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STATISTICAL RESEARCH OF CORRELATION OF IMPLEMENTED TQM AND QUALITY SYSTEMS IN THE SUPPLY CHAINS BY FUNCTIONS AND PROGRAMS THAT ARE CERTIFIED INDIVIDUALLY

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Abstract: *The authors started from the goals of both concepts and confirmed that the concepts of KMS and TKM differ in several key aspects. In the same sense, the results of the company achieved by implemented QMS or TQM are not identical.*

QMS and TQM have in common is that the company works as good organized system according to a documented quality system. The differences are primarily reflected in the fact that KMS focuses on strong leadership, development of mutually beneficial relationships with suppliers and a systematic approach to management, while TKM focuses on: customers and their satisfaction, teamwork and employee cooperation with mutual respect, integration of organizational systems, strategic and systemic approach to governance, and considers relationships with all stakeholders to be beneficial.

However, according to knowledge by authors, some researchers suggest that the QMS needs to be first achieved (and ISO 9001: 2015 certification), in order to create a more favorable base with an environment for TQM implementation. On the other hand, according to research by several authors, QMS often acts as an obstacle to extrapolating the quality system to the level of TQM, through which the company achieves better performance.

Today, by the way, there is no firm consensus in theory and practice on the direct relationship between a certified QMS and TQM. The authors concluded that it is justified only if to first identify the performance of the company in accordance with the certified QMS, and then the performance in a

similar company (applying benchmarking to companies of the same level of development and competitive potential) with the implemented TQM, and performs off comparison of both concepts. It is logical that both QMS and TQM directly affect the company's performance, so that specific effects could be identify, observed, measured and analyzed.

The appropriate research model in this paper was tested by data collected by a survey from a significant number of companies that have different certified quality systems (QMS, EMS, IMS, SMS, HACCP, OHSAS, etc.) or unique TQM, with companies having different performance with QMS (focused on product delivery and high quality and repeatability services) and TQM (with main aim at continuously increasing consumer satisfaction achieved through the integral quality of delivered goods or services).

Key words: TQM, QMS, certification, KPIs, company performance, customer satisfaction, statistical analysis.

INTRODUCTION

In order to verify the conclusions and hypotheses in the development of a scientific paper entitled "Economic optimization of transport systems at the level of supply chains", which is positioned in the field of optimization of transport and logistics systems in supply chains (LS) and intended to expand the thematic framework of academic studies in DH field , at the Faculty of Business Studies and Law, practically as an upgrade to the already identified models in the TT field, some of which are studied at the Faculty of Information Technology and Engineering "University Union - Nikola Tesla", two surveys were conducted, as follows:

SURVEY-1 (RESEARCH OF CORRELATION OF IMPLEMENTED TQM AND QUALITY SYSTEMS BY FUNCTIONS THAT ARE PARTIALLY PROVIDED AND CERTIFIED AT THE COMPANY LEVEL, PRODUCTS AND SERVICES).

Survey - 1 was conducted for statistical evaluation of hypotheses, as follows:

- Hypothesis H1: TQM makes a very significant contribution to improving enterprise performance because contains optimal solutions for ensuring consumer satisfaction.
- Hypothesis H2: TQM is easier to introduce and gives a full contribution to the performance of the company if the company is already implemented

several key quality systems by areas or functions

Hypothesis H3: Extremely high level of standardization at the level of the company's quality system hinders employee creation as well as the implementation of innovations so companies have a lower level work efficiency

SURVEY-2 (RESEARCH ON CORRELATION OF SUPPLY CHAIN PERFORMANCE, IMPLEMENTED TQM AND CONSUMER SATISFACTION).

Survey - 2 was conducted for statistical evaluation of hypotheses, as follows:

Main Hypothesis H0: The success of supply chains (LS) depends on the quality of service potential and the quality of the service process with a high level of customer satisfaction.

Auxiliary hypotheses:

Hypothesis H1: at the level of transport-logistics arrangements contribute to improvement quality of supply chains (LS).

Alternatives:

Hypothesis H2: Ancillary services contribute to improving the quality of LS.

Hypothesis H3: Higher level of integral quality of LS attracts more customers / users and increases total volume of realized transport and logistics services.

Due to the reduction of costs and shortening the time of their implementation, the survey was not conducted on a systematic and stratified (scaled distribution of social groups and classes according to their greater or lesser social power) random sample of respondents, but surveys were conducted based on a random sample of respondents.

Analyzing the social status of the respondents, it can be noticed that the survey was conducted on persons who are primarily or exclusively employed in education. However, it can be further noticed that in within the respondents, there are significant social differences in the amount of income because on that occasion,

managers, professors and executive bodies, clerks and auxiliary workers were interviewed, which in any case gives a more realistic picture of the survey results.

Pensioners did not participate in the survey. When analyzing the results obtained through the above surveys, there is a noticeable difference in the answers to the questions asked by persons at different levels of social scale and personal income.

