
METHODS FOR EFFICIENCY IMPROVEMENT OF PRODUCTION AND LOGISTIC PROCESSES

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Abstract

In the changing economic environment, global competition where the customer demands are changing continuously, the enterprises have to focus on cost reduction, efficiency improvement, higher productivity and profitability. In the production, the resources (raw materials, humans, machines, equipment, etc.) are always limited. It is very important for the manufacturing companies to produce cost effective final products in a short lead time which can be achieved by minimized cost and higher effectiveness, and therefore, efficiency improving methods are needed. There are lot of tools and sophisticated methods for design, analysis and improvement of production and logistical processes. The author introduces the most often applied methods for it, which are the simulation, Lean method and layout design. The paper summarizes the characteristics, typical application fields of these methods and the reasons for application of these. Main aims of logistics process improvement and the main steps and advantages of the described methods are introduced.

Key words

Process improvement, simulation method, lean method, facility layout design

INTRODUCTION

Globalization, growing market competition, more complex products and fluctuating customer demands require efficient operation of production and logistic processes; therefore the enterprises have to focus on cost reduction and efficiency improvement.

This research study is very important and actual, because the efficiency improvement and the cost reduction are very important for manufacturing enterprises in order to increase competitiveness.

There are a lot of tools and sophisticated methods for design, analysis and improvement of production and logistical processes. Application of efficiency improvement methods leads to

the improvement of KPIs (Key Performance Indicators), e.g. shorter lead time, higher productivity, higher utilization of resources and lower operational cost will be achieved.

In the study, the most often applied improvement methods such as the simulation, Lean method and layout design are introduced. These methods are often applied in more and more companies in many sectors, including automotive, electronics etc., in order to increase their competitive advantage.

The article summarizes the characteristics, typical application fields, reasons for application, main steps and advantages of the three methods.

MAIN AIMS OF PRODUCTION AND LOGISTIC PROCESS IMPROVEMENT

The production and logistics goals originated from general corporate goals, of which maximal customer satisfaction is one of the most important. Actually, all the other goals can be derived from this one; they all are listed in the following paragraph.

With shorter lead time, the customer would get the ordered product in the shortest time possible. Economical and profitable operation of enterprises can be achieved by utilizing the maximal production (or service) and logistics capacities, which includes the optimal utilization of human sources and equipment. Flexible production (or service) and logistics are needed to answer the demands of the rapidly changing economics and dynamic customer demands. The development of business processes can be accomplished only by high transparency and by the continuous monitoring of the systems efficiency, since the process that can be measured can be also improved (1, 2).

Ensuring and enhancing the quality of the processes is of the top priority for customer satisfaction. Nowadays, sustainability and the use of environmental-friendly materials and technologies, as well as green waste management and recycling are also defined as a goal. In terms of cost reduction, the main goal is to decrease stocks and to operate production and service processes efficiently throughout the whole supply chain and at each individual member in the supply chain (3, 4).

SIMULATION METHOD FOR EFFICIENCY IMPROVEMENT

The simulation model “simulates” the complex system to be evaluated, in order to reproduce its behavior. The simulation model is a little bit simpler when compared to the real system. This simplification makes it possible to examine complex systems (5, 6).

Behavior of the real system can be understood by the analysis of the model.

Often used software applications are e.g. PlantSimulation, Flexsim, Simul8, etc.

Application fields of simulation

Typical application fields of simulation are as follows:

- Design and analysis of production and service systems,
- Optimization of supply chains,
- Design and analysis of material flow systems, etc.

The most common application field of simulation software is the analysis of production and logistic processes. This is because of the following tendencies:

- Production activities are very complex stochastic processes,
- Customer demands are changing extremely fast, which results in changing Production volume and product variety,
- Pressure of cost reduction and efficiency improvement.

Simulation can be applied, for example, when we have to plan a new facility, or optimize an existing facility.

Reasons for application of simulation software

Simulation analysis of production processes is required in case of:

- Deterministic processes of complex and big systems;
- Stochastic processes of systems and processes in which influencing events occur randomly (e.g. breakdowns of machines, problems of component supply, etc.)

Aims of simulation in the analysis of production or logistical processes (7, 8):

- Comparisons of system variations,
- Analysis of deterministic and stochastic processes,
- Providing the possibility of bottleneck analysis,
- Optimization of systems parameters to improve productivity,
- Elimination of wastes of processes,
- Examination of system parameters, etc.

Main steps of a simulation process

The main steps of a simulation process are as follows:

Step 1: Preparation of the simulation analysis

Firstly, the objectives of the simulation analysis and the Key Performance Indicators (KPI) to be improved should be determined.

The next task is the development of a model to simulate the complex real process to be examined.

Step 2: Run simulation, evaluation of results

Results of the simulation run are the output data which should be evaluated and analyzed.

Step 3: Making suggestions

System modifications should be defined based on the results of simulation runs.

Step 4: Implementation

Proposals should be implemented in the real system to improve performance.

Advantages and disadvantages of simulation

Simulation is the most common method for design and analysis of systems.

Besides advantages, there are some disadvantages.

Advantages of simulation:

- Simulation can help to understand the behaviors of complex real processes.
- Effects of changing the system parameters can be tested.
- New model or system variations or operation strategies can be tested.
- Bottleneck of the system can be found.
- Examined system can be visualized.

