Value Stream Management in high variability production systems

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Abstract

Increasing customer requirements and high pressure from global competition are forcing companies to a holistic optimization of their business and production processes. To ensure the competiveness of enterprises in future, it is necessary to introduce a process-oriented view instead of a departmental thinking. This paper describes the application of Value Stream Management by the University of Luxembourg in collaboration with the industrial partner Rotarex S.A., a provider of gas control solutions headquartered in Luxembourg. With the help of Value Stream Analysis and Design, relevant material and information flows are captured, analyzed and finally optimized.

Keywords – *Added Value, Lean Production, Process Optimization, Value Stream Management, Variability*

I. INTRODUCTION

The concept of Lean Management contains comprehensive approaches with regard to the design of waste-free and customer-oriented process organizations. The establishment of Lean Production leads to an increase in productivity within industrial organizations. Thereby, the parameter lead time serves as an indicator for the efficiency of the whole value chain. For a holistic analysis and optimization of process flows, the method Value Stream Management (VSM) is a valuable approach for the application in industrial enterprises [1].

In this paper, the basic concept of VSM is explained. In addition, the application of VSM in a real industrial environment with a special focus on high variability production systems is shown. After a brief introduction to the principles of VSM and the identification of waste, the application of VSM in a production system with high variability at Rotarex S.A is described. Finally, the paper ends with a description of the VSM results achieved at Rotarex S.A., including a collection of specific measures for improvement.

II. BASIC PROCEDURES OF VALUE STREAM ANALYSIS AND DESIGN

In a first step, the current state of production-related data on material and information flows is captured with the help of Value Stream Analysis. During the subsequent Value Stream Design phase, existing material and information flows can be optimized by the means of seven design principles, which are formulated in the works of Rother and Shook [2]. The future state of the value stream is developed based on its current state and the associated data collection. The results of Value Stream Management with regard to the current and future state are represented in a well-arranged Value Stream Diagram.

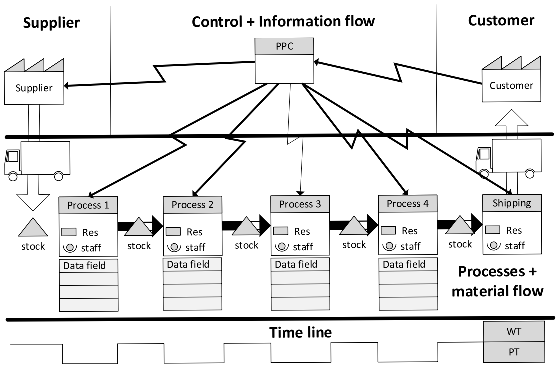

Figure 1 Basic structure of a Value Stream Map

In Fig. 1 the basic structure of a Value Stream Diagram is shown [3]. The value stream visualization consists of following individual sections:

- customer
- supplier
- processes and material flow
- production control and information flow
- time line

The sum of the collected processing and waiting times for all relevant process steps equals the lead time of the respective value stream. A comparison of waiting time and processing time for the current state reveals in most cases need for improvement. The ratio between processing time (value-adding) and waiting time (non-value-adding) is a suitable indicator to evaluate the current state in comparison with the future state.

III. IDENTIFICATION OF WASTE

The term waste refers to all activities that either result in unnecessary costs or activities without any impact on value creation. There are several possible sources for waste within a production line. According to Taiichi Ohno [4], waste can be divided into the following seven forms:

- over-production
- waiting
- transportation
- over-processing
- inventory
- movement
- defects

In addition, Jeffrey K. Liker specifies the unused potentials of employees as a further form of waste [5].

The identification of waste, especially of over-production, is one of the fundamental measures for improvement. Large inventories and implicitly a high commitment of capital are caused by over-production. Moreover, every other form of waste is reinforced due to over-production.

IV. APPLICATION OF VALUE STREAM MANAGEMENT AT ROTAREX S.A.

Rotarex S.A. is a privately owned company headquartered in Luxembourg, dealing with the development and manufacturing of high-pressure valves, tube fittings and pressure regulators for almost all types of gases and application areas.

