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APPLICATION OF SIX SIGMA METHOD TO EMS DESIGN

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Abstract

The Six Sigma method is a complex and flexible system of achieving, maintaining and maximizing the business success. Six Sigma is based mainly on understanding the customer needs and expectation, disciplined use of facts and statistics analysis, and responsible approach to managing, improving and establishing new business, manufacturing and service processes.

Key words

management, LCA, SixSigma, quality, environment

Introduction

Globalization and instant access to information, products and services keep changing the way of customers' behaviour. Current policy changes in the economy and society should be carried out in accordance with the principles of sustainable development and environmental protection. Therefore, our country introduces a series of voluntary environmental tools and methods such as environmental audits, Environmental Management Systems (EMS according to ISO 14 001), environmental assessment and labeling of products, Life Cycle Assessment (LCA), ecological profile of the product etc. With their introduction, the organizations create the way for a balanced and integrated approach in terms of economic, quality, environmental and security interests. One of the major tools used in practice especially abroad, is Six Sigma, whose implementation has been gradually promoted in business also in Slovakia.

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Concepts of Six Sigma

The word “Sigma” is a statistical term that measures how far a given process deviates from perfection as a new methodology using old tools. Six Sigma is a comprehensive system for achieving, maintaining and maximizing business success. The basis of Six Sigma is a detailed knowledge of customer requirements, disciplined use of facts and objective data, statistical analysis and ongoing efforts focused on optimizing business processes. Six Sigma revolves around a few key concepts:

- Critical to Quality: Attributes most important to the customer;
- Defect: Failing to deliver what the customer wants;
- Process Capability: What your process can deliver;
- Variation: What the customer sees and feels;
- Stable Operations: Ensuring consistent, predic-table processes to improve what the customer sees and feels;
- Design for Six Sigma: Designing to meet customer needs and process capability.

Philosophy and methodology of improvement by Six Sigma method

It is said, that philosophy and methodology of Six Sigma improvement is a revolution in increasing the efficiency of organizations. In recent years, it has become popular not only with specialists in the field of process improvement, but has become also common on the boards of directors and senior management of the world’s largest industrial companies, as well as in programs improving services in banks and hospitals. It has much in common with its predecessors, while there is a new approach in the organization and standardization process improvement projects and measuring their benefits. Six Sigma is a method of improving productivity, efficiency and quality of products and services. Based on perfect understanding of the requirements and expectations of customers, it is a proven tool to eliminate errors in processes leading to customer satisfaction. Six Sigma is implemented through its own employees. The involved employees represent the most important capacity of improvements. Focusing on customers, processes and staff makes Six Sigma a way of building and developing a new corporate culture. The method Six Sigma is a high technological method used by engineers and statisticians to fine-tune products and processes. But that is just a part of the truth. Six Sigma presents a measurement and statistics as an essential part of improving. It aims at nearly complete coverage of all customer expectations. The term Six Sigma is derived from the mode of a control process, which shows less than 3.4 defects per million opportunities.

Six Sigma is mainly based on understanding the customer needs and expectations, using the facts, data and statistical analysis and a thorough approach to managing, improving and creating new business, production and service processes. Six Sigma in particular focuses on:

- Method of measuring quality, which allows you to compare different processes according to the achieved level SIGMA – variability of process 6];
- Project-oriented methodology for solving problems using statistical tools;
- The quality improvement system, aimed at reducing errors and maintaining them at a low value, "Six sigma", meaning DPMO (DPMO = Defects per Million Opportunities);

- Philosophy and managerial strategy oriented on customer satisfaction and making decisions based on verified data.

Chosen Six Sigma methods

Six Sigma is based on six basic principles that help with launching the initiative implementation of Six Sigma method to production companies or service industries. Sigma uses the base tools to improve the quality of products and processes as MSA (Measurement System Analysis), IPO Diagram (Input-process-output), CE (Cause-and-effect diagram), Histogram, Pareto diagram, DMAIC (Define, Measure, Analyze, Improve, Control) , Run chart, Control chart, Scatter diagram, Regression Analysis, DOE (Desing of Experiments), FMEA (Failure Mode and effect analysis), SOP (Standard Operating Procedure) and QFD (Quality Function Deployment).

