

MANUFACTURING PRODUCTION SYSTEM IMPROVEMENT BY USING LEAN TOOL WITH SIMULATION MODELING

Harmeet K. Chhabra, Ashish Manoria, Lokesk Bajpai

Abstract— Quality Value Stream Mapping (QVSM) has successfully been used as a lean tool in manufacturing processes. Applying this tool in other areas is an interesting issue for organizations and might involve particular considerations and adaptation. In this research work the effect of the shift from the traditional style of manufacturing production system to the application of modern techniques of lean in one of the manufacturing industries to improve the flow of production system and demand processing by reducing line intersections with optimal usage of available facilities. Quality value stream mapping, (QVSM) have been used to represent the production flow line. Therefore; two quality value stream mapping have been drawn, one to represent the current status of the production flow line and the other to represent the modified-status after eliminating most of the identified wastes. ARENA software has used to develop the simulation models, with applying pull system of lean tools for the modified status instead of the push system that has used in the traditional style of production. Thus, numbers of add values (AV) have been obtained over several periods of run-time for the designed simulation models. Then a future state map is drawn to show how things should work for best competitive advantage. Quality Value Stream Mapping helps to identify the current flow of material and information in processes for a family of products, highlighting the opportunities for improvement that will most significantly impact the overall manufacturing production system of company.

Index Terms— Lean Manufacturing Principle, Quality Value Stream Mapping, Wastes, Shares resources, Production Systems Evaluation and Improvement.

I. INTRODUCTION

The manufacturing industries today are faced with increasing challenges with respect to cost effectiveness, lead time and quality of the production system. Dealing with these contradictory goals, an Important task is the selection of suitable solutions for the integration of inspection processes within the process chain, which are necessary to ensure the required production quality. For this, supportive and easily applicable planning techniques are required to analyze and design the configuration of a respective process chain [1].

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Lean approach has been applied more than frequent in many manufacturing floors over these few decades. Started in the manufacturing industry, sequential improvement initiatives were implemented to enhance the manufacturing practices changes. The research described a case where lean production principles were adapted for the process sector of heavy manufacturing plants. Quality value stream mapping is one of the key lean tools used to identify the opportunities for the various lean techniques [2]. Lean helps companies to provide exactly what the customers want and it is a way of doing more with less use of resources, like human efforts, equipment, time and space. The Formulated five key lean principles that are expected to be addressed in order: Specify Value, Identify the Value Stream, Flow, Pull and Perfection [3]. A value stream is a collection of all actions value added as well as non-value added that are required to bring a product or a group of products that use the same resources through the main flows, from raw material to the arms of customers. These actions are those in the overall supply chain including both information and operation flow, which are the core of any successful lean operation. Value stream mapping is an enterprise improvement tool to assist in visualizing the entire production process, representing both material and information flow [4]. We can use Quality-VSM as a Lean method to identify the opportunities of improvements for future periods of time. Quality-VSM method is also associated with production activity, being used for:

- ✓ Efficiency of production activities;
- ✓ Logistics activities;
- ✓ Supplying activities;
- ✓ Software development;
- ✓ Developing new products;
- ✓ Industrial activities related.

Because the Quality-VSM is an analytical method, and is based on details, depending on the level of details, the QVSM can address only to a process step, to one or the production lines, or to the entire factory [5].

II. RESEARCH METHODOLOGY

To start improving Manufacturing productivity by identifying waste and then removing it by implementing lean principle in the industry there is no other tool better than Quality-VSM. The Quality Value Stream Mapping method (Q-VSM) is a visualization tool oriented to the Toyota version of Lean Manufacturing. It helps to understand and streamline work processes using the tools and techniques of Lean Manufacturing. The goal of Q-VSM is to identify, demonstrate and decrease waste in the process. Waste being any activity that does not add value to the final product, often used to demonstrate and decrease the amount of 'waste' in a manufacturing system. VSM can thus serve as a blue print for Lean Manufacturing. This section presents a methodology to

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develop a Quality value stream mapping to identify material and information of current state.

