Conf-9209242--5

PNL-SA--20309

DE93 001506

INITIATING CONTINUING IMPROVEMENT WITHIN GREENFIELD SITES: A FEDERAL REMANUFACTURING FACILITY CASE STUDY

J. C. Montgomery
B. K. Paul

September 1992

Presented at the
American Production of
Inventory Control Society
1992 Remanufacturing Seminar
September 23-25, 1992
Salt Lake City, Utah

Work Supported by
the Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Richland, Washington 99352

INITIATING CONTINUING IMPROVEMENT WITHIN GREENFIELD SITES: A FEDERAL REMANUFACTURING FACILITY CASE STUDY

Joseph C. Montgomery
Brian K. Paul
Pacific Northwest Laboratory
Richland, Washington

Background

The setting for this study was a federal government remanufacturing depot, responsible for the replacement and overhaul of large wheeled vehicles. These vehicles include 2.5 and 5 ton trucks and their major subordinate component items such as engines, axles, and transmissions. At the time of the case study the depot was involved in the design and construction of a 400,000 square foot hard metal subordinate items remanufacturing facility. The purpose of the facility was to consolidate all existing subordinate item remanufacturing under one roof. Commodity items to be remanufactured within the facility included engines, transmissions, transfer cases, axles, differentials, power generators, and other components.

Continuous Improvement on the Shop Floor

From the onset, the concept of consolidating existing processes under one roof had posed a significant material handling problem. Digital simulation was used to analyze material flow patterns within the new facility. As a result it was determined that, without changing the existing flow of material between processes, significant choke points would form in the areas of shared-capacity resources such as cleaning and painting. It was estimated that these choke points, representing piles of work-in-process (WIP) inventory, would clog aisles and prevent forklifts from making essential deliveries. Thus, a strategy was needed for controlling the buildup of WIP inventory within the new facility.

To accomplish this objective, a program was begun to certify the WIP inventory levels of each subordinate item commodity line within existing facilities prior to the move into the new facility. This program focused on training workers in new methods of inventory control, production control, and quality control needed to minimize the WIP levels required within the new facility.

Work crews within the existing subordinate item facilities were for the most part organized around the disassembly, rehabilitation, subassembly, final assembly, and final test of engine components. Shared resources existed for cleaning components and painting finished assets. The manual transmission commodity was selected to prototype the certification process on the basis of commodity importance and positive crew morale. A cross-functional task team was formed involving several manual transmission workers, two workers from the production control department, and one quality control inspector.

This team was responsible for redesigning the manual transmission line so that a level of WIP inventory suitable for the new building could be maintained.

To accomplish this redesign, the team progressed through five successive phases: 1) analysis, 2) education, 3) design, 4) planning, and 5) implementation. During the analysis phase, the team was oriented to the problem of WIP inventory within the new facility. Task team members were asked to measure and compare the space requirements for overhauling transmissions within existing facilities with the capability of the new facility. It was found that, while working space in the old and new facilities was approximately equivalent, storage space within the new facility was substantially less than in the old facilities. It was determined that since the WIP inventory storage space was not accommodated for in current plans for the new facility, it would be the responsibility of the team to redesign a line capable of operating with 33% less floor space.

To do this, further analysis was conducted into the origin of the WIP inventory. Three major causes were determined for WIP inventory. First, no production and inventory control method currently existed for excessing spare component parts generated by the scrappage of manual transmission control components. A control component was defined as the component with the highest scrap rate which could not be cost-effectively procured. In this case, the control item would vary between several transmission components depending upon the relative scrap rates of certain rehabilitated components. Second, it became obvious that the final test equipment located near the final assembly line was a production bottleneck. This was mainly because the two test stands which existed were both specialized to handle only one type of transmission and were awkward to changeover and setup. Finally, it was determined that the existence of non-conforming new parts also caused a significant number of delays which ultimately resulted in the pile up of WIP inventories.

Upon completion of the analysis phase, the task team was split into several focus teams, with each focus team to attack a different problem. An educational curriculum was provided to each of the focus teams to provide new ideas for redesigning the line's production and inventory control, the setups for the test stands, and the quality control of new parts. Each module of the educational curriculum was conducted as a two to four hour workshop providing the teams with the background needed for the design phase. Pull production and inventory control concepts were conveyed via a series of human simulations involving the construction of paper models and other such mock demonstrations. A short setup reduction workshop was conducted to get the test stand team into redesigning the test stand setups.

The quality focus team concluded that the quality control of new parts was beyond the scope of their capability. Consequently, the quality focus team shifted from improving the quality control of new parts to the quality control of the remanufacturing line. Prior to the startup of the case study, much effort had been expended to integrate the quality control function into the remanufacturing line. As such, some ad hoc quality control training was provided to the quality focus team to assist in this process.