By the way, the results of the survey in any case contain certain errors of the random sample that occur because the sample is not representative, ie. does not necessarily reflect the characteristics of the basic population or population, as well as because the surveyed population sample is relatively small.

In support of the above thesis, a substantial difference in the general assessment of the quality of the supply chain by the auxiliary worker can be further noticed. workers with low incomes (gave a general grade of 3) in relation to the assessment of a director who has a high income (general grade 5). For persons with minimal and low incomes and pensioners, the price of goods is the most important, while other elements given in the survey of supply chains are essentially less important for them or not important at all. For them, for example, the possibility of parking, the kindness of the staff, and the recommendation for supply chains are irrelevant.

I- SURVEY ANALYSIS:

Factors of interest for improving the quality of supply chain services and customer satisfaction.

Question number 1: (Recommendation of others is important for the choice of supply chain).

If the essay answers to the survey question are converted into numerical values, the following is obtained:

| | |
|---|--|
| 1 | Absolutely irrelevant |
| 2 | Essentially irrelevant |
| 3 | It doesn't matter or it doesn't matter |
| 4 | Important |
| 5 | Absolutely important |

| xi | fi | x2 | xifi | fixi2 | Cumulative below | Cumulative above |
|----|----|----|------|-------|------------------|------------------|
| 1 | 3 | 1 | 3 | 3 | 3 | 62 |
| 2 | 10 | 4 | 20 | 40 | 13 | 59 |
| 3 | 10 | 9 | 30 | 90 | 23 | 49 |
| 4 | 30 | 16 | 120 | 480 | 53 | 39 |
| 5 | 9 | 25 | 45 | 225 | 62 | 9 |
| Σ | 62 | 55 | 218 | 838 | | |

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{218}{62} = 3,516$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{838 - \frac{(218)^2}{62}}{62} = \frac{838 - 766,52}{62} = \frac{71,48}{62} = 1,153$$

and standard deviation $\sigma = \sqrt{1,153} = 1,073$

Conclusion: A total of 39 respondents or 62.9% answered that the recommendation of others for the choice of supply chain is important or absolutely important, while 13 respondents or 20.96% answered that this fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 3,516, which means that the majority of respondents answered that the recommendation of others for the choice of supply chains is important or absolutely important.

Question number 2: (Service supply potential).

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{258}{62} = 4,16$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1110 - \frac{(258)^2}{62}}{62} = \frac{1110 - 1073,61}{62} = \frac{36,39}{62} = 0,587$$

and standard deviation $\sigma = \sqrt{0,587} = 0,766$

Conclusion: A total of 56 respondents or 90.3% answered that the service potential of the supply chain is important or absolutely important, while 4 respondents or 6.4% answered that this fact is absolutely irrelevant or essentially irrelevant. The average value of individual responses is 4.16, which means that the majority of respondents answered that the service potential of the supply chain is important or absolutely important.

Question number 3: (Affordable prices).

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{267}{61} = 4,38$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1195 - \frac{(267)^2}{61}}{61} = \frac{1195 - 1168,67}{61} = \frac{19,16}{61} = 0,314$$

and standard deviation $\sigma = \sqrt{0,314} = 0,56$

Conclusion: A total of 57 respondents or 93.4% answered that affordable prices are important or absolutely important, while 1 respondent or 1.6% answered that the stated fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 4.38, which means that the absolute majority of respondents answered that affordable prices are important or absolutely important.

Question number 4: (Method of payment).

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{244}{62} = 3,93$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1014 - \frac{(244)^2}{62}}{62} = \frac{1014 - 960,25}{62} = \frac{53,75}{62} = 0,87$$

and standard deviation $\sigma = \sqrt{0,87} = 0,93$

Conclusion: A total of 51 respondents or 82.2% answered that the method of payment is important or absolutely important, while 8 respondents or 12.9% answered that the stated fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 3.93, which means that the absolute majority of respondents answered that the method of payment is important or absolutely important.

Question number 5: (Delivery speed - delivery of goods to the customer).

If the essay answers to the survey question are converted into numerical values, the following is obtained

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{272}{61} = 4,46$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1236 - \frac{(272)^2}{61}}{61} = \frac{1236 - 1212,8}{61} = \frac{23,2}{61} = 0,38$$

and standard deviation $\sigma = \sqrt{0,38} = 0,62$

Conclusion: A total of 59 respondents or 96.7% answered that the speed of delivery of goods to the customer is important or absolutely important, while 1 respondent or 1.6% answered that this fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 3.93, which means that the absolute majority of respondents answered that the speed of delivery of goods to the customer is important or absolutely important.

Question number 6: (Delivery of purchased goods from the place of unloading to the buyer).