Generally Quality Value Stream Mapping has four major steps as given by;

- Product Manufacturing,
- Drawing current state mapping ,
- Drawing future state mapping,
- Develop work plan for implementation of future state mapping.

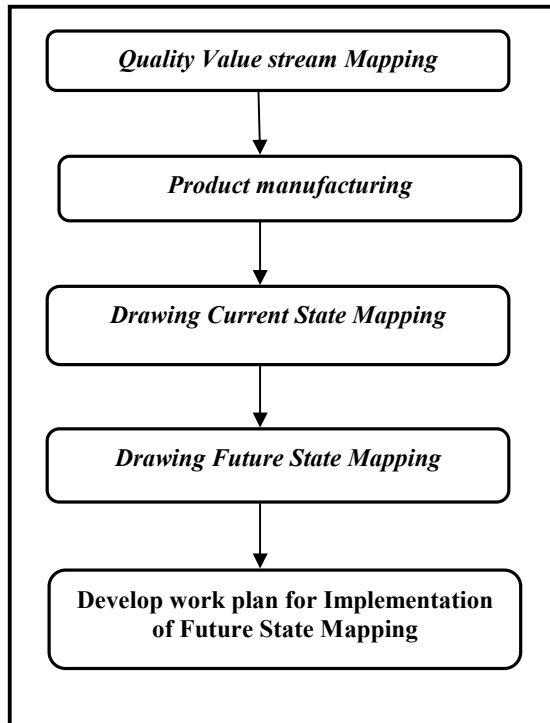


Figure:-1 Quality Value Stream Mapping Process.

III. INDUSTRIAL BACK GROUND

The research issue has studied in an Indian production companies for “Sigma Transformer Industries in Bhopal (M.P), india”. It is one of the oldest industries in Bhopal, India, which is characterized by a traditional style of production, in terms of administration and management, organizing contracts with suppliers and customers, the flow of production line, planning and control at both levels of processes and inventories. The goal was to prove the possibility of applying modern concepts such as lean manufacturing principles of production for the purpose of accessing best performance and work productivity by eliminating wastes of the traditional system to be able to develop and compete with the similar global industry. The basis of this work depends on the study and analysis of the reality of current work status, then classifying activities and operations, consisting of the production line into the value-added (VA), (Non-VA), and (Necessary Non-VA) activities.

IV. APPLYING VSM WITH SIMULATION MODELING

The Quality Value stream mapping has used as a pictorial representation of all activities required to produce the product, including those in the supply chain, as well as those in internal operations. A predefined set of icons are generally

used to construct the quality value stream mapping see table no 1. Simulation models have designed for the constructed QVSM of the related production system in order to simulate the designed models in a dynamic environment to describe the effect of changes on the system performance in movable and quantified terms. Working principle of this research is to reduce the level of non-value activities present in any form by implementing the various tools available in lean tool kit. Therefore, value stream map has constructed as a first tool helps to visualize the non-value-added activities.

SYMBOL	NAME OF SYMBOL
	<i>Process Box</i>
	<i>External Suppliers</i>
	<i>Ware house</i>
	<i>Kanban</i>
	<i>Process Box</i>
	<i>Data Box</i>
	<i>Physical pull</i>
	<i>Push Arrow</i>
	<i>Super market</i>








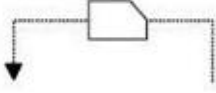

	<i>Kizan Lightning Burst</i>
	<i>Inventory</i>
	<i>Work cell</i>
	<i>Information flow</i>
	<i>Shipping Arrow</i>
	<i>With drawal Kanban</i>
	<i>Kanban Arriving In Batches</i>
	<i>Kanban Path</i>
	<i>Kanban Post</i>

Table no 1:- Set of icons used in constructing Quality value stream mapping.

In the Sigma Transformer Industries in Bhopal making 50000 Products are manufactured there. But main tunnel floor was chosen because it was most critical product from the point of view of safety purpose of the customer. There is a lot of scope for study and go for further improvement in the process to enable higher production rate. Hence this was selected for the case study.