Upon completion of the education phase, the focus teams began the design phase of the project. For example, a human simulation was used to design the production and inventory control of the new line. Engineering drawings were used to document the new test stand designs and procure the parts needed to assemble these designs. In conjunction with design efforts (and moving into the planning phase) cost and benefit estimates and project timelines were developed for both of the above designs. A presentation summarizing design and cost/benefit analyses was prepared and given to management. Upon receiving concurrence and support from management, the project teams moved into the implementation phase with a considerable degree of enthusiasm.

Initial benefit estimates from the work performed by the focus teams showed $1.1 million first year savings with $900,000 per year follow-on savings. Total investment of manpower in this project was less than two person-years. Payback on the project is estimated in less than one year. In addition, the task team was able to develop a remanufacturing system design capable of maintaining a sufficient level of WIP inventory without exceeding the floor space constraints demanded by the new facility. The changes proposed by the task team were quickly accepted on the shop floor and are being acted upon by shop floor employees.

After the completion of the initial study, several employees determined on their own initiative that the shop floor layout was also responsible for many of the WIP buffers in the system. With permission from their supervisor and the plant manager, these employees were allowed to try to improve upon the layout design which had been developed for the new facility by the equipment contractor. The contractor design required significant amounts of material movement between disassembly and reassembly, thus increasing the amount of WIP inventory levels. Based upon a few cellular manufacturing guidelines provided during the course of the case study, the employees were able to redesign the shop floor so that all component level material movement was eliminated from the manual transmission line. Two significant innovations were included developed by the employees in addition to those already identified. First, it was proposed that modular cleaning equipment be used in place of centralized cleaning equipment as shown in the contractor's design. Upon investigation of modular cleaning equipment available, production engineering staff were able to locate a suitable replacement allowing for significant reduction of facility floor space. Second, the employees proposed the design of a cart for holding the transmission during reassembly. Use of the cart allowed the employees to do away with the cumbersome conveyor lines proposed by the vendor and further consolidated the layout design. Overall, the performance of the employees far exceeded the expectations of the original project goals.

Continuous Improvement in PP&C

During the course of the above efforts it became increasingly clear that number one production problem-- lack of parts-- was not being addressed. Lines frequently were shut down for hours or days while waiting for critical parts to arrive. Shop floor improvements would be of little significance until that problem could be resolved.

Consequently, it was decided that improvement efforts should be undertaken with the Production, Planning, and Control (PP&C) organization as well.

This organization was in a very difficult situation at this particular time. First, parts problems, a chronic concern, were becoming increasingly critical. While opinions as to the cause of parts shortages varied widely, basically no one fully understood all of the PP&C job tasks and details of the workflow. The organization was essentially seen as a "black box" from which parts emerged. Consequently, shop members tended to blame them for parts shortages and related problems, resulting in interdepartmental conflict as well as low morale. Second, staffing levels had been recently reduced in a cost-cutting effort, leaving an insufficient number of staff members to cover all tasks associated with providing parts to the lines. Third, a number of organizational changes were about to impact the organization significantly (see Figure 1). These changes included: 1) a new MRP II software system that was about to be introduced nationwide in the agency, 2) moving into the consolidated maintenance facility and the associated need to standardize PP&C activities (which varied considerably from line to line), 3) changes in contracting procedures due to the pursuit of competitive bids for contracts, 4) modernization efforts on the lines that affected parts usages, and 5) changes in workload. In addition, shortly after efforts to improve PP&C were begun, it was completely reorganized, with the work groups being decentralized and placed under the direct control of shop management. Given that current performance was already problematic, the addition of so many new factors appeared to be overwhelming.

To attack these issues, a cross-functional team was assembled, with members coming from various areas of PP&C as well as from the shops, including a well-respected shop manager. The approach shown in Figure 1 was developed following extensive consideration of all of the issues. This approach incorporated many of the same basic components as was used by the shop floor teams. Accordingly, the process analysis was undertaken by the team. Following basic training in interviewing and in workflow analysis, two-person teams interviewed the supervisor of one PP&C group and her subordinates. The interviews gathered information on the work processes and workflow, what was going well, and what the perceived problems were. In addition, data was collected on time required to perform tasks as well as typical queue time, resulting in a picture of overall process cycle time. Team members developed extensive workflow analysis diagrams to illustrate information and work flow and to help put together a complete picture of the problem areas. These diagrams were reviewed and validated with PP&C members. Revisions to the diagrams were made where necessary to correctly capture the work. The final diagrams portrayed workflow within the PP&C work group from beginning to completion, across all positions within the group.

In the course of these activities, a number of problem areas were identified. These included: lack of training of PP&C staff, outside interference with PP&C decisions by those with authority but poor knowledge of parts system, understaffing in key areas, lack of understanding by key PP&C people of shop needs, lack of sharing of critical information among PP&C staff, and bringing programs into shops before sufficient parts are fully available. Problems in the parts receiving process proved fairly concrete. These included multiple handling of parts during delivery, random arrival of parts shipments throughout the day (disrupting efforts to supply the lines), excessive time signing paperwork on each package received, overcrowding and inaccessibility of storage areas, wasteful movement of parts from one storage area to another, inaccurate inventories, and improperly identified parts.

