Production lead time improvement and waste reduction through lean manufacturing implementation

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1. Introduction

For being alive in this period of competitive world, it is necessary for manufacturers to find best practices to decrease the manufacturing lead times to catch the productivity improvement and achieve the customer satisfaction. In view of that, lean approach has been applied in many manufacturing companies to accomplish the reduction in total production lead time (TPLT) through eliminating the sources of wastes and identifying improvement opportunities during the production flow. In this regard, value stream mapping (VSM) is employed as one of the widely used lean techniques to recognize waste and values in production stations. A value stream considers all the actions (both value added and non- value added) currently required to bring a product through the production flow from raw material into the arms of the customer. VSM is a visual analytic technique that helps practitioners to see and understand the flow of material and information as a product makes its way through the value stream. In the VSM approach, time is divided to value added time and non-value added time on the timeline, thus, it is tried to use lean tools to eliminate non-value added time and optimize value added time towards shortened TPLT.

In view of the above-mentioned issues, this paper presents a stepwise procedure to map, assess, and improve the TPLT, while the manufacturing processes are well laid out in a value stream map.

2. Stepwise procedure

Details of the method of this paper are elaborated in this section. The method is also summarized in **Error! Reference source not found.**1.

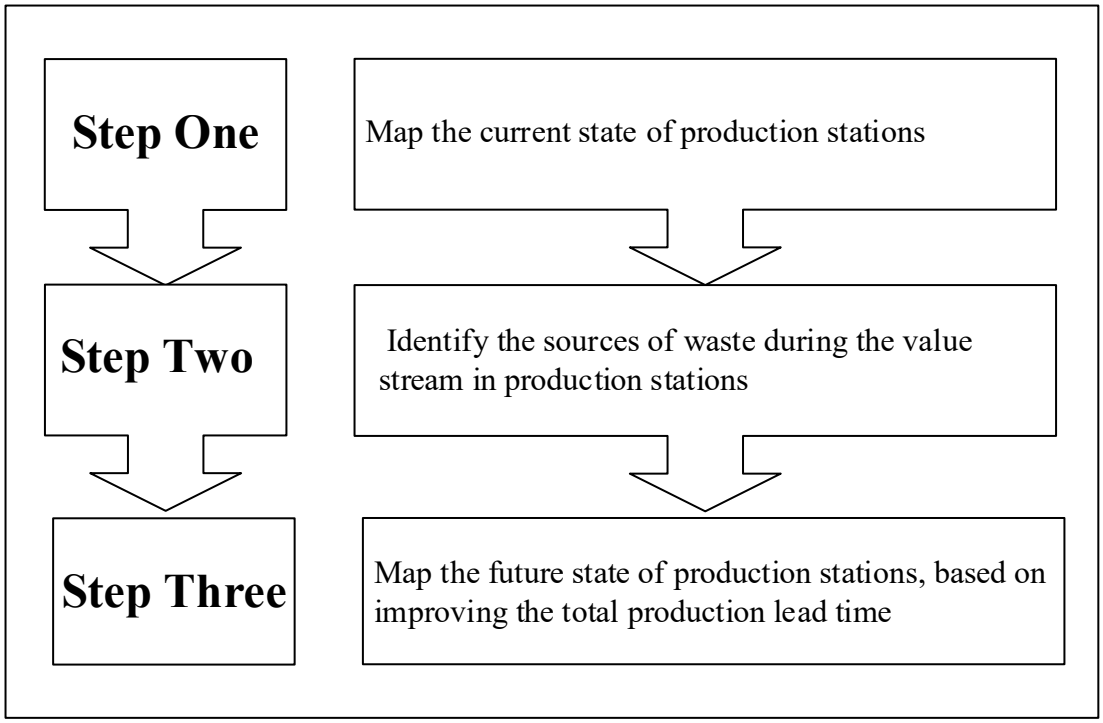

Figure 1: the stepwise procedure

Step one- Map the current state of production stations

To have an overview on the existing status of production main stream (as it is shown in Figure 2), a current state map is drawn to present the production stations and in each station, data's including; cycle time, change over time, uptime, operator quantity, inventory levels, method of material flow between stations and MRP information sharing system are represented. In continue, the value added times and non-value added times are divided and demonstrated on the timeline which is drawn under the current state map to make a visual tracking of time during the value stream.