Measurement System Analysis

Diffusion of the watched commodities' parameter can be connected by the commodity itself (deformation, ovality) or the system of measuring. The system of measuring is made by operator, benchmark and the method (the way) of measuring. Measuring System Analysis (MSA) is a tool for the evaluation of accuracy and advisability of the measuring system. It goes with testing (measuring) the chosen parameter by an operator or a group of operators. It monitors the influence of repeatance (one operator copies the measuring of the watched commodity's parameter) and reproducibility (group of operators measures the very same parameter) of the total variance. The goal of MSA is to estimate how the system of measuring contributes to the total variance of watched parameter, Fig.1 [6]. Most of the time, analysis of the measurement system is used in the phase of Measurements.

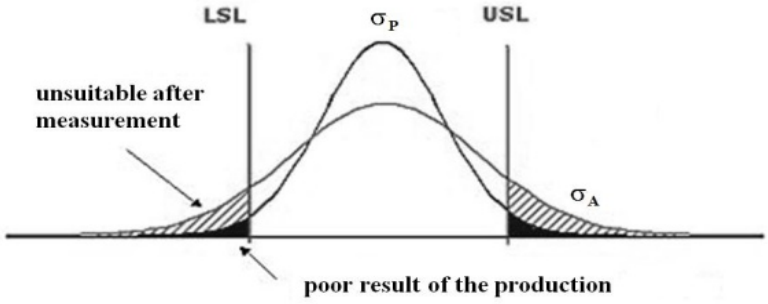

Fig. 1 *Measurement System Analysis*

Legend: *Tolerance = USL – LSL (area of matching values for the customer), LSL - Lower Specification Limit,USL - Upper Specification Limit,* σ^2_A *(absolute) =* σ^2_P *(of product) +* σ^2_M *(of measurement system),* σ^2 *– variance*

Analysis of the causes and consequences

CE (Cause-and-effect diagram) is a tool to solve problems through finding the cause of their occurence. It helps to find all possible causes, to split causes into cathegories and

organize their relationships and impact on output, and to identify opportunities for improvement. In general, these categories are commonly known as 7M causes:

- Man -people, job;
- Methods and mechanics, process;
- Machine – machines, eguipment;
- Measurement;
- Management - system of organisation and management;
- Material;
- Mother Nature - environment.

A more detailed analysis of each factor gives a diagram that resembles a fish bone as seen in Figure 2.

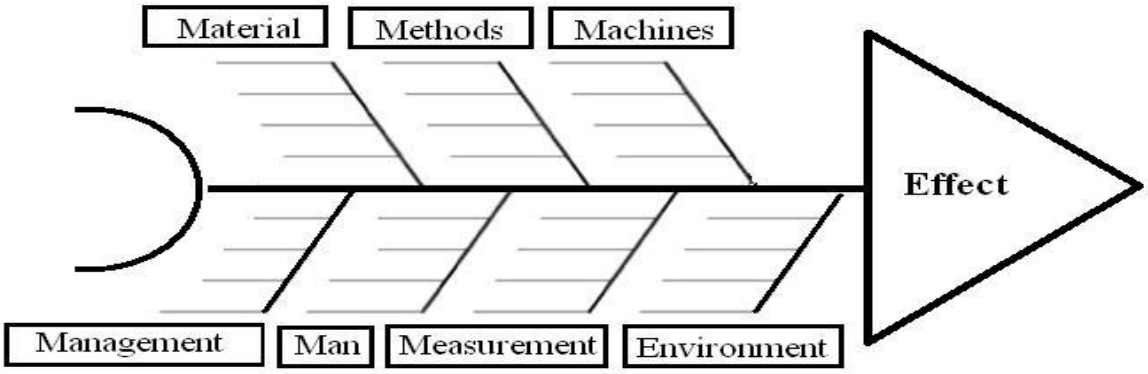

Fig. 2 *Fish bone 7M diagram*

Histogram

Histogram is a perfect tool for visualization of the frequency of the wathced phenomenon in process. It is a bar chart made from number of categories, showing their splitting. Customer tolerance can be added (LSL, USL) to watched process.

Pareto Diagram

Pareto diagram is a bar chart for discrete data, indicating the frequency of non digital data. These categories are arranged in descending order. The tool that allows determining the impact of input factors to an endpoint.

DMAIC

It is the common option for the model of improving the process based on Deming**'**s circle PDCA (Plan-Do-Check-Act). DMAIC (Define-Measure-Analyze-Implement-Control) is in the Six Sigma metodology being used as the standart routine for planning and implementation of the project. The abetment for Six Sigma projects is displayed in Figure 3.

