Insights in husbandry, enrichment, and new techniques and tactics

TECH TIPS

Value Stream Mapping of **Mouse Cage Production**

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Historically, the staff working in cage wash at the University of Houston washed rodent cage components and stored the components on the clean side of cage wash. The rodent husbandry staff assembled the cage components before they were transported to the animal rooms on bulk carts. Dirty cages were loaded on the same bulk carts and returned to the cage wash area to be washed. The process was performed repeatedly throughout the day. All components of the caging system and the bulk carts were washed in a rack washer. As the rodent population grew, the number of cages to be processed increased. This in turn increased the number of trips to and from cage wash and the number of times a day that a bulk cart needed to be washed. It soon became evident that despite the number of cages washed, prepared, and stored on clean side, the limiting factor for this process was the amount of rack washer time needed per day to process clean bulk carts. The purchase of more bulk carts would not eliminate this problem, but actually would have increased the amount of the rack washer time needed per day to process clean bulk carts.

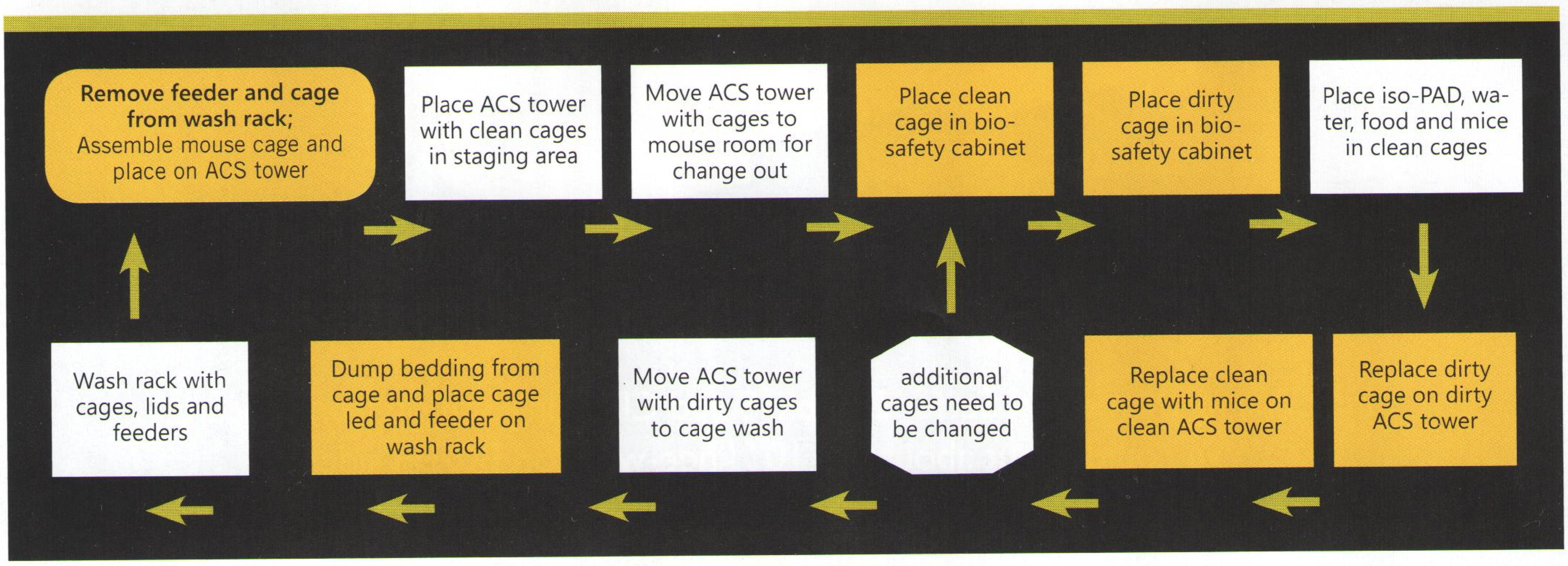

Figure 1. Value stream map demonstrating the steps needed from dirty cage dumping through lifespan of a mouse cage and ending with dirty cage dumping. The steps in which a cage is handled are highlighted in yellow. The cage is handled 6 times from clean side cage wash until its return to the dirty side cage wash.

Figure 2. A photo from dirty side cage wash that demonstrates the location of the carrousel and dump station to the location of the universal wash rack. The floor pattern is diagramed.

Figure 3. The lids are loaded on the top two shelves of the universal rack using one lid per slot. The lower 6 shelves are loaded with Optimice® cages. The feeders are loaded on the universal rack with the lid inside the cage (insert). This allows for efficient reassembly of the feeder within the cage after washing.

