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Professional paper

PROPOSED METHODOLOGY FOR IMPLEMENTING QUALITY METHODS AND TECHNIQUES IN MACEDONIAN COMPANIES

Elizabeta Mitreva[1], Oliver Filipovski[1]
elizabeta.mitreva@ugd.edu.mk

[1]*University Goce Delcev Shtip, Faculty of Tourism and Business Logistics, 2000 Shtip, Macedonia*

Abstract

Providing quality in a business company is a matter related not only to the work done by individuals, but also with machines and the technology of the production processes as well. Therefore, it is necessary to provide statistical control in terms of estimating both the stability and the capability of production processes as well. However, control solely is not enough. A constant improvement of the processes by reducing the variants is necessary as well. Thus, it comes to the point that using SPC (Statistical Process Control) cannot be a mean of measuring the current performance. Instead, it provides a base for improvement of those processes. While designing the standard operative procedures, a suitable methodology for methods and techniques of SPC needs to be interposed, in order to perform a flawless production and methodology for optimization of costs. This paper provides a methodology proposal of SPC as a subsystem of the TQM (Total Quality Management) system that will assist managers in Macedonia in terms of designing a solid quality system. The proposed methodology provides a solid support of the top management, because the results gained from the outcomes of the partially implemented methods and techniques at some companies in Macedonia indicate that implementing SPC methodology and methodology of costs optimization can help achieving both the defined quality and better productivity by smallest costs. These methods have given same effects in number of diverse companies which refers to the universality of the proposed methodology.

Key words: *quality methods and techniques, TQM system, process stability, percent of the defects, cause of defects, methodology.*

INTRODUCTION

Methodology for statistical process control

Certain companies that have designed a solid filed quality system which covers every business process, own a base for a successful implementation of SPC (Statistical Process

Control) and teamwork that otherwise would have been imposed in case of a malfunctioning quality system [1].

The defining of the obligation and the responsibility of the employees via SOP (Standard Operative Procedures) gives an opportunity to each employee to participate in resolving issues that are visible after measuring certain traits by the useful implementation of SPC [2].

Hence, the capability of the employees in resolving issues is being increased [3]. Each employee is trained to implement the methods and techniques for flawless work performance which is quite important for a company. Each day one faces problems that need to be effectively resolved, so the ability for an improvement of the company as a whole is increasing. The results from the implementation in practice imply that the quality system should assist the companies to overcome their problems in terms of defining, design, control and process's improvement [4-5].

The companies that implement flawless work methods and techniques have achieved rising of the quality level in every business process, as well as reduction of all kinds of costs, price reduction of products, gaining confidence of the purchasers/users and improving in regard of the knowledge of the employees. At the same time, those companies result with better motivation, increased productivity and with their presence on a larger number of markets [6].

According to the results of the research [7], it has been verified before that the Macedonian companies do not pay much attention on the quality, insufficiently favor additional education, do not invest in innovativeness, etc. Also, there is a small number of companies where there is an actual quality system implemented and there is no evidence that much attention has been paid to the care of the employees, clients, deliverers. Furthermore, a weak implementation of SPC is noticeable as it is considered that the teamwork is a step back in the past. In short, this methodology of technological development is unknown to the Macedonian companies, meaning that they have a lack of ***an integral model for implementation and designing of TQM system.*** *This paper provides a methodology proposal of SPC as a subsystem of the TQM (Total Quality Management) system that will assist managers in Macedonia in regard of designing a solid quality system.*

EXPERIMENTAL

Proposal methodology for implementing quality methods and techniques in Macedonian companies

This flow of building a subsystem of SPC as a subsystem of TQM system is done through following activities, figure1:

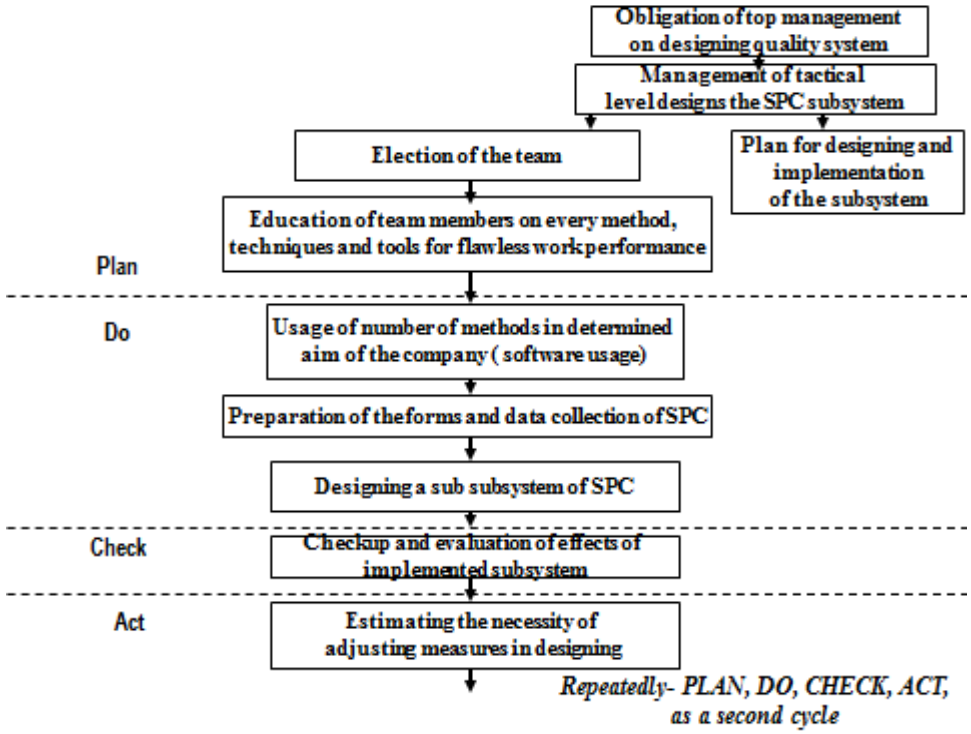

Figure 1. Process flow for designing of SPC subsystem

(Plan) step 1: Plan to design and implement of the subsystem of SPC

Step 2: Election of the team

The team is responsible for designing and implementation of the subsystem for flawless work performance. During the election, it is necessary to hire highly professional and adequate individuals that with their experience, knowledge and skills would allow solid design of the subsystem for evaluation of the stability and the capability of the processes aiming to manage them as well as to rationalize them.

Step 3: Team member's education on methods and techniques for flawless production

Methods and techniques for flawless work performance are used on each management level for the following purposes: evaluation of the results, optimization, evaluation of both the stability and capability of processes, detection and preclusion of defects while working etc. Therefore, we come to the fact that all these levels are to be educated and trained for an efficient usage.

- **At a strategy level** - Education and training are necessary in order to be able to use delicate methods and techniques for quality management such as FMEA analysis, QFD method, electronic data management, internal audit, technical/ network planning, experiment planning, quality cost analysis, etc.
- **At a tactical level,** the education and training are necessary for the usage of the statistical method for cost optimization, methods of quality anticipation, methods for determination of the vision and companies in development, planned experiment, etc.

- **At an operative level,** the education and training are necessary to be able to use the statistical methods for assessing the capability and stability of the processes, correlation, regression, dispersion, control cards, dependence of the indicators of product quality by the production factors, etc.
- **At a routine level** education and training of the employees is necessary to use the basic tools for quality providing such as the Pareto diagram, Ishikawa diagram, Poka - Joka method, trend card and all the methods that the employees can easily understand and apply in their daily work. The most useful methods are the self-control and the Poka - Joka method.

(Do) step 4: Using different methods and techniques for an assigned tasks and confirmed aid in the company. Software packages are more and more of a usage as they appear as fast and simple to be used.

There are a number of methods and techniques for flawless work that would be used:

- methods for detecting the place where most of the defects appear (expressed in percentage);
- methods for detecting the cause which allows defects;
- methods for following the process flow;
- methods on decision making;
- methods for evaluation of the stability and the capability of processes;
- methods for estimation of the dependence means;
- methods for evaluation of dispersion of means etc.

Step 5: Preparation form for data collection of SPC

The documents and other files which contain information for stability and capability of the processes could be written, transferred and accepted by number of means. Forms should be as follows:

- simple;
- easy for computer processing;
- comprehensible for the employees.

After collecting all data it is necessary to present it on a graph with a previous arrangement. The documentation of the used statistical methods is of enormous meaning in preparation **quality files.**

Step 6: Designing a subsystem of SPC in a company

Within the subsystem for SPC managements, the following needs to be defined:

- what is to be controlled;
- place of collecting, revising and analyzing of results;
- staff obliged to collect, revise and analyze the results;
- manner of presenting the results;

- information path;
- creating and realization of the policy of quality checkup;
- preparation, operationalization and accomplishment of the plan and program of the quality checkup;
- determination and realization of the manner, procedure and the means of quality control of the materials and products which go in and out of the company.