If the essay answers to the survey question are converted into numerical values, the following is obtained:

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{262}{61} = 4,29$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1152 - \frac{(262)^2}{61}}{61} = \frac{1152 - 1125,3}{61} = \frac{26,7}{61} = 0,44$$

and standard deviation $\sigma = \sqrt{0,44} = 0,66$

Conclusion: A total of 58 respondents or 95.08% answered that the delivery of purchased goods from the place of unloading to the buyer is important or absolutely important, while 2 respondents or 3.2% answered that this fact is absolutely irrelevant or essential. The average value of individual answers is 4.29, which means that the absolute majority of respondents answered that the delivery of purchased goods from the place of unloading to the buyer is important or absolutely important.

Question number 7: (System of related supply chain services - delivery in one place).

If the essay answers to the survey question are converted into numerical values, the following is obtained:

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{246}{62} = 3,97$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1024 - \frac{(246)^2}{62}}{62} = \frac{1024 - 976,06}{62} = \frac{47,94}{62} = 0,77$$

and standard deviation $\sigma = \sqrt{0,77} = 0,88$

Conclusion: A total of 53 respondents or 85.48% answered that the system of related supply chain services - delivery in one place is important or absolutely

important, while 5 respondents or 8% answered that this fact is absolutely irrelevant or essential. The average value of individual answers is 3.97, which means that the absolute majority of respondents answered that the system of related supply chain services - delivery in one place is important or absolutely important.

Question number 8: (Staff expertise).

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{273}{62} = 4,4$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1228 - \frac{(273)^2}{62}}{62} = \frac{1228 - 1202,08}{62} = \frac{25,92}{62} = 0,42$$

and standard deviation $\sigma = \sqrt{0,42} = 0,65$

Conclusion: A total of 58 respondents or 93.5% answered that the expertise of staff is important or absolutely important, while 3 respondents or 4.8% answered that this fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 4.4, which means that the absolute majority of respondents answered that the expertise of staff is important or absolutely important.

Question number 9: (The kindness of the staff).

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{271}{61} = 4,44$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1225 - \frac{(271)^2}{61}}{61} = \frac{1225 - 1203,9}{61} = \frac{21,1}{61} = 0,346$$

and standard deviation $\sigma = \sqrt{0,346} = 0,588$

Conclusion: A total of 58 respondents or 95.08% answered that the kindness of the staff is important or absolutely important, while 0 respondents answered that this fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 4.44, which means that the absolute majority of respondents answered that the kindness of the staff is important or absolutely important.

Question number 10: (How to resolve a complaint).

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{281}{61} = 4,6$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1309 - \frac{(281)^2}{61}}{61} = \frac{1309 - 1294,4}{61} = \frac{14,6}{61} = 0,239$$

and standard deviation $\sigma = \sqrt{0,239} = 0,489$

Conclusion: All respondents answered that the way of resolving the complaint is important or absolutely important.

General assessment of supply chain quality

| xi | fi | x2 | xifi | fixi2 | Cumulative below | Cumulative above |
|----|----|----|------|-------|------------------|------------------|
| 1 | 0 | 1 | 0 | 0 | 0 | 58 |
| 2 | 4 | 4 | 8 | 16 | 4 | 58 |
| 3 | 23 | 9 | 69 | 207 | 27 | 54 |
| 4 | 24 | 16 | 96 | 384 | 51 | 31 |
| 5 | 7 | 25 | 35 | 175 | 58 | 7 |
| Σ | 58 | 55 | 208 | 782 | | |

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{208}{58} = 3,59$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{782 - \frac{(208)^2}{58}}{58} = \frac{782 - 745,9}{58} = \frac{36,1}{58} = 0,62$$

and standard deviation $\sigma = \sqrt{0,62} = 0,79$

Conclusion: Respondents gave a general assessment of the supply chain of 3.59.

Out of a total of 58 respondents, 31 or 53.44% gave a general assessment of the supply chain of 4 or more, 23 or 39.6% gave a rating of 3, while a rating of 2 was given by 4 respondents or 6.9%.

II- SURVEY ANALYSIS:

Quality assessment of supply chains by customers / users

Question number 1. (Preference is given to supply chains located in larger centers?)

If the essay answers to the survey question are converted into numerical values, the following is obtained:

| | |
|---|--|
| 1 | Absolutely irrelevant |
| 2 | Essentially irrelevant |
| 3 | It doesn't matter or it doesn't matter |
| 4 | Important |
| 5 | Absolutely important |

| xi | fi | x2 | xifi | fixi2 | Cumulative below | Cumulative above |
|----|----|----|------|-------|------------------|------------------|
| 1 | 4 | 1 | 4 | 4 | 4 | 54 |
| 2 | 15 | 4 | 30 | 60 | 19 | 50 |
| 3 | 13 | 9 | 39 | 117 | 32 | 35 |
| 4 | 19 | 16 | 76 | 304 | 51 | 22 |
| 5 | 3 | 25 | 15 | 75 | 54 | 3 |
| Σ | 54 | 55 | 164 | 560 | | |

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{164}{54} = 3,037$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{560 - \frac{(164)^2}{54}}{54} = \frac{560 - 498,07}{54} = \frac{61,93}{54} = 1,147$$

and standard deviation $\sigma = \sqrt{1,147} = 1,07$

Conclusion: A total of 22 respondents or 40.7% answered that the advantage of supply chains in larger centers is significant or absolutely significant, while 19 respondents or 35.1% answered that this fact is absolutely irrelevant or essentially irrelevant. Out of the total number, 13 respondents or 24% answered that the average value of individual answers is 3,037, which means that the absolute majority of respondents answered that the location of supply chains is not important or irrelevant in terms of its market advantage.

