

## SIX SIGMA AND ITS APPLICATION IN RAILWAY SECTOR

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### **ABSTRACT**

*The methodology of Six Sigma is considered a quality philosophy for achieving corporate goals. Big companies have ambitious goals – they want to extend their competitive advantage within the global economy. This article deals with an implementation of the Six Sigma toolkit to railway sector processes. It is essential to fully understand the pros and cons of each tool's utilization. The article focuses particularly on application the Pareto Chart into railway transport processes in order to offer new approach of dealing the problem of train delays.*

### **KEY WORDS**

*Six Sigma. Pareto analysis. Railway sector. Quality management.*

### **JEL CLASSIFICATION**

*L15, M11.*

### **INTRODUCTION**

In current hypercompetitive environment, the companies have to stay flexible and offer the high-class products and services with focus on the customers' needs. It is very important to analyze individual processes, benchmark competing businesses and find out why some companies get better or plateau. In terms of achieving the excellent results, they need sufficiency of relevant information regarding to the functioning of particular processes. It is needful to have a coherent vision how to organize all elements in organization. The success also depends on the staff. Thus, companies have to engage each employee in order to reach their expectations. Depending on their enthusiasm and determination and providing desired outcomes in accordance with quality standards, the customer satisfaction can be adequately increased. Process improvement is never-ending, requiring constant effort and representing a journey – not a goal.

## 1 THEORETICAL FRAMEWORK

The high competition also pertains to situation in transport market, where railway undertakings have to respond to constantly changing conditions. Therefore, it is essential to find out new manners to improving the quality of provided services. There will always be flaws and faults needing to see the light of day and to be amended and corrected (Schonberger, 2008).

In general Six Sigma is a tool for improving productivity, creating internal teamwork, or reducing costs, and an effective approach to a broad-based quality control program (Thomsett, 2005). Simultaneously Six Sigma is a methodology for minimizing mistakes and maximizing value, and the statistical term for a process that produces fewer than 3.4 defects per million opportunities for defects (Gygi, DeCarlo, Williams, 2012). Six Sigma comprises of a solid, structured and rigorous logical method - called DMAIC (define, measure, analyse, improve and control) (Miller, 2016).

The process is understood as a summary of mutually arranged activities changing inputs into outputs by consumption of certain resources in controlled conditions (Nedeliaková, 2015). Acquired knowledge can be applied to decision processes in railway sector. It allows us to find out which key variables have decisive influence. This way, required service punctuality in passenger railway transport can be achieved.

## 2 METHODOLOGY

Within the Six Sigma methodology, the basic cycle (DMAIC) with five phases is generally used. The aim of this structured problem-solving method is to map and measure the characteristic of the processes and sequentially examine and analyse data and information and propose a solution (Martínez, 2016).

The definition phase deals with determining the customers, targets, processes and business problem. Performance is mapped and evaluated in the phase of measurement by key performance indicators. The analysis phase deals with main delay reasons. In this step, Pareto chart can be very useful tool. The following improve phase should provide improvement in order to elimination of main defects. In the final phase, proposed improvements are controlled and final effects are evaluated in relation to determined goals.