(Check) step 7: Checkup and evaluation of the effects by using SPC refers to:

- process study;
- analyzing of process where using the methods and techniques of SPC for flawless production the stability of processes is being assessed;
- process quality control;
- quality control of materials, segments, subsets and products sets.

(Act) step 8: Estimation of the necessity of adjustment measured within the designed subsystem of SPC

According to the checkup and the evaluation of effects using SPC, it is recommended to have the following improvement measures of the subsystem implemented by improving the following matters:

- norms;
- indicators;
- methods and instruments for quality control.

And the cycle begins anew.

RESULTS AND DISCUSSION

This methodology as well as a part of those methods was implemented at a factory of rail vehicles in order to estimate the process stability, number/ percent of the defects, machine stability, detection of both the cause of defects and variations, etc. The following are statistical methods which were introduced:

- **Trend card -** in order to see the dynamics in the traffic release of travel and freight wagons during 2011.

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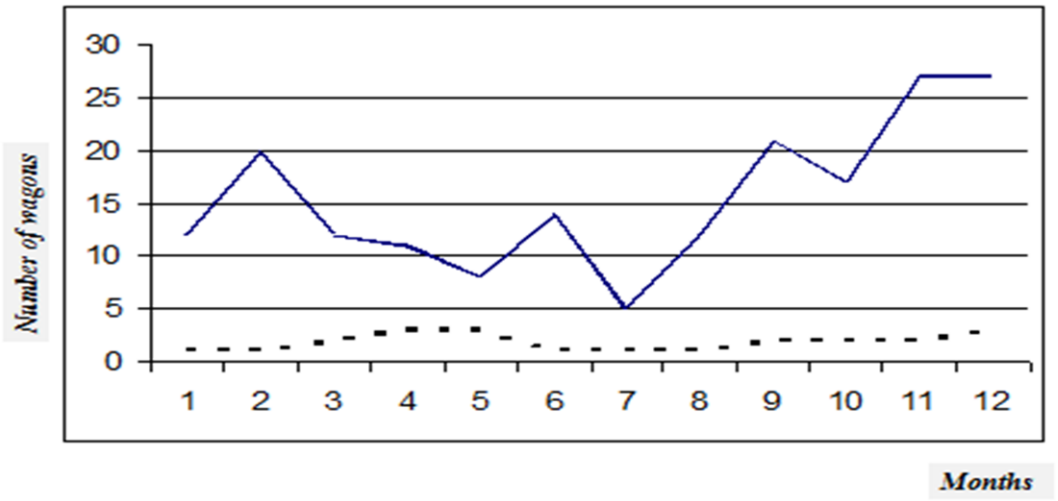

Figure 2. Trend card for the number of the released travel and freight wagons expressed in months during 2011

Legend: ——— *Number of freight wagons*

– – – *Number of passenger wagons*

- ***X-R control card*** is to confirm the stability process of the production of capsules as a useful method for provision of a stable process in terms of achieving the smallest variation of the internal diameter of the capsule. This is quite significant, since the daily production of this factory amounts 2000 capsules, which is 42.000 per month and 504.000 per year.