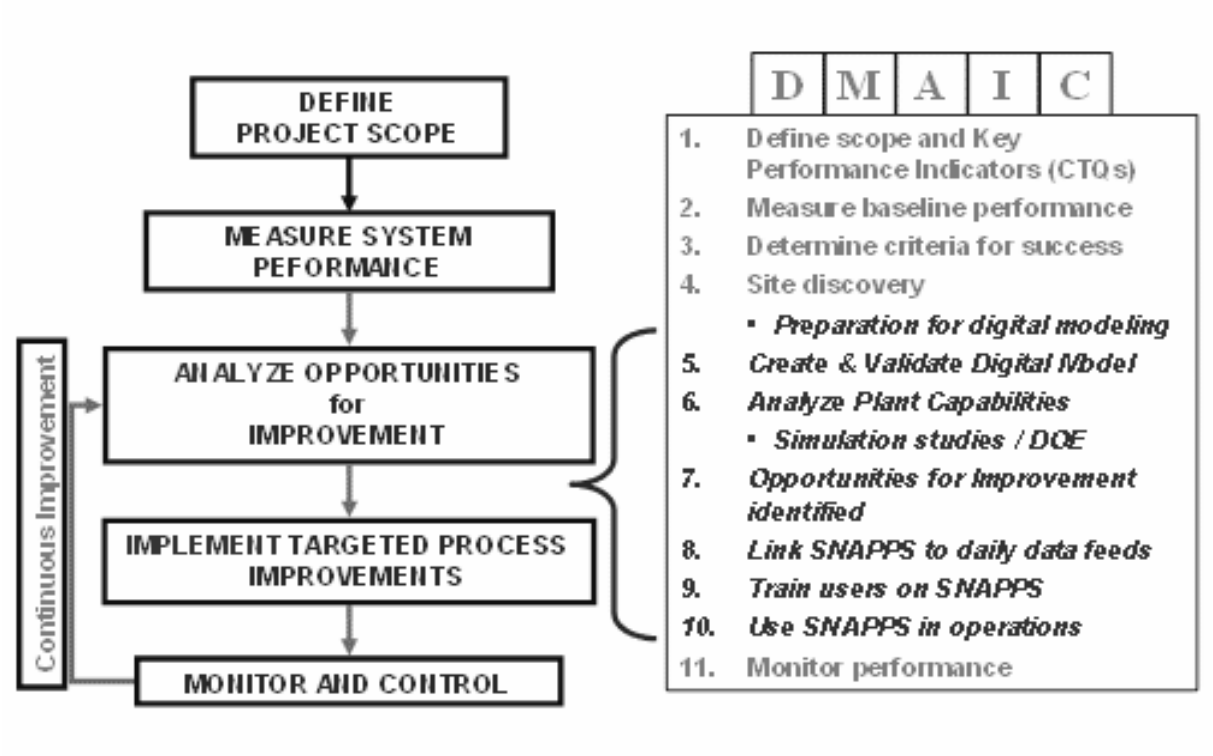

Fig. 3 *The ab-etment for Six Sigma projects*

Implications for Environmental Management

The Six Sigma method could be applied to EMS design because it has been successfully implemented in many large corporations in order to improve the quality of products and business processes. The company noted that while Lean Six Sigma projects focused on improving the operational efficiency and product field, direct reductions in energy use, air emissions, waste reduction, greenhouse gas emissions, and other environmental impacts also coincided. The implication of environmental performance lines to reduction of the overall environmental impacts [4].

Potential benefits: By eliminating variation, production processes are less-defect. A reduction in defects can, in turn, help eliminate waste from processes in three fundamental ways:

- fewer defects decrease the number of products that must be scrapped;
- fewer defects also mean that the raw materials, energy, and resulting waste associated with the scrap are eliminated;
- fewer defects decrease the amount of energy, raw material, and wastes that are used or generated to fix defective products that can be re-worked.

Six Sigma is the tool which helps focus attention on reducing conditions that can result in accidents, spills, equipment malfunctions, reduce the solid and hazardous wastes (e.g., contaminated rags and adsorbent pads) resulting from spills and leaks, and their clean-up. This method is focused on product durability and reliability, and increase of the life cycle of products.

Potential disadvantagies: Lack of technical capacity to effectively utilization of Six Sigma tools can potentially decrease the effectiveness of the strategy, and/or result in unexpected waste if incorrectly applied.

Conclusion

The fundamental idea of Six Sigma is that if performance is improved, quality, capacity, cycle time, inventory levels, and other key factors as reduction waste, energy sources and environment will also improve. Thus, when these factors are improved, both the provider and the customer experience greater satisfaction in performing business transactions.

One of the major tools used in practice especially abroad is Six Sigma, whose implementation has been gradually promoted in business also in Slovakia.

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