Question number 2. (The recommendation of others is important for the choice of supply chains)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{196}{54} = 3,63$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{752 - \frac{(196)^2}{54}}{54} = \frac{752 - 711,4}{54} = \frac{40,6}{54} = 0,75$$

and standard deviation $\sigma = \sqrt{0,75} = 0,867$

Conclusion: Out of a total of 54 respondents, 36 or 66.7% answered that the recommendation of others is important or absolutely important for the choice of supply chains, while 8 respondents or 14.8% answered that this fact is absolutely irrelevant or essential. The average value of individual answers is 3.63, which means that the majority of respondents answered that the recommendation of others is important or absolutely important for the choice of supply chains.

Question number 3. (Supply chain advertising)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{185}{54} = 3,43$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{675 - \frac{(185)^2}{54}}{54} = \frac{675 - 633,8}{54} = \frac{41,2}{54} = 0,76$$

and standard deviation $\sigma = \sqrt{0,76} = 0,87$

Conclusion: Out of a total of 54 respondents, 29 or 53.7% answered that supply chain advertising is important or absolutely important, while 10 respondents or 18.5% answered that the stated fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 3.43, which means that the majority of respondents answered that advertising is important for the choice of supply chains.

Question number 4. (Service potential)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{243}{55} = 4,42$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1087 - \frac{(243)^2}{55}}{55} = \frac{1087 - 1073,6}{55} = \frac{13,4}{55} = 0,24$$

and standard deviation $\sigma = \sqrt{0,24} = 0,49$

Conclusion: All respondents answered that service potential is important or absolutely important for the choice of supply chain.

Question number 5. (Affordable prices)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{242}{54} = 4,48$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1100 - \frac{(242)^2}{54}}{54} = \frac{1100 - 1084,5}{54} = \frac{15,5}{54} = 0,29$$

and standard deviation $\sigma = \sqrt{0,29} = 0,536$

Conclusion: Out of a total of 54 respondents, 53 or 98.1% answered that affordable price is important or absolutely important for the choice of supply chains, while only 1 respondent or 1.8% answered that the stated fact is not important or irrelevant. The average value of individual answers is 4.48, which means that the majority of respondents answered that affordable price is absolutely or absolutely important for the choice of supply chains.

Question number 6. (Method of payment)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{224}{55} = 4,07$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{960 - \frac{(224)^2}{55}}{55} = \frac{960 - 912,3}{55} = \frac{47,7}{55} = 0,867$$

and standard deviation $\sigma = \sqrt{0,867} = 0,93$

Conclusion: Out of a total of 55 respondents, 50 or 90.9% answered that the method of payment is important or absolutely important for the choice of supply chains, while 4 respondents or 7.2% answered that this fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 4.07, which means that the majority of respondents answered that the method of payment is important or absolutely important for the choice of supply chains.

Question number 7. (Choice of alternatives for transport of goods and execution of services)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{222}{54} = 4,11$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{920 - \frac{(222)^2}{54}}{54} = \frac{920 - 912,7}{54} = \frac{7,3}{54} = 0,135$$

and standard deviation $\sigma = \sqrt{0,135} = 0,367$

Conclusion: Out of a total of 54 respondents, 53 or 98.1% answered that the choice of alternatives for transport of goods and services is important or absolutely important for the choice of supply chains, while only 1 respondent or 1.8% answered that this fact is not important. nor is it irrelevant. The average value of individual answers is 4.11, which means that the majority of respondents answered that the choice of alternatives for the transport of goods and services is important or absolutely important for the choice of supply chains.

Question number 8. (Speed of delivery-delivery of goods to the customer)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{239}{54} = 4,43$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1071 - \frac{(239)^2}{54}}{54} = \frac{1071 - 1057,8}{54} = \frac{13,2}{54} = 0,24$$

and standard deviation $\sigma = \sqrt{0,24} = 0,49$

Conclusion: All respondents answered that the speed of delivery-delivery of goods to the customer is important or absolutely important for the choice of supply chains. The average value of individual answers is 4.43.

