



USING OF STATISTICAL METHODS IN THE MAKING DECISION PROCESS – CASE OF MACEDONIAN COMPANIES

TATJANA ATANASOVA-PACHEMSKA¹, EVICA DIMITRIEVA¹, SANJA PACEMSKA²

¹ Faculty of computer sciences - University „Goce Delcev”, Stip, Macedonia, tatjana.pacemska@ugd.edu.mk

¹ Faculty of computer sciences - University „Goce Delcev”, Stip, Macedonia, evica.dimitrieva@ugd.edu.mk

² Education Development Bureau, Ministry of education and science, Skopje, Macedonia, sanjapacemska@gmail.com

ABSTRACT: *Good working and managing of a company depends on good decisions made by managers and employees. Decision-making process is going to be effective if statistical methods are applied. Using the statistical methods, available information and data, specific models and control cards can be made, which are going to be evaluated and tested, and this will help in decision-making process.*

Precisely this prompted us to conduct research in some Macedonian companies in order to determine how often statistical methods are applied in decision making process. The research was conducted in companies from different industries and managers of different age, gender and education level.

The sample is random and it is not representative. In Macedonia 40 companies were investigated.

Key words: *statistical methods, application and use.*

1. INTRODUCTION

Statistical thinking and implementation of statistical methods takes more important role in the management of companies nowadays. Statistics are essential in business because using them is profitable; without profit business is almost road to nowhere. Every business plan starts with a detailed exploration of the environment and the actions are mostly based on statistical data, which may affect the final decision. In order to maintain optimal stability of the process, making continuous improvements, to survive and prosper, the company management should know and use certain tools and methods in quality management. Without the use of specific tools and methods, no organization can be successful even though it works. Without use of these tools and methods, organizations can not continuously improve and go down the road of business excellence of its system, its processes and products and / or services. For all these activities, it is necessary to recognize and properly use statistical methods. The task of leadership is to recognize the importance of statistical tools and methods of quality management and proper application, to achieve specific improvements in performance.

The application of statistical tools should be practiced in every company. It is known that 95% of the company's problems can be solved using basic tools. Without statistical analysis (analysis of quality in the process) there will be no effective work / management, and there will be no positive results. The application of statistical methods in companies requires: 1 - understanding the need, 2-training, 3-using suitable software users.

The aim of our research is the application of statistical methods in decision-making process in part of the Macedonian companies.

The subject of the research in this paper is to determine which statistical methods (simple and advanced) are applied in companies and to what extent the application of statistical methods depends on the activity of enterprises. As well to examine the impact of demographic characteristics of managers and departments in which they operate on the application of statistical methods.

2. METHODOLOGY

The research was conducted from 1-st of January to 30-th of March, 2013. The research was conducted electronically and in printed form. The questionnaire was sent to 100 companies in Macedonia selected by random choice from a database of certain areas from Internet. The questionnaire is correctly completed and delivered by 40 companies. Questionnaire was made in accordance with the defined object and purpose of the research. The questionnaire contains 21 questions related to the use of statistical methods in companies.

During the research quantitative and qualitative methods were used. The survey was conducted using quantitative method with managers of companies and afterwards statistical processing of the questionnaire was done. The qualitative approach in the analysis of data obtained from the questionnaire was applied, depending on the individual characteristics of managers.

