

Maritime Cast Shop Integrated Improvement Plan

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Tasks 5-8

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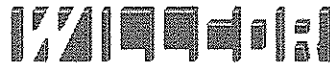
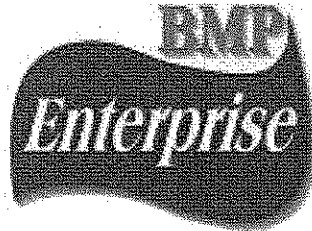
Interim Report

Prepared for Defense Logistics Agency under the Industrial Base Innovation
Fund

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Understanding future effects of today's decisions



ACKNOWLEDGMENT

The Willcor Team would like to acknowledge the superb accomplishments of all of the team members that contributed to the overall success

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EXECUTIVE SUMMARY

The Maritime Cast Shop Integrated Improvement Plan, sponsored by the Defense Logistics Agency’s Industrial Base Innovation Fund, resulted in significant increases in productivity, reduction of work-in-progress, and substantially reduced cycle times that will lead to reduced casting lead time at the participating Maritime Cast Shop (MCS).

Key company measures over the most recent six months (June-November 2009) of this project demonstrate the impact of the plant floor improvements described in subsequent sections:

- 20% Improvement in efficiency in Upgrade and Inspection
- 26% Reduction in work in progress (WIP)
- 28% Reduction in the close out report rate through the quarter ended Sep 2009
- 34% Value added capacity increase in Inspection (constraining department) resulting in reduced cycle/lead time
- 4.7% Scrap reduction from the same timeframe of the previous year

The Willcor Team developed a unique approach to improving operations for foundries. The Willcor approach varies from traditional tactics that target single cast components and improve performance ‘one casting at a time’. The Team’s methodology took a comprehensive system view and targeted improving foundry operation work processes and product lines.

The project was accomplished in two phases. The first phase being an assessment to tailor the plan to the unique needs of the MCS foundry and ensure an effective use of resources. A ‘menu’ of activities was presented to the MCS management. The MCS selected activities and the Willcor team formed action groups to accomplish those activities. Sites at which MCS improvement activities were conducted included the MCS upgrade facility and the MCS foundry operation.