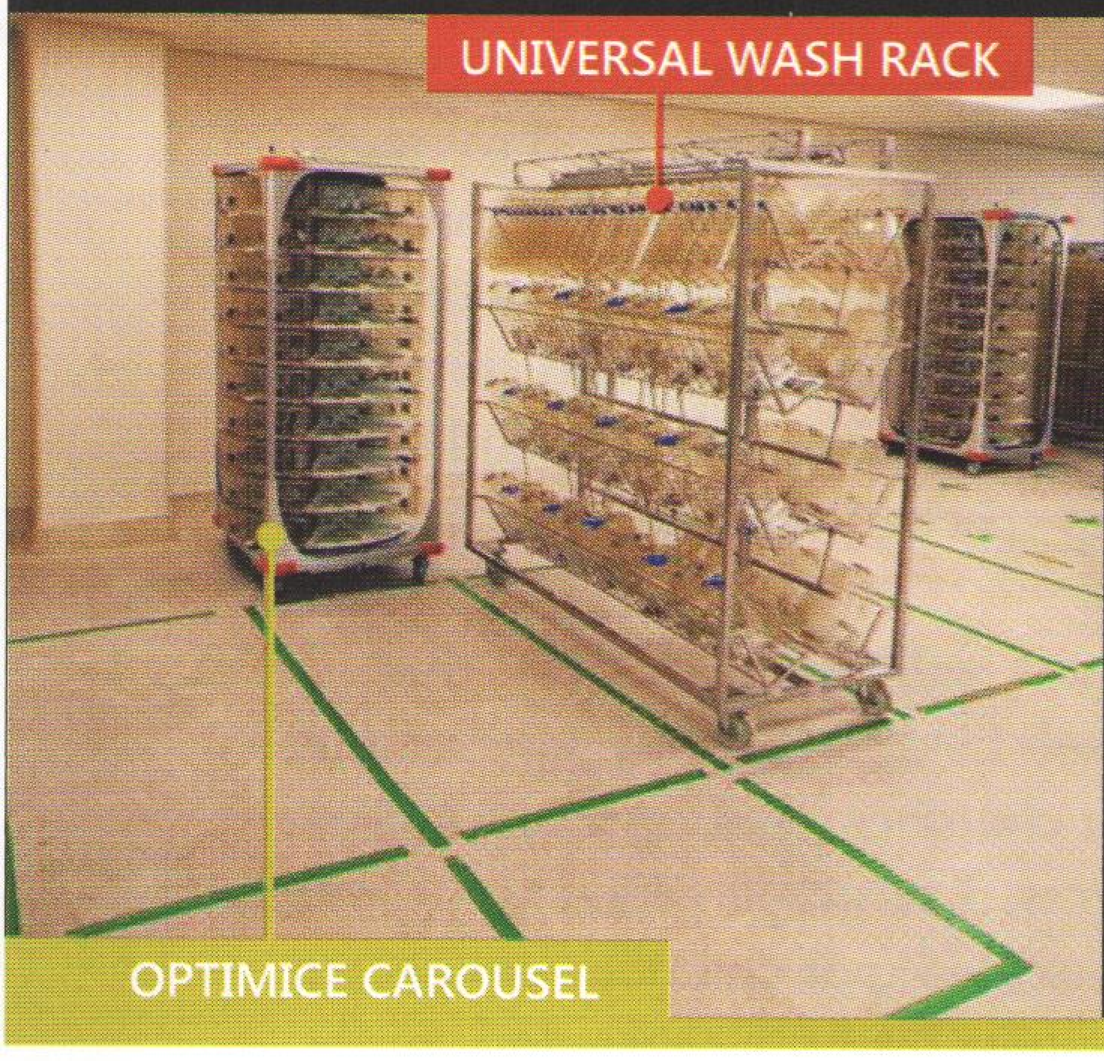

Figure 4. A photo from clean side cage wash that demonstrates the location of the carousel and clean universal wash rack. The cage, feeder, and the lids can be assembled directly from the universal wash rack without restacking any component of the cage. The assembly of 100 mouse cages on the carousel takes less than 15 minutes.

