OPTIMIZING CLINICAL ENGINEERING USING LEAN TOOLS: THE UNIVERSITY OF OTTAWA HEART INSITUTE EXPERIENCE

Timothy J. Zakutney, MHSc, PEng, CCE[*], Li Pekcan[†]

[*] *Department of Biomedical Engineering, University of Ottawa Heart Institute, Ottawa, Canada*

[†] *GE Healthcare Canada*

INTRODUCTION

Operations management and optimization is a key component of all healthcare organization's quality improvement plans and initiatives. LEAN, Six Sigma, and other optimization tools are gaining tremendous inertia and application in the healthcare environment.[1] Successes have been realized in improvement of workflow and patient care processes in emergency departments, medical imaging programs, and operating room programs.[2,3] Reduced costs and increased throughput have also been achieved. Biomedical Engineering (BME) at The University of Ottawa Heart Institute (UOHI) recognized that improvements were required in their operation and investigated the application of a LEAN tool, 5S, to their operation. By identifying and mitigating the presence of waste and wasteful activities, the main goals of this exercise were to create a more efficient work environment, enhance the team's focus on infection control, and to establish a platform for performance and continuous improvement. The exercise was performed in 3 phases over a 2 month period in 2010 with the assistance of GE Healthcare Performance Solutions (GE HPS) Consultants.

PROCESS

The process followed included 3 distinct phases to ensure a successful project from initiation to completion.

Phase 1 – Preparation

Preparation of the project was mainly focused on ensuring that the BME staff was well informed of the LEAN philosophy and the exercises that would be performed. This was primarily accomplished through in-servicing, discussions, and presentations to the group. Presentation materials were provided by GE HPS and further customized by the BME Manager.

In addition, internal stakeholders including senior management, housekeeping, facilities, and health and safety were engaged in the process. All of these auxiliary stakeholders would play a role in performing this exercise and as such, specifics on timelines and roles and responsibilities were communicated to these groups. As in any quality improvement initiative, it is important to identify and determine a baseline of performance from which possible future improvements can be compared against. As LEAN is associated with the reduction of wasteful processes, data was collected to identify the breakdown of time associated with value-added, value-enabled, and non-value added activities in order to set a foundation for future improvements and monitoring. This data was collected by GE HPS consultants through shadowing BME staff through day-to-day operations. Value added activities identified included preventive maintenance, urgent corrective maintenance, and user education. Value-enabled activities included operational documentation and consultation. Non value-added activities included those wasteful tasks such as travelling, duplication efforts, and searching and waiting for parts, supplies, and technology. Figure 1 shows the breakdown of these results prior to the 5S event. It is noted that 52% of all activities are non-value added functions attributed to

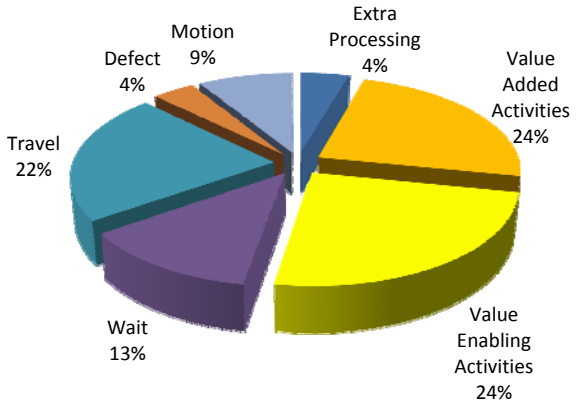

Figure 1. Work task breakdown Pre 5S Event

Table 1. Metrics before and after the LEAN event.

Metrics	Pre Event	Post Event
Inventory levels	> $25,000	< $5,000
Space used in department for inventory	14 m^2	5 m^2
Distance travelled to repair ventilator	61 m	3 m
% of Time spent Travelling	22%	13%
% of Time spent Searching for supplies and equipment within the lab	9%	2%
Infection control	Limited to technology-specific cleaning and wipe-downs	Daily wipe-down of benches and laboratory spaces

waste. This data is reflective of 5 days of observation of all staff members and accepted as a representative snapshot of the overall operation of the department. Table 1 also outlines some key metrics and statistics associated with departmental operations prior to the exercise.

