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ANALYSIS OF EFFECTIVE IMPLEMENTATION OF SPC

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Abstract: *This article deals with the analysis and conclusions of the questionnaire survey that was the main tool of the second phase of the research on the complex and effective application of SPC realized at the Department of Quality Control of the Faculty of Metallurgy and Material Engineering, VŠB-Technical University of Ostrava, Czech Republic.*
Key words: *effective SPC, complex SPC, problem-solving process, process improvement, questionnaire*

1. INTRODUCTION

Statistical process control (SPC) is an approach to the process control that has been widely used in many industrial or non-industrial fields. The main goal of SPC is an identification of abnormal variation caused by assignable causes with the aim to make the process stable, minimize the process variation and improve the process performance.

Effective application of SPC is such complex application that leads to the process improvement. Meeting this goal is affected by many technical, statistical, methodical, social and economical factors. But in practice there are many factors mentioned above that are not considered when implementing and applying SPC. In practice it often led to ineffective and failure applications, de-motivation of users and consequently to de-evolution of SPC (Kelly & Drury, 2002). SPC must be built as the complex problem-solving process.

In spite of a lot of literature on SPC regarding predominantly statistical factors there are few publications that offer practitioners complex methodology for implementing SPC as a problem –solving process. General SPC implementation issues can be found in (Does et al., 1997), (Kelly & Drury, 2002), (Antony & Taner, 2003). But only one proposal of the comprehensive framework for the SPC application with the special emphasis on the SPC as the problem-solving process can be found in (Dasgupta, 2003). Unfortunately this proposal does not respect all phases of the problem-solving process.

Development of the complex and effective implementation of SPC was the object of the research realized by the Department of Quality Control at the Faculty of Metallurgy and Material Engineering, VSB-Technical University of Ostrava in the Czech Republic. During the first phase of this research complex and effective SPC implementation was defined and described and the SPC cycle was developed (Noskievicova, 2010). Based on this cycle the system of factors affecting SPC applications was designed and analyzed (Noskievicova, 2010). During the second phase of the research the hypothesis "there are many factors that are not considered when implementing SPC" was verified using the questionnaire survey in companies in the Czech Republic.

Prezentation of the results of the second phase of this research is the main goal of this article.

2. RESULTS OF QUESTIONNAIRE SURVEY

The questionnaire was send to companies using e-mail. Companies were selected arbitrary using free databases (European database and business directory Inform). Results were made anonymously. The results were returned to the firms that had been interested in. In total 260 companies from various industrial fields and with various number of employees were addressed. The questionnaire was completed and returned by 44 companies. 50% respondents answered that they had not applied SPC yet, 9% have contemplated SPC implementation and 41% have been using it. From Fig. 1. it can be seen that predominantly producers of cars and their suppliers have been applying SPC. Large number of companies from automotive industry reflects the structure of the Czech economy and the fact that stable processes are required by ISO/TS 16 949: 2008 defining special requirements on quality management system in automotive production. The most companies applying SPC were rather large organizations. 35% companies have been using SPC less than 5 years, 24% less than 10 years and 41% more than 10 years.

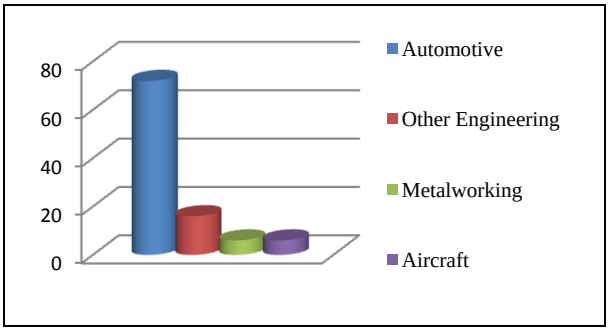

Fig. 1. Business structure of companies using SPC

Questionnaire was divided into free parts. Analysis of the practical application of the factors of effective implementation of SPC that had been studied and defined in relation with the SPC cycle in the previous research phase (Noskievicova, 2010) was the aim of the first part. The second part was focused on the collection of detailed information about SPC applications. The last part was designed for recording the additional information about every organization (business area, size, number of SPC applications).