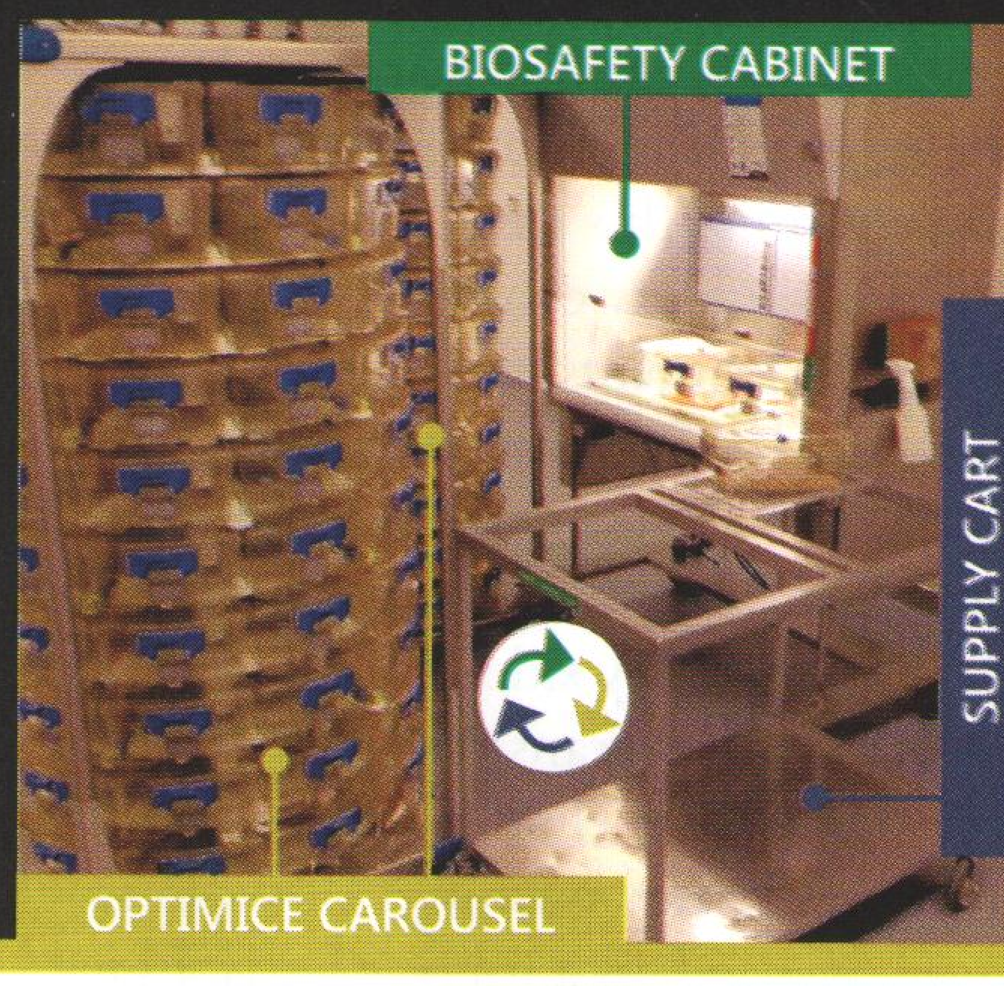

Figure 5. The carousel with dirty cages is relocated adjacent to the carousel with clean cages, supply bulk cart and biosafety cabinet. A husbandry staff member positioned in the middle of the work circle can change cages with minimal travel. The iso-PAD enrichment bedding is added to the mouse cage during this portion of the process.

Several solutions to this problem were proposed and most were focused on one aspect of the process, such as faster wash times and different ways to sanitize bulk trucks. We chose to define the product for the entire process using Six Sigma tools and eliminate waste in the process by using lean management tools.

Six Sigma focuses on the processes of defining and developing a quality product. The "voice of the customer tool" was used to identify the key drivers of customer satisfaction and the perceptions of the quality of the product. Understanding the customer's needs, efficiencies in effectively designing, delivering, and improving the product can then take place.[1] Historically, different customers existed in the process requiring different products. Clean side staff required one product—clean cages from the dirty side staff. The husbandry staff required two products from two suppliers—clean cages from clean side staff and clean bulk trucks from dirty side staff. The dirty side staff required dirty cages and dirty bulk carts from the husbandry staff. Although these products are related in sequence, dirty side staff was required to make a decision of which product (clean cages or clean bulk trucks) to produce. By redefining the customer as the investigator that paid the per diems, and the product identified as a sanitized, assembled mouse cage delivered to the animal room, the focus could then be placed on refining the entire process.

One of the key concepts in the lean management system is the elimination of waste. Waste is not defined as garbage or rubbish, but inefficiencies or items that do not add value to the product. Eliminating inefficiencies in transportation, inventory, motion, waiting, over-production, over-processing, and defects have been proven to increase productivity by getting a process under control. The production of a sanitized, assembled mouse cage delivered to the animal room is related to washing, storing, assembling, and transporting mouse cage components. The value stream mapping tool was used to define all processes.

Value stream mapping is the visual representation of the material and information flow of a specified product family. It is a useful tool with in a systematic approach to lean implementation.[2] This tool was used to define current state and future state of the process. This case study presents a process developed for providing a sanitized, assembled, clean mouse cage that is delivered to the animal room. It should be noted that this final product replaced several other products in the historical process such as stacked cages, stacked lids, washed feeders, and the most common product, clean bulk carts.

Discussion

The current value stream map for the production of a sanitized assembled mouse cage is outlined in Figure 1.

