (i.e., single piece flow as opposed to batching work). The goal of the system is to achieve load leveling by balancing the quantity, type, and sequence of work, avoiding peaks and valleys in the production schedule and maximizing staffing efficiency.



A basic tenet of Lean Production is that cost saving can be achieved through the elimination of waste. There are **seven types of waste** identified in the Lean Production System including:

- Overproduction—production not associated with demand
- Waiting—time between value-added production steps
- Transportation—movement of products unrelated to production
- Motion—unnecessary or excessive movement of equipment or people
- Inventory—too many components on hand
- Over processing—unnecessary procedures
- Defective products—time required for the detection and repair of defects

The **Just-in-Time (JIT)** inventory strategy is another fundamental philosophy of Lean Production. JIT is designed to reduce on-hand inventory and its associated costs. The goal of JIT is to operate with the least amount of resources required to consistently deliver just what is needed, just where it is needed, just when it is needed, and in just the right amount.

The Lean concept to be covered in this article is **error-proofing**. The concept of error-proofing prevents defects at the source. The line (or procedure) is stopped at the point where an error is detected rather than farther down the line. There is a one-by-one inspection of each process phase to detect abnormalities. If a defect or error is detected, the line is stopped and the abnormality is corrected immediately. Organizations implementing Lean Production practices must create a culture in which workers feel empowered to openly identify problems and affect change.

Lean Tools and Methods

The application of Lean Production concepts begins with the identification of a problem area that requires improvement (e.g. excessive walking for a patient). Once the problem has been identified, a team of participants from all associated levels and functions is assembled. At this point, different improvement methods can be applied. Each method has a similar intent but varies in depth and breadth.

During an improvement event, participants strive to understand the factors contributing to the problem and performance measures (i.e., metrics) are established. For example, participants might time and map personnel steps or equipment movement associated with a care procedure to understand if staff is traveling long distances to gather supplies necessary to complete the care procedure. Once data is gathered, participants identify waste and brainstorm solutions to improve efficiency. Alternative ideas are tested using full-scale mock-ups and implemented as

permanent changes. Sustaining improvements over time is achieved through follow-up activities, including tracking metrics, identifying additional modifications, and encouraging participant feedback.

The Rapid Process Improvement Workshop (RPIW) is a Lean method focused on quick assessment (typically a five-day process) of an identified problem, with low-cost, easy to implement improvements. The 3P (Production, Preparation, Process) method is a process intended for larger improvement projects, including building design. 3P is focused on flow. This is the process we used and will comment more on it later.

One of the more specific and focused Lean tools is the **5S method** (i.e., sort, simplify, sweep, standardize, self discipline), which is a systematic approach to organize and manage a specific workspace or work flow to improve efficiency and reduce waste. The 5S method may be utilized alone or in conjunction with other improvement events. The 5S concepts include:

- Sort—the removal of all unnecessary items from the workspace
- Simplify—the orderly arrangement of items required for the process or procedure
- Sweep—daily systematic efforts to keep work environment clean and orderly
- Standardize—performing a task in the same way, with the same steps, regardless of whom is performing the work
- Self-discipline—sustaining practices and procedures developed in the preceding steps

The Park Nicollet/Ellerbe Becket Lean Experience

Park Nicollet is applying Lean principles to its healthcare service lines to maintain standardized work practices; leading to the adoption of best practices, the reduction of medical errors, quick resolution of patient problems, and the reduction of patient waits through single-piece flows. The organization is interested in load leveling (24-7 capabilities),



reducing waste to lower costs to patients, improved care team efficiency, inventory control, and increased profitability at Medicare payment levels.

The Heart and Vascular Center

Park Nicollet's new Heart and Vascular Center is located on the Methodist Hospital campus (426 beds) in St. Louis Park, Minnesota. Park Nicollet's Heart and Vascular Center practices a team approach to cardiovascular care with cardiology, CT surgery, vascular surgery, and interventional radiology working in collaboration to deliver patient care. State-of-the-art diagnostic and procedural capabilities include six catheterization labs with a dedicated pre-post holding unit, two nuclear/CT cameras, dedicated CT and MRI equipment, and 16 echo rooms.

