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IMPROVEMENT OF PROCESSES IN METALLURGY COMPANY

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The field of quality is very important for a company under current conditions. It is necessary to continuously improve the quality of provided services. Even though metallurgy is focused on production, not on providing services, even in these companies great variety of services exists, which is important to improve all the time. One of these production supporting services are the repairs. This article analyses and solves the problem of insufficient promptness of the repairs in a metallurgy company.

Key words: Metallurgy Company, Process Improvement, Six Sigma, Repairs

Unapređenje procesa u metalurškoj kompaniji. U suvremenim uvjetima poslovanja područje kvalitete vrlo je važno za kompaniju. Neophodno je kontinuirano poboljšanje kvalitete pružanih usluga. Iako su metalurške kompanije fokusirane na proizvodnju u njima postoje velik broj različitih usluga koje je potrebno unaprjeđivati cijelo vrijeme poslovanja. Jedna od tih usluga koje podupiru proizvodnju je održavanje. U članku se analizira i daje rješenje problema nedovoljno brze reakcije službe održavanja u metalurškim kompanijama.

Ključne riječi: metalurške kompanije, unaprjeđenje procesa, six sigma, održavanje

INTRODUCTION

The importance of quality improvement is nowadays undeniable. Many companies understand quality in different ways. By using methodology DMAIC in Six Sigma the possibilities for improvement in the repair processes in the metallurgy company should be pointed out. This article is focused on the problem of length of the repairs for the purpose of quality improvement, because the quality of provided service is being considered. With respect to the size of the company, the repairs are provided by an independent department. In 2008 there was an increased amount of prolongations of production downtimes resulting in creation of production loss. For this reason in this article the possibilities of elimination of this problem will be pointed out. In the theoretical part of the article the focus will be on the problem of the method six sigma and the basic tools for quality improvement.

BASIC TOOLS OF IMPROVEMENT

Pareto´s diagram is a diagnostic tool that can be used for a quick and simple determination of crucial errors, items or tools. For its construction the primarily absolute frequency is used. Its construction results from the empirical principle 80-20. Pareto´s diagram originates from the use of Pareto´s principle; however its first use in practice is attributed to J.M.Juran. Pareto´s diagram could be understood as an extension of cause-and-effect diagram or at least be based on it. [1].

The process of data arrangement, data classification and data tabulation helps to determine the most important problems that are needed to be removed. The construction of Pareto´s diagram is quick and simple. The cause of each error is carefully examined and recorded into the frequency table. According to this table, the individual categories are sorted decreasingly. The height of the column is then equivalent to the frequency of given category. At the same time these categories are depicted on the horizontal axis from the most frequent to the least frequent. The proportionality of the category division is shown by so called Lorenz curve that represents cumulative relative frequency of the given categories [2, 3].

During the analysis of possibilities for improvement it is necessary to identify all impacts that influence the phenomenon, which needs to be improved. All potential impacts that can actually influence the monitored process it reflects.

For determination of each individual cause of the problem the most frequent method used is brainstorming. Correctly and carefully created Ishikawa diagram should quickly identify the causes of quality problems and subsequently use the correct repairs for their elimination [4].

QUALITY AND ITS IMPROVEMENT

Gitlow, [5], defines quality as “an assessment of product or service to the customers or users. “ El-Haik and Yang, [6], defines quality as the ratio of attributes that given product has and our expectations we have for product or service. For this reason it is necessary to refer

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to Juran's definition of quality, which says that quality is fitness for use.

In the beginning of quality improvement, the basic tools for improvement are used: histogram, development diagrams, correlation diagram, Pareto diagram, Ishiwawa diagram, regulation diagram and control sheets. The history of modern quality improvement begins with Shewharth regulation diagrams [5]. Consequently, he managed to create PDCA cycle, which gained its success later. Gradually, TQM quality improvement system was used in practice. A newest approach to quality improvement is the Six Sigma method, whose crucial aspect of success is the ability to implement to the assessment economical and other characteristics besides quality [6, 7].

SIX SIGMA A DESIGN FOR SIX SIGMA

Nowadays, Six Sigma represents the most increasing managerial company system for improvement. One of the main principles of this methodology is reaching only „3,4 PPM". This phrase determines a situation, when for every million of products produced, there are only 3,4 discordant products (supposing normality of error distribution) [8]. The key aspect of success of this methodology is, contrary to its predecessors, the fact that it implements into the processes of project assessment not only the quality assessment, but also economical and other characteristics, which are commonly used in company's practice. Consequently, it interconnects and compares these characteristics, getting the synergistic effect from their utilization [9]. By using DFSS methodology it gets even higher synergic effect, due to using the tools of classic methodology Six Sigma early in the phases of projecting, designing and research. DFSS represents discontinued constant improvement. By this method we get ahead of time compared to Six Sigma improvement and the costs are reduced due to the fact that the repair costs and costs of changes in design are in the early phases incomparably lower than in the phases of production or sale [6].