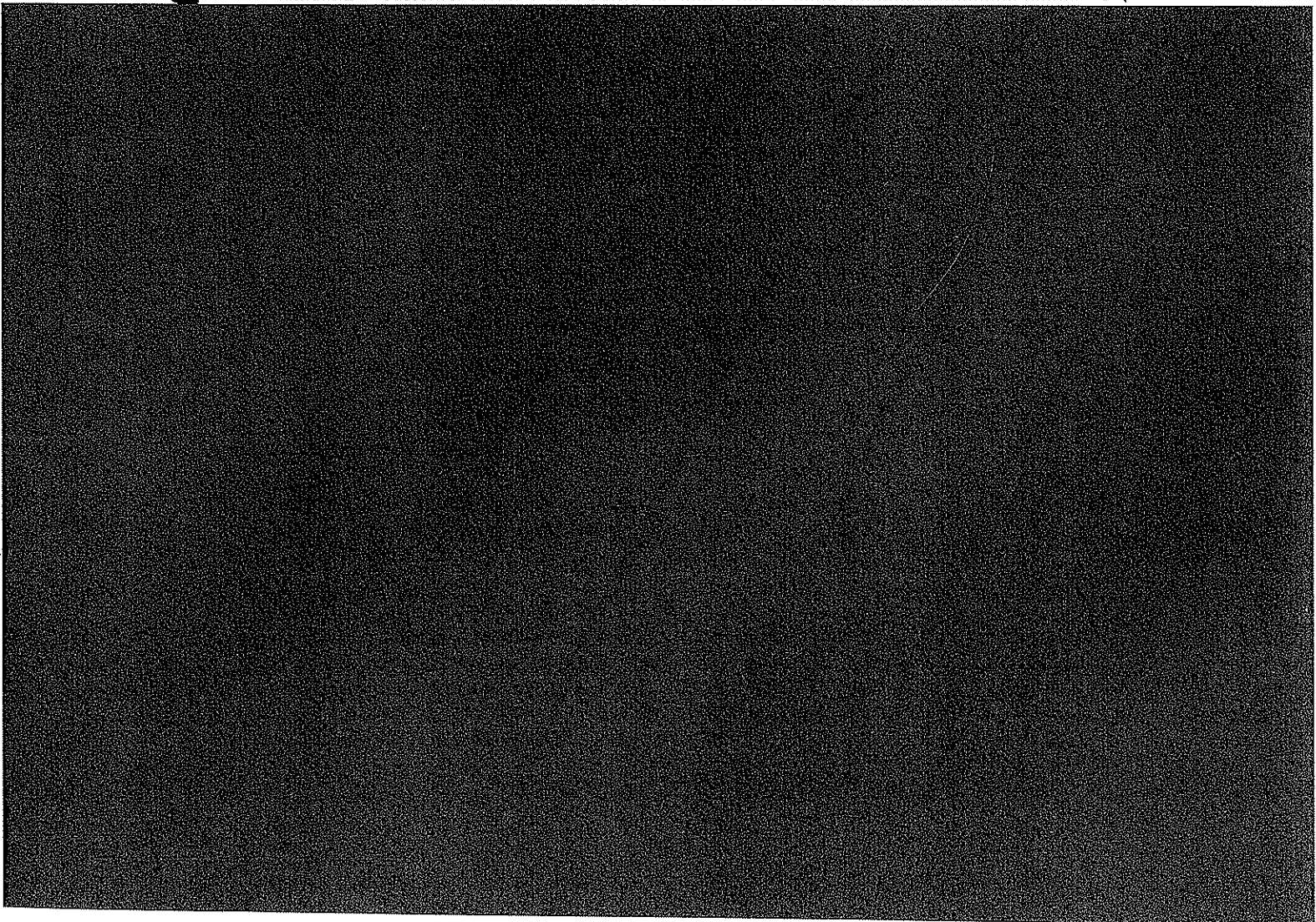
At the MCS upgrade facility, the Willcor Team conducted projects centered on the principles of Lean Engineering and JobShop Lean. The first significant activity was to perform Lean engineering training. Brainstorming with the MCS on limiting constraints and desired improvement areas lead to a number of projects. These projects generally addressed constraints that limited capacity and also methods to reduce transportation and handling, both of which had a positive impact on cycle time and projected lead times.

At the MCS cast operation, the goal was to provide off-the-shelf cost effective tasks that would lead to improved 1st time casting quality. As efforts progressed, training in Lean Engineering principles was added to the scope of the work and resulted in the conduct of 5S shop organization efforts as well as the establishment of daily stand up meetings between mechanics and supervisors. Projects that successfully went forward included improved facilitation of scrap and revert, use of 3-D CAD drawings, and mold heating. Though not completely implemented at the time of this report, progress was made in the implementation of Manufacturing Resource Planning software, temperature monitoring and weight management at the melt station improvements.



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1 SUMMARY

1.1 INTRODUCTION

Under the auspices of the Maritime Cast Shop Integrated Improvement Plan this project provided significant improvements to a specialized maritime defense and commercial sector foundry.

The Willcor Industrial Base Innovation Fund (IBIF) proposal was a result of observations made while assisting General Dynamics Electric Boat to improve their supply chain which included critical casting suppliers. Shipbuilders periodically experience construction schedule delays with resultant cost increases resulting from castings issues. Casting issues in shipbuilding include the late delivery of components as well as the late discovery of latent quality issues. Costs of shipyard delays are typically vastly out of proportion with the actual cost of the casting itself.

During the conduct of previous efforts, it was noted that casting houses supporting U.S. Navy shipbuilding have several common characteristics:

- The manufacturing effort is typically high mix, low volume
- Radiographic casting upgrade processes and the subsequent defect weld upgrade, review and approval process is a cycle time driver
- The business is frequently small, often under one hundred employees
- Environmental policies discourage the development of new casting businesses or expansion of existing operation, and therefore most of the maritime foundry industrial base has been established for several decades
- The business has not made the investments to incorporate state of the art practices in;
 - Physics based finite element solidification modeling software tools
 - Technical process innovations and improvements
 - Continuous improvement techniques developed specifically to support reducing cycle time and waste in high mix, low volume manufacturing