The first part of the questionnaire has contained 13 questions (see Tab. 1.) evaluated with 0-5 points (0 – no opinion, 1 – superior, 5 – substandard). The questions were statistically evaluated using average, standard deviation and variation coefficient computed from assigned points and every result was also depicted using the graph. As to the average the worst result had the question number 5 (see Tab. 1.). Further weaknesses of the practical implementations of SPC were signalled by variation coefficient (values more than 50%) at the question number 1, 6, 7 and 12 (see Tab.1.). It can be generalized that nearly all weaknesses have been connected with human factor and they can have an influence on the motivation of involved employees.

The questions of the first part were elaborated in more detail in the second part of questionnaire (see Tab. 2).

Some questions were closed, some were open.

No.	*Question*
1	Does top management support SPC activities?
2	Has SPC been perceived positively (as an effective instrument for quality improvement)?
3	Has customer satisfaction been the main reason for the SPC implementation?
4	Have involved workers been successfully educated and trained for SPC?
5	Have workers´ knowledge about processes and successful SPC implementations been shared through the whole organization?
6	Are authorities and responsibilities for SPC activities clearly defined and declared?
7	Has SPC been realized in teams?
8	Is suitably made random sampling the basis for data collection in the SPC system?
9	Has measurement system analysis been done regularly and systematically?
10	Has data processing in SPC been done regularly and systematically?
11	Have SPC activities been regularly reviewed?
12	Are results of SPC practically used for the process control and continual improvement?
13	Have controlled processes been kept well on the target value and the process variability continually reduced?

Tab. 1. List of questions - 1st part of questionnaire

No.	*Question*
1	Did SPC application lead to the cost reduction?
2	Has your organization the SPC coordinator?
3	Do exist instructions for the treatment of the control charts?
4	What is your way of data collection for SPC?
5	Who realize following activities: • Supervision of controlled processes; • Supervision of involved workers; • **...**
6	What is the way of the control chart processing?
7	What type of control chart has been used?
8	Is compliance with SPC instructions reviewed?
9	Does OCAP exist?
10	How are assignable causes identified?
11	How are corrective or improvement actions proposed?
12	What is the content of the SPC training courses?
13	What should make training courses more efficient?
14	What is the biggest contribution of SPC to your company?
15	What is the obstacle for successful SPC implementation in your company?
16	Was SPC applied in your company in the past?
17	Do you consider restoration of SPC in your company?

Tab. 2. List of questions - 2nd part of questionnaire

In spite of the limited number of companies that had answered and returned the questionnaire (44 of 260) there were revealed many weaknesses of the practical application of SPC in companies in the Czech Republic. Not every SPC application was effective and complex. The main problems are as follows:

- Most of companies have no coordinator for SPC.
- Some reviewed companies have no instructions for SPC.
- Except one case companies use only classical control charts irrespective of the process character.
- Some companies have OCAP but they don´t use it or some firms have no OCAP at all.
- Some companies declared problems with deficient number of workers, insufficient knowledge and financial limits for purchasing measurement equipments.
- Inconsistent data collection, their recording and processing were defined as a large obstacle in the SPC applications.
- Information obtained from the SPC is used for the real process control only in a restricted way.

3. PROPOSALS OF IMPROVEMENTS

Based on the weaknesses identified through the questionnaire analysis the following improvements were set:

- Putting the basic principle of SPC that considers implementation and application of SPC as a complex and long-range process into practice;
- Realization of training courses focused on an introduction of benefits of SPC;
- Continuous training courses on consolidation and improvement of the workers knowledge (presentation of successful SPC applications, clarification of requirement to use information from the SPC system for the real control, accenting of the requirement to observe rules, clarification of consequences of non-observance of these rules);
- Training and application of more sophisticated control charts when nature of the process needs it (control charts for non-normal characteristics, automated manufacturing, low-defect processes, processes with low repeatability);
- Revision of the SPC instructions with the aim to have clear quality rules and to save time of involved workers;
- Clear declaration of responsibilities and authorities;
- Standard using of OCAP and its continuous updating.

4. CONCLUSION

This paper presented results of the research related to the complex and effective implementation and application of SPC that had been realized by the Department of Quality Control at the Faculty of Metallurgy and Material Engineering, VŠB-Technical University of Ostrava, Czech Republic.

Based on the definition of the complex and effective SPC implementation and on developing the system of factors affecting SPC applications questionnaire survey was realized. In this paper its contents and analysis were presented, revealed weaknesses of the practical SPC applications were described and solutions for improvements were proposed.

In further research questionnaire survey is planned to be expanded to other companies in the Czech Republic and also abroad and it should cover also non-manufacturing organizations.

5. ACKNOWLEDGEMENTS

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