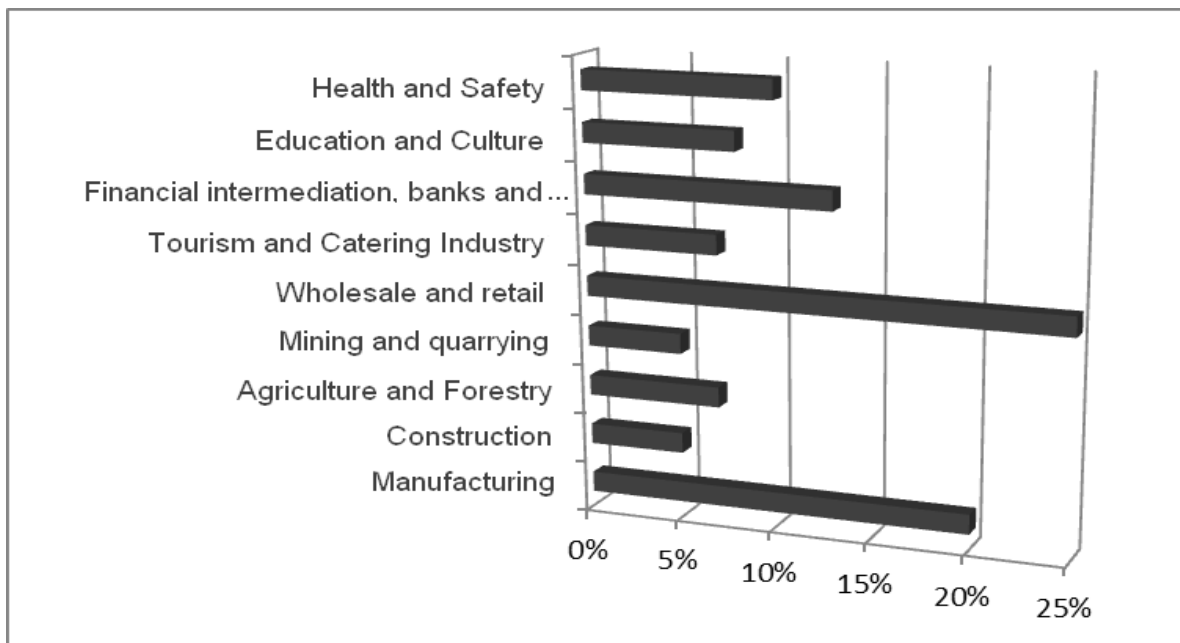
The answers in the questionnaire were processed quantitatively with statistical methods, through direct collating data and using statistical application, with the tabular calculator Microsoft Excel. During the statistical data processing Pearson χ^2 -test was applied, statistical data was processed, ranked and also comparative analysis of the processed data was made.

3. RESULTS AND DISCUSSION

3.1. Characteristics of companies in the research

In the survey 40 companies from Macedonia were included, selected by random choice. Most of the companies which were interviewed (Figure 1.) were from manufacturing, wholesale and retail. Then financial brokerage companies were covered including banks, insurance companies, the construction companies and travel agencies. Also a few companies from agriculture and forestry, mining and non-economic sector, health, education were included.