Step two- Identify the sources of waste during the value stream in production stations

During Gemba walk in production stations to map the current state, the material flow and information flow from raw material to final product are recorded. Hence, the gathered data need to be investigated through a specialist team to identify the sources of waste and the potential improvement opportunities. Although the production streams differ from one case to another, some general techniques such as brainstorming and cause-and-effect analysis are useful to be employed.

Step three- Map the future state of production stations, based on improving the total production lead time

Based on identified sources of waste through the analysis of current state map, applying lean tools make improvements to eliminate excess inventory, reduction in change over time,

eliminate work in progress, optimizing cycle time of each station, line balance, increase manpower productivity and finally decrease the TPLT in the future state map.

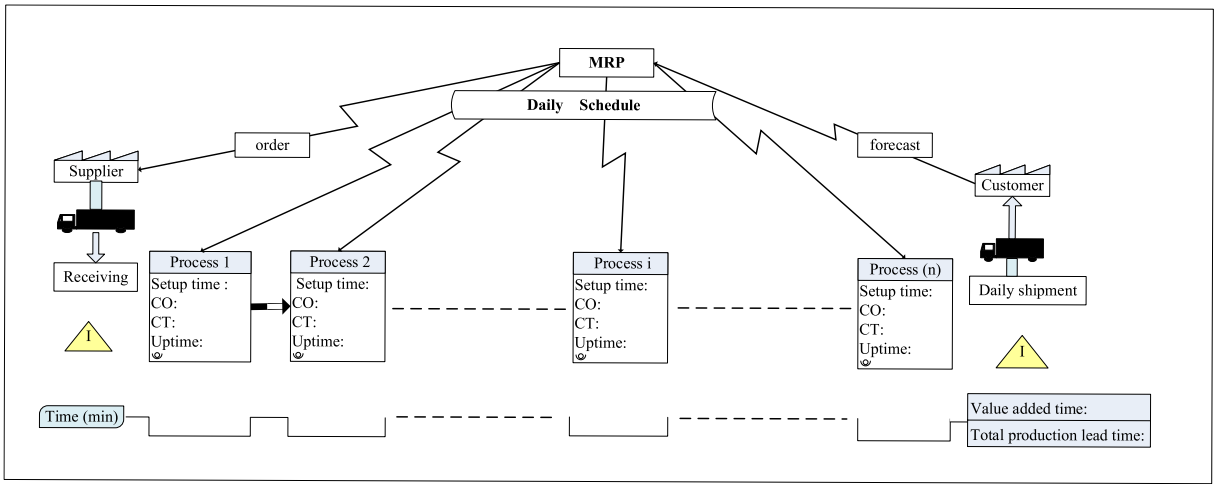

Figure 2: Value stream map

3. Implementing the stepwise procedure in a real life case

According to the main steps defined in section 2, the stepwise procedure of this paper is implemented in the production stations of a refrigerator factory in Iran and the future state map is designed as it is demonstrated in Figure 3.