Takt Time = Available Time/ Customer demand
Takt time = $27 \times 1320 \times 60 / 50000$
Takt time = 43 sec
Number of shifts per day = 3,
Number of working days = 27
Net working time per day = 1320 min.
Demand for month = 50000
Cycle time = 43 sec

Lead time = 8 sec

Production per day = $1320 \times 60 / (30+8) = 1552$ parts per day

V. RESULTS AND DISCUSSION

When cycle time for each process is compared with takt time it is found that cycle time of manufacturing process exceeds the takt time so there is need to improve the process capability of manufacturing process to meet the demand of customer within the time. So it can be improved by using various lean tools but here we are improving the cycle time of manufacturing process by introducing a new manufacturing machine process as shown figure 2 and figure 3 and by improving layout of manufacturing shop.

Cycle time before improvement = 43 sec.

Cycle time after improvement = 20 sec.

% improvement in production = $(2828 - 1552) / 1552$

There is near about "82%" improvement by improvement in value adding activities. The efficiency of Quality Value Stream Mapping is revealed when the team goes to the production process, talks to workers and observes how the product is actually made from the beginning to the end. Quality Value Stream Mapping must be drawn in such a way that can be understood by anyone: all the operators, the management, suppliers and the customer. Only on this condition the team can discover the real problems from the current process flow and create a vision of how the process should look like by making improvement

VI. IMPLEMENTATION OF THE CURRENT PROBLEM OF MANUFACTURING PROCESS

After the Future State Map developing, in most cases the map does not remain as it was drawn. The map can suffers some changes because new problems or improvements appear. Remember that the Future State Map is the starting point for a good plan of improvements.

Regardless of the discipline or research methodology used by each company to create her own planning and improvement manufacturing program, the first step is to develop an action plan or a project outline that includes all process improvement tasks. All the actions added to the plan should be focused on improving the entire process by eliminating production waste. To implement successfully, the project team should follow a standardized approach to implementation of the action plan. Lean manufacturing implementation provides a great number of the tools and concepts required to make change a reality, and it implements change at the same speed as mapping the process. For eliminating errors and defects, each company has her own quality systems for detecting and minimizing the actual manufacturing problems or potential ones. These systems can be directed just for a product, a process step or for the entire flow, by checking the product at each step of the manufacturing production line by implementing checking plan or placing an extra person which can supervise the stream flow. It is not everything to find and isolate the defects, but it is necessary to find the cause leading to these problems. To encourage employees to participate actively in creation and implementing quality Value Stream Mapping (Q-VSM), the best method to gain their trust is to show them that their input is value and their ideas are appreciated.

FIGURE:- 2 CURRENT STATE MAPPING:

