Forecasting And Analysis Of Trends In Area Of Quality Management System

Aleksandar Vujović [1]
Zdravko Krivokapić [2]

[1] Aleksandar Vujović-
Assistant professor - Faculty
of Mechanical Engineering
Podgorica

[2] Zdravko Krivokapić- Full
professor - Faculty of
Mechanical Engineering
Podgorica

Abstract: This research presents chronology and trends in area of quality management system through nonconformities. The aim of the work is to forecast possible scenario to foresee activities for future period and time what will point out on critical indicators and on possible measures for improvement. Furthermore, research identifies advantages, disadvantages and possibilities, especially for production and service sectors. The work presents long-term research on quality management system and experience and knowledge that are obtained based on real indicators.
Keywords: ISO9001,nonconformites,improvement,analysis

1. INTRODUCTIVE REMARKS AND SETING OF HYPOTHESIS

We are the witnesses of an increasingly intensive process of globalisation and competitiveness which becomes prominent and now encompasses the Third World countries as well. The technologies have been progressively transferred from highly developed countries to less developed ones as well as crowded regions with low labour cost. In order to achieve uniformity and ensure equal conditions and procedures for all, the globalisation process follows the standardisation process.

This process is achieved also in the part of system of management through quality which becomes inevitability. Even that there is some mitigate results, quality management system may lead of financial performance improvement of the organisation [1,2].

The ISO 9001 standards, which represent the basis, or the model for quality management system implementation tend to become an obligation, confidence condition, authorisation, participation in certain public auctions etc. This indicates on the significance of this system as well as the obligation to improve, in order to ensure a more competitive position and promote the overall organisation performance.

From the standpoint of our country and close environment, we can speak about important development of the quality management system and via practical implementation and foundation in scientific circles. This topic is discussed in various seminars, workshops and academic conferences.

There are many organisations which deal with consulting and the implementation of management system, and many certificate bodies which have competent examiners who have finished courses mainly with foreign and well-known lecturers, and that meet the requirements for reaching the status of assessors based on norms defined by standards.

Apart from their regular domestic accreditation checks, some certificate bodies have regular checks performed by foreign accreditation assessors, and they also figure and participate actively in international institutions. This indicates the importance granted to the processes of the system quality management, to the competence of the assessors and to views and opinions that they express concerning its references and the levels of its achievement.

The organisations which have implemented the quality management system can be seen as unique or equal systems, through respect for process model and systemic approach as well as other principles of the quality management system.

However, from another standpoint, applying the same reference does not reflect in the same manner on the organisations of production and service sectors [3].

Although it was created as a model which is equal to all the types of organisations, in the sense of four generic products, its implementation, efficiency and effectiveness as well as its impact on organisation performance is not the same. This certainly depends on the arrangement of individual systems, habits, organisation, and relation to work, and even on psychological predisposition and relation to modern management methods and manner and wish to accept them, etc.

Naturally, this kind of interpretation can now be transferred to individual modules of system of management through quality, and speak of its implementation, efficiency and effectiveness in the production and service sector. Apart from its activities, the size of the organisation can also play a significant role [4], but that aspect will not be discussed in this work.

Through a long-standing research of literature and dealing with scientific and research work in the area of system of management through quality, through great experience gained by conducting and participating in many projects of implementation of the system of management through quality, the authors' experience shows that the production agencies in the module "improvement" are much better than those from the service sector.

Also, the production agencies understand the process model better and have a clearly defined and perceived product, and they can thus meet the requirements in the module 7 better.

The experience referring to two other modules is the same. Based on such observation and interpretation, it can be assumed that those relations will be kept in future; also, the following hypothetical view can be determined:

H1: production organisations have more favourable trends and foreseeing in the sense of meeting the requirements of ISO 9001 standards than the service organisations.

In order to prove this hypothesis, this work will include an inductive way of concluding, and in the fields of unification, examination, analysis of experimental data and conclusions, and in the areas of gaining a

generally applicable knowledge about specific facts reflecting in experimental data. In the method of scientific research work, the methods *ex post facto – past facts* were used: methods of the experiment when concluding is performed based on the facts in the work which reflect in experience of large number of firms. [5, 6]

The aim of this work is to come to conclusions in the sense of formulated hypothesis, as well as certain knowledge which can be used for the future activities of improvement in the area of ISO 9001 standards and defining preventing activities, all based on real indicators gained in the experiment and based on detailed analysis and insight in the data.

2. EXPERIMENTAL DATA (SOURCE, SIGNIFICANCY AND SPECIFICITY)

Today, the experimental research has a completely different dimension from what was once seen as an experiment. The laboratory research and classical plans of experiment tend to move towards domination of natural experiments which describe the reality and accuracy of a certain process [7] in a more credible way. The authors of this work were guided by such facts and they have used precisely the real experiment in this work, as well as data which occur.

A new living and working environment is monitored by development and constant auditing of international standards, and thus the standards of management through quality.

A large number of data emerging in communication or as results of different processes and working activities impose a constant striving of the managers in the sense of effective and efficient managing. Of course, all this causes the nonconformities which create obstacles and low organisation performance. This carries along the weakening of financial power of the organisations and their employees to the moment of elimination from the market and a complete collapse. It is, therefore, necessary to identify the nonconformities at the right time and in the right manner, then take measures for their removal and gain knowledge which will be used in the future on the basis of the experience of others.

This approach was dealt with by a generally small number of researchers. This approach has not been applied in the area of the quality management system, and thus the cognition gained with it is very significant [8,9]. Of course, in accordance with that, it is necessary to develop models for prevention activities and the reduction of the number of corrective measures to the lowest possible level.

For the purpose of the research, the following possibilities were used: if the check and findings about nonconformities are unified for a large number of organisations and the analyses are conducted, we can reach general recommendations for corrective and preventive activities in terms of standard observed and can reach certain peculiarities and conclusions in respect of production and service organisations.

Also, it is important to follow the progress of the process of occurrence of nonconformities chronologically. It is important because in that manner certain changes can be seen and trends can be noticed.

Thus, the data were collected especially for the period from occurrence of ISO 9001 standards in 2001 to March 2004 (period 1), from 2004 to 2006 (period 2) and in particular from 2006 to 2008 (period 3). The data were not collected cumulatively but individually for each period. That provides for possibility to see the changes and point to certain trends with a view to gaining knowledge on improvements, corrections, prevention and so on.

The unification of the nonconformities for the period from March 2004 has been performed at the level of external certification checks, and they were gained during the working visits of qualified assessors in the organisations from Montenegro and Serbia.

From the overall number ofnonconformities, 190 were gathered in 