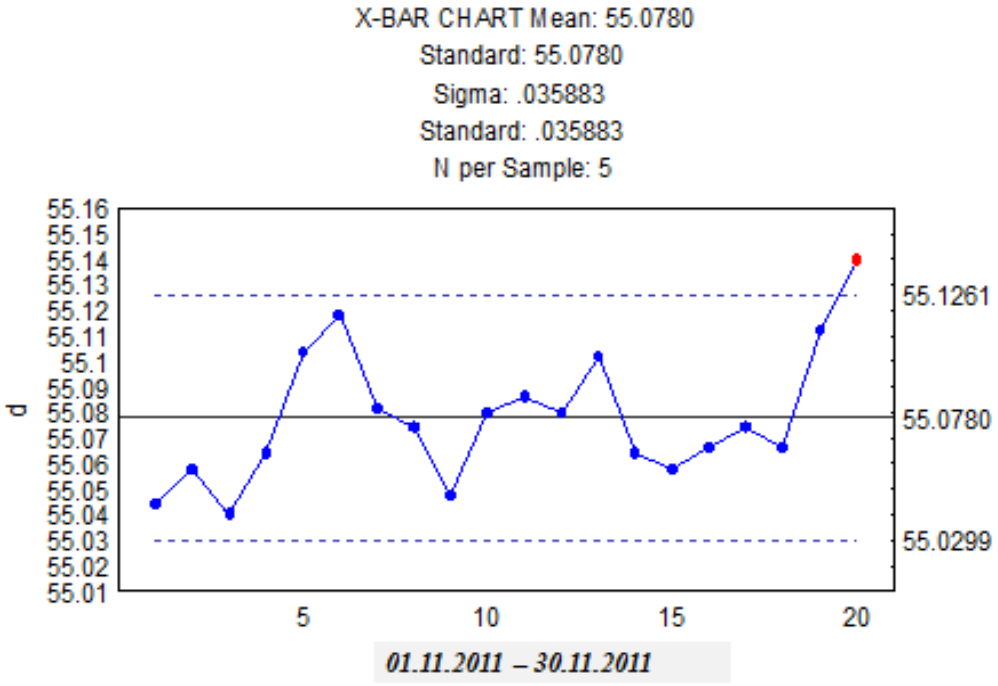

Figure 3. X - R control card for determination of the production stability process of the capsules

Figure 3 presents a stable process, except on 25.11.2011 where it goes beyond the upper limited level. However, those exceptions are not exceeding the tolerated control limitations.

Within the period from first till the eighth day in the month there are variations which are result of the process from the very start, with some implemented adjustment measures. As a result, the process was stabilized. This condition is being maintained until 25.11.2011 when it anew demands additional intervention. This control card depicts whether the process flow is in accordance with the expectations of the stabilized processes or products.

- ***Correlation and regression analysis*** has been changed in order to confirm the qualitative and quantitative dependence of the degree of exploitation of the tempering temperature and the hardness of steel according to Brinell, which is quite significant for the optimization of those processes, Fig 4.

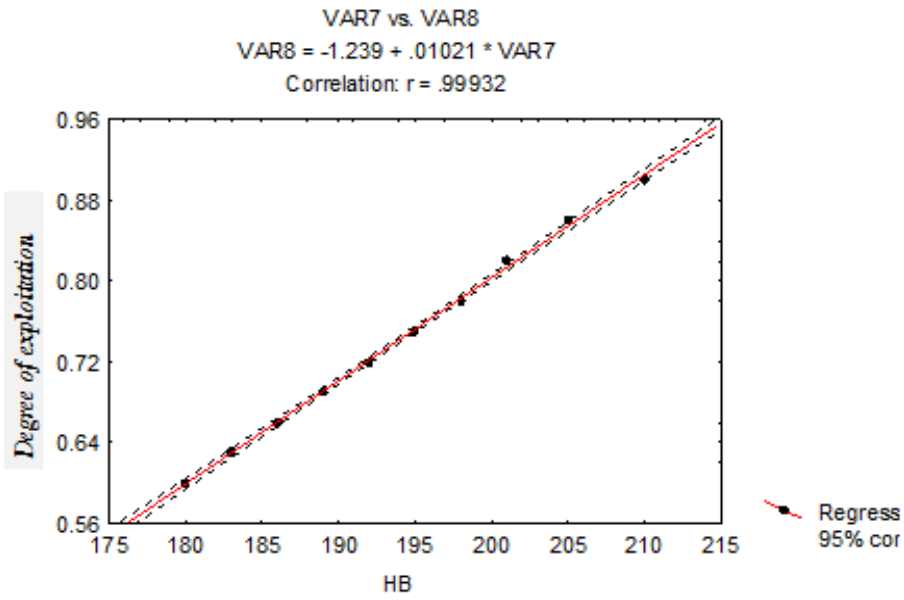

Figure 4. Reliance of the degree of exploitation of the steel hardness according to Brinell

Figure 5. presents a diagram of correlation between the tempering temperature and the degree of exploitation.