PROCESS MAPS AND DEVELOPMENT DIAGRAMS

In theory, it is possible to encounter the terms as process maps and development diagrams. According to several authors they are even synonyms. Gitlow defines development diagram as "graphical (picture) representation of the flow of various operations of the process used for documentation of this process." [5]. Construction of development diagram can provide important information about the process that can help people concerned to understand, modify or improve the process. Standard symbols, introduced by American National Standards Institute, are used for construction of development diagrams [10].

Fitzgerald et al. defines two types of development diagrams [11]:

- *System development diagram* – graphically represents the order of operations creating process
- *Project development diagram* – represents the plan of area, usually containing the flow of work and goods, equipment distribution, storage areas, warehouses, etc.

Gitlow claims the following advantages of using development diagrams opposed to using written or verbal descriptions. According to them the functions of communication tool, planning tool provide a systematic overview, define tasks, depict internal relationships, support logical correctness, facilitate breakdown removal and document the system [5, 12].

IMPROVEMENT OF REPAIR PROCESSES

In the metallurgy company the breakdown of the devices occurs regularly. Such situations are not rare. The breakdown repair is executed either by employees of the department where the breakdown occurred, if the breakdown is easily reparable, or by employees of maintain department. These employees are assigned to the breakdowns based on the waiting list which determines the order of repairing each of breakdowns.

At 2008 there was executed approximately the same amount of breakdowns than in 2007. Also the average value of repair did not change since 2007. On the contrary, there was an increased amount of loss caused by breakdown downtimes. For this reason an improvement team was created and its task was to identify the causes of such increase of loss in downtimes and remove their causes.

For improvement of repair process it will be used DMAIC methodology, which is a part of Six Sigma. For this reason each step of improvement are determined by this methodology.

Define

In the beginning it is necessary to define all the facts. In this project of improvement we focus on the process of devices repair in the metallurgy company. The process of repair consists of several steps is presented in the following map, Figure 1.

The arising of a breakdown is also understood as an identification of the breakdown by the operating personnel. Immediately after identification of the breakdown the personnel determines its seriousness. If the breakdown is not complicated, the repair will be executed by the operating personnel, who have the basic skills for repairing common breakdowns of devices. If the breakdown is serious (complicated), the personnel will report to maintain department. This report contains, besides the description of breakdown, its priority. Based on this information, the dispatcher places the given report into the system of breakdown reports in the appropriate order. In this system the repairs with a high priority are preferred. Consequently a team is dispatched to repair the device according to the waiting list. In some cases it

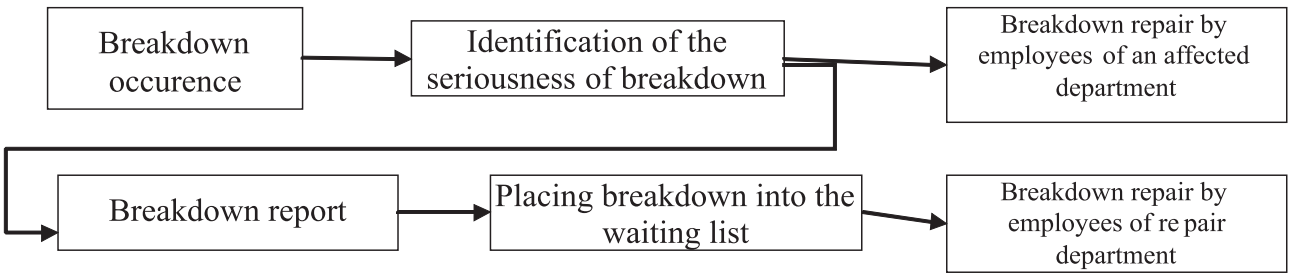

Figure 1 Process map of repairs

is possible that the repair will not be executed immediately, but after some time due to the occurrence of more significant breakdowns. The repair priority is represented on a scale 1 to 5, where 1 is the highest priority and 5 is the lowest one.

Measure

The loss can be understood in this case as every decrease of revenues due to the production downtime.

The development of loss caused by the downtime of devices and tools in 2008 increased approximately in 30 %. The amount of this loss is represented in Figure 2. In 2008 there was reported approximately the same amount of breakdowns as in 2007.

The structure of every breakdown according to their repair priority is represented in the following graph. In Figure 3. can be seen that in 2007 there where 30 % of breakdowns with the highest priority. In 2008 this category represents approximately 55 %.

Also the average time, which elapsed from reporting the error till the correction, was found out. By comparison was found out that errors identified as critical have been repaired in average of next 3 hours. Errors identified as the least serious were corrected in average of nearly 1,5 days (32,56 hours - non-stop operation).

Analyze

The observed increase in breakdowns with the highest priority is suspicious. For this reason we decided to evaluate retrospectively, if the degree of assigned priority was appropriate. There were created three groups, i.e. a group where the repair priority was assigned right. The second group represents breakdowns, whose repair priority was undervalued, i.e. the priority assignment was lower than it should have been. The third group is made of breakdowns, whose repair priority was overvalued, so they should have had a lower priority than one recorded in the breakdown system. The ratio of those groups is in the following graph. We can see that in 2008 there are up to 50 % of breakdowns that were overvalued, Figure 4.