The Center also includes a cardiac rehabilitation unit with walking track and fitness center, connection to operating rooms, the ER, in-patient units, a demonstration kitchen to teach healthy cooking, a retail shop offering doctor recommended products, and a conference center with cardiac imaging presentation capabilities. The project was completed in August, 2005 (43 months from programming to occupancy) with construction costs totaling \$40 million. Former cardiovascular care programs and spaces were undersized and dispersed. The new



project served as an opportunity to better facilitate a team approach to care.

In addition to supporting Lean practices, design themes for the facility included combining all heart and vascular patient services in one location and providing a supportive, non-threatening outpatient experience in a non-

institutional healing environment. Exterior and interior design was inspired by a nearby creek and wetland. Stone from local quarries, recycled granite, and art from area artists combined to make the facility feel approachable. Wetland appreciation was supported through artwork and educational displays.

Ellerbe Becket employed a multi-disciplinary team approach to facility design. Staff and patient input was collected through surveys, design sessions, and “show and tell.” The overall design process was physician-led, and the ideal patient experience was developed from the results of a Lean 3P workshop.

A multi-disciplinary team including patients and staff from all levels and functions was assembled. A week-long workshop was conducted after three weeks of extensive data collection and preparation. The team’s objective was to design a quality service that could be delivered at the required demand volume, with the correct timing for the lowest possible cost (i.e., in accordance with Lean principles). Lean looks to optimize the 7 flows. In medicine these flows translate to the flow of patients, clinicians, medications, supplies, equipment, information, and process engineering. Team members first worked to define flow challenges and preferred flow patterns from the patient perspective. Optimal flow was

accomplished through simulation techniques and timed exercises. Alternative solutions were examined and modeled, and the best process and design were selected. Ideally, 3P sessions should be conducted prior to architectural design work. The Heart and Vascular Center 3P workshop was conducted after construction on the project had begun limiting options for extensive design changes. The final design reflected the adjacencies required for patient-centered flow. The heart and vascular service is continually improved through The Rapid Process Improvement Workshops.

Applying Lean principles to the design of the Park Nicollet’s Heart and Vascular Center has resulted in a 73% decrease in patient walking distance, a 30% decrease in staff walking distance, overall cost avoidance of \$400,000, staffing cost avoidance of \$140,000, and capacity gains resulting in an additional \$2.5 million in charges.

Conclusion

This case study demonstrates that the processes and methods of Lean production can be successful in reducing costs and improving safety and quality in healthcare. Many improvements identified through Lean procedures have design-based solutions. Future collaboration between healthcare clients and designers at the beginning of the design process can be expected to yield even greater improvement results.

Resources

- Liker, J. (2004). *The Toyota way: 14 management principals from the world’s greatest manufacturer*. —New York: McGraw-Hill.
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- Womack, J. (2007). *The machine that changed the world: The story of lean production—Toyota’s secret weapon in the global car wars that is revolutionizing world industry*. New York: Free Press.

About the Authors

Jon M. Buggy, AIA, is a managing principal of Ellerbe Becket's Minneapolis office. He has worked in all facets of the business, from project architecture to marketing to his status today as one of the country's foremost authorities on healthcare design. Buggy also serves on Ellerbe Becket's Board of Directors. In addition to Park Nicollet's Heart and Vascular Center, his recent projects include Sanford Health, Boekelheide Neonatal Intensive Care Unit, and Abbott Northwestern Hospital, Neuroscience/Orthopedic/Spine Patient Care Center.



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Related Research Summaries

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“Packaging Solutions to Reduce Medication Errors” —*Applied Ergonomics*

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“Hospital Construction Management” —*Nursing Management*

“Assessment of Patients in Emergency Departments” —*Environment and Behavior*

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“A Self-Contained Operating Table” —*Anaesthesia*

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