Phase 2 – 5S Event: This phase occurred over 1 week in duration which included a 5S hands-on rapid improvement process which saw the transformation of departmental workspaces, processes, and implementing tasks in order to sustain the efforts for the future. The 5S event focuses on identifying components of waste in 7 broad areas; motion, waiting, inventory, defects, extra-processing, transportation, and overproduction. A 5S event includes a sequence of steps that when implemented help to identify those sources of waste and help to eliminate or significantly reduce their occurrence.

1. Sort: Sorting of the BME shop occurred over 1½ days and involved the removal of all tools, equipment, supplies, and moveable furniture. During this time all devices and supplies were categorized based on urgency and frequency of use and temporarily stored, recycled, or redistributed as needed.

2. Shine: Following sorting of the area, the entire space was fully cleaned and disinfected including floors, benches, cabinets, and cupboards. This required the assistance of housekeeping and occurred over a period of a ½ day.

3. Set in Order: During this stage, a redesign of the BME space was discussed amongst all staff using workspace planning software. Electronically, locations for staff, key functional areas, and supplies were identified. Following agreement in principal, equipment, and supplies were relocated into the space focusing on frequency and urgency of use and their proximity to the key staff members. Simulations were used to have the staff "exercise" their new workspaces performing real world tasks.

4. Standardize: In order to ensure all areas were addressed, the work was performed with partners. One challenging the other to identify what essential requirements, supplies, and tools were need to accomplish the desired tasks. This was in an effort to reduce the requirement of equipment and supplies to perform the staff function while maximizing available space. Visual cues were utilized extensively to identify the appropriate space for tools and supplies.

5. Sustain: Maintenance of the work accomplished by the staff required the development of processes and steps to ensure compliance for the future. Daily tasks related to LEAN are determined by the staff to be performed on a daily basis. In addition, weekly inspections by management are to be performed with feedback to the staff on the results.

Phase 3 – Sustain and Future Improvement: In order to sustain and build on the achievements of the staff, an Improvement Committee was created comprised of select staff members. This committee developed a terms of reference and meets periodically to prioritize quality improvement initiatives. The committee also facilitates and directs more detailed inspections and process improvement exercises for staff work areas, departmental processes, and work areas. The Committee reports back to the department through the monthly departmental meeting.

RESULTS

The LEAN project performed by BME resulted in a significant reduction of time associated with wasteful activities. Figure 2 illustrates the breakdown of work components after the 5S event. Value added components of work now compromise 64% of work performed and wasteful components had decreased by 30%. Table 1 outlines some additional statistics and metrics changes from the exercise. Specifically, significant reductions in costs associated with inventory levels were achieved. This also resulted in reduction in the space required for supply and part storage from 14m^2 to 5m^2. Prior to the transformation, BME spent 22% of their time travelling for the day to day operations. This was reduced to 13%. For

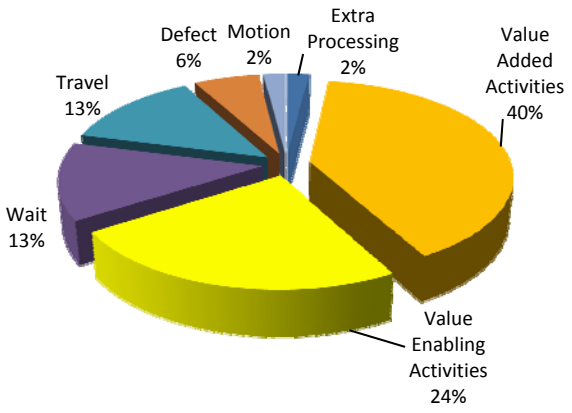

Figure 2. Work task breakdown Post 5S Event

example, for a specific representative repair process, the total distance travelled decreased from 61m to 3m for one intervention. Figures 3a and 3b are spaghetti diagrams utilized as a method to illustrate staff travel, showing the path travelled by a technologist in the performance of a ventilator PM. As is illustrated, there is a drastic reduction in the traveling required within the BME workspace to accomplish this task. Additionally, only 2% of the department's time is spent on searching for supplies and equipment; a reduction from 9% prior to the 5S experience. A new inventory management process was also developed by the group to streamline the maintenance of supply stock and ensuring availability when required by the clinical group.