Disadvantages of simulation:

- Usage of simulation software requires special expertise.
- It is time consuming to develop a simulation model.
- The simulation model includes simplifications which can result in incorrect outputs.

LEAN METHODS AND TOOLS FOR PERFORMANCE IMPROVEMENT

Application fields of Lean Methodology

Lean Manufacturing is a performance-based process used in manufacturing organizations to increase their competitive advantage in an increasing global market [9-11].

Nowadays, this philosophy is applied in many sectors including the automotive, electronics, white goods, and consumer products manufacturing, etc.

Reasons for application of Lean-based Improvement

In today's increasing global competition, many manufacturers use lean manufacturing philosophy in order to optimize quality and costs, thereby gaining a competitive advantage.

The essence of the Lean philosophy is the continuous improvement and elimination of wastes (over production, waiting, unnecessary motion, transportation, inventories, over-processing, producing defective products, etc.) (11, 12).

Main steps of a Lean Project in an industrial environment

The main steps of a lean project generally are as follows:

Step 1: Determination of objectives

At first, the most important KPIs should be defined and measured.

Step 2: Study and evaluate the examined process

Value Stream Mapping (VSM) is an efficient method for visualization of wastes in the process [3]. There are a lot of other tools and methods for elimination of wastes e.g. Takt-time analysis, Heijunka, Single Minute Exchange of Dies (SMED), Jidoka, Kaizen, Flexible manufacturing system, 5S, etc. (13-15).

Step 3: Implementation of suggestions

Pilot project should be run, suggestions and changes should be achieved. Results of the project can be measured by the improvement of the defined KPIs.

Advantages and disadvantages of the Lean-based process improvement

Application of Lean-based process improvement has many advantages and disadvantages.

Advantages of Lean-based process improvement:

- Lean tools are easy to use due to their simplicity.
- Lean tools provide the possibility to find potentials for improvement.
- Bottlenecks and wastes can be found easily.
- Lean methods require very little time effort.

Disadvantages of Lean-based process improvement:

- The examined process includes simplifications of the real process.
- The whole system cannot be analyzed, only a part of it.

FACILITY LAYOUT DESIGN FOR EFFICIENCY IMPROVEMENT

The definition of facility layout may be given as the arrangement of machinery and flow of materials from one facility to another. It minimizes the material handling costs, while considering any physical restrictions on such arrangement (16-18).

Application fields of Layout Design

The Facility Layout Problem (FLP) is relating to location of objects (e.g. machines) on a site and the material flow between these objects.

Reasons for application of Layout Design

In the production, resources (raw materials, humans, machines, etc.) are always limited. It is very important for the manufacturing companies to produce the cost effective products which can be manufactured at the minimized production cost and higher effectiveness.

The most important reasons of design/redesign of facility layouts are the continuously fluctuating customer demands, product variety, production volume which can result in a wrong utilization of space, machines, workers, etc. (19, 20).

The optimal facility layout provides higher utilization of resources and cost reduction (21, 22).

Main steps of the facility Layout Design

The main steps of the facility Layout Design are the following:

Step 1: Define the objectives of the facility design

Generally, the main objectives of the facility layout planning are: to minimize the total distance of goods flow, the material handling cost and the time spent in the manufacturing system.

Step 2: Specify the main and supporting activities of the manufacturing process

Constraints and requirement relating to the activities (e.g. workstations), human resources, equipment and material flows have to be defined.

Step 3: Determine the space requirements for all activities

Space requirement for all of objects and material flow paths have to be calculated.

Step 4: Generate alternatives for facility layouts

Variations of layouts have to be formed including alternative facility locations and material flow paths.

Step 5: Selection of the most effective facility layout

The elaborated layout variations have to be compared based on the KPIs, defined in Step 1.

Step 6: Implementation of the optimal layout

The optimal facility plan has to be selected and implemented.

Advantages and disadvantages of the facility Layout Design

Application of facility Layout Design for process improvement has many advantages and disadvantages.

Advantages of facility Layout Design:

- Effective facility layout can reduce significantly the operational costs of the company.
- Adequate facility layout can result the improvement of the performance of production lines.
- Optimal layout results in the improvement of a lot of KPIs.

Disadvantages of facility Layout Design:

- Only some layout alternatives are evaluated, not all of the possible alternatives.
- Mathematic expertise and competences are required.
- It is often computationally intensive and time consuming.

SUMMARY

In a competitive market, manufacturing companies have to produce cost-effective products which can be manufactured at the minimized production cost and higher effectiveness.

There are lot of tools and methods for design, analysis and improvement of production and logistical processes.

The goal of efficiency improvement methods is to achieve shorter lead time, higher productivity, higher utilization of resources, lower operational cost, etc.

In the study, three most often applied improvement methods were introduced, which are Simulation, Lean Method and Layout Design. These methods are often applied in more and more companies in many sectors including the automotive, electronics, etc. to increase their competitiveness.

In the article, the characteristics, typical application fields, reasons for application, main steps of processes and advantages of these three methods were introduced. Therefore, the three improvement methods (simulation, Lean method, layout design) can be compared.

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