Lean Concepts for Vivarium Operational Excellence

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With the advent of advanced genomics, the availability of genetically manipulated mouse strains and other animal models have increased. We have seen increased use of animal models both in basic sciences and translational research, especially in the past two decades. However, vivarium operations did not keep up with much needed management efficiency strategies to deal with the industry-like operations that ensued with high animal use. Our facility is no different and we implemented lean concepts for improving efficiency in our operations that resulted in a nimble and sustainable facility.

What Is Lean?

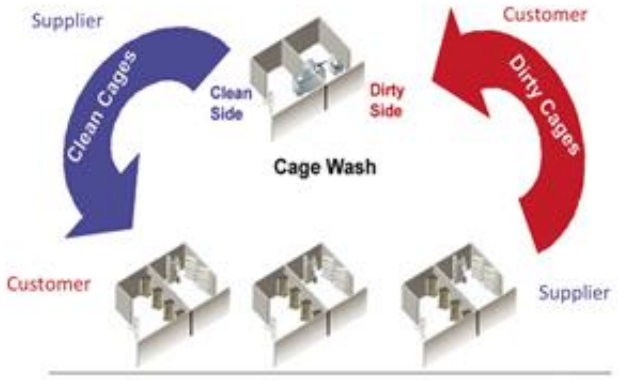
The principles of the Toyota production system are relentless attention to detail, commitment to data-driven experimentation, and charging workers with the ongoing task of increasing efficiency and eliminating waste in their jobs. This collection of ideas is often termed "lean."[4] Lean primarily identifies and eliminates the seven types of waste in every process, creating a value-added, streamlined flow of processes that are continuously improved. Process mapping, a lean tool, makes the invisible visible through mapping of the process. It is a structured approach that uses simple graphics to document key activities, decision points, timing, interdependencies, and players. All these visible points become opportunities for streamlining and improvement.

At the Biological Resource Center (BRC) of National Jewish Health, our most extensive study of the application of lean principles to animal facility operations and management involved an ambitious initiative intended to solve the day-to-day rodent cage processing and operational hurdles. The BRC supports all animal research needs at National Jewish Health. The facility has a daily average of 8,000 static micro isolator rodent cages (4-5 animals per cage), plus a few rabbit (20) and guinea pig (30-40) cages. Among the many challenges that we faced, the lack of enough clean cages and a daily backlog of dirty cages was a major frustration. Our discussions with colleagues reinforced that we share this problem.

We used value stream mapping to identify the flow and process involved with cage processing. Upon analysis of the flow, we realized that it perfectly fits the supply chain and distribution model and could be improved using lean tools and concepts.

The entire cage processing, supply, and return of dirty cages is like a closed loop, however all involved parties play more than one role (supplier or customer) depending on the nature of the work and their respective position in the loop at any given time (Figure 1).

Figure – 1



Clean Cage Supply

The clean side cage wash team is the supplier and animal care technicians are the customers. The supplier must provide the product (clean cages) just enough to match the customer demand.[1] This concept prompted us to evaluate the real demand and resources to manage the supply; in other words the exact number of cages and types (full setups, bottom cage only, large cages, etc.) for a given day. Those calculations helped us to remove excess cages from the distribution. In retrospect, we were processing more than needed.

With the required number of cages known in advance, the clean side cage wash team processed and staged the predetermined supply, allocated for different areas. Even with calculated supply, we experienced some problems of technicians not having enough clean cages in the mornings and the dirty side backed up by the afternoon. Revisiting the process map again, we identified problems with distribution among technicians.

Technicians had free access to the clean cage supply and typically would take enough to either complete a room or their work assignment, but with no clear consistency of work distribution on a daily basis. For example, some of the technicians take a significant portion of clean cages (just to finish the room), and created either a short supply or lack of cages for other technicians. The same scenario repeated the next day. Management staff was monitoring the work loads and room changes on a weekly basis and there were no guidelines for daily work flow. For example, a technician can have 600-800 cages to change per week, but there was no requirement for a daily allocation of work load, he/she could complete the task in 2 days or 5 days. The variability created another major problem, lack of accountability. The technician that was short or had no cages was either delegated to non-value added tasks or nothing was known if he or she didn't speak up. The lack of consistent distribution on a daily basis was also the cause for a back-up of dirty cages, which is discussed in following sections.