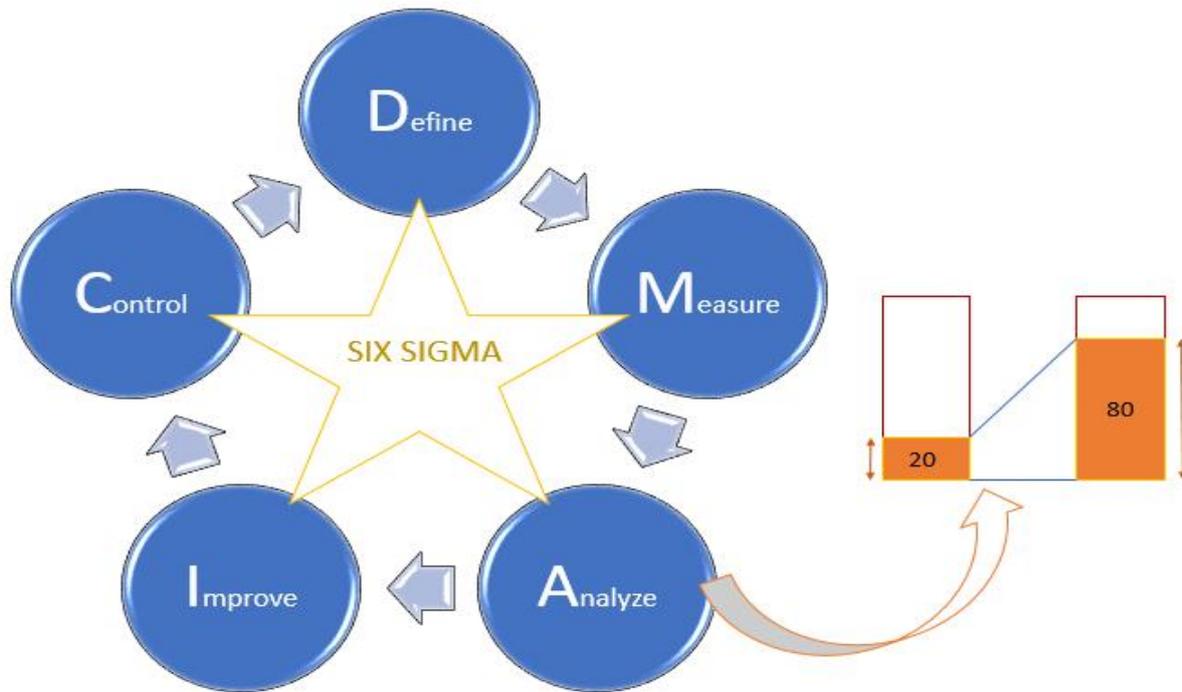


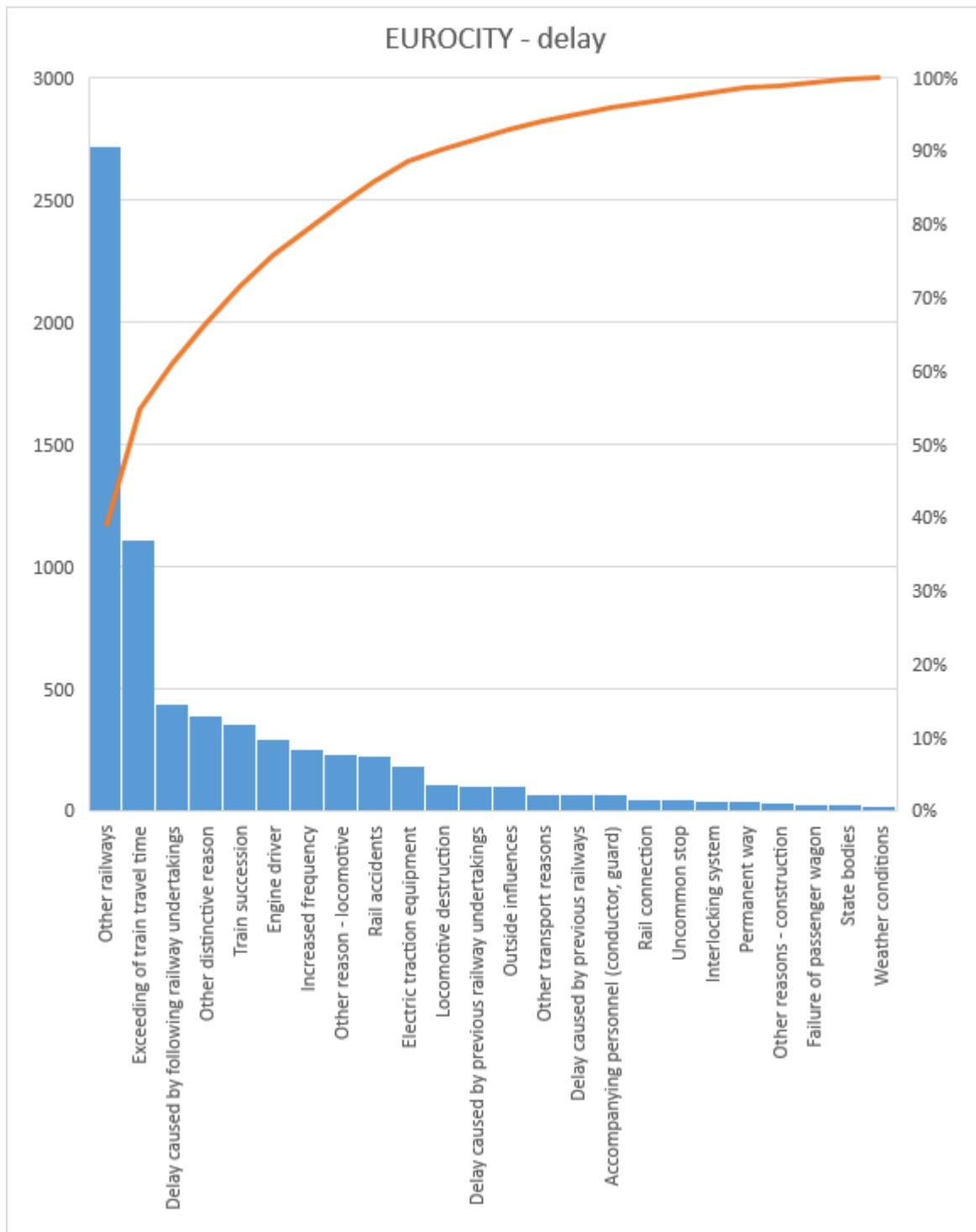
Figure 1 DMAIC

Source: author

The Pareto analysis can be used to identify those critical elements that are most likely to lead to significant improvement in overall project completion time (Pyzdek, 2003). Pareto charts was named after Alfredo Pareto and are based upon the 80:20 principle, which means that 80 % of the quality problems are caused by 20 % of the cases (Bedi, 2006). The Pareto chart belongs to the group of basic quality control tools. The main aim of the Pareto chart is to emphasize the most significant factors, which influence the business performance at the most.

### 3 RESULTS AND DISCUSSION

Practical application of the Six Sigma tool in terms of railway transport was shown on example of train delays. The survey was conducted during December 2016 with the help of data about delayed EuroCity trains which connect main European cities using the intercity rail network. Provided data are categorized by frequency and code of delay (listed on x-axis in the Graph 1). The quality criteria are defined by amount of train delays, which are visualized by the Lorenz curve (by minutes per month and cumulative percentage values).

