JOB SHOP LEAN

For Related Articles Search
lean manufacturing
at www.geartechnology.com

Ed's Note: This is the third article in an eight-part "reality" series on implementing Continuous Improvement at Hoerbiger Corporation. Throughout 2013, Dr. Shahrukh Irani will report on his progress applying the job shop lean strategies he developed during his time at The Ohio State University. These lean methods focus on high-mix, low-volume, small-to-medium enterprises and can easily be applied to most gear manufacturing operations.

Dr. Shahrukh Irani, Director IE Research, at Hoerbiger Corporation of America

The Tiger Team

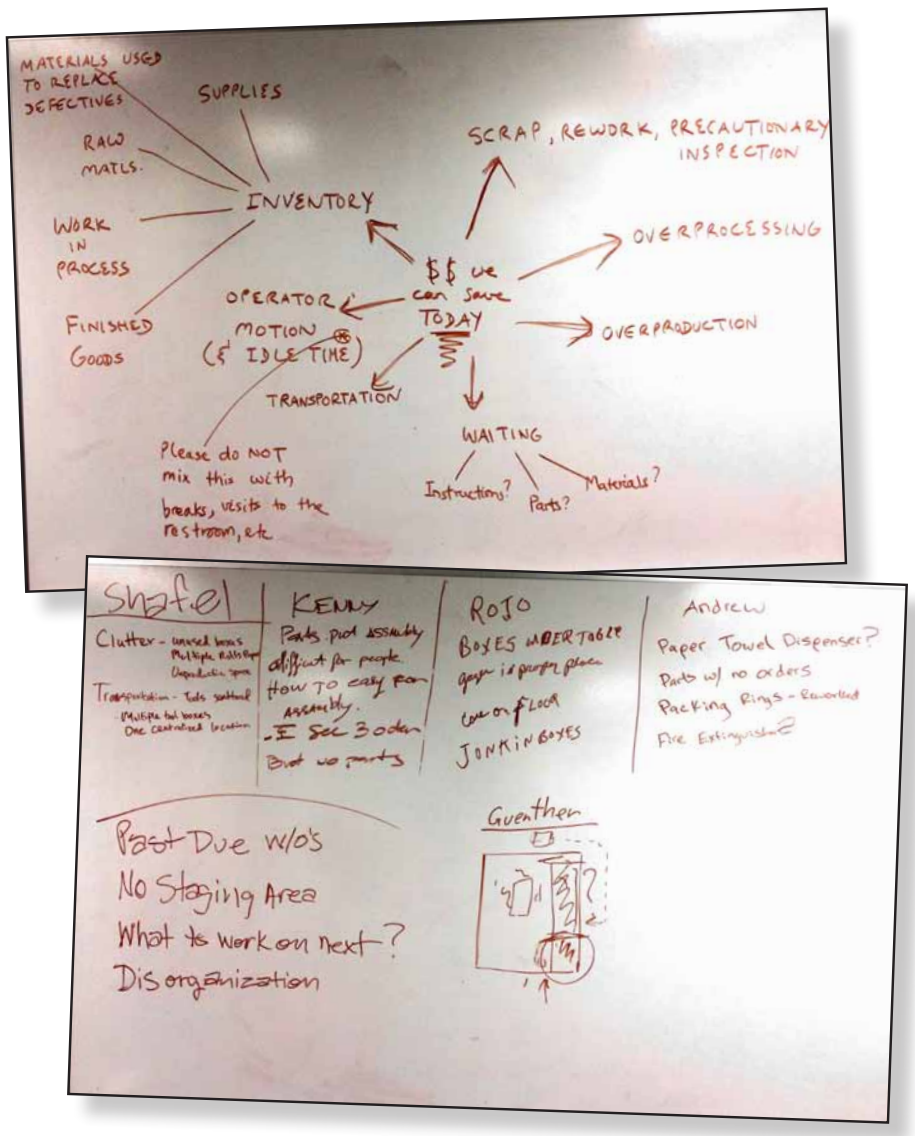
The initial approach to engage the workforce in implementing their own continuous improvement (CI) projects consisted of a weekly one-hour training session delivered to supervisors and team leaders. This approach was ineffective because considerable time was needed to conduct weekly audits of each department/cell to assess if the attendees had applied what they had just been taught. A different approach was needed. This led to the creation of the Tiger Team. Why Tiger? Because we wanted to take big bites out of the waste that existed in the shop and in the front office.

