Continuous Improvement in an MRP Job Shop? You Bet!

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Introduction

There are many success stories of manufacturers that have committed themselves to World Class Manufacturing (WCM) principles. These principles form the basis of Lean Manufacturing. However, it is a common misunderstanding among other manufacturing professionals that in order to adopt WCM principles in their own companies, one must first adopt a pull system using cellular manufacturing. In other words, in order to implement Statistical Process Control (SPC), Total Employee Involvement (TEI), Total Productive Maintenance (TPM) and the various other programs that come under the WCM umbrella, you would first have to establish manufacturing cells.

If you use, and are satisfied with, an MRP driven push system using shop orders to initiate and control production, you may think that you are excluded from using other WCM techniques. Nothing could be further from the truth. Although the majority of manufacturing professionals would argue that a pull system is superior for most operations, the use of a push system and WCM principles are not mutually exclusive. To illustrate this point, I am presenting this case study of a manufacturing operation that successfully blended push techniques under an MRP system with many of the programs normally found under the WCM banner. I will discuss how and why this happened, which WCM programs we adopted and how we integrated them into our operation. I will conclude with recommendations for other small to medium size manufacturers who wish to begin the WCM journey without giving up their MRP system.

The Setting

The setting for this paper is a typical job shop manufacturing division located in the rural southeastern United States that employed 150 people. Reviewing the manufacturing operation, the General Manager discovered long lead times, excessive scrap, a poor customer service level, inadequate inventory turns and lagging profitability. He quickly realized these were the warning signs of a dying manufacturing plant. Having read about the gains in lead time reduction, increased customer service and improved profitability from several manufacturers that had implemented manufacturing cells, he decided to follow their lead and implement cellular manufacturing. Until then all manufacturing occurred in batch lots that were planned using an MRP system and controlled with shop orders. A manufacturing cell was formed and arranged in the classic U-shape for operator accessibility. However, upon starting production the cell immediately ran into problems. It was taking longer to manufacturer parts than it had previously. It was also taking more employees to produce the same amount of parts; on top of that, the cell was frequently down and producing nothing at all.

About this time I began working at the division as Operations Manager. I started working directly with the people who operated the cell. We spent the next several

months reviewing literature on cellular manufacturing and working with the Industrial Engineering department of Auburn University, which had done a great deal of work on cellular manufacturing. Upon completing this review, we realized that much of the preliminary work that should be done prior to setting up a cell had not been done. Examples of this include:

- To be successful, rapid setup times on all equipment in the cell are a necessity. In our case it took at least ninety minutes to set up each of four machines in the cell. Having cross-trained employees who can set up all of the machines in the cell is considered another prerequisite of successful cellular manufacturing. The employees in our cell could set up none of the machines, and we had to depend on setup personnel from outside of the cell (who would fit us in when they had time).
- Since the unscheduled breakdown of one machine in a cell would bring the entire cell to a halt, a TPM program is considered critical to the success of a cell. We did not have a TPM program, operating on the basis of fixing machines only after they broke down. We also did not have a spare parts crib. When we needed spare parts, we had them flown in next day air. As a result, our cell was often down for 1 - 2 days per week for maintenance.

Now that we recognized many of the problems, what should we do? We decided to dismantle the cell and return the equipment to the batch arrangement that we had previously. We then agreed to go back and see if we could apply the WCM techniques to our operation while remaining a job shop.

The First Step

First we concentrated on teaching Statistical Process Control (SPC) to the machine operators. Our scrap rate was an unacceptably high 3% of production. This led to us scheduling extra production just in case the product got scrapped while in process. However, since scrap wasn't consistently 3%—sometimes it was under 1 % and sometimes over 8%—we would still end up with both overruns and shortages.
In order to introduce SPC, we first had to face a problem that is common in many manufacturing plants throughout the country. Some of our employees didn't possess the math skills needed to analyze the SPC data. To overcome this hurdle, we offered a remedial math class prior to giving SPC training. A local adult education instructor taught the math class on site. Our training manager presented the SPC training itself. It consisted of classroom training of 1.5 - 2 hours per week for three months. After each training session, employees immediately applied the lessons learned on the shop floor before they could be forgotten.

We implemented extensive follow-up procedures after the SPC training was completed. The result of our SPC program was a reduction of scrap of 50 percent the first year and 80 percent over three years.

Continuous Improvement Projects

Next we began working on continuous improvement projects. We assembled project teams that consisted primarily of hourly employees and provided them with team training based on The Team Handbook.[1] The training included: how to conduct a meeting, setting an agenda, various methods of generating ideas such as brainstorming, data gathering and analysis techniques and finally how to prepare a final report and presentation. Although many of these techniques were second nature to members of the management team, they were new to most of the hourly work force. On the basis of the problems we encountered with the manufacturing cell, we decided the first two continuous improvement projects would be setup time reduction projects.[2] Over the next year, we reduced the setup time on two of our major equipment groups from an average of 1.5 hours to an average of 20 minutes. We had other continuous improvement projects that led to reorganizing our equipment and changing our process flow.

Reduction of WIP

At the same time that we were attacking the long machine setups with team projects, we addressed two other inadequacies that the cell had exposed: the lack of cross training and a TPM program. There is only one way to have people cross-trained, make the commitment and allocate the resources necessary to get it done. On a short—term basis this can be financially painful, because you not only lose efficient production from the trainee but also from the trainer. However, the long—term benefits far outweigh the short-term pain. Instead of running unnecessary production just to make sure everyone has work to do; workers could be moved to the areas of true production needs. Machine breakdowns also contributed to excess WIP in the plant. When a breakdown occurred, the supplying operation would keep producing parts that would pile up in front of the broken-down equipment. We implemented a TPM program based on the principles of daily operator maintenance with periodic scheduled maintenance by the maintenance department. In addition, we established a spare parts crib so in the event of a breakdown we could pull the part out of stock and get the equipment up and running again.

