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Framework for Continuous Improvement of Production Processes and Product Throughput

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Abstract

This paper introduces a new framework that allows continuous improvement for the reliability of production process and product throughput. The new framework allows engineers with less effort to define and measure failures of production processes, also enable to analyse these failures. It can be done by identifying the most critical operations in the process that influence on Key Performance Indicator (KPI) such as throughput of that process. Based on the received results, engineer can apply corrective actions and perform continuous improvement by performing daily monitoring of production processes. Current paper involves a basic concept of improvement methodology that followed by a framework development and its description, moreover, a case study regarding this research is under consideration to implement the framework and visualize the results. The framework allows the company decrease production lead time and increase product throughput KPI with less expenditures. This new framework also integrates various tools and methods like Six Sigma DMAIC, FMEA, TOC, FC, swim-line diagram.

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1. Introduction

There are many problems that manufacturing companies face today, for instance, unreliable production processes, bad product quality, financial losses, delay in product delivery etc., but often, companies do not understand the root causes of these problems. As the rule, problems in manufacturing start from various causes, e.g.,

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inadequate labor qualification, unbearable working conditions, old technologies applied, material supply, etc., leads to the worsening of company efficiency. As a result, this worsening may cause to non-fulfillment of customers' expectations and consequently loss of position in the market. Therefore, in order to survive in the competitive market, companies should always be able to satisfy their customers by continuously improving their production processes and measure these improvements with the help of suitable KPIs.

The objective of this research is to develop framework that allows continuous improvement for the reliability of production process and required KPI. The new framework will be applied into Six Sigma DMAIC methodology. With the help of presented framework, company can decrease production lead time and subsequently increase product throughput that improves product on-time delivery to a customer. Today customer satisfaction is very important for business success, as a high level of customer satisfaction leads to a high level of customer loyalty; consequently it also creates greater chances to repeat product order and company financial revenue [1]. The new framework integrates various tools and methods that help engineers to find out problematic operations in the process and eliminate root causes of problems quickly and with less expenditure. The framework serves as role of a "dashboard" like in a cockpit, which allows monitor production processes in an up-to-date way due to the constantly renewal data from production floor, for example, data from Enterprise Resource Planning (ERP) system [2]. This framework is suitable for SMEs and can be applied in big enterprises, which have batch production. Furthermore, it is focused on the improvement of production processes on a production floor.

2. Basic concepts applied in the research

This section provides the background of the basic concepts and the definitions that have been used in this research.

2.1. Key Performance Indicators (KPIs)

Measurement of any performance in business is very important principle because it shows gaps between current and desired performance, it indicates where necessarily move to close the unwanted gap. Therefore, carefully selected KPIs precisely show where to take action in order to improve performance [3].

KPIs help an organization to define and measure progress towards selected goals. If an organization has defined its goals, then it is necessary to measure the progress of those goals. A business organization may have its own KPIs that are based on customer's feedback, for example delivery of product on time [4].

In addition, KPIs are used for evaluating the company current status or for foreseeing the possible benefits after implementation of some modifications in the system. KPIs are quantifiable dimensions that are agreed to beforehand, they reflect the critical success factors of an organization and it depends on the particular company where these KPIs should be evaluated, also they are different depending on the organization [5]. Nowadays KPIs are used in most business areas for monitoring of the performance of production, procurement and management of entire supply chain, etc. The KPIs represent a company's performance that must fully be understood how effectively a company competes in the marketplace. For this reason company needs to measure its own performance and compare it with competitors [6].

Reviewing different literature of many authors, there are found three important KPIs: Quality, Cost and Delivery [5, 7, 8]. However, the Delivery notion is quite broad (it can be measured from order receiving until the physical order delivery to the customer), therefore this research is considering only manufacturing part of this notion - production lead time (for example the period from product manufacturing started until the product manufacturing ended). During this time, manufacturing line should release specified amount of products and the ability of production line releases needed amount of units called – Throughput, which is under consideration in this paper.

2.2. Production Route (PR) card

It is a card that gives the detail of an operation to be performed in a production process. It is used to instruct the production people to take up the production work. The content and formats of the PR card can vary from a company to company. In general, it contains: an item and the number of quantities to be produced; production time; physical dimensions; any additional information that may be required by the production worker. PR card traces the route to be taken by a product during a production process [9, 10].