The team was designed to include (i) managers who are well-versed in the concepts, methods and CI tools, (ii) shop employees who have demonstrated an enthusiasm and/or prior expertise in implementing CI and (iii) office staff who expressed interest in initiating CI projects in departments that are "above the shop floor," such as Customer Service, Purchasing, Design, Engineering and Sales/Marketing.

Schedule of Activity

The initial plan called for the Tiger Team to meet at least once a week for a period of three months. Each meeting usually consisted of two parts:

- First, the SME (Subject Matter Expert) in the team would make a presentation to the rest of the team on a basic



Tiger Team members each received a notepad to record every instance of waste in the CA Cell.

problem-solving method/tool that is frequently used by CI teams.
- Next, the team would go to a particular area in the shop where they would engage and collaborate with the employees in that area to apply the method/tool they had just learned to improve the workspace and/or the work processes performed in that area.

This weekly routine continued in that particular area for the entire period of three months, or until sufficient improvements had been made to justify ceasing work in that area.

Focus of the Tiger Team's First Project

Our group was a mix of talented individuals drawn from different departments who wanted the team to impact any project at many levels. The team was confident that it could (i) re-engineer the daily work processes and (ii) re-design the work system to eliminate waste in any manufacturing cell or department that was assigned to us. Where should we do our first project such that waste elimination would have a clear-cut impact on the business? That dilemma was quickly solved for us. As part of a massive supply chain reorganization, corporate decided that HCA-TX would build a certain family of products in the existing "CA Cell." Currently, this cell built assemblies using machined parts that were being sourced from our sister plant in Florida. Now that HCA-TX would be responsible for the entire "CA Value Stream," the Tiger Team had found just the right project. Our goal was to observe and understand how the CA Cell worked, document and map how it really operated and determine what it would take to fit the existing pieces together into a more efficient and effective production system.

Ground Rules for the Tiger Team

- Everyone has an equal say — No pulling rank or position.
- There is no single answer for any problem.
- Learn by doing — It is okay to fail as long as you try and try again to get a better result.
- Every idea is good — Just prove that it is really good.
- Ask "Why?" five times if you think that the work system cannot be improved.

Every surface in the room was crammed, stuffed or stacked with junk.

- Maintain a positive attitude — Avoid blaming anyone or anything.
- Keep an open mind to change.
- Practice mutual respect — Treat others the same way that you would have them treat you.

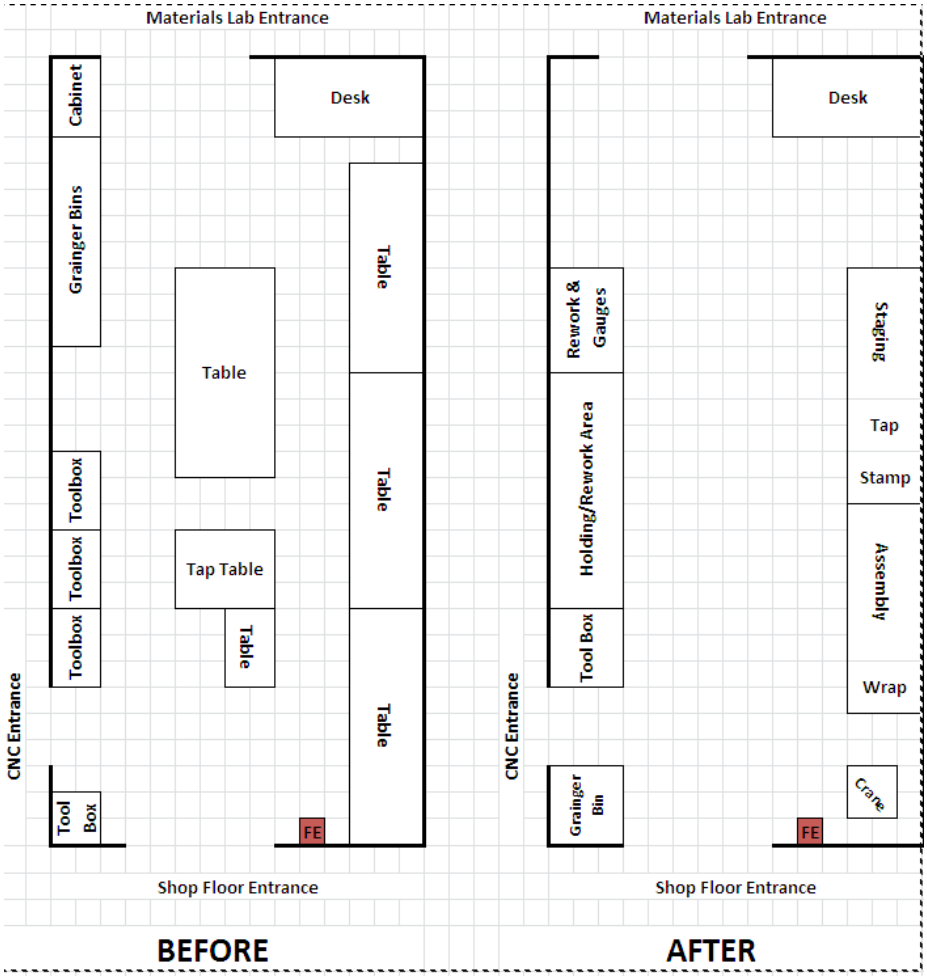
Subsequent meetings covered Value Stream Mapping (VSM), Process Mapping, Flow Diagrams, Operations Process Charts built from Bills Of Materials (BOMs), Problem-solving Tools (Five Why's, Ishikawa Diagram, etc.).