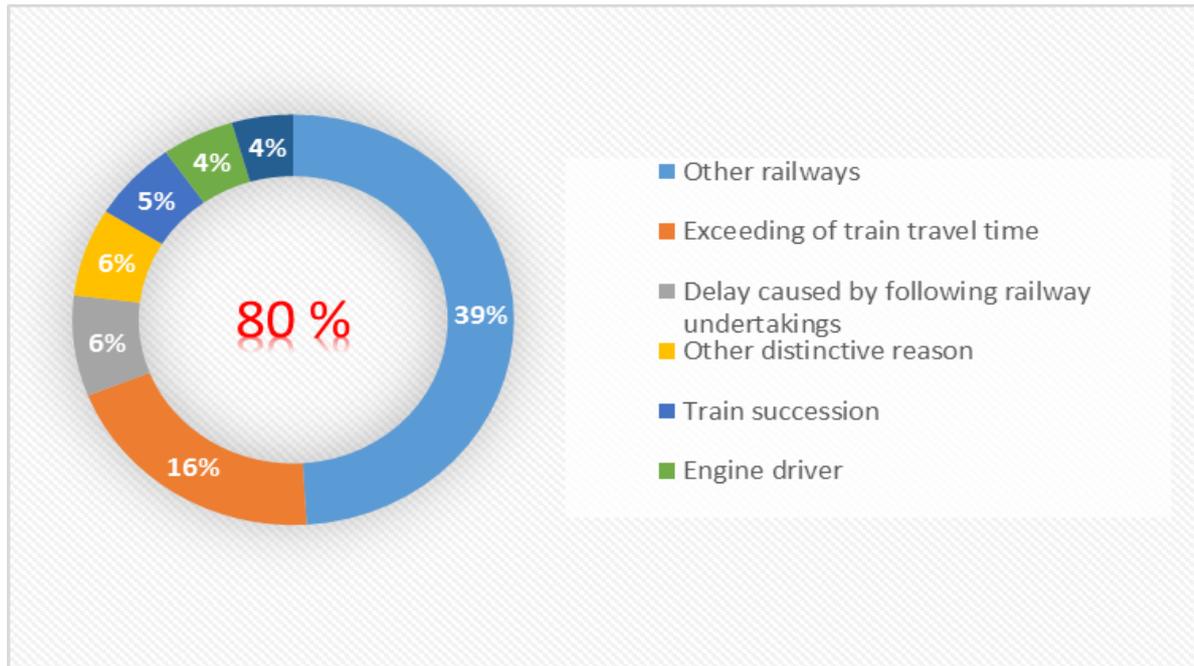


Graph 1 EUROCITY delay

Source: author according to internal data of ŽSR

In the Graph 1, the lengths of columns represent frequency of train delays. Each cause of train delay (see codes of delay) is illustrated by real value in minutes with negative impact to train punctuality. The most numerous group of them are delay reasons caused by

infrastructure managers and railway operators. It is 3 000 minutes per month in this case which has the non-compliance effect to scheduled train timetable.



Graph 2 Group of train delay reasons causing 80 % of overall train delay

Source: author according to internal data of ŽSR

Graph 2 presents most significant factors, which affect train delay. These are other railways, exceeding of travel time and following railway operator, train journeys' arrangement and engine driver. It is important to determine main reasons of train delay in order to detailed review of code of delay as well as identifying mutual connections. In Slovak Republic, ministry of transport penalizes public transport operators for non-compliance with planned timetable. Each percentage point of the overall delay is penalized by 5 000 €. This allows us to improve transport operation and save public finances. Therefore, it is necessary to enhance communication between infrastructure manager and railway operators.

Another step in process of suggesting innovative ideas for enterprise development is brainstorming. Selected member of staff consisting of operators and top managers should conduct brainstorming to achieve common targets (for maintenance and enhancement). The Graph 1 depicts the Pareto principle, where 7 main delay reasons cause approximately 80 % of train delays. According to the knowledge about Pareto analysis utilization, this principle can be applied in conditions of railway transport.

## CONCLUSION

The customer satisfaction is one of the fundamental quality criteria. At the beginning of the improvement process, it is important to define the current situation and search for bottlenecks. The Six Sigma quality management approach is highly process-oriented. It focuses on the waste of sources elimination as well as removing the deviations in service area and industry. Currently, improving the quality by implementation of various quality improvement approaches is very popular. However, it is disadvantageous to succumb to current trends and rely on them completely and immediately. The achievement of success depends on the synergy between the various elements. Therefore, it is necessary to analyze the data and their interconnection. The impact of establishment of new methods on the development enterprise processes can be diverse and achieve different dimensions. Therefore, it is necessary to focus on the tools, which are beneficial for business operation in the future.

The purpose of this paper was to suggest and explain new possible approach, usable in dealing one of the most essential problems in railway sector – train delays. The article highlights the necessity of analyzing all train delays' factors particularly. It is considerable to deal with detailed analysis of delay reasons in order to eliminate their occurrence in the railway network. This way, passenger satisfaction would be achieved and public financial burden could be decreased.

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