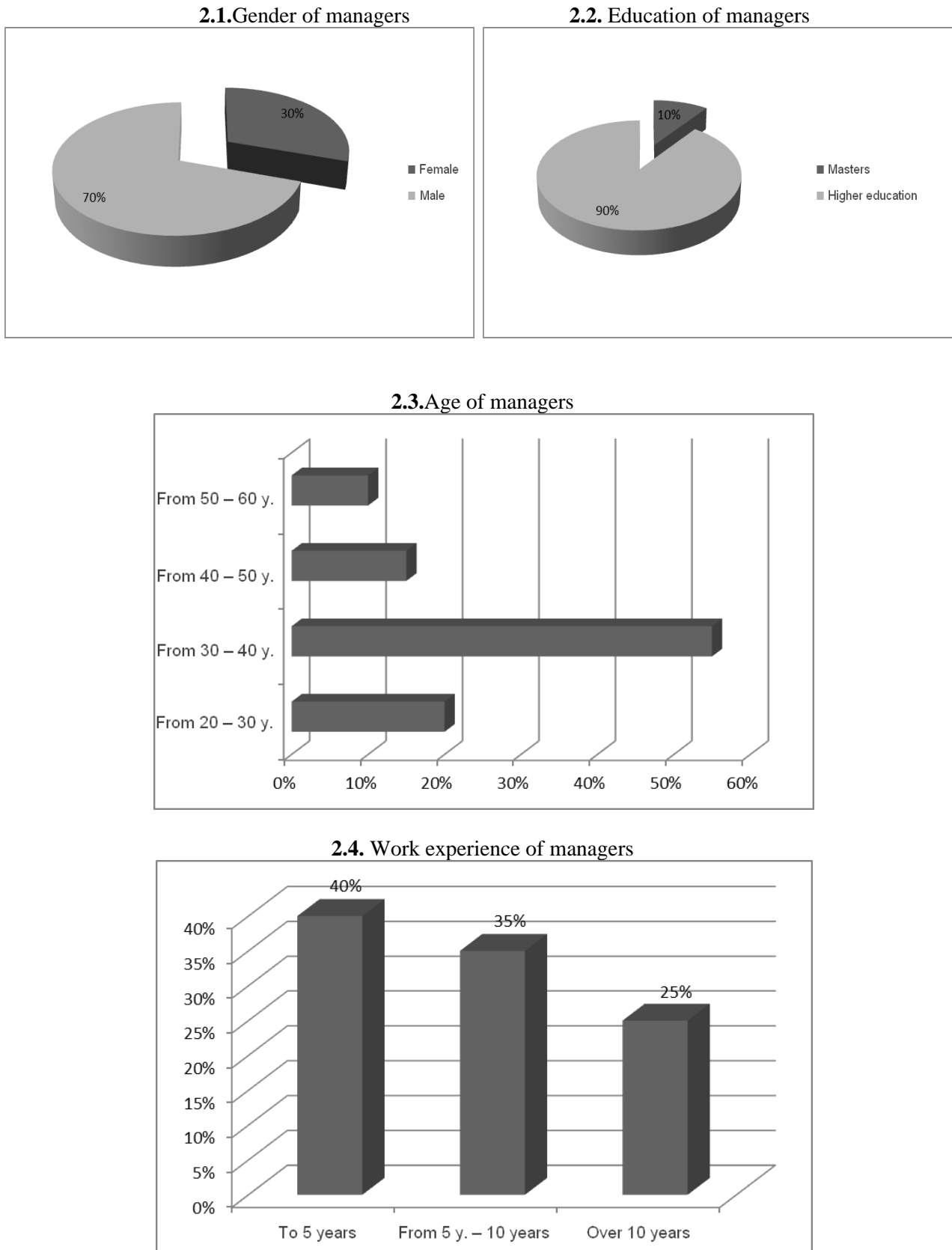
Figure 1: General characteristics of companies



3.2. Characteristics of managers in the research

This section analyzed the usual demographic characteristics of managers from enterprises: gender, age, education and work experience, also specific characteristics about the job: workplace and sector or department where they work.

Figure 2: Demographic characteristics of managers in the sample



From the charts that are illustrated, we can concluded that most managers (70%) are men with higher education (90%), and 50% of them are from 30 to 40 years old.

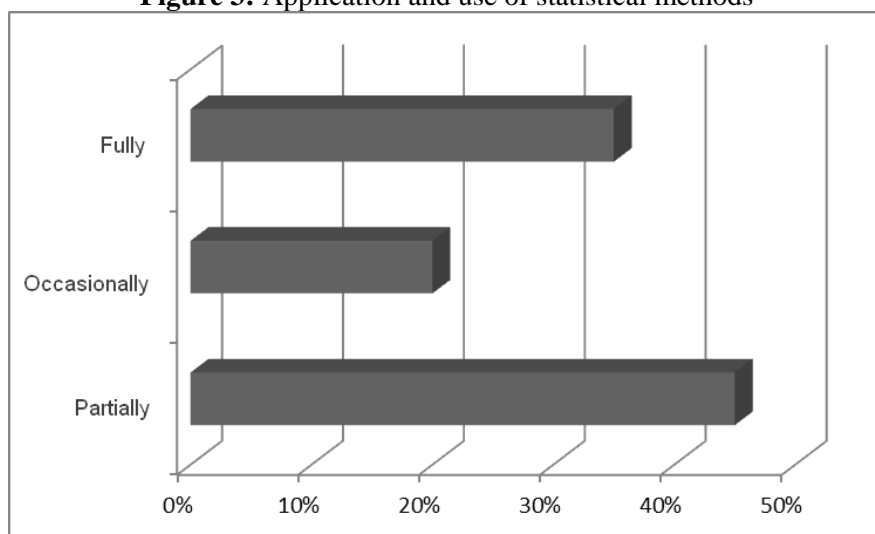
There are a few managers who have acquired higher education - the degree of Master, 10% of respondents, 40% of managers are with work experience up to 5 years, while 25% of managers have work experience over 10 years.