What We Did

Sort (The First S in 5S): The CA Cell hosts one full-time operator, and the room that houses it measures just 30' x 15'. Just about every surface in the room was crammed.It really was no wonder that the team could claim resounding success on that day when it undertook the removal of any and all junk from the room housing the CA Cell. Teaming up with the full-time operator and the floater from the machine shop, we achieved this goal by filling up countless trash cans and quarantining items for other departments to review, especially if they were going to be disposed of. This phase of 5S was sorely needed given the mess that cell was in, almost as if it had been used as a dumping ground by other departments. The removal of unused or unneeded tooling helped to consolidate the remaining tooling into the single mobile toolbox that was purchased for the cell.

Shine (The Second S in 5S): We wanted the cell to project a visual appeal that would not only make us proud but also impress customers and visitors touring our facility. Among the many enhancements that our maintenance department helped to make were several coats of epoxy for the floor, fresh new paint for the walls, the ceiling tiles were fixed and an array of bright ceiling lights were mounted right above the re-located assembly tables. Later, we would like to install a synchronized digital clock inside the cell and, outside the entrance, mount a framed photograph of the main product that the cell assembles. Beside that product's photograph, we hope to post the autographed photographs of the two employees who work in the cell, mainly to reinforce their pride and identity working in the cell.

Set (The Third S in 5S): There is a reason why the layout of any production system is essential for Lean, regardless of whether it is a single workstation, a single machine, a cell, a machine shop or an entire factory. Flow happens (or fails) primarily because of a good (or bad) layout. In the case of our CA Cell, the initial layout of the cell had tables and shelves lined along all the walls. A large table with lighting and racks on it sat in the middle of the room. Several small tables and benches were scattered all over the room. Assembly was not dedicated to a single table; instead, multiple in-process assemblies, rework, and projects in different phases of completion were strewn throughout the room. The Tiger Team spent several consecutive weekly meetings just standing around the cell and watching how work was done (or delayed) in the cell. During one meeting, we mapped the movements of the full-time assembly operator from start to finish around the cell (Flow Diagram aka Spaghetti Diagram). After every session inside the cell, the team would reconvene upstairs. The good ideas started pouring in! The large table in the middle had become a crutch. It had good lighting and that was the only reason it was being used. Next, we found that about half of the steps were being performed against one wall, and the rest of the process along the other wall. A couple of steps were even being done on the small tables in between! All of these problems were solved simply by implementing an assembly line/cell that required placement of two tables side-by-side and moving the toolbox, fixtures and gauges onto them, or adjacent to them at POU (point-of-use) locations. In turn, this freed up space inside the cell. Now, material that was earlier staged in carts kept outside the cell could be positioned in a 2-cart "Kanban queue" just inside the entrance to the cell. We also knew that other departments, particularly our supervisors, needed an area inside



Before and After layouts of the CA Cell.

the cell to work on special projects. To address this need, we added a rework/project table, as well as a staging rack for jobs and parts needing further attention. Thereby, anyone doing support work inside the CA Cell no longer needs to worry about interfering with the core assembly work being done in it.