Dirty Side Cage Wash Team

Animal care technicians are the suppliers and the dirty side cage wash team is the customer. Analyzing the process map, we found that there was an uneven flow of product to the customer. For example, all the dirty cages from various rooms showed up around the same time, or there would be no dirty cage supply for a while, especially in the morning. This highlighted another important aspect, the issue of bottlenecks. The processing speed of the dirty side team is constrained by the speed of the tunnel washer and rack washer causing a bottleneck. It is always important to keep feeding the bottlenecks to gain the maximum efficiency from the machines.[1] Our machines were idle in the morning and they cannot increase speed in the afternoons to compensate, although we had a lot of cages to process.

We hypothesized that daily, consistent distribution of cages to all technicians could potentially eliminate both the

distribution problems in the mornings and the backup at the dirty side if dirty cages were returned earlier. This required our technicians to perform cage changing daily throughout the week, for which we calculated the daily cage numbers required for each technician, to complete his or her assignment for the week.

Even with daily distribution of cages implemented, the dirty side was backed up by the end of the day. We found that the dirty cages were not returning any earlier, as only a few technicians contributed for the early returns, but not the majority. Revisiting the map and flow again, it was clear we had no consistency within the animal rooms, especially with what was being done by each technician relative to others. For example, some technicians started changing cages prior to any other activity, while other technicians did other activities like census, weaning, etc., and got to the cage changing at later time. The variability among technicians in rooms also created issues with the flow of dirty cages to cage wash, creating a backlog of dirty side cage wash with bottlenecks.

We worked with our technician team to have the cage changing done in all the rooms consistently first thing in the morning prior to any other aspects (unless a crisis occurred). We were cautiously optimistic about the result. We did well, except for the fact that we still had our bottlenecks idle at least until 9:30–10:00 a.m., where we had the most return of dirty cages. As the cage wash team arrives at 8:00 a.m. and factoring in 30 minutes for warm-up of machines, we realized the need for dirty cages at dirty side by 8:30 a.m. to get a head start with machines/bottlenecks. Our team decided to have an 8:30 a.m. drop off of the dirty cages by all technicians or via a runner from each team. To facilitate monitoring of the 8:30 a.m. drop-off, we had a sign-up sheet at the dirty side cage wash where technicians indicated the number of cages dropped off, the time, and their initials. This fix worked and we now had enough cages at 8:30 a.m. to feed the machines and all the cages were being processed within the same day with no back-logs. All clean cages were staged for teams as per the predetermined numbers. It took us one year by the time we had the flow organized with everyone's consensus.

Accountability

An important and serendipitous finding during this process was the data/tool for accountability. Upon analyzing the 8:30 a.m. drop off, we observed significant variability in the number of cages returned from various technicians despite similar arrival times. This presented us with questions about speed, quality, and expected cage changing rates. We identified that we never had a benchmark for speed or efficiency, although every technician was trained for the same microisolator technique. We did time-in-motion analysis within our facility and also reviewed past references. With the data we had, we concluded that 45 cages per hour was a reasonable benchmark for our facility (not including the time for organizing the supplies or resources). With an established bench mark and with knowledge of predetermined cage numbers for each technician (on a daily basis), we not only knew the expected number of dirty cages at 8:30 a.m., but we also had the accountability for time from each technician. For example, if a technician had 600 cages per week, that is 150 cages per day for a 4 day cage change-out, or 3.3 or 3.5 hours per day for cage changing. If we factor another hour for resource allocation, we still have 3.5 hours from the technician that we can consistently expect during the week. Any deviations from the bench mark were regularly identified and discussed with an emphasis on addressing the root problem that could be either resource allocation or training. With accountability we managed to improve productivity that saved 3 full-time equivalents (FTEs) (from natural attrition) at the most needed time. We saved not only FTEs, but we also significantly reduced the overtime paid and operational expenses (Figures 2, 3).