3.3. The use of statistical methods in companies

There are sectors that are traditionally focused on using quantitative methods such as: planning and analyse, sales, production and control (Shimichevich, V. 2007).

Most managers who use statistical methods work in planning sectors, manufacturing sectors, procurement and control, and cost control. Statistical data are mostly used by the head of planning and analysis, production and finance, while marketing managers use fewer statistical data methods. On the question „How much statistical methods are used in companies”, most managers (45%) answered that they use statistical methods partially, but one third of respondents said that they permanently use them (Figure 3).

Figure 3: Application and use of statistical methods



In terms of statistical thinking of managers, many of the respondents about 45% (Table 4.) consider that further statistical education is needed and that this will help in the use of statistical methods during their work and decision making process.

Only 30% of respondents were known about statistical methods, and a quarter believe that they do not need additional statistical education and training.

Table 1: Statistical thinking of managers for further statistical education

Statistical thinking of managers for further statistical education	Number of companies	%
Training is needed	18	45
Statistical methods are known	12	30
No additional training is needed	10	25
Total	40	100

The respondents were interviewed about the type of statistical methods they know and are used in their companies. The majority of respondents know and use basic statistical methods (descriptive statistics) - graphs, arithmetic average, median and standard deviation. Fewer respondents know about linear trend, regression analysis, hypothesis testing, control cards, etc.

Table 2: Knowledge of selected statistical methods

Knowledge of selected statistical methods	Number of companies	%
Graphs	35	26
Arithmetic average	25	19
Median	22	17
Standard deviation	18	14
Linear trend	7	5
Hypothesis testing	10	8
Control cards	6	4
Regression analysis	9	7

Table 3: Using of selected statistical methods

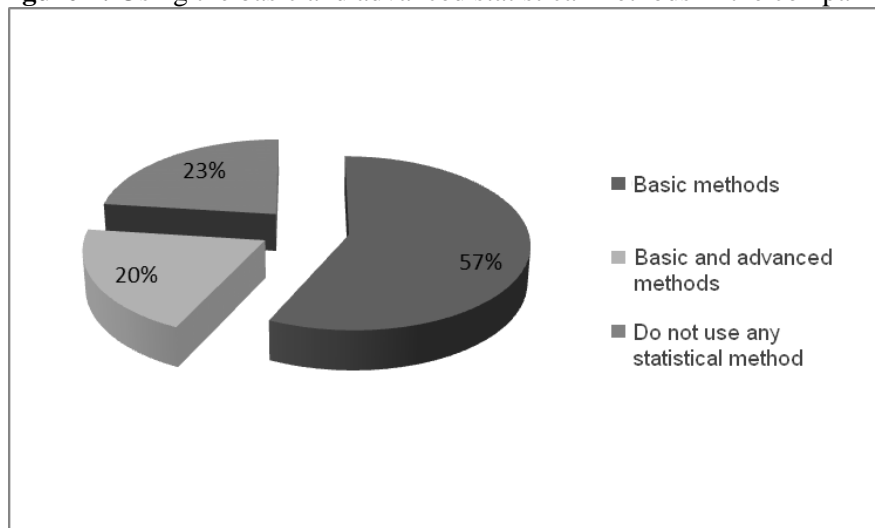
Using of selected statistical methods	Number of companies	%
Graphs	25	30
Arithmetic average	15	18
Median	11	13
Standard deviation	9	11
Hypothesis testing	8	9
Linear trend	5	6
Control cards	5	6
Regression analysis	6	7

For the purposes of the research, statistical methods are divided into basic and advanced methods:

- basic statistical methods: graphs, arithmetic average, median, standard deviation
- advanced statistical methods: linear trend, hypothesis testing, control cards, six sigma and regression analysis

The answers of respondents for using of statistical methods (basic and advanced) in their work are presented in the following graph:

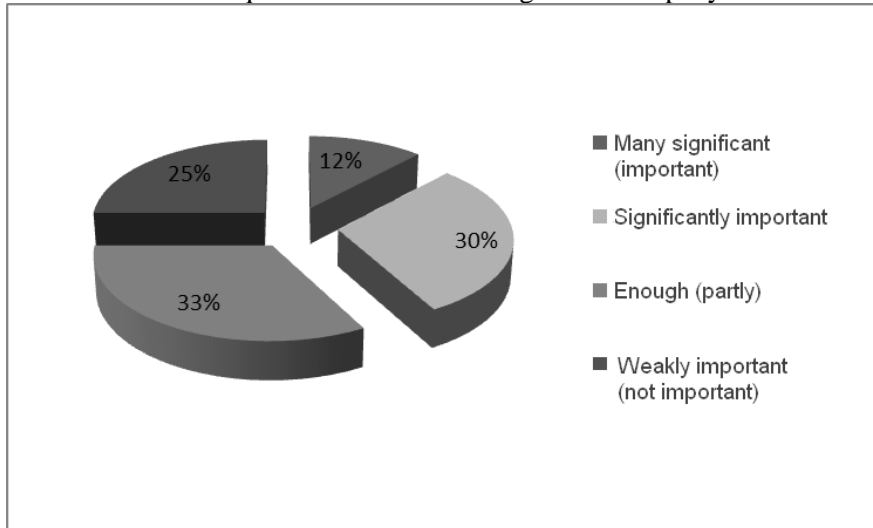
Figure 4: Using the basic and advanced statistical methods in the companies



The graph shows that most of the companies apply and use only basic statistical methods (57% of companies), basic and advanced statistical methods are used in 20% of companies, while 23% of companies do not use any statistical method.

About the degree of significance of the statistical methods in performing their work during decision making process, statistical thinking of managers, and the importance of statistical methods in their businesses, following results were obtained :

Figure 5: Statistical thinking of managers about the degree of significance of statistical methods and techniques for decision making in the company



42% of managers considered that statistical methods and techniques are important in decision making process. The fact that 12% of the managers considered that statistical methods are not important in process of decision making is worrying.

In order to determine whether the application of statistical methods in the company depends on its activity we have used Pearson χ^2 test.

Table 4: Using of statistical methods in relation to the activities of the company

Activity	Basic methods	Basic and advanced methods	Do not use any method	Total
Industrial	8	6	1	15
Service	15	2	8	25
Total	23	8	9	40

The obtained results show that industrial companies more often use statistical methods than service companies and a small number of them do not use statistical methods, compared with the service companies whose number is .

Industrial companies use basic and advanced methods as much as basic methods compared with the service companies which use them very rarely. Service companies mostly use basic statistical methods. The resulting value of X^2 is 7,55 is greater than spreadsheet value of 5.991, with 2 degrees of freedom and significance level of 0,05 ($X^2 = 7,55$, p-value = 0,05). This result shows that there is interdependence between the variables examined, or differences are significant, because the obtained frequencies differ from the expected frequencies.

We may conclude that the alternative hypothesis is accepted, and that there is a statistically significant difference in the use of statistical methods depending on whether there are industrial or service companies. These results are expected, knowing that industrial companies have a greater need for the use of statistical methods, because of their important role in quality control.

While the resulting value of the contingency coefficient C, which indicates the strength (height) the connection is 0,40 ($C = 0,40$) indicates that the dependent modality of examined variables is relatively weak.

The relationship between demographic characteristics of the managers and the application of statistical methods in the company was evaluated . The data from the survey are presented in the following table.

Table 5: Using statistical methods in terms of characteristics of managers

	Basic methods	Basic and advanced methods	Do not use any method	Total
Gender				
Male	15	10	3	28
Female	10	1	1	12
Total	25	11	4	40
Age				
From 20-40 years	10	15	5	30
From 40-60 years	8	1	1	10
Total	18	16	6	40
Education				
Masters	1	3	0	4
Higher Education	18	7	11	36
Total	19	10	11	40
Working experience				
To 5 years	9	6	1	16
Over 5 years	15	2	7	24
Total	24	8	8	40
Number of years at current managing position				
To 2 years	10	10	6	26
From 2-10 years	11	3	0	14
Total	21	13	6	40

According to the survey, demographic characteristics or gender of managers has no significant impact on the use of statistical methods. Male managers use more basic and advanced statistical methods, in comparison of female managers who use them less. The resulted value of $X^2 = 3,53$ and p-value = 0,05, indicating that *there is no statistically significant dependence between the use of statistical methods and gender of managers*. This shows us that the tested variables are interdependent, and the differences are not significant, because the obtained frequencies did not deviate much from the expected. The resulting value of the contingency coefficient C, which indicates the strength (height) the connection is 0,28 ($C = 0,28$) indicates that the dependent modality of examined variables is very weak.