Question number 9. (Delivery of purchased goods from the place of unloading to the buyer)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{233}{54} = 4,32$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1023 - \frac{(233)^2}{54}}{54} = \frac{1023 - 1005,3}{54} = \frac{17,7}{54} = 0,33$$

and standard deviation $\sigma = \sqrt{0,33} = 0,57$

Conclusion: Out of a total of 54 respondents, 53 or 98.1% answered that the delivery of purchased goods from the place of unloading to the buyer is important or absolutely important for the choice of supply chains, while only 1 respondent or

1.8% answered that this fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 4.32.

Question number 10. (How sustainable is the supply chain thesis: Success = Narrow specialization)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{202}{54} = 3,74$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{780 - \frac{(202)^2}{54}}{54} = \frac{780 - 755,6}{54} = \frac{24,4}{54} = 0,45$$

and standard deviation $\sigma = \sqrt{0,45} = 0,67$

Conclusion: Out of a total of 54 respondents, 41 or 75.9% answered the thesis Success = Narrow specialization that it is important or absolutely important, while 4 respondents or 7.4% answered that the stated fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 3.74, which means that the majority of respondents answered that the thesis Success = Narrow specialization for the choice of supply chains is important or absolutely important.

Question number 11. (Supply chain service system - one-stop delivery)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{215}{53} = 4,06$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{891 - \frac{(215)^2}{54}}{53} = \frac{891 - 872,2}{53} = \frac{18,8}{53} = 0,35$$

and standard deviation $\sigma = \sqrt{0,35} = 0,59$

Conclusion: Out of a total of 53 respondents, 47 or 88.7% answered that the system of related supply chain services - delivery in one place is important or absolutely important for the choice of supply chains, while 1 respondent or 1.8% answered that this fact absolutely irrelevant or essentially irrelevant. The average value of individual answers is 4.06, which means that the absolute majority of respondents answered that the system of related supply chain services - delivery in one place is important or absolutely important for the choice of supply chains.

Question number 12. (Regular monitoring of supply chain competitiveness ratings)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{215}{55} = 3,91$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{873 - \frac{(215)^2}{55}}{55} = \frac{873 - 840,4}{55} = \frac{32,6}{55} = 0,59$$

and standard deviation $\sigma = \sqrt{0,59} = 0,77$

Conclusion: Out of a total of 55 respondents, 44 or 80% answered that regular monitoring of the supply chain competitiveness rating is important or absolutely important for the selection of supply chains, while 4 respondents or 7.27% answered that this fact is absolutely irrelevant or essential. The average value of

individual responses is 3.91, which means that the majority of respondents answered that regular monitoring of supply chain competitiveness ratings is essential or absolutely important for the selection of supply chains

Question number 13. (Ancillary services that are free of charge)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{210}{52} = 4,04$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{878 - \frac{(210)^2}{52}}{52} = \frac{878 - 848}{52} = \frac{30}{52} = 0,57$$

and standard deviation $\sigma = \sqrt{0,57} = 0,76$

Conclusion: Out of a total of 52 respondents, 46 or 88.46% answered that non-charged ancillary services are important or absolutely important for the choice of supply chains, while 4 respondents or 7.69% answered that this fact is absolutely irrelevant or essential. irrelevant. The average value of individual answers is 4.04, which means that the majority of respondents answered that for the choice of supply chains, it is important or absolutely important that the accompanying services are not charged.

Question number 14. (Accompanying services that are charged)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{225}{54} = 4,17$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{955 - \frac{(225)^2}{54}}{54} = \frac{955 - 937,5}{54} = \frac{17,5}{54} = 0,32$$

and standard deviation $\sigma = \sqrt{0,32} = 0,57$

Conclusion: Out of a total of 54 respondents, 51 or 94.4% answered that the accompanying services that are charged are important or absolutely important for the choice of supply chains, while 1 respondent or 1.8% answered that this fact is absolutely irrelevant or essentially irrelevant. The average value of individual answers is 4.17, which means that the absolute majority of respondents answered that the accompanying services that are charged are important or absolutely important for the choice of supply chains.

Question number 15. (Staff expertise)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{240}{54} = 4,44$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1088 - \frac{(240)^2}{54}}{54} = \frac{1088 - 1066,6}{54} = \frac{21,4}{54} = 0,39$$

and standard deviation: $\sigma = \sqrt{0,39} = 0,63$

Conclusion: Out of a total of 54 respondents, 52 or 96.3% answered that the expertise of staff is important or absolutely important for the choice of supply chains, while 1 respondent or 1.8% answered that this fact is absolutely irrelevant or essential. The average value of individual answers is 4.44, which means that the absolute majority of respondents answered that the expertise of staff is important or absolutely important for the choice of supply chains.

Question number 16. (The kindness of the staff)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{242}{54} = 4,48$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1102 - \frac{(242)^2}{54}}{54} = \frac{1102 - 1084,5}{54} = \frac{17,5}{54} = 0,32$$

and standard deviation $\sigma = \sqrt{0,32} = 0,57$

Conclusion: Out of a total of 54 respondents, 52 or 96.3% answered that the kindness of the staff is important or absolutely important for the choice of supply chains, while none of the respondents answered that this fact is absolutely irrelevant or essential. The average value of individual answers is 4.48, which means that the majority of respondents answered that the kindness of the staff is important or absolutely important for the choice of supply chains.