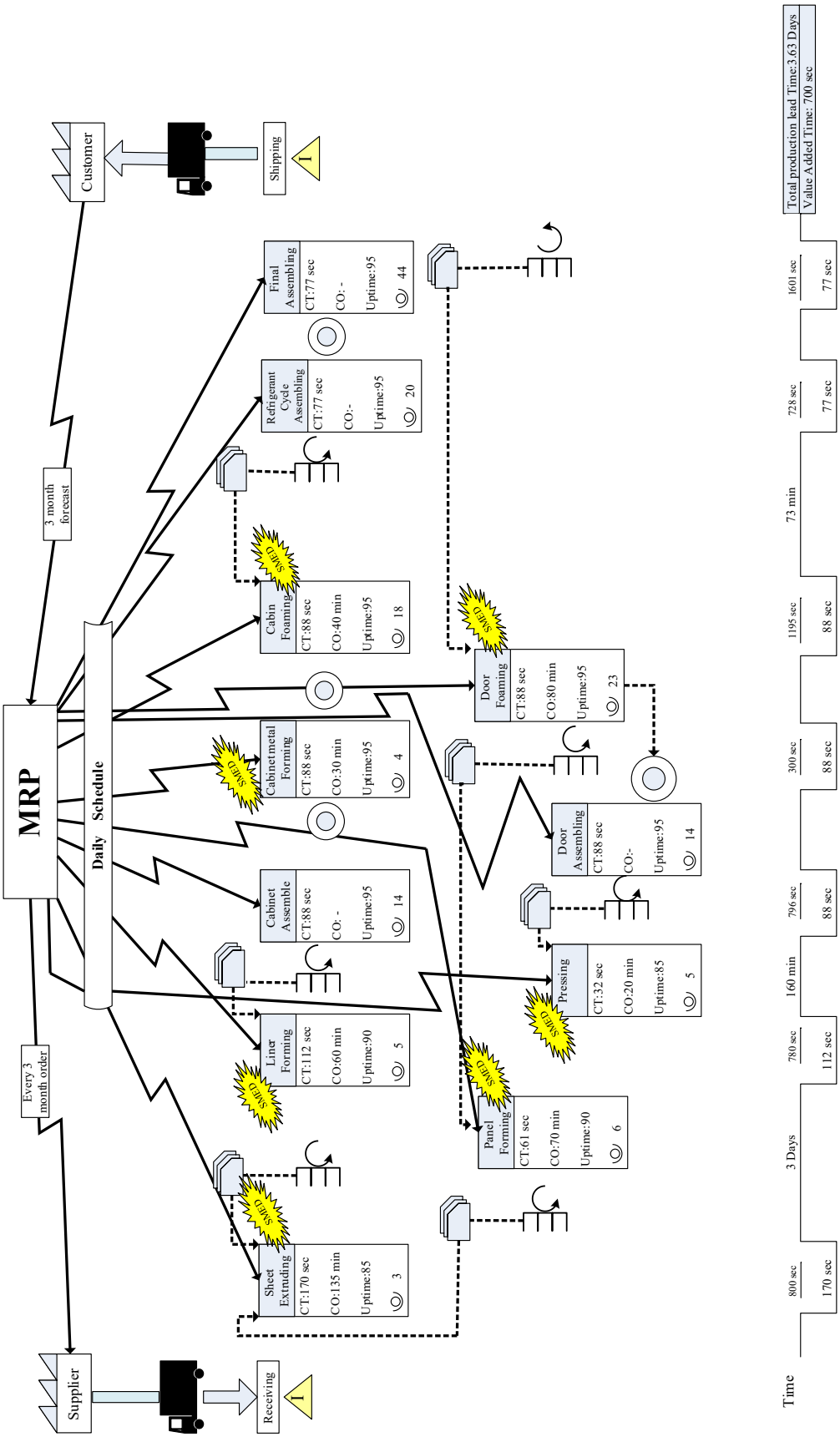

Figure 3: Future state map of implemented procedure in a refrigerator factory

4. Result

Based on the comparison between current state and future state of the production stations in this case study, a reduction of 78.73% is achieved in TPLT.

In particular, a series of lean tools were applied in future state map which consist of:

- Applying Kanban, Supermarket pulling system and Sequenced-pull ball system for material flow which led to eliminate excess inventory and work in progress and increased flexibility of manufacturing systems

- Increasing productivity by improving line balance, eliminating working loss such as ergonomic loss, increasing employees' satisfaction and increasing work skills by training.

- Applying single minute exchange of die (SMED) to reduce the change over time.

Finally, it is remarkable that this improvement is the result of implementing the stepwise procedure as explained in this paper.

Authors' Bio:

Dr. Ahmad Ebrahimi is an assistant professor and head of the MBA Department at the Faculty of Management and Economics in Science and Research Branch, Islamic Azad University, Tehran, Iran. Ahmad was also nominated as an Academic Fellow by the International Council of Management Consulting Institutes (ICMCI) in 2020. He has completed the three degrees of BSc, MSc, and Ph.D. in Industrial Engineering at Iran University of Science and Technology. Also, he has been proactively involved in the industry for 21 years and published several papers in peer-reviewed international journals and conferences as well as implemented various case studies. His teaching, research, and consultancy interests that he is thoroughly fascinated in, are; Operations and Supply Chain Management, Data Science and Business Analytics, Quality Management and Engineering, Lean Manufacturing, Sustainability, Industry 4.0, and Applied Statistics.

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