Figure – 2

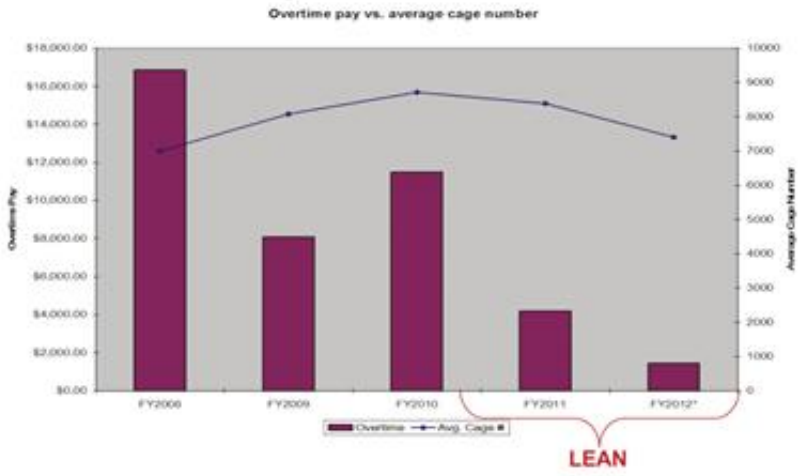


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Figure – 3 (a)

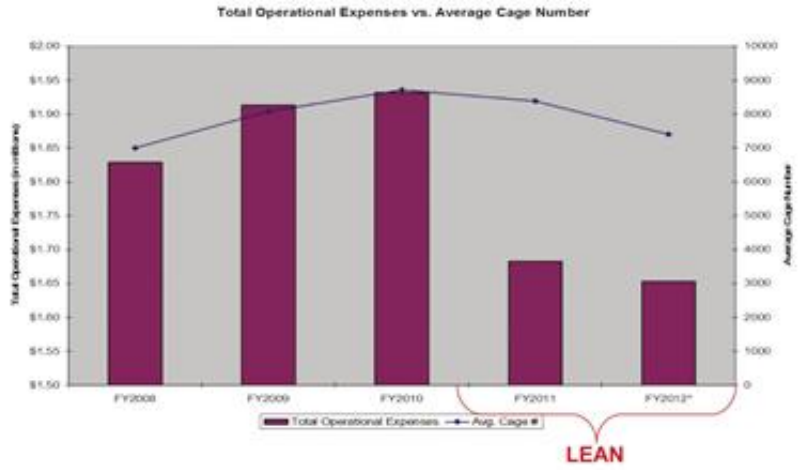

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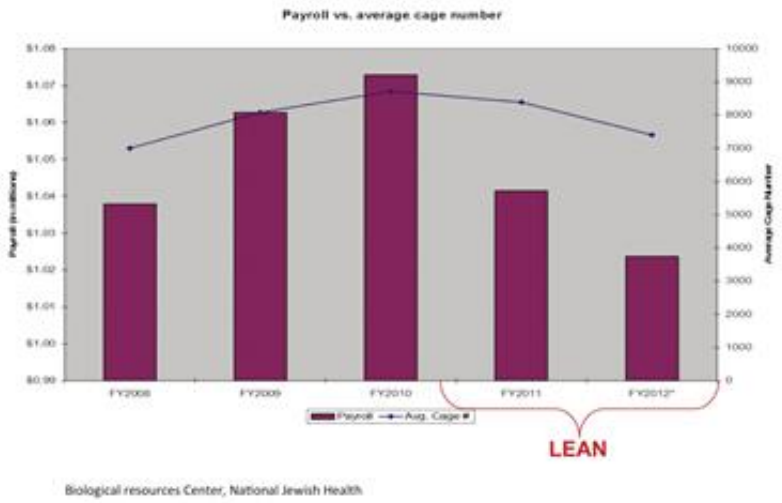
Figure – 3 (b)



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Discussion

We did not start this process with the intended results in mind. Our goal was to streamline the process for efficiency and quality, which in turn eliminated the waste that was invisible. Identification of waste is difficult because people may place a high value on established processes that are perceived to be the right way, on clearly defined and observed hierarchies, and on tight command and control. With such perceptions, the existing processes were never questioned, a hurdle for any change. Taiichi Ohno, the principal architect of the Toyota system, identified seven wastes that everyone in a manufacturing operation should strive to eliminate: 1) overproduction; 2) unnecessary transportation; 3) inventory; 4) worker motion; 5) defects; 6) over processing; and 7) waiting.