Question number 17. (Regular information about the offer via the Internet and leaflets)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{212}{54} = 3,93$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{874 - \frac{(212)^2}{54}}{54} = \frac{874 - 832,3}{54} = \frac{41,7}{54} = 0,77$$

and standard deviation $\sigma = \sqrt{0,77} = 0,88$

Conclusion: Out of a total of 54 respondents, 44 or 81.5% answered that regular information on the offer via the Internet and leaflets is important or absolutely important for the selection of supply chains, while 5 respondents or 9.3% answered that this fact is absolutely irrelevant. or essentially irrelevant. The average value of individual answers is 3.93, which means that the majority of respondents answered that regular information about the offer via the Internet and leaflets is important or absolutely important for the selection of supply chains.

Question number 18. (Customer-customer consulting services)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{211}{53} = 3,98$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{867 - \frac{(211)^2}{53}}{53} = \frac{867 - 840}{53} = \frac{27}{53} = 0,5$$

and standard deviation $\sigma = \sqrt{0,5} = 0,71$

Conclusion: Out of a total of 53 respondents, 45 or 84.9% answered that customer or customer counseling services are important or absolutely important for the choice of supply chains, while 3 respondents or 5.66% answered that this fact is absolutely irrelevant or essentially irrelevant. . The average value of individual answers is 3.98, which means that the majority of respondents answered that customer or customer counseling services are essential or absolutely important for the choice of supply chains.

Question number 19. (Manner of resolving complaints)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{249}{54} = 4,61$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{1161 - \frac{(249)^2}{54}}{54} = \frac{1161 - 1148,2}{54} = \frac{12,8}{54} = 0,24$$

and standard deviation $\sigma = \sqrt{0,24} = 0,49$

Conclusion: all respondents answered that the way of resolving complaints is important or absolutely important for the selection of supply chains. The average value of individual answers is 4.61.

Question number 20. (Customer participation in improving existing supply chain services)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{216}{54} = 4$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{894 - \frac{(216)^2}{54}}{54} = \frac{894 - 864}{54} = \frac{30}{54} = 0,55$$

and standard deviation $\sigma = \sqrt{0,55} = 0,74$

Conclusion: Out of a total of 54 respondents, 48 or 88.8% answered that the participation of customers in the improvement of existing supply chain services is important or absolutely important for the choice of supply chains, while 3

respondents or 5.55% answered that this fact is absolutely irrelevant. or essentially irrelevant. The average value of individual responses is 4, which means that the majority of respondents answered that the participation of customers in the improvement of existing supply chain services is important or absolutely important for the choice of supply chains.

Question number 21. (Customer participation in the creation of new supply chain services)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{219}{54} = 4,05$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{919 - \frac{(219)^2}{54}}{54} = \frac{919 - 888,16}{54} = \frac{30,84}{54} = 0,57$$

and standard deviation $\sigma = \sqrt{0,57} = 0,75$

Conclusion: Out of a total of 54 respondents, 46 or 85.2% answered that customer participation in creating new supply chain services is important or absolutely important for the choice of supply chains, while 3 respondents or 5.55% answered that this fact is absolutely irrelevant. or essentially irrelevant. The average value of individual answers is 4.05, which means that the absolute majority of respondents answered that the participation of the customer in creating new supply chain services is important or absolutely important for the choice of supply chains.

Question number 22. (Informing about the expansion of the range and conditions of placement of supply chain services)

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{217}{53} = 4,09$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{909 - \frac{(217)^2}{53}}{53} = \frac{909 - 888,5}{53} = \frac{20,5}{53} = 0,39$$

and standard deviation $\sigma = \sqrt{0,39} = 0,62$

Conclusion: Out of a total of 53 respondents, 49 or 92.45% answered that for the selection of supply chains it is important or absolutely important to inform about the expansion of the range and conditions of placement of supply chain services, while 2 respondents or 3.77% answered that this fact absolutely irrelevant or essentially irrelevant. The average value of individual answers is 4.09, which means that the majority of respondents answered that information on the expansion of the range and conditions of placement of supply chain services is important or absolutely important for the choice of supply chains.