CONCLUSION

Continuing work is being performed to sustain this work. This experience has resulted with a cultural shift of BME and greater focus on patient care. The new workflow and efficient workspaces has resulted in a much more relaxed and stress-free environment. One of the key contributors to the success of this exercise was the independence and accountability of the BME staff to discuss, develop, and finalize all aspects of space and process reorganization. BME Management provided some guidance but all decisions were made by BME staff. These helped in assuring acceptance of the results and also promote sustainability of the actions taken.

The significant reduction in waste associated with travel and motion are expected out of this exercise, as the 5S tool is primarily concerned with workspace organization

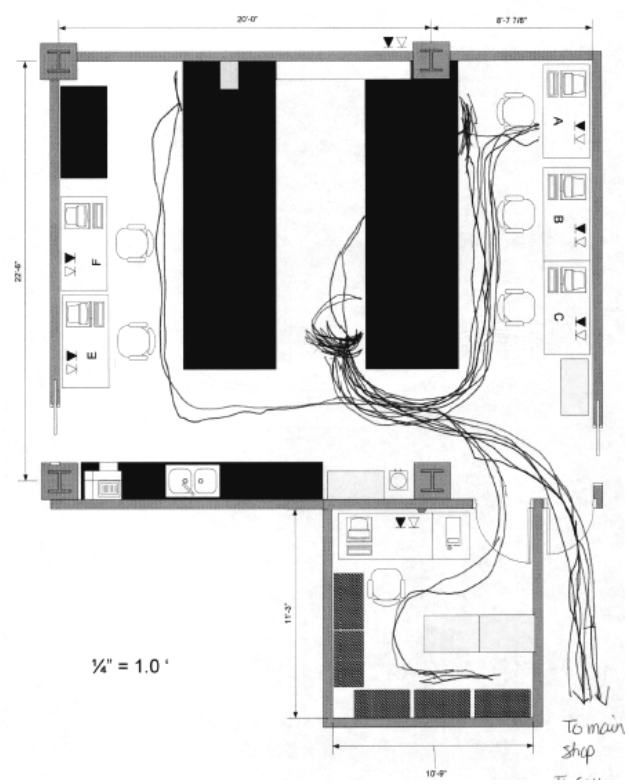

Figure 3a. Staff travel associated with the completion of a ventilator PM PRE 5S event.

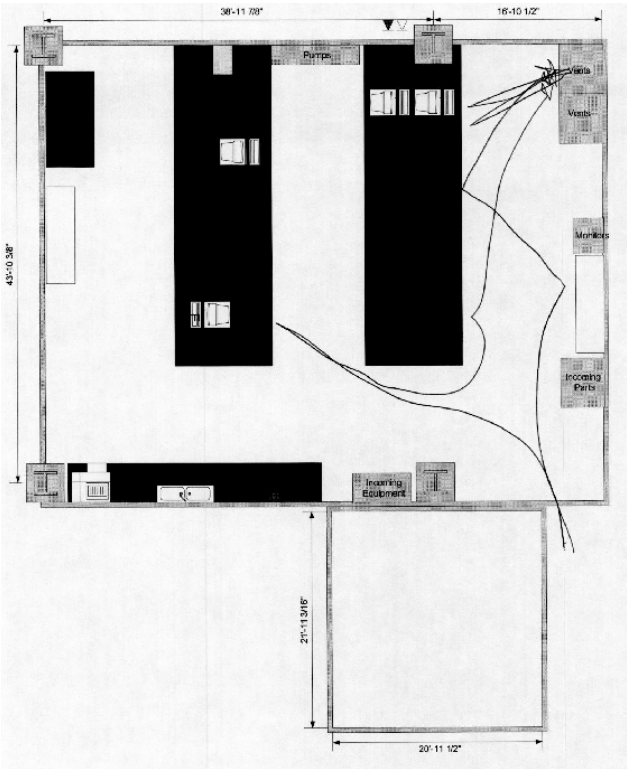

Figure 3b. Staff travel associated with the completion of a ventilator PM POST 5S event.

and flow. Further investigation of LEAN tools such as process mapping can be used to further address the waste aspects of defects, waiting, and extra processing.

Subsequently to this exercise, a relocation of a satellite BME workspace was required. The skills and tools learned from this 5S exercise were applied in this second relocation with great success. As well, several LEAN initiatives have started in the programs of cardiac surgery, clinical services, and cardiac imaging as a result of this successful first attempt at a LEAN implementation.

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