

# Investigation of Usage of Statistical Tools Usage in Research Domain of Management System

<sup>1</sup>V.Dhivyasree, <sup>2</sup>Dr.E.N.Ganesh

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**Abstract:** The paper represents the research about the use of statistical tools and methods in organizations of metal- processing industry. Those organizations have coordinated their business and management system with the requirements of International Standards for quality, environment and safety. The summary of extensive research about the possibilities of applying the modern business methodology improvement, "Six Sigma" is represented. Research results show that the oldest and the simplest methods are the most popular and the most used methods in practice. There are few organizations that apply statistical tools and methods proposed by professional and scientific literature and others don't use it. Reasons for that are various and they are represented in this paper.

**Keywords:** Management systems, improvement, statistical tools and methods.

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## 1. INTRODUCTION

In addition to being "the first", it is very important to have a greater quality product due to competition and to meet demands, needs and expectations of customers. The main difference between successful and less successful organizations is that the first one recognizes and respects consumer needs and demands. Accordingly they improve their processes and put product quality on the first place [2,5]. Organizations have to plan and apply processes of control, measurement, analysis and improvements to be able to continuously elevate efficiency and effectiveness of management system. This is also a reason for issuing ISO/ TR 10017 as a guide for organisations in defining statistical techniques that can be useful during implementation, application, sustaining and improvement of management system.[1]. The knowledge about statistical techniques and their proper application are huge. Evidence for that can be seen in business strategy "Six Sigma" or "Lean Six Sigma" that is focused on development and production of products and services. This strategy is close to perfection and it is based on the use of statistical techniques [3,4].

## 2. REASONS FOR DOING IMPROVEMENTS

The goal of every improvement is rationalization. By combining rationalization and targeted investments, the best efficiency can be achieved. The goal is to achieve a better quality product and service by using fewer material, energy and other resources as possible. Improvement of any process in the organization and overall system is inevitable. If this is not achieved, even the best organization are condemned to failure. Accordingly, even the best structured management systems must be subjected to a continuous improvement process. Only in this way, all preconditions for quality products and services can be ensured. This creates conditions for meeting customer requirements, their needs and expectations. The final result is to satisfy all interested parties (customers, suppliers, owners, workers, subcontractors, employees, local communities, investors, etc.). For example from the aspect of continuous improvement, achieving quality cannot be a fixed goal. Quality can be compared with automatic stairs in the supermarket. They're in a constant move and going up. The same is with quality. It constantly has to be advanced in the sense of being better, bigger, stronger, safer, reliable, adequate, cheaper, etc. To achieve that organization has to take a continuous improvement path not only from the aspect of products or services that are final outputs, but it has to encompass all phases of main and logistic processes which lead to that very output, while respecting the proper environmental standards, work safety, energy rationalization and other demands during the whole process. Basically, improvement actions can be observed through gradually and "breakthrough" improvements based on the PDCA cycle principles. Those actions all called in literature "Quality Improvements – QI". Figure 1 represents application of continuous improvement in gradual and "breakthrough" way of improvement [12].