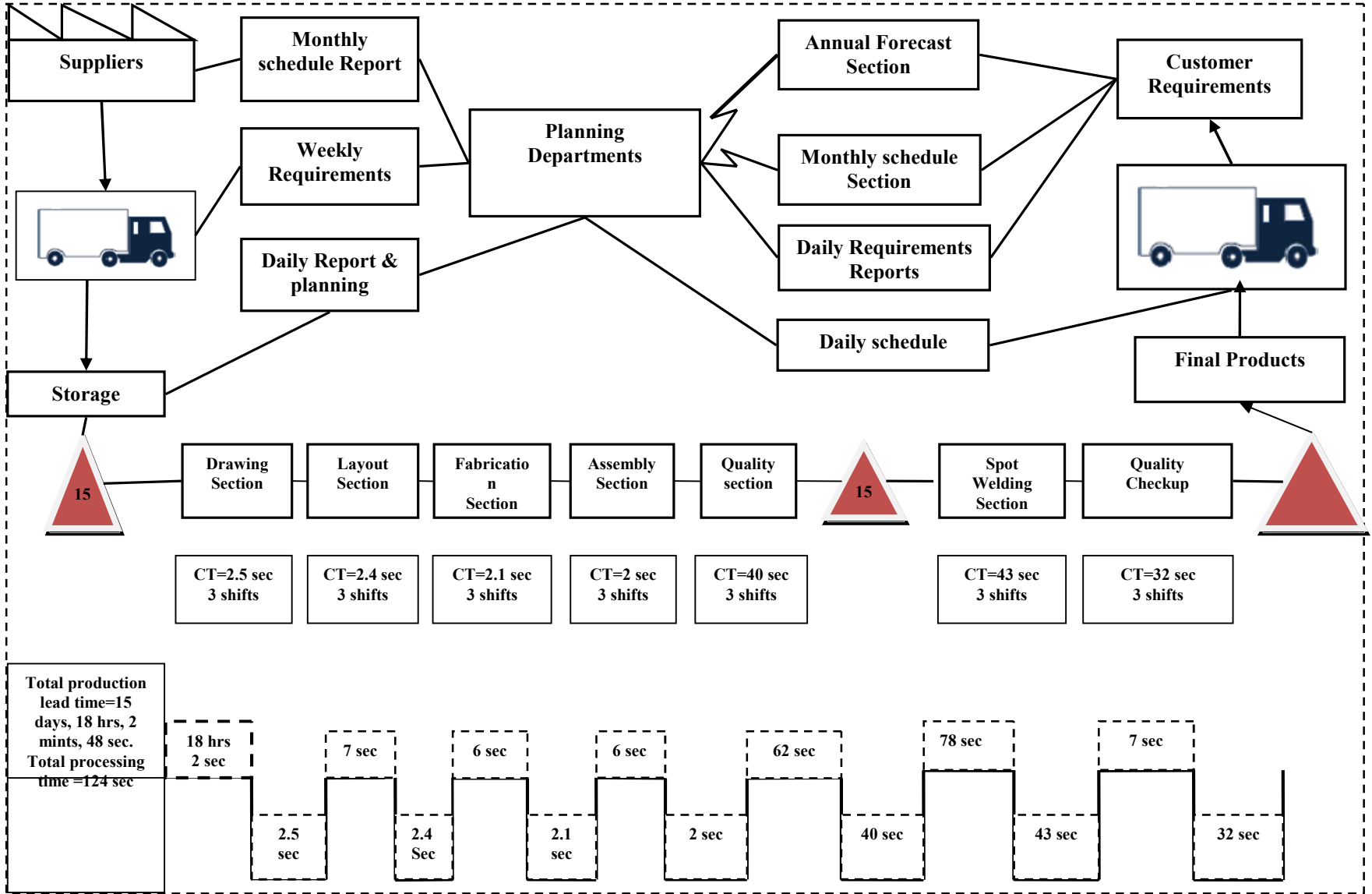
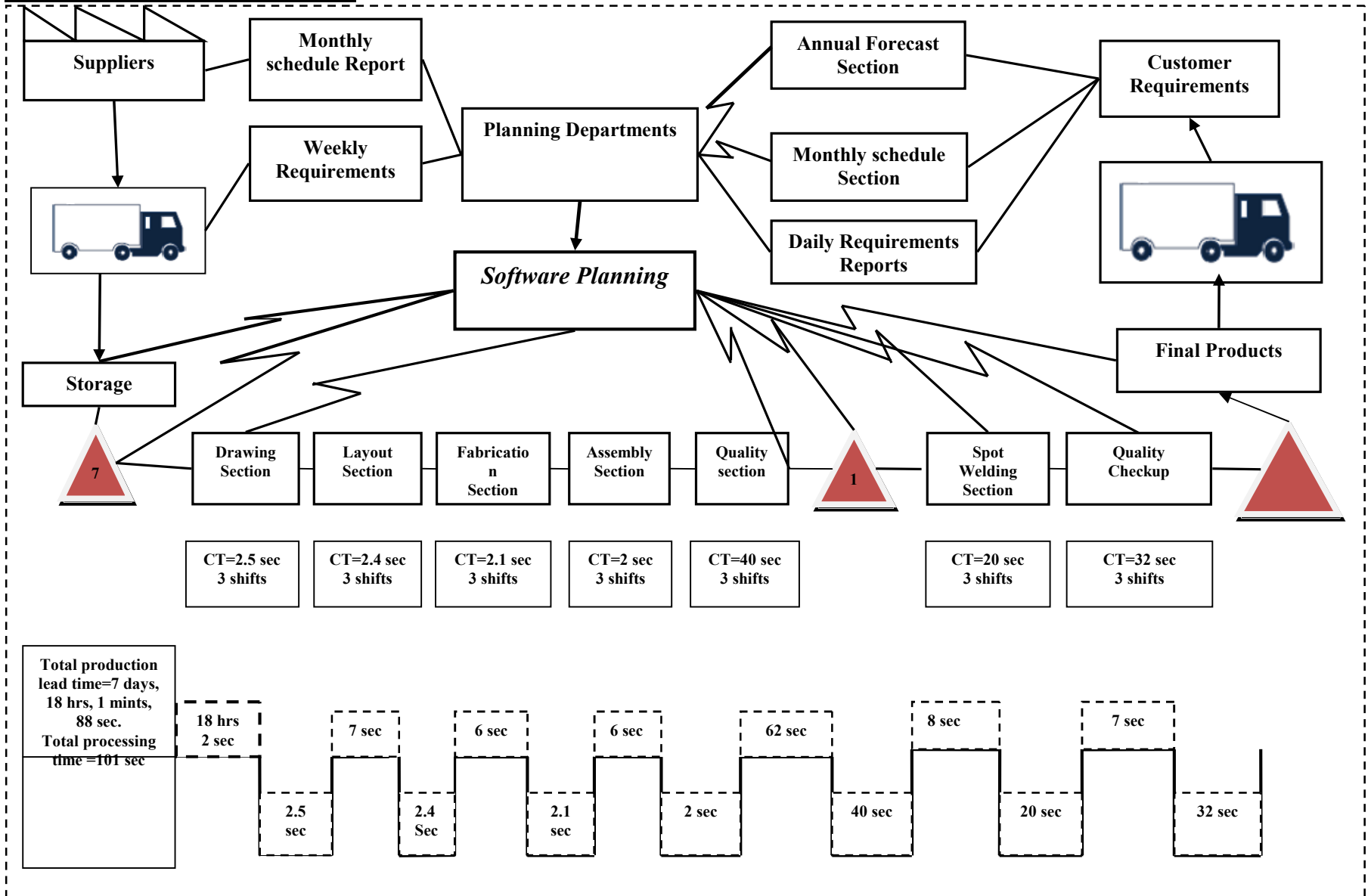


FIGURE:-3 FUTURE STATE MAPPING



CONCLUSION

Some important conclusions have found from the results of this research study:

- The results of this study were a success from the point of view of lean manufacturing as well as cost savings. All parties involved benefited from this success. The manufacturing production efficiency in the implemented future state, i.e. the time spent on doing value added work, increased by 82% relative to the current state. This improvement was driven by the reduction in lead-time which itself was due to transportation improvements and bringing the extended quality value stream closer to the customer.
- Lean production means continuous improvement, we must keep on changing future state into current state that will not end during our life. VSM have been proven to be a greatly useful tool to eliminate some waste in a cycle and find there are more waste for you to eliminate in next cycle, during which lean becomes a habit or culture.
- The VSM is an extremely valuable tool helps to apply lean aspects for continuous improvement efforts. By simulation modeling of VSM, one can obtain a dynamic picture, which describes the effect of changes on the operating system that might be missing when the VSM has used alone.
- Simulation modeling becomes a powerful tool for management decision making by analyzing the effect of various factors of change within the system without making the actual or physical changes, so it contributes in money saving and time.
- The research is very important in the development of the old traditional industrial production systems used in Indian manufacturing industries to be able to continue in the market and compete with similar international products, and contribute to the development of the country's economy.

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