Now with our setups reduced, our employees cross-trained, and both our TPM and SPC programs in place, it was time to focus on WIP inventory reduction. By using the following methods to reduce WIP, we were able to reduce our manufacturing space by 30 percent while increasing production by over 50 percent.

- We taught several key employees how to read the daily MRP scheduling reports so that the operators could make decisions on when to change over equipment.
- We instituted a “no parts touch the floor” rule. Any time the WIP inventory filled the tables at the receiving operation, the supplying operation would have to cease production until room became available. Operators hated to stop production because they were paid a group-based efficiency bonus based on production.

- Our staging areas for WIP inventory at each operation consisted of tables that were 4 feet by 12 feet. We began cutting the tables in half and removing tables representing between 15 % and 25 % of the total staging area every six months. The “no parts touch the floor” rule forced the workers at different operations to work closely together in coordinating their schedules so that they did not have to shut down their equipment.
- When we did have a build up of excessive WIP, we moved our cross trained employees there to got it processed.

Supplier Management

Now we focused on our suppliers. We had two main raw materials—steel bars and carbide tips. We put out bids once a year for raw materials and went with the lowest bidder. The lowest bidder for our steel rods was a large, well-known supplier. However, because to the supplier our volumes were relatively small, they would only make one shipment per month. Orders had to be placed two months in advance. Each month we had to forecast (and to a great extent, guess) what type of steel we would need at the end of the month three months from now and place our order. The normal result was that at the beginning of each month we got a huge shipment of steel bars that overwhelmed our storage area. Meanwhile, at the end of the month (after we had invariably forecasted wrong about precisely what type of steel we needed) we would run production based on what type of steel we had, as opposed to what kind of orders we had from customers. The steel company was also located approximately 800 miles away, making it difficult to arrange face-to-face meetings to solve problems.

One day we were approached by a company that was located approximately 50 miles from our plant that manufactured steel rods. We sent a team consisting of managers and setup operators to review their facility and equipment. By including the setup operators on the trip, it would be easier to get them to buy into the change. This was important because the change would mean fewer inventories, a situation that often caused anxiety on the plant floor. Satisfied they could meet our requirements, we discussed ordering and delivery policies. They agreed to manufacture to our MRP generated projections and deliver once a week based on firm orders with a four-day lead-time. We agreed to take any inventory they built based on our projections. This had an immediate impact on our inventory turns and production scheduling. Gone were the days when we scheduled around the steel that we had at the end of the month. We no longer had the storage problem at the beginning of the month due to the huge shipment. Finally, if there was a problem, it was an easy drive to get together for a meeting.

We faced a similar situation with our tip supplier. Although they did deliver weekly, they manufactured to order and demanded an eight—week lead-time. We were still faced with trying to predict what we needed eight weeks in advance. Since they manufactured to order, if something went wrong during their manufacturing process, we would have to wait up to four extra weeks to get our order completed. We negotiated with another firm that agreed to warehouse the tips for us based on our MRP projections and ship with a

four—day lead-time. After changing vendors for both steel and tips and adjusting to the new order patterns, we were able to reduce our raw material safety stock from six weeks to one week.

Communication

Improving communication was the other critical element of our continuous improvement process. We did this in a number of ways:

- Monthly plant meetings—during these meetings the General Manager provided an update on business conditions, discussed safety and productivity issues, and answered questions from all employees.
- Weekly supervisors' meetings—issues of concern to the department were discussed. Quarterly brainstorming sessions were held to generate ideas for new improvement projects.
- Weekly newsletters—these let all employees know how we stood against such key goals as shipping, labor efficiency, scrap and purchased burden items. The newsletter also served to help educate employees about how their actions affected the financial status of the company.

Summary

While maintaining the production flow of the job shop, we were able to implement many of the WCM concepts that people normally associate with a pull system environment. To recap we:

- Implemented Statistical Process Control
- Started employee problem-solving teams
- Initiated a Total Productive Maintenance program
- Began cross training all employees
- Implemented setup-time reduction programs
- Switched to vendors which could provide high fill rates with short lead times
- Implemented a vendor certification program
- Formalized improved communication programs

Although implementing these programs was not easy or painless, the many benefits that resulted from these changes far outweighed the problems associated with implementation. Some of the key benefits were:

- Inventory turns improved from six to eighteen
- Service level improved from 30 percent to 97 percent
- Scrap was reduced by 80 percent in three years
- Average throughput time was reduced from twelve weeks to two
- Sales increased by 50 percent as our quality and service level improved. We handled this increase in production with a 30 percent reduction in floor space
- Profitability increased dramatically

So you see, you can get on the WCM path without manufacturing cells. Based on my experience, I would argue that prior to implementing cellular manufacturing, you should first implement many of these programs so your cell doesn't fail like ours did. The important thing is to work on some of the programs outlined above and get on the path of continuous improvement. Who knows, the improvement you see in your operation (and profitability) may be more dramatic than ours!

References

1. Peter R. Scholtes and other contributors, The Team Handbook - How to Use Teams to Improve Quality , Joiner Associates, Inc., Madison, Wis., 1989
2. Mark K. Williams, CFPIM, "From Zero To Teamwork--A Manufacturing Journey', APICS 37th International Conference Proceedings. Falls Church, VA: APICS 1994

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Mark has over 20 years of industry experience in various roles including Director of Demand Planning, Senior Manager of Materials, Plant Manufacturing Manager, Distribution Center Manager, Corporate Internal Auditor and Production Control Manager.

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