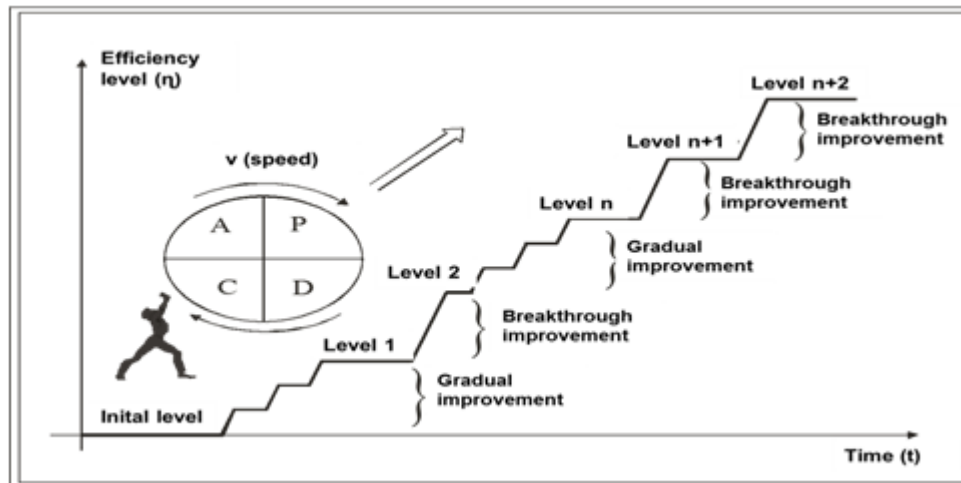


Figure 1: Continuous improvement

### 3. PLACE AND ROLE OF STATISTICAL TECHNIQUES IN IMPROVEMENT PROCESS

Only companies that strive toward business excellence and consider improvement process and business improvement their obligation can successfully use modern improvement methods. Their application is not excluded at lower organizational levels (organization in terms of development and business results). Some researches show that simpler methods and tools are used at lower levels, and more complex ones on higher organization levels. As an instrument, statistical methodology, has found its application in organizations thanks to quality management system development. For successful application of statistical techniques in all organization processes, full management commitment to management systems (primarily quality) is required. This commitment starts with top management and runs through all management structures. The goal of every management systems is achieving the expected or required quality by reducing disturbances in business processes. The emphasis is on processes rather than on products or services. This approach enables variability control, and moreover prevents creating product and service nonconformance. A series of mathematical and statistical techniques are used in quality management and other systems, but on the other hand, specific requirements and quality management problems, environment problems and others impose the need to improve existing ones and develop new, more efficient mathematical and statistical decision-making techniques.

There are only few managers or employees in Japan who are not familiar with the seven traditional quality improvement tools. Those are techniques from descriptive statistics, known as "seven tools" [5]. Today are more often mentioned seven new methods of statistical process quality control. In "Management for Quality Improvement: The 7 QC Tools," Mizuno mentions seven new management tools for statistical quality control, which are the result of research done all around the world by the Japanese Society for Quality Control Technique development. Definitely, organizations are not limited with those 7 + 7 techniques. There are many other methods, simple and complex that deserve to be used or applied in specific conditions. It is also difficult to imagine an organization that does not need any of the techniques and methods in their business [6].

### 4. RESEARCH ABOUT THE APPLICATION OF STATISTICAL TECHNIQUES

Regarding the cognition and significance about the benefits of using statistical tools and methods, many indicators show that companies in practice do not use them often as they should. The research was conducted in Croatian engineering companies in three Counties. Surveyed companies had their quality management, environment and work safety systems according to International Standards for Quality ISO 9001, ISO 14001 i OHSAS 18001. Research goal was to determine the condition of statistical- methods usage in business and possible reasons of insufficient levels of methods usage. The assumption for not using statistical techniques in everyday business were several reasons: cultural, insufficient level of knowledge, inefficient management, size of the company, ownership structure, business activity, non-harmonized criteria of certification houses, etc. Research results have been used to make proposal for more efficient and effective use of statistical methods in companies in order to increase the efficiency and efficiency of their management systems. Survey was conducted by using questionnaire that was sent to targeted companies.

Table 1 shows companies categorization according to employees number. Total amount of surveyed companies was 59.

**Table 1: Categorization of surveyed companies by the number of employee's**

Company category	SIZE (due employees number)	Number of Companies -FREQUENCY			
		County 1	County 2	County 3	□
O1	<50	11	8	6	25
O2	51-100	8	6	6	20
O3	101-200	3	4	3	10
O4	201-300	1	0	1	2
O5	>300	0	1	1	2
Total		24	20	15	59

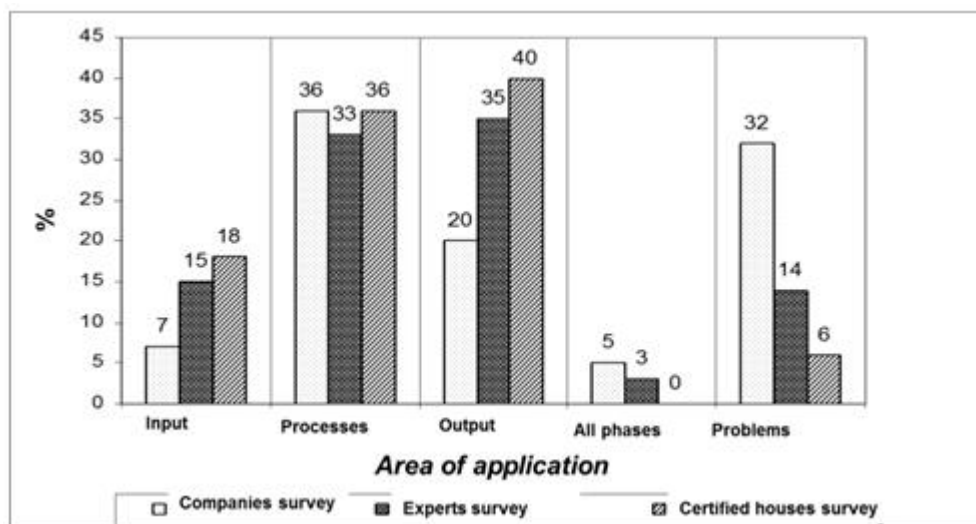
#### 4.1 Survey results display

On a survey question: "Do you use statistical techniques?" respondents have answered YES or NO. The results are shown in Table 2.

**Table 2: Respondents answers about the use of statistical techniques**

Respondents answer	Company size					Σ
	O1	O2	O3	O4	O5	
YES	2	4	7	1	0	14 (24%)
NO	23	18	4	0	0	45 (76%)

The respondents who use statistical techniques (14% of respondents) had to answer which of specified techniques they use and in which situations they use them more frequently: process input, process output, in the process of product or service realization, in every phase and for problems solving in management systems (figure 2) [9,10].



