

Survey and Overview on Analysis of Lean Techniques for Economically Sustainable Foundries

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Abstract: Lean manufacturing is a set of tools to improve the quality of manufactured products and reduce the total cost. The foundry industry, as well as manufacturing in general, has significant challenges in the current regulatory and political climate with developing an economically and environmentally sustainable business model. Lean manufacturing has proven itself as a model for both economic sustainability and environmental stewardship. This paper will review the current literature and describe how lean manufacturing and green manufacturing can give a detail framework for the economically sustainable and environmental foundries. Lean and green techniques which can be applied to foundries in a global context will be described.

Keywords: Sustainable Foundries lean manufacturing, Total Productive Maintenance, Lean Tools and Implementation Strategies

1. INTRODUCTION

The foundry industry faces specific challenges with respect to economic and environmental sustainability. Foundry processes require substantial energy, typically generated using fossil fuels; whether onsite or remotely at an electrical power plant. Melting the material consumes the majority of this energy; however, other energy intensive processes such as heat treatment are also included in many foundry operations. Also, a majority of foundries utilize sand as a molding material. The binders utilized can often include organic compounds, and, when pollutants which are regulated burned out in the casting process, release volatile organic compounds and hazardous air. The casting finishing process can also utilize organic materials which can result in environmental impacts as shown in the Fig. 1.

In addition to having environmentally sensitive processes, the business structure of the foundry industry has hindered its ability to develop and implement sustainable practices. Despite the challenges, castings will continue to be critical components for many of the essential products for both developed and developing countries. Foundries can become economically and environmentally sustainable businesses with the systems approach offered by implementing lean and green methodologies.

2. EXISTING AND PROPOSED SYSTEM

Existing system

The lean manufacturing movement was first highlighted in contemporary manufacturing by a five-year study done at Harvard University by Womack, Jones, and Rose which was published in a book called "The Machine that Changed the World" in 1990 [9]

The history of the automobile industry was studied and the quality and productivity improvement techniques applied by Toyota were termed "lean production". This production system, termed the Toyota Production System, TPS, is the over-arching framework and philosophy that can be used to organize manufacturing facilities and processes as well as to restructure suppliers and customers to provide best quality, lowest cost, and shortest lead time through the elimination of the several forms of waste and involving all the employees [4]. As more and more companies attempted to become lean and struggled with lean implementation, it became apparent that applying lean as only set of tools on the production floor did not work. In his follow up book about lean manufacturing, Womack

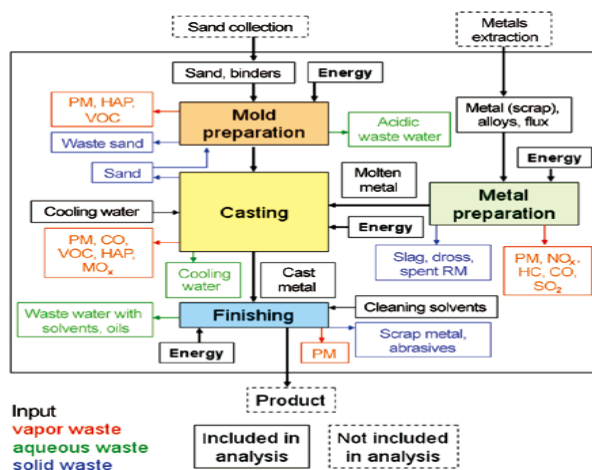


Fig. 1: Example of foundry system waste streams

tackled the process to become lean and defined five steps to guide its successful implementation [8].

The Shingo Model recognizes “Cultural Enablers” as the foundation of a lean enterprise. Culture as a central lean implementation requirement is reiterated in the US Environmental Protection Agency (EPA) study of lean manufacturing and agreed upon by many other studies [9, 3].

• Proposed system

Since, industries are primarily made up of small foundries with unique product and process combinations limiting the ability to develop technologies that benefit a large group of foundries. Objectives and proposed solutions for the above problem definition are listed as follows.

- The foundry industry, as well as manufacturing in general, has significant challenges in the current regulatory and political climate with developing an economically and environmentally sustainable business model.
- Lean manufacturing has proven itself as a model for both economic sustainability and environmental stewardship. Several recent studies have shown that both lean and green techniques and “zero-waste” policies also lead to reductions in overall cost. While these strategies have been examined for general manufacturing, they have not been investigated in detail for the foundry industry.
- The Prime objective is to implement the lean manufacturing techniques in foundries for enhancing performance.

Table 1: Lean Manufacturing System Models

Lean Manufacturing Waste	Lean Waste Reduction Tools and Technique	Lean Business Outcome
Overproduction	5 S	Improve Quality
Inventory of Raw Materials	3 R / 5R	Reduce Cost
Work in Process Inventory(WIP)	Value Stream Mapping(VSM)	Right Time Delivery
Inventory of Finished Product	Kanban	Customer Satisfaction
Waiting of Equipment	Kaizen	Increase Profitability
Waiting of People	Pokayoke	Improve Productivity
Unnecessary Movement of Materials	SMED (Single Minute Exchange of Dies)	Reduce Lead Time
Unnecessary Movement of Finished Product	Takt Time	
Unnecessary Movement of Equipment	Just in Time	
High Rework or Defects	Operator Care program	
Excessive scrap	ISO 9000	
High rejection	Total Productivity Maintenance(TPM)	
Frequent warranty claim	Total Quality Management(TQM)	
Lost people potential or Unused creativity		
Poor Plant Layout		

3. TECHNOLOGY USED

In the present research it is proposed to adopt following methodology

- The identification and steady elimination of waste (muda - wastefulness).
- As waste is eliminated quality improves while production time and cost are reduced.
- A non exhaustive list of such tools would include: Value Stream Mapping, Five S, Kanban (pull systems), poka-yoke (error-proofing), Total Productive Maintenance, elimination of time batching, mixed model processing, Rank Order Clustering, single point scheduling, redesigning working cells, multi-process handling and control charts (for checking mura - unreasonableness).
- Analyzing the data acquired by applying lean technology for foundry using statistical tools.

4. POSSIBLE OUTCOMES

By applying lean manufacturing techniques the outcome expected are

1. Waste reduction
2. Improvement in productivity
3. Overall cost of manufacturing in foundries

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