Safety and Ergonomics in the Workplace: Watching the operator lift each heavy final assembly and hold it up during shrink-wrapping, often turning it around while doing that, raised a red flag. The new layout includes a jib crane and an automatic shrink-wrapping machine to wrap each final assembly before it is placed on a cart and rolled into the Shipping department. Anti-fatigue mats have been bought to reduce standing fatigue for the operator. The ceiling drop for the air hose has been repositioned to reduce the travel time and effort that the operator had to exert yanking on the hose whenever he required to blow air to clean an assembled unit.

Inventory Rationalization: Several pockets of inventory were stored in the cell, all used in the final products. We found that these items were poorly maintained and controlled. BOMs, drawings, or both, would be wrong. Fortunately, our expert operator was self-correcting these issues. To ensure accuracy and quality, we pulled all of our gaskets, O-rings, and tie rod stock out of the cell into the Receiving department. Now, only the correct items are delivered to the cell at the time of assembly. This also allows our operator to know if a BOM or drawing is incorrect, which permits us to fix it immediately at that time, making it accurate for the next time that BOM configuration is pulled. After a few months, not only were our inventories accurate, but we could also ensure better quality of our final product.

The products assembled in the CA Cell also require fasteners. Our part number Rolodex contained about 50 different nuts, bolts, washers and plugs. What we found was that we were actually stocking 150 different part numbers. Obviously something was wrong! To eliminate this issue, we teamed up with our MRO supplier (Grainger). We started from scratch and built our inventory from our current drawings, ensuring that our engineering group had a feedback loop to us if revisions were made or new fasteners created. We set acceptable minimum/maximum levels for each fastener and labeled the fastener bins with a picture of the part, dimensions, Grainger reference number, and most importantly, our ERP reference number. This way there is no room left for error, ensuring that we procure and use the correct fasteners.

Where Do We Go From Here?

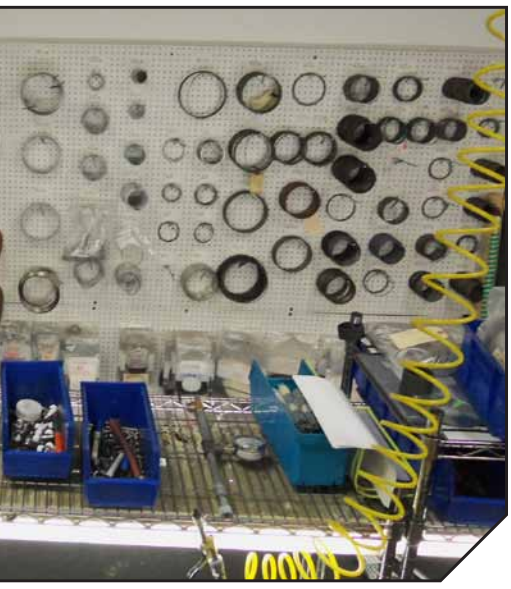
Integrated Product and Process Design (IPPD): Each assembly uses threaded tie rods for shipping and installation purposes. We found that we were calling out for and procuring smooth rods, threading them ourselves then cutting them down to size. This was all being done during assembly, thereby wasting the operator's time as follows: The operator would start assembly, see that he needed tie rods, stop work, thread the rod and cut it to specification, then complete the assembly. Today, we procure threaded tie rod, which has eliminated the threading and sawing operations. The threaded rod is less expensive than the smooth variant. Next, we plan to locate the saw used to cut the tie rod to size adjacent to the CA Cell; thereby, the operator will use his idle time to cut and fill a buffer of tie rods which would allow him to work uninterrupted during assembly periods.

WIP Reduction and Continuous Flow using Transfer Batches: Transfer batches are not as good as one-piece flow. But at least they are smaller than the shipment batch (aka process batch, if you are familiar with Eliyahu Goldratt's Theory of Constraints (TOC). We realized that for the CA product, most of our order quantities are small (less than 10 units), although on occasion we receive large orders of 50 or more. So, all these years, just to hold those ***occasional*** large orders we had packed all those tables into the single room that housed

Several pockets of inventory were stored in the cell, all used in the final product/s.

the CA Cell. That is not going to happen anymore! Now, instead of running a large order as a single batch, we are using our ERP system's capability to split an order. Okay, so we still do not know the optimal number of transfer batches that a shipment batch should be broken into. At least we plan to allow transfer batches up to a maximum size, and no more. This will make all the in-house activities related to the Value Stream for the "CA Cell" product family more manageable ex. we could start building an order using on-hand parts even as additional parts are on order. Or even give the Shipping department a heads-up so they can ready a table to package a particular CA order, even as the CA Cell is sending more completed assemblies on the next push cart from across the aisle that separates them.