Efficiencies in Dirty Side Cage Wash: Dirty cages are returned to the dirty side cage wash on the Optimice® carousels (Animal Care Systems, Inc., Centennial, Colorado). The cages are dumped and placed on a universal wash rack using a circular 4-step pattern (Figure 2). This 4-step continual pattern facilitates the dumping of cages, loading of the universal wash rack and returning the staff member to the dirty carousel to select another cage for dumping. The staff use a constant flow pattern rather than pivoting or twisting while standing in one place. The feeders, lids, and cages were washed at the same time (Figure 3). This facilitated the reassembly process in the clean side cage wash.

Efficiencies in Clean Side Cage Wash: The wash cycles in the 900GP series rack washer (IWT S.R.L Casale Litta (VA), Italy) for both carousels and cages have been optimized based on AccuPoint 2 ATP sanitation monitoring system (Neogen Corporation, Michigan) for sanitation confirmation. A completed wash cycle was optimized to take less than 8 minutes. A complete carousel containing 100 mouse boxes occurred in a defined assembly station (Figure 4). The assembly of a complete carousel with 100 mouse boxes and feeders by one staff member took less than 15 minutes.

Efficiencies in Transportation and in the Animal Room: The complete carousels with 100 mouse boxes and feeders were determined to be the most efficient way of transporting sanitized cages to the mouse rooms. This clean cage carousel was positioned adjacent to the biosafety cabinet and a dirty cage carousel (Figure 5). The enrichment bedding (Teklad T.6910 Irradiated iso-PAD, Harlan Laboratories, Inc., Indiana) and water bottles were added to the clean caging and mice were transferred from dirty cages to clean cages. The dirty cages were transported back to the dirty side cage wash using the carousel. Utilizing the carousels as transportation devices eliminated the use bulk carts as well as eliminated the need to devote rack washer time to bulk cart washing. This also ensured that the carousels were washed on a routine basis. Floor space in the clean side and dirty side cage wash was more readily available because the bulk carts were eliminated.

Conclusion

The flow analysis of building a mouse cage resulted in dramatic changes to the process. Historically, we attempted to determine how many cages a technician can change an hour. As it turns out, moving mice between cages is a very limited portion of the entire process. Before the analysis, mouse cages were washed, bedding was added automatically, mouse cages were then stored until assembled, sent to the animal rooms for change out, and returned to cage wash to repeat the process. It was difficult to determine how many times a cage was handled during this process. By using tools of the lean Six Sigma process, the entire process of moving cages throughout the animal facility was studied. The efficiencies identified were not devoted to one area and the addition of one product or device did not make the difference. Efficiencies were gained in the mouse room and cage wash areas by eliminating nonvalue added steps in the entire process.

Now, cages are washed and assembled, moved to the animal rooms, and stored in the animal rooms after bedding and mice are added. One week later, the mice are removed and cages are returned to the cage wash area on the carousels to repeat the process. This is all accomplished by handling the cages only 6 times. The use of iso-PAD enrichment bedding was a key component that facilitated the cage assembly process in the clean side cage washroom. The irradiated, flat, and compressed sheet of cotton bedding was easily added to the cages during the cage change out process. This allowed the assembly of the cage directly from the universal wash rack and eliminated unloading cage lid and feed from the wash rack and storing them assembly later.

The elimination of bulk carts for transporting cages throughout the animal facility resulted in the dramatic reduction of wash cycles devoted to sanitizing the bulk carts. Prior to using the carousels as storage and transport devices, many of the rack wash cycles per day were devoted to washing bulk carts that had been returned to cage wash with dirty cages. This also resulted in considerable wait times for the staff prior to continuing cage change out procedures. Using carousels to transport cages allowed wash cycles to be devoted to washing cages or carousels. It also ensured that the carousels were washed during cage change out, eliminated the need to track the length of time a carousel stayed in a room, and eliminated the waiting for a clean bulk cart and storage of cage components. The use of the carousels as transportation and storage devices also eliminated the over processing of cages and cage components, further freeing up space in the clean side cage wash storage area.

One additional advantage not realized initially was that assembled cages on the carousels could be readily sterilized using a hydrogen peroxide vapor chamber (SixLog Corporation, California). In a separate process, 3 carousels (300 cages) could be moved into a hydrogen peroxide vapor chamber, connected to recirculating fans to draw vapors into the cages, and sterilized at room temperature in a 40-minute cycle.

The use of lean and Six Sigma tools has not only allowed a more efficient cage handling process to be developed, but also changed the entire sequence of the process. The assembled mouse cages on carousels are only briefly stored in the clean side cage wash area. The storage has been moved to the animal rooms. Rather than focus on the speed or quantity of cages a technician can change, efficiency was gained throughout the entire process. Our focus is no longer concerned with how many cages can be changed by a technician; the focus is now about delivering an assembled mouse cage to the mouse room by handling the cage as few times as possible. The process is less about speed and more about moving mouse cages around the animal facility and storing cages with mice in them.

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