General assessment of the quality of supply chains by customers / users

| i | i | 2 | ifi | ixi2 | Cumulative below | Cumulative above |
|---|---|---|-----|------|------------------|------------------|
| 1 | 0 | 1 | 0 | 0 | 0 | 50 |
| 2 | 3 | 4 | 6 | 2 | 3 | 50 |
| 3 | 1 | 9 | 3 | 89 | 24 | 47 |
| 4 | 9 | 6 | 6 | 04 | 43 | 26 |
| 5 | 7 | 5 | 5 | 75 | 50 | 7 |
| Σ | 0 | 5 | 80 | 80 | | |

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{180}{50} = 3,6$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{680 - \frac{(180)^2}{50}}{50} = \frac{680 - 648}{50} = \frac{32}{50} = 0,64$$

and standard deviation $\sigma = \sqrt{0,64} = 0,8$

Conclusion: Out of a total of 50 respondents, 26 or 52% gave an excellent or very good grade, 21 respondents or 42% gave a good grade, while 3 respondents or 6% gave a sufficient grade. The average value of individual answers is 3.6.

It can be concluded that the subject value of 3.6 is at the same time a general assessment of the quality of supply chains by the customer.

IS - SUMMARY EVALUATION OF THE SURVEY:

Factors of interest for improving the quality of supply chain services and customer satisfaction

If the essay answers to the survey question are converted into numerical values, the following is obtained:

| | |
|---|--|
| 1 | Absolutely irrelevant |
| 2 | Essentially irrelevant |
| 3 | It doesn't matter or it doesn't matter |
| 4 | Important |
| 5 | Absolutely important |

| i | f _i | 2 | if _i | ixi ² | Cumulative below | Cumulative above |
|---|----------------|----|-----------------|------------------|------------------|------------------|
| 1 | 7 | 1 | 7 | 7 | 7 | 615 |
| 2 | 28 | 4 | 6 | 12 | 35 | 608 |
| 3 | 30 | 9 | 0 | 70 | 65 | 580 |
| 4 | 312 | 16 | 248 | 992 | 377 | 550 |
| 5 | 238 | 25 | 190 | 950 | 615 | 238 |
| Σ | 615 | 55 | 591 | 1331 | | |

Total average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{2591}{615} = 4,21$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{11331 - \frac{(2591)^2}{615}}{615} = \frac{11331 - 10915,9}{615} = \frac{415,1}{615} = 0,67$$

and standard deviation $\sigma = \sqrt{0,67} = 0,82$

Taking into account the answers in the survey to the 10 questions asked, it can be concluded that the total mean value of the parameters of the random sample of the population is 4.21.

Out of a total of 615 questions asked regarding certain factors of interest for improving the quality of supply chain services and customer satisfaction, respondents gave 550 answers or 90% that they are important or absolutely important.

Out of the total number of questions asked, there were only 35 answers or 5.69% in which it was stated that the offered factors are absolutely irrelevant or essentially irrelevant for improving the quality of supply chain services and customer satisfaction.

Respondents also gave 30 responses or 4.91% in which they gave their opinion that the offered factors of interest for improving the quality of supply chain services and customer satisfaction are not important or irrelevant.

The obtained summary results of the statistical analysis of the survey, and taking into account the low level of standard deviation (0.82), as a measure of deviation of individual responses from their mean, suggest that they can be accepted as correct hypotheses, given that the absolute majority The response in the survey was that the factors of interest offered to improve the quality of supply chain services and customer satisfaction are essential or absolutely essential.

IIS- SUMMARY EVALUATION OF THE SURVEY:

Quality assessment of supply chains by customers / users

If the essay answers to the survey question are converted into numerical values, the following is obtained:

| | |
|---|--|
| 1 | Absolutely irrelevant |
| 2 | Essentially irrelevant |
| 3 | It doesn't matter or it doesn't matter |
| 4 | Important |
| 5 | Absolutely important |

| xi | fi | x2 | xifi | fixi2 | Cumulative below | Cumulative above |
|----------|------|----|------|-------|------------------|------------------|
| 1 | 9 | 1 | 9 | 9 | 9 | 1186 |
| 2 | 64 | 4 | 128 | 256 | 73 | 1177 |
| 3 | 89 | 9 | 267 | 801 | 162 | 1113 |
| 4 | 703 | 16 | 2812 | 11248 | 865 | 1024 |
| 5 | 321 | 25 | 1605 | 8025 | 1186 | 321 |
| Σ | 1186 | 55 | 4821 | 20339 | | |

The average expected value of the parameter evaluation (answer to the question) in this case is:

$$\bar{x} = \frac{\sum x_i f_i}{n} = \frac{4821}{1186} = 4,06$$

While the variance:

$$\sigma^2 = \frac{\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N}}{N} = \frac{20339 - \frac{(4821)^2}{1186}}{1186} = \frac{20339 - 19597}{1186} = \frac{742}{1186} = 0,626$$

and standard deviation $\sigma = \sqrt{0,626} = 0,791$

Taking into account the answers in the survey to the 22 questions asked, it can be stated that the total expected mean value of the parameters of the random sample of the population is 4.06.

Out of a total of 1186 questions asked regarding certain factors of interest for improving the quality of supply chain services and customer satisfaction, respondents gave 1024 answers or 86.3% that they are important or absolutely important.