"Kitbans" Help to Simplify Supply Chain Management: Everyone is familiar with a kanban (card) being associated with a batch quantity for a single part number. A "kitban" is simply extending the same idea to ensure completeness of all the components that will be required to assemble a single, or batch, of products. In the short term, we will continue to receive machined parts (the cups and flanges that go into the final product assembly) from Florida. Each case is built from a specific list of parts, i.e. X pieces of Cup X and 1 piece of Flange Y. However, analysis of our ERP records showed that we may get one cup on Monday, one cup on Tuesday, another on Thursday and the last one next Monday. Guess when assembly of that particular unit began? Only when that last cup arrived next Monday! Consequently, we are discussing with our sister plant in Florida how their machining cells could coordinate the completion times of the components in the kit of components that comprises a particular CA assembly, and ship that complete kit to our plant early enough so we can assemble and ship the assembly on time. This sup-



ply chain nightmare sound familiar to those of you who make gear assemblies? Besides, this will streamline our material handling and labor costs for the same activity.

Ratcheting Up by Several Notches the Training Given to Tiger Team Members: Management has been requested to consider allowing team members to receive more training. Currently, the training that is being offered to the team is loosely drawn from the training program developed to teach the *Quick-Start Approach to JobshopLean*. In addition, a simple training program on CI has been developed that will be offered only to the really interested and motivated employees, especially targeting those who first "did a tour of duty" on the Tiger Team! Please email *shahrukhirani1023@yahoo.com* to receive a copy of this curriculum. It utilizes Productivity Press's (now CRC Press) *Lean for Operators (Shopfloor Series)* and popular videos available from Society of Manufacturing Engineers, Greater Boston Manufacturing Partnership and Lean Enterprise Institute.

Compensation for Team Members: Rewards and incentives are under discussion. Of course, the usual ideas are being thrown around (shirts, lunches, "honor parking spots," etc.). But, it is heartening that management has taken a very serious view of those who do, and do not, actively participate in one of more Tiger Team projects. There has been talk of linking promotions, overtime and bonuses to active and valuable participation in our CI program!

(Toyota) Lean will meet Job Shop Lean: It is but natural that these two flavors of Lean, primarily developed for **low**-mix **high**-volume manufacturing and **high**-mix **low**-volume manufacturing, respectively, come together at HCA-TX. The CA Cell will need to become more flexible as it begins to make a wider range of products in the same product family. Heijunka (mixed model production) will have to be implemented. The CA Cell will pull kits of parts from a supermarket which will have to be sized and configured to carry inventories of different parts that get used in popular product configurations. This supermarket will be replenished with parts that will be machined in a FLEAN (Flexible and Lean) machining cell that will be designed and scheduled using Drum-Buffer-Rope or Finite Capacity Scheduling logic.

The current state of the CA Cell. Upper management has begun to take notice of the Tiger Team's activities.

Cell Performance Display Board: This is going to be a standard display with a focus on Quality, Cost, Delivery, Improvement Ideas, and possibly an area where the cell members can post some personal details.

The Word is Spreading among the Employees

The next Tiger Team project is being done in the MPC Cell. Kenny Pham and Dhananjay Patil (a graduate intern from the University of Texas at Arlington) have already started working with the cell's team. Having a Tiger Team member who has already worked on the CA Cell project has fired up the employees in the MPC Cell. They have already completed the Sort and Shine phases of the standard 5S effort!

Upper management has got a whiff of the activities of the Tiger Team. We may be asked to make a presentation at the Global Production Conference scheduled to be held later this year. We hope to include a short video documenting the work that we did in the CA Cell.

Andrew Reynolds has been the inventory and warehouse supervisor at HCA-TX for two years. Previously, he had been a production supervisor in the machining cells. While in college, he worked for two years in Hoerbiger Service, Greenville, SC. He is an accounting graduate from Furman University.

Dr. Shahrukh Irani is the director of industrial engineering (IE) Research at Hoerbiger Corporation of America (www.hoerbiger.com). In his current job, he has two concurrent responsibilities: (1) To undertake continuous improvement projects in partnership with employees as well as provide them on-the-job training relevant to those projects and (2) To facilitate the implementation of JobshopLean in HCA's U.S. plants.