Typical lab animal facilities and programs are loaded with these wastes. It only takes an intuitive manger or worker to examine the process and define steps as waste per one of the seven categories. If waste goes unaddressed, it creates inefficiency further down the workflow.

Although we were knowledgeable of the concept, we were dealing with a culture change as we started implementing lean concepts. As expected, we faced resistance for the new initiative especially for benchmarks and accountability, and it is the navigation of resistance and change management where we had to spend the most time. To achieve consensus we focused on our objectives to identify the best simple and efficient practice that resulted in a value-added process. As the new process or change was implemented, we experienced setbacks before realizing the needed results. Managers need to be aware of this and should always be available to facilitate the process despite initial setbacks.

The three most important attributes required from managers during implementation are “go see,” “ask why,” and “show respect.”[2] It is important for managers and leaders to recognize progress. At each step the team needs to celebrate the small wins, regardless of the end result. Even in a large-scale, long-term change initiative, it is imperative to generate a steady stream of short-term wins if we want to reach the ultimate finish line. John Kotter identified six ways these wins benefit the overall transformation effort: 1) they provide evidence that sacrifices are worth it; (2) they reward change agents with a pat on the back; they help fine-tune vision and strategies; (3) they undermine cynics and self-serving resisters; (4) they keep bosses on board; and (5) they build momentum.[3]

Of course, there will be resisters to any change effort and we were not immune to it. Our approach was to start with people who were ready and supportive and leverage them to create measurable success. Many resisters came on board as the change effort gained momentum, confidence, a track record, and was supported with strong communication. For this reason, we did not place an emphasis on resisters at the beginning of our implementation. Once the success of improved efficiency had been realized, the staff was excited and proposed

several improvement initiatives. The outburst of creativity and constant questioning by the staff of the value added nature of the processes signaled the embracement of lean as a culture.

Conclusion

We are experiencing difficult economic times where efficiency in laboratory animal facilities is not an option but warranted. Embarking on new initiatives like efficiency, productivity, and meritocracy can create friction with existing culture, especially if the initiatives are novel for the institution. Hence, all efforts for improving efficiency and accountability should be considered as organizational and cultural change initiatives.

These insights have two implications. The first is that it is futile to try to change culture independent of changing behavior. We can't try to change the culture magically at the beginning of a change initiative either. It must be addressed toward the end of the change process after people see and feel the results of the change and as they experience the desired new behaviors. This was our experience after we successfully resolved the cage flow and accountability issues. The second aspect is perseverance. A major change initiative may be completed successfully and it may begin to change people's behavior and their sense of what is important and possible. But that alone is not enough for the changes to stick. Without deliberate, ongoing efforts to anchor the changes in culture, the old ways of doing things will soon smother change and reassert their dominance.

It takes true leadership, a culture of candor, team work, and a decentralized decision-making approach to create an empowered team that is excited and can lead the intended change initiatives with lean. Likewise, our profession requires great change leaders that are continuously learning and growing, who recognize efficiency and incremental progress as a continuous process, and who show up with enthusiasm and passion for each new wave of improvement. Relatively few, however, are comfortable in the world of continuous transformation where one major improvement and change initiative succeeds another. The increasing complexity of lab animal programs calls for multifaceted change leaders with a variety of experiences and a depth of judgment. These rare change agents are restless, curious, and are always looking for ways to get better. They are at home with high levels of uncertainty. Their passion, enthusiasm, and conviction are infectious. They can deliver organizational improvement and create a culture where employees enjoy the intrinsic satisfactions of success, productivity, and creativity, as well as a better reputation and greater compensation. A great change leader is no one but, you.

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2. John Shook E-letters. [Internet]. 2011. How to go to the Gemba: Go see, ask why, show respect. [Cited June 21, 2013] Available at: www.lean.org
3. Kotter J. 1996. Leading change. Boston (MA): Harvard Business School Press.
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Additional Resources

Welch J, Welch, S. 2005.Winning. New York (NY): Harper Business.