Based on benchmarking and other related work, Willcor conceived of an approach to improve foundry product lines beyond the traditional tactic of improving “one casting at a time.” The proposal included four elements integrated into a program designed to improve the upgrade process and first time cast component quality:

- Job Shop Lean - reduce production lead times on short-run, low volume, castings
- Physics Based Software Tools – off the shelf technology to improve mold design
- Technical Processes Assessment – deploy industry best practice technologies
- Computed Radiography – digital files to replace costly film and improve cycle time

Significant progress was made on these tasks with the exception of Computed Radiography. The delay of approval by NAVSEA for standards for the application of Computed Radiography on nuclear, Level I and SUBSAFE components, the primary products of this foundry, made the execution of this task problematic. (Note: The MCS foundry has decided to buy Computed Radiography equipment for preliminary quality



and information shots. The forward leaning thinking of this foundry will place it at the forefront of Computed Radiography use once these standards are approved.)

The MCS decided to partially implement the Physics based solidification modeling capability as originally proposed by BMP. The MCS had questions on the cost benefit equation given the very small production runs and the investment in Computer Aided Drawings (CAD) which have not been made available from the customers. The portion of this task that was completed was highly successful. The MCS hired an engineer who was trained under this task in CAD tools. The CAD capability allowed the MCS to outsource solidification modeling to an outside provider.

The success criteria of this project is the number of recommendations and projects that are “transitioned” for use by the MCS. The Maritime Cast Shop Integrated Improvement Project resulted in the implementation of numerous plant flow changes, concepts and technologies with significant investments made by the MCS, all of which have contributed to significant improvements in the manufacture of cast components and the reduction of schedule and cost risk to submarine and aircraft carrier construction shipyards. A summary is provided as Attachment A.

1.2 SUMMARY, RESULTS OBTAINED AND CONCLUSIONS

1.2.1 JOB SHOP LEAN

Typical lead times for maritime sector valve bodies are about 30 weeks. Larger castings such as hatches and hull trunks are typically double this lead time. A cladding process applied to a cast component can have lead times that approach two years. Job Shop Lean (JS Lean) has successfully reduced similar lead times when applied by the DLA R&D Enterprise Team (DLA-J339) and the Logistics R&D Branch (DLA-DSCP) to forges in the aviation and land sectors. The Willcor team successfully applied JS Lean techniques to maritime sector foundries during the course of this work.

The MCS upgrade facility (Upgrade) and foundry (Cast shop) are true job shops; they both contain a number of “monuments” and job-to-job variation demands a high degree of flexibility on the shop floor. The foundry and weld upgrade facility are integral parts of the value stream. Upgrade is integral to the nuclear, Level I and SUBSAFE maritime foundry castings and determines about 65-85% of product lead time.

The primary goal of this task was to reduce the average cycle time for castings that are processed in the upgrade facility. Second tier objectives which supported the primary goal were:

- To reduce the total time spent to complete weld/grind/inspect cycles for emergent repair on the castings
- To improve work-flow and reduce Work in Process (WIP) by improving the storage, control of workstation queues, and improving scheduling and tracking of active orders
- To identify and improve production constraints and bottlenecks
- To increase value-added utilization of resources in the work cells identified as constraints



During early efforts the Inspection Department was identified as a critical constraint which, along with other intra-shop transportation and handling, contributed to a large amount of WIP present on the shop floor.

- To achieve these goals and objectives, specific projects undertaken were:
Implementation of a manufacturing cell and associated area layout improvements which reduced casting transportation and handling.
- Implementation of a scheduling system between the constraint department (Inspection) and the non-constraint departments (Grinding, Welding and Radiography.)
- Improvements in the Inspection Department (constraint department) layout, supporting tool access/organization, which improves overall plant throughput.
- Analysis and identification of ways to improve throughput in shipping and receiving which was co-located with inspection.

Initial focus was placed on improving the overall plant constraint, which was inspection capacity. The Team initially found over production at several work centers in the upgrade facility. Inspection did not have the capacity necessary to increase throughput and therefore reduce cycle and lead time. Theory of constraint methods were applied to this bottle-neck and the team achieved a throughput increase of 34% at inspection.