Based on the results, it was found out that the problem of increase the loss from failures is caused by overvaluing repair priority. Thus it is necessary to create a system of assessment of breakdown repair priority that would be more objective.

Figure 2 Loss development caused by breakdowns

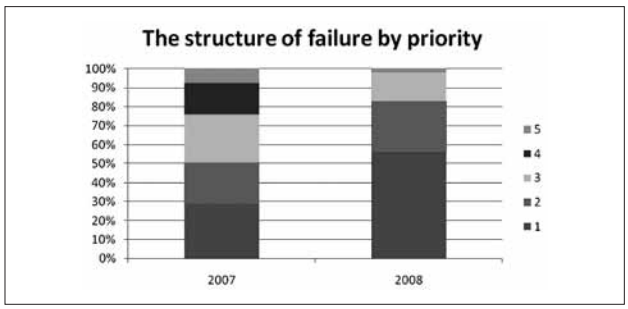

Figure 3 Structure of reported breakdowns with respect to their importance in years 2007 and 2008

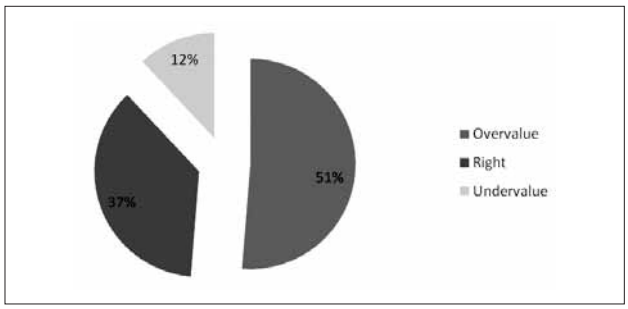

Figure 4 Assessment of suitability of the priority of repairs

For these groups the finding of the average length of repair has been held again. It was found out, that mistakes, whose priority of repair was overestimated, had significantly lower average value than those ones who were properly assessed in terms of their priorities. This means that the corrections could have been made also later.

Improve

For improvement of this condition it is necessary, as we wrote in the previous part, to improve the system of priority assignment of breakdown repair. Until now this system was based solely upon objective assessment. In case we wanted to improve the current situation without

the change of the assessment system; we would need to increase the amount of employees of repair department. That would represent additional financial costs. The production loss would be reduced at the expense of additional costs. During the analysis of this solution we found out that the benefit of such a solution would be only negligible.

The given situation is caused by the changeability of assessment. Employees are assessed based on their productivity and if the devices are stopped it resulted with decreasing of production. Each department has defined production goals, based on above mentioned assessment. For this reason each operating personnel tries to acquire the repair as soon as possible resulting in overvaluing the repair priority.

Thus the only way is the change of priority assessment system. To make the assessment objective, it should be executed by an independent person, who would only evaluate the priority of these breakdowns. Due to the uninterrupted working time, such a person would have to work non-stop, so for a 3 shift working time it would be necessary to have at least 10 people available during the month. If this activity was executed by a repair dispatcher, his working load would significantly increase, while the time for transport in the area is long due to the limited speed of vehicles, local conditions and the size of the area. The transport from the center of the factory to any point would last up to 30 minutes. For this reason this step would be financially demanding.

For determination of an objective priority assessment we decided to create a unified assessment questionnaire, in which the personnel will, based on the given questions, determine the degree of priority for breakdown repair. In this questionnaire the personnel determines the priority based on the following questions:

1. Does the breakdown cause stop of production?
2. Does the breakdown endanger the safety of employees?
3. How many employees are affected by this breakdown?
4. What is the estimated value of a daily loss?

Based on the answers is assigned the repair priority and the waiting list for repairs is created.

Control

To verify that the situation was remedied, there was used an indicator for false repair assessment. This indicator will be monitored for individual weeks and individual manufactories. This way it would be possible to identify potential manipulations with the assessment system. Consequently, the ratio of false repair assessments will be monitored by the p-diagram. The volume of the loss from the repairs has decreased about 15 % in comparison to the previous year after introduction of new steps.

CONCLUSION

In this article we pointed the possibility of utilization of Six Sigma method in the metallurgy company. Specifically we applied methodology DMAIC for improvement of repair processes. The repairs are executed constantly in this company, thus their coordination is very important. For this reason the company can this way increase their quality level of repair services, where speed is one of the aspects of quality. The level of quality was considered to be already high in present time.

The use of DMAIC algorithm for the case of services is unusual. Adaption of this procedure to the following conditions is considered to be the greatest contribution of this article. These adjustments can also be used for further improvement projects that will be dealing with quality of service. Therefore the scientific contribution of this article is in the adaptation of the original methodology DMAIC, which was primarily designed for the needs of improving product quality.

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Note: The responsible translator for English language is Tibor Fellegi, Košice, Slovakia.