**Figure 2: Use of statistical techniques according to the area of application**

Respondents who use statistical techniques are asked to answer which of technique that are mentioned they really use. Due to comparison, the results of surveyed experts and certification houses were also given.

**Table 3: The results of companies' usage of the above mentioned statistical methods**

No.	Techniques or groups of statistical techniques according to ISO /TR 10017:2003	Company size				Σ
		O1	O2	O3	O4	
«Seven Tools».	Cause and effect diagram	2	4	6	1	13
	Histogram	1	3	5	1	10
	Scatter diagram	0	0	0	1	1
	Pareto diagram	2	4	7	1	14
	Control charts	0	0	0	1	1
	Flow chart	2	4	7	1	14
	Content sheet (ispitni list)	2	3	5	1	11
«The 7 QC Tools».	Matrix diagram	0	0	1	1	2
	Relationship diagram	0	0	0	1	1
	Matrix analysis	0	0	0	0	0
	Arrow shape diagram	0	0	0	1	1
	Process maps	0	0	0	0	0
	Tree diagram	0	0	1	1	2
	Casual diagram	0	0	0	0	0
15.	Experiment plan	0	0	0	0	0
16.	Hypothesis testing	0	0	0	0	0
17.	Measurement analysis	1	1	2	1	5
18.	Process ability analysis	0	0	1	1	2
19.	Regression analysis	0	0	0	1	1
20.	Reliability analysis	0	0	0	0	0
21.	Sampling	0	1	5	1	7
22.	Simulation	0	0	0	0	0
23.	Control Charts (SPC)	0	0	0	1	1
24.	Statistical Tolerance	0	0	0	0	0
25.	Time series analysis	0	0	0	0	0

Table 4 represents respondent's opinion about the utility from using statistical techniques in business.

**Table 4: Utility from using statistical techniques**

No.	Utility from statistical technique application	Company size					%
		O1	O2	O3	O4	O5	
1.	Without significance	1					7,1
2.	Moderately useful	1	1				14,3
3.	Useful		1	4			35,7
4.	Significantly		2	3	1		42,9
TOTAL ANSWERS							

Respondents who answered negatively on question about the use of statistical techniques were asked to indicate three reasons why they are not using mentioned techniques. Their reasons are showed in table 5.

**Table 5: The reasons for not using statistical techniques**

No.	The reasons for not using statistical techniques	Number of respondents who don't use statistical techniques (45 x 3 answers = 135)	Percentage (%)
1.	Branch type	10	7,41
2.	Individual production	4	2,96
3.	Lack of knowledge	33	24,44
4.	Inadequate management engagement	25	18,52
5.	Cultural reasons	5	3,70
6.	100% control is better	11	8,15
7.	Size of the company	30	22,22
8.	Poor IT support	13	9,63
9.	Nobody demands it	2	1,48
10.	Combination of the above mentioned reasons	1	0,74
11.	No adequate reason	1	0,74
TOTAL ANSWERS (45 x 3 – each respondent could mention three reasons for not using statistical techniques)		135	100

## 5. SHORT COMMENT ON SURVEY RESULTS AND CONCLUSION

Research data showed that two thirds of respondents who use statistical techniques have learned those techniques by them self, without supervision and training that was organized by their employer. In that sense, management has a great responsibility for supporting their stuff to learn and share knowledge.

- Research showed that few organizations (only 24% of respondents) from the metal processing industry are using statistical tools and methods that are currently proposed in the literature, especially in ISO / TR 10017: 2003.
- Statistical descriptive techniques are commonly used in practice. The most used techniques are Seven Tools: Pareto diagram, Ishikawa diagram and Flow chart. The 7 QC Tools are used only in three organizations and they use only Matrix chart and Tree diagram. The main reasons for that is lack of knowledge (24% of respondents). Similar situation is also with other techniques mentioned in ISO/TR 10017:2003.
- Figure 2 represents percentage of organizations that use statistical techniques due to area of application. More than half of respondents (58%) use these techniques in processes and are able to solve various types of problems. Only few organizations use these techniques at process input or process output. In this paper due to comparison are also given the results of survey done by quality experts and certification houses.
- More than 70% of organizations considers utility from using those techniques useful or significant.
- Application of statistical techniques is related to the size of an organization. The results show that bigger organizations in relationship with small ones, use various tools and they use them more frequently.
- Research has shown that form of ownership has an influence on the application of statistical techniques. Most organizations who use techniques are Ltd. companies or Joint Stock Companies. The influence of ownership structure has been excluded from future research.
- Data showed that region's where organizations are registered don't have direct influence on the use of statistical techniques and as a previous factor is excluded from further research.

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