The cross-functional team is currently in the process of documenting problems discovered, developing recommendations for addressing these problems, and communicating their findings. Presentations of findings have been made by the team to maintenance management as well as to top depot management. These presentations have been very well-received by both groups. Additional training is being provided to provide the team with expertise needed for subsequent steps in the process. Topic areas have included inventory record accuracy, materials management, operation of the new maintenance facility, additional training on workflow analysis, and the presentation of APICS Certification Review Courses such as Production Activity Control, Master Planning, Materials and Capacity Requirements Planning, and Inventory Management. Training in pull manufacturing and JIT are also scheduled.

The plan for the near future is to initiate "interim fixes", based on team recommendations, in order to help stabilize and control the PP&C processes. As training continues, the team will establish the new requirements for PP&C based on MRP II and pull manufacturing. As shown in the figure, the team will pull together all the different drivers of PP&C changes and develop an integrated vision of PP&C functioning in the new environment. At the same time, they will monitor the impact of the interim fixes to assess their effectiveness. The vision of a new PP&C will lead to prototype implementation within a PP&C group, followed ultimately by implementation across PP&C.

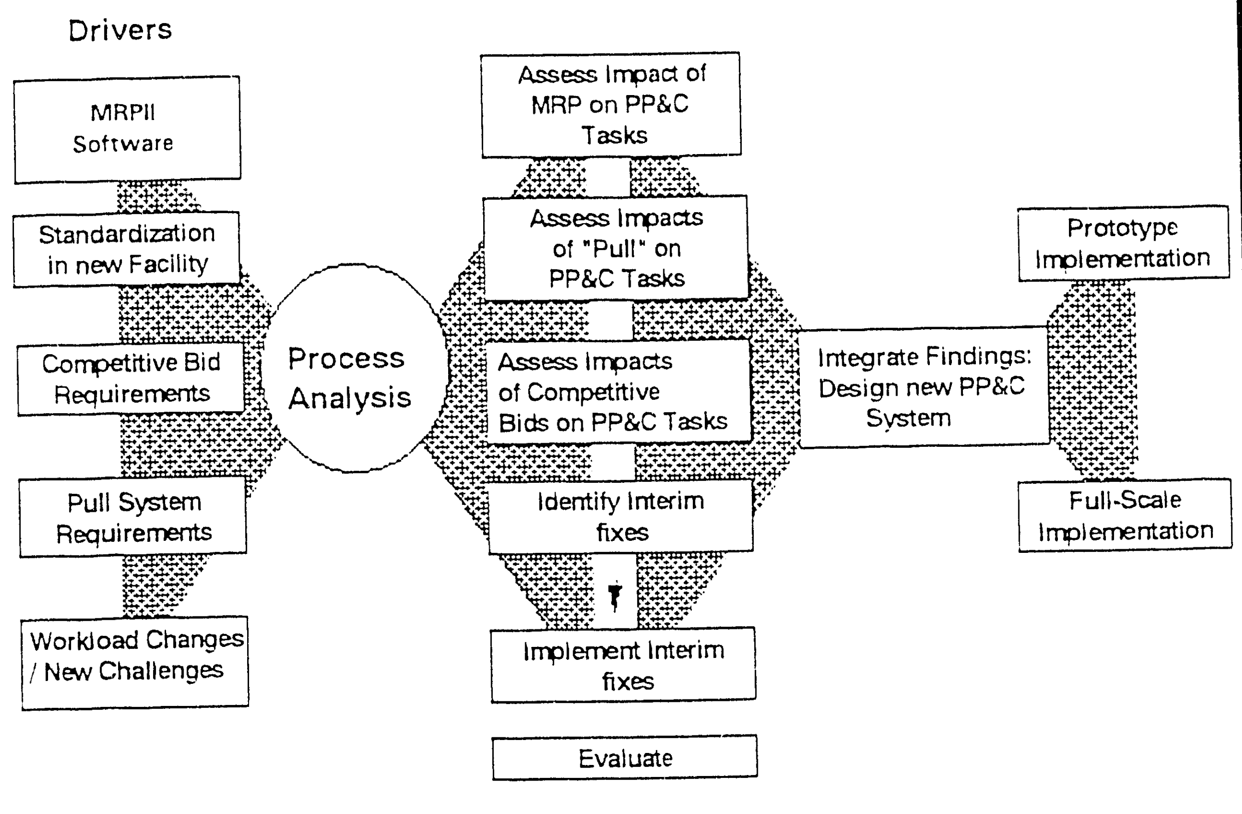

Figure 1. Five Driver Model of Continuous Improvement for PP&C

END

DATE
FILMED
12/23/92