In terms of the age of managers who use statistical methods was obtained value of $X^2 = 6,83$ and p-value = 0,05, which is greater than the spreadsheet value $X^2 = 5,991$, and shows us that *there is a statistically significant relationship between the application of statistical methods and the age of the managers*. The value of the contingency coefficient C is 0,38 ($C = 0,38$) indicates that the dependent modality is weak.

For the application of statistical methods in terms of the level of education of managers is received value of $X^2 = 6,14$ and p-value = 0,05. So these two variables, namely the use of statistical methods and the level of education of managers are statistically significantly related. The value of the contingency coefficient C is 0,36 ($C = 0,36$) which means that dependent modality is weak.

For the application of statistical methods in terms of the level of work experience of managers is received value of $X^2 = 6,67$ which is larger than the value of the spreadsheet value X^2 , and p-value = 0,05 (threshold of significance of 5%). So work experience of managers has a statistically significant impact on the application of statistical methods in the companies. The value of the contingency coefficient C is 0,38 ($C = 0,38$) means that dependent modality is weak.

Regarding the use of statistical software in their work, most managers use Excel, while other softwares that are listed in the questionnaire, such as SAS, SPSS, Statistics, Minitab are not used by the managers, because they need additional training .

The results obtained from the managers about the role of statistical thinking and the benefits of the implementation of statistical methods and techniques showed: 60% of them responded that they are increasing the quality of the product, while 45% of them are thinking that the introduction of statistical methods will contribute to improve the control at managers, 55% of managers responded that companies will increase the efficiency of the process.

The application of statistical methods helps the managers for making the right decisions based on facts, so managers are required to have basic knowledge of statistical methods and statistical thinking.

The frequent causes for not using the statistical methods and techniques are the high cost of the implementation, the time required for implementation and the lack of knowledge.

4. CONCLUSION

The aim of the research was to investigate the use and application of the statistical methods in Macedonian companies.

This research has shown that most managers know statistical methods but generally use basic statistical methods (descriptive statistics). Statistical methods are used in many manufacturing companies, in relation of the service companies.

Industrial companies use basic and advanced statistical methods while service companies use more basic statistical methods. Some managers believe that the statistical methods are important, other that they are important part of their work in making decisions. Regarding the characteristics of the managers, there is no statistically significant difference in the use of statistical methods depending on whether is it male or female. In examining whether there is statistical significance of the use of statistical methods in relation to the age of the managers, the level of the education and work experience it is confirmed the hypothesis that there is statistical significance. In terms of statistical software managers often use Excel in their work. Sectors in which statistical methods are most used in companies are: sector for planning and analysis, manufacturing and less service sector and sector for supply and control. As a key factor for the successful introduction of statistical methods more managers deemed that is necessary training and software for statistical processing of the obtained data.

The opinion of most managers is that the introduction of statistical methods will increase the product quality, and control to the work process, increasing the efficiency of the process and all that will help in making right decisions at work. The research on the application of statistical methods in Macedonian companies is rare, and it can be concluded that this paper is a good platform for further research into participation the quality of decision-making foundation.

BIBLIOGRAPHY

- [1] Duncan, A. J., (1986), Quality Control and Industrial Statistics – 5th edition, Homewood, IL: Irwin
- [2] Gareth, R.J.; Jennifer, M.G., (2005), Contemporary Management – 4th edition, New York
- [3] Lee. J.K.; Larry, P.R.; Manoj, K.M., (2007), Operation management: processes and value chains, Pearson
- [4] Paul. N.; Villijam, L.C.; Betty, M.T., (2007), Statistics for business and economics – 6th edition, New Jersey
- [5] Ravindranath, C.P., (2011), Statistics and Statistical Methods for Software Engineering
- [6] Shimichevich, V., (2007), Research of statistical methods and statistical thinking in Croatian business practice, Economic Review, 58 (7-8) 445-464 (2007)