A special characteristic of Rotarex S.A. is the large number of product variants due to the assembly of individual valve components on the main piece of the valve. With regard to five different business areas, there are further value streams, which need to be investigated during a holistic application of Value Stream Management.

The goal of Value Stream Management at the site of Rotarex S.A. was a reduction of the high capital commitment due to large inventories in combination with an increase of productivity and a stronger adherence to delivery dates. The first objective of the industrial project was to analyze the share of value creation for the current state of valve production. Based on this analysis, an optimization of material and information flows led to a reduced lead time and simultaneously to an increased share of value creation.

Figure 2 Valve of product family “B0480”

The selection of a coherent product family from the product portfolio of Rotarex S.A. was the basis for the Value Stream Analysis phase. With the help of this artificial product range limitation, a first analysis was achieved with a lower complexity compared to the entire product portfolio of Rotarex S.A. For the selection of the product family, a weighting function including following evaluation criteria facilitates the decision:

- sales volume
- number of customer orders
- variability of average order quantity

In the following, relevant material and information flows in connection with the selected product family “B0480“ were collected at the site of Rotarex S.A. (cf. Fig. 2). In a first step, customer specific data, e.g. annual demand quantity, was collected in order to calculate the customer tact time. In the following, the different process steps as well as associated parameters and inventory levels were captured. In addition, an analysis of valuable supplier information, e.g. delivery frequency and quality, was carried out. Finally, relevant information concerning customer order processing as well as production planning and control was collected.

After a processing of the captured data sets, the complex process sequences for the manufacturing of the product “B0480“ and the interdepartmental responsibilities for the processing of customer orders could be mapped transparently in a Value Stream Diagram. This holistic representation of the value stream enables an efficient Value Stream Design phase with the identification of potentials for improvement in relation to the material and information flows.

V. RESULTS AND IMPROVEMENT MEASURES

A thorough analysis regarding the current state of valve production leads to very useful results. Especially high levels of inventory in the receiving and dispatch warehouses and also between several production steps could be revealed. In addition, a non-value-adding packaging process as well as dual storage facilities could be identified. With respect to the investigated product family, nearly the entire material flow is arranged in a push system in combination with a centralized production control at every process step and two mainly separated production planning and control (PPC) systems.

Based on the Value Stream Analysis phase and the identified improvement potentials, a future state was developed according to the Value Stream Design principles. Therefore, the main focus was on the optimization of material and information flows in order to gain an efficient production system in accordance to the concept of Lean Production. Defined supermarket pull systems reduce unused stocks and warehouse stages for the product family "B0480". In an ideal state, incoming customer orders lead to a maximum resource utilization within the involved production processes. Moreover, a faster and more precise processing of customer orders can be achieved due to a reduced lead time. In this context, the customer and supplier interfaces have been examined in terms of delivery frequency, so that a daily delivery to the customer can be assured. Furthermore, a change in the production planning system was envisaged. The two previously separated planning systems could be merged into a central production planning system for Rotarex S.A. By means of this central planning system, customer orders could be processed quickly and the administrative efforts between the different departments could be reduced. With regard to the controlling of information flow, the introduced supermarket pull system, a Kanban system and the precise layout of the supermarket systems were presented. These first ideas for improvement were documented in a catalogue containing measures for improvement.

The implementation of the identified measures for improvement could lead to a reduced lead time of 1.9 days from the receiving of the customer order to the first partial delivery in the future state. This equals a lead time reduction of about 10 days in comparison with the current state. The share of value creation would rise on 0.22, which would be 5.5 times higher than the value in the current state (0.04).

A detailed specification of the proposed catalogue of measures will be developed in a workshop by the University of Luxembourg in collaboration with Rotarex S.A.

VI. CONCLUSION

The method Value Stream Management offers an effective and comprehensive framework to visualize material and information flows in a transparent way. Based on the description of the VSM method, the application of Value Stream Management for high variability production systems was investigated during a project between the University of Luxembourg and the industrial partner Rotarex S.A.

As a result, different measures for value stream improvement were presented. The final aim of these improvement measures is to optimize material and information flows. A reduced lead time and capital commitment as well as an increase of productivity and a stronger adherence to delivery dates are envisaged. A successful implementation of the proposed measures will ensure the competitiveness of Rotarex S.A. in a global market environment.

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