Based on analysis of a sampling of casting patterns, the MCS decided to implement a cell that would co-locate workstations for Grinding and Welding. The capability for grinding or welding technicians to perform self inspection using portable Magnetic Particle Inspection hand held units was also developed. This provides technicians the ability to self-inspect and reduces the number of surface defects found at the final ‘buy off’ formal inspection. The following benefits are realized with implementation of this cell:

- 26% - 42% reduction (part number dependant) in the total number of part moves throughout the shop and reliance on bridge crane and forklifts whose availability and slow speed of operation contribute to inefficiencies
- 20% - 42% reduction (part number dependant) in the number of intra-shop Grind⇒Inspect⇒Weld⇒Inspect loops

Personnel and resource limitations at the MCS required implementation of cell improvements to be accomplished in phases. Phase 1 is complete and additional phases are in planning.

Key company measures over the most recent six months (June-November 2009) of this project demonstrate the impact of the plant floor improvements described in subsequent sections:

- 20% improvement in efficiency in Upgrade and Inspection
- 26% reduction in work in progress (WIP)
- 28% reduction in the close out report (report shows planned to actual labor element per casting and any problems encountered) hourly rate through the quarter ended Sep 2009



- 34% Capacity increase in the overall constraining department, Inspection
- 4.7% scrap reduction from the same timeframe of the previous year

Theory of Constraints methods were applied which reduced WIP, an indicator of increased throughput through the plant and Inspection constraint. Increasing Inspector’s “value added” inspection time by 34% provided concrete evidence of additional capacity gains in the plant constraint. This improvement reduces cycle time and overall lead times of the castings, a key goal of the project. Improved quality of castings, another goal of the overall project, also contributes to reduced WIP as this causes less work content in Upgrade. Scrap rate trends during this six months show a 4.7% reduction from the same timeframe of the previous year.

Improved productivity measures such as reduced labor hours as a percentage of sales are being observed. This observation demonstrates success in removing non-value added activity in the Upgrade and Inspection processes. Initial casting quality also appears to be improving based on the company’s recent casting close out reports. These reports provide data on work performance against standard or planned hours. In a recent set of about forty close-out reports only one casting exceeded planning estimates.

1.2.1.1 Conclusions

Job Shop Lean has proven to be a flexible and adaptable methodology that is equally successful in the MCS foundry as it was in prior DLA forge applications. The MCS foundry and associated upgrade facility has improved in a number of critical areas as demonstrated by improving company measures which indicate capacity/throughput has been increased, which in turn reduces the lead time of critical maritime castings. JS Lean has proven to be an excellent precursor to other technically focused foundry process improvement methods.

1.2.1.2 Lessons Learned

1.2.1.2.1 Process Mapping

It is recommended that process mapping (and value stream mapping) which identifies areas of waste and improvement opportunity areas precede efforts focused on the foundry technical process. Process mapping helps the technology focused efforts get off to a faster start as the entire process has already been mapped out and viewed from a holistic “system” level. The methods/tools used in JS Lean and quality improvement efforts have many similarities and are often synergistic. Group technology approaches which are a cornerstone of JS Lean are an important starting point in a custom foundry such as this that has a high mix/low volume business or product base. The WILLCOR Team believes that the hands on approach taken with an engineer or engineer intern (with appropriate JS Lean training and ongoing mentoring) working onsite with the company accelerated the pace of adoption of the methods and improvements. Strong involvement and coaching of managers by the company President/CEO is essential to achieving the rapid success MCS has seen to date.



1.2.1.2.2 Customer Driven Hold Points

An ancillary issue observed at the MCS and by the WILLCOR team at many other component manufacturers is the untimely accomplishment of customer required hold points. Customer required hold points are essential elements of the customer’s supply chain quality assurance plan. These hold point requirements should not be diminished but should be better managed.

The untimely accomplishment of customer required hold points cause components to be stored as work in progress until the customer can accomplish the inspection. As with any WIP, cost and lead time is increased and instability in schedules is created.

It is incumbent on the shipbuilding industry to recognize this issue and take steps to mitigate its impact.