Out of the total number of questions asked, there were only 73 answers or 6.15% in which it was stated that the offered factors are absolutely irrelevant or essentially irrelevant for improving the quality of supply chain services and customer satisfaction.

Respondents also gave 89 responses or 7.5% in which they expressed their opinion that the offered factors of interest for improving the quality of supply chain services and customer satisfaction are not important or not.

The obtained summary results of the statistical analysis of the survey, and taking into account the low level of standard deviation (0.791), as measures of deviation of individual responses from their mean, suggest that they can be accepted as correct main and auxiliary hypotheses, given that the absolute majority The response in the survey was that the factors of interest offered to improve the

quality of supply chain services and customer satisfaction are essential or absolutely essential.

CONCLUSION

Due to the reduction of costs and the shortening of the time of their implementation, the survey was not conducted on a systematized and stratified (scaled arrangement of social groups and classes according to their greater or lesser social power) random sample of respondents, but surveys were conducted on the basis of a random sample of respondents.

The majority of respondents who participated in the surveys are primarily or exclusively employed in education. Furthermore, it can be noted that there are significant social differences among the respondents, ie. in the amount of income, as well as the evident difference in the answers to the questions posed to different categories of respondents, which in any case gives a more realistic picture in the results of the conducted surveys.

As an example, the essential difference in the general assessment of the quality of the supply chain can be cited in the support worker ie. of a low-income worker (he gave an overall rating of 3) compared to the rating of a director who has a high income (an overall rating of 5). For people with minimum and low incomes and pensioners, the price of the goods is the most important, while the other elements given in the survey of supply chains are essentially less important for them or not important at all. For high-income earners, the possibility of parking, the friendliness of the staff, or someone's recommendation for supply chains are more important than the price of goods.

Otherwise, the results of the survey in any case certainly contain certain errors of the random sample chosen in this way, which are caused by the fact that the sample is not representative, ie. it does not adequately reflect the characteristics of the underlying set or population, as well as because the surveyed population sample is relatively small.

Despite the possible errors that arise when evaluating the hypotheses using the method of a random sample of respondents, it can be concluded that the results of

the conducted surveys passed the critical point of success, so it can be concluded that they served the purpose.

The overall results of the statistical analysis of the surveys, and taking into account the low level of standard deviation, as a measure of the deviation of individual responses from their mean value, point to the conclusion that they can be accepted as correct main and auxiliary hypotheses, bearing in mind that the absolute majority of responses in the survey whether the offered factors of interest for improving the quality of supply chain services and customer satisfaction are essential or absolutely essential.

REFERENCES

1. Blejec Chambers, Paul Tukey, "Graphical Methods for Data Analysis", Wadsworth, 1998.
2. Krstić G., Šoškić D., "Ekonomska statistika", Centar za izdavačku delatnost, Beograd, 2015.
3. Lancaster K., "Mathematical Economics", Macmilan, New York, 2014.
4. Lovrić M., "Osnove statistike", Ekonomski fakultet, Univerzitet u Kragujevcu, 2018.
5. Macura R., "Osnove statistike" BLC College, Banja Luka 2019.
6. Marjanović M., "Statistika u ekonomiji i poslovanju sa zbirkom rešenih zadataka", Visoka poslovna škola strukovnih studija, Leskovac, 2016.
7. Njegić R., Žižić M., "Osnovi statističke analize", Centar za izdavačku delatnost, Beograd, 2006.
8. Paskota M., "Osnove kvantitativnih istraživanja", Saobraćajni fakultet, Beograd, 2007
9. Pavlić I., "Statistička teorija i primjena" Izdavačko preduzeće Panorama, Zagreb, 2010.
10. Prem S. Mann, "Uvod u statistiku", Centar za izdavačku delatnost - Ekonomski fakultet, Beograd, 2009.
11. Šegrt S., "Kvantitativne metode i ekonomski modeli ", praktikum, Fakultet za informacione tehnologije i inženjerstvo, Beograd, 2021.

12. Šegrt S., "Kvantitativne metode i ekonomski modeli ", skripta, Fakultet za informacione tehnologije i inženjerstvo, Beograd, 2021.
13. Šegrt S., "Kvantitativne metode i ekonomski modeli", udžbenik, Visoka škola za menadžment i ekonomiju, Kragujevac, Fakultet za poslovne studije i pravo, Beograd, 2021.
14. Šegrt S., "Poslovna statistika", praktikum, Fakultet za poslovne studije i pravo, Beograd, 2021.
15. Šegrt S., "Poslovna statistika", skripta, Fakultet za poslovne studije i pravo, Beograd, 2021.
16. Šegrt S., "Poslovna statistika", udžbenik, Visoka škola za menadžment i ekonomiju, Kragujevac, Fakultet za poslovne studije i pravo, Beograd, 2021.
17. Vuković N. Spasić S., "Statistika za inženjere", Univerzitet Singidunum, Beograd, 2011.