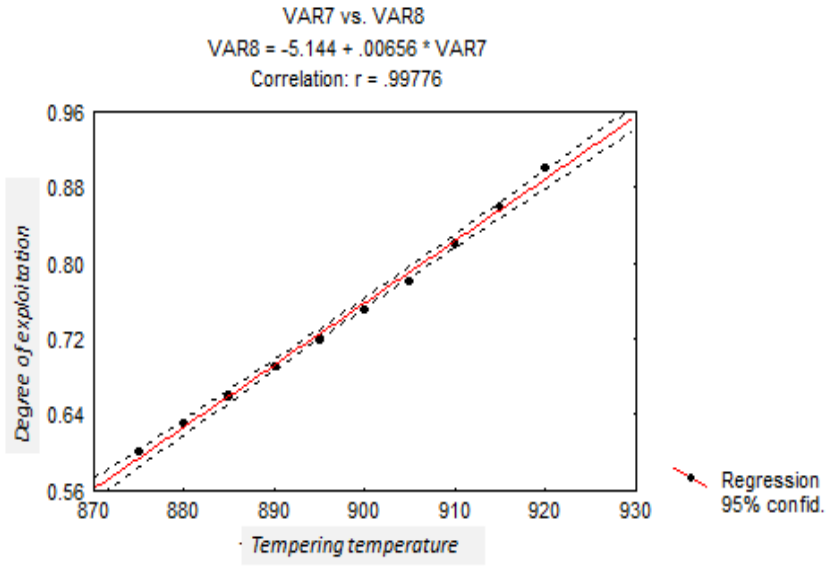

Figure 5. Dependence between the tempering temperature and the degree of usage

The displayed result on Fig.4 clearly shows that the correlation coefficient is $r_{x, y} = 0.99932$, denoting that between those two parameters there is a strong reliance. This can be seen again in figure 5 where the coefficient of correlation is $r_{x, y} = 0.99776$. As for the diagrams, it could be verified that those parameter are mutually dependent, which is shown in production practice.

- ***The Pareto approach*** has been applied in the working unit for freight wagons, where a direct contact with the customers has been established. By analysing the claims for compensation we can perceive the phase of reconstruction of the rail-vehicles where most of the working lapses appear.

Due to this fact, an analysis of 50 freight wagons has been conducted. The table 1 displays the number of complaints per division in the working unit for freight wagons expressed in euros, the complaints percentage, as well as the cumulative percentage of complaints.

Table 1. Number of claims for compensation (displayed in euros) per department in a working unit for freight wagons

Ordinal Number	Type of Department	Number of Claims for Compensation (displayed in €)	Percentage of Claims for Compensation (%)	Cumulative Percentage of Claims for Compensation (%)
1	Blacksmith's Department	6.885	47,7	47,7
2	Lower Engine Department	2.459	17,0	64,7
3	Upper Engine Department	1.967	13,6	78,3
4	Brakes Department	1.803	12,6	90,9
5	Carpenter's Department	656	4,5	95,4
6	Dye works Department	328	2,2	97,6
7	Round-slot Department	328	2,2	100
Total		14.426	100	

According to the Pareto approach, it is notable that the largest number of claims for compensation appears in the blacksmith department, where 47, 7% out of the total number of complaints fall in this particular department.

The analysis of the problematic operations leads to analysis of the causes of the condition in order to eliminate the irregularities which, again, cause defects. The cause of the defects can be derived from several factors, such as: human, machine, methods of work, material, tools. The analysis of the additional costs that have pervaded from the complaints on the repaired products in the Blacksmith's Department for compensation during the first six months of 2011 has been displayed in the figure 6.

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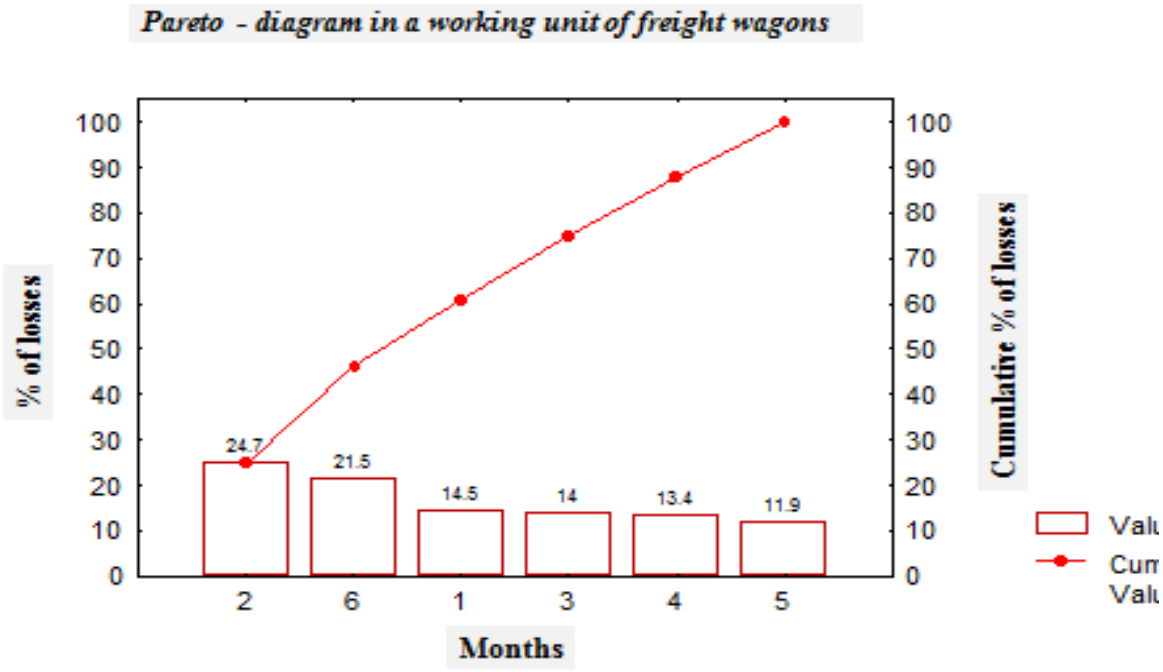

Figure 6. Losses due to claims for compensation (displayed in %) in the first six months of 2011 in the Blacksmith's Department

By implementing the CE (Cause and Effect) approach, we can come to a realization about what causes the largest percentage of loss (due to the claims for compensation) which appear in February (24, 7%) and in June (21, 5%) respectively.

- ***Implementation of the Ishikawa diagram or CE (Cause and Effect) approach for tracing the causes for the complaints***

In order to determine the causes for the losses that came out as a result from the claims for compensation, we have implemented the Ishikawa diagram (figure 7) in the Blacksmith's Department.

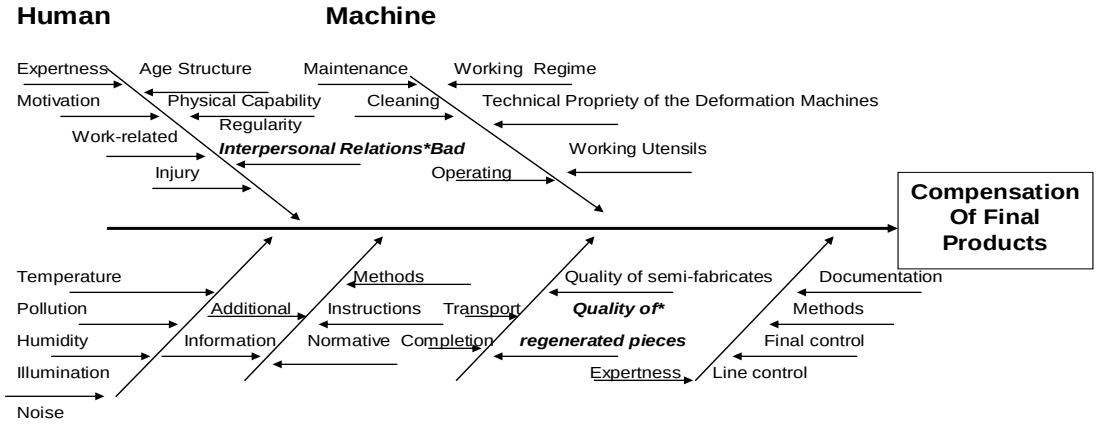

Figure 7. Ishikawa Diagram for detecting the motives of the claims for compensation of finished products in the Blacksmith's Department

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After the detailed analysis of the factors and sub-factors which can contribute the further progress of the defects, by the elimination principle we come to the following events and acknowledgements:

- The interpersonal relations within the Blacksmith's Department are heavily violated. There are frequent disputes among the manager and the immediate executors of the tasks. Due to this condition, frequent interventions by the management are required.
- The claims for compensation of the ready-made products that come out from the Blacksmith's Department are -above all- based on the regenerated input parts that do not meet the requirements, but are produced in the working unit for mechanical preparation, i.e. in the unit for mechanical treatment of metals.

After the analysis of the reasons for claims for compensation of products in the department of mechanical preparation of metals in the working unit of mechanical preparation (figure 8), we have come to following acknowledgements:

- It has been noted that the welding torches were technically defective. Due to outdating, the voltage has been irregularly maintained in a stable condition which is of great importance for welding. The intervention takes place in every four months;
- The working equipment, i.e. the lathes is in unsatisfactory condition (dilapidated). In such condition, the equipment cannot provide both the required precision and the quality of processing. The intervention takes place in every four months;
- Both the lineal control and the final control do not perform their function adequately to the standard operative procedures.

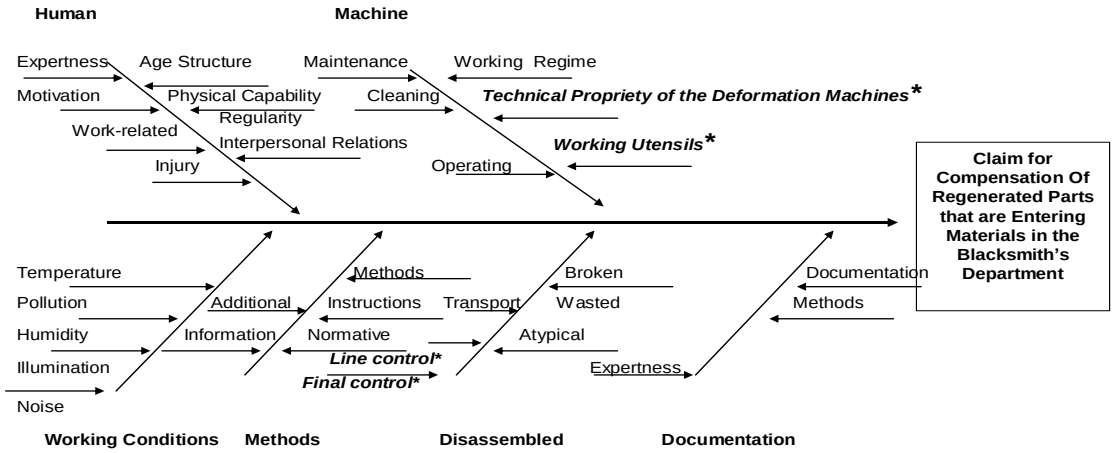

Figure 8. Ishikawa Diagram for detecting the motives of the claims for compensation of finished products in the Mechanical Processing of Metals Department

The computer systems [8] by their hardware and software components present a solid base for fast transfer of information required for realization of the working processes. These are always linked with the answers to the questions (What?-Who?-How?-Where?-When? as well as to the ones answering Who?-To Whom?) which give a report for the completed tasks within the company. Again, by the implementation of this methodology, the defined quality can be effectuated with both increased efficiency and with lesser amount of costs in the working process.

Those methods and techniques were implemented in confectionary production factory where the defined quality was accomplished. Hence, the clients were countenanced in regard of defective products and factory competition on the market has increased, as well as the profitability. Therefore, the defects and the costs of working were reduced and the content and involvement of the employees in decision making was increased. All of these refer to the fact which points to the universal implementation of this methodology into practice, no matter on which business field it has been exercised.

CONCLUSION

Proposed benefits - methodology for designing and implementation of statistical process control are:

- use of the statistical methods and techniques makes the defects reduction a remarkable beneficence especially when the confirmed quality is being demanded with least cost of working;
- by using software packages the efficiency in usage of statistical methods and techniques is increased;
- through the quality cost analysis the losses could be easily controlled and cut down to minimum in terms of consumption of materials and energy.

Besides these, other significant effects are to be achieved, such as:

- involvement of every employee in quality achieving;
- dedication of the employees towards quality improvement;
- full commitment of the top management towards the system according TQM and their continuous improvement;
- ability to solve problem on each level;
- minor but significant improvement of processes and products;
- optimization of business processes;
- reduction of the responsibility for decision making to a lower level.

Without top management solid dedication towards the given goals for quality and consistency of their application, all the efforts would be a pure waste of money and time and at the same would reduce the ability towards success for an upcoming initiative of such kind. The methodology for statistical process control as a segment of TQM system has a feedback as a result of the necessity of a permanent improvement of the working processes. Repeating or spiral repetition of these cycles of benefits would be easily noticed. Therefore, the organization attitude towards those initiatives would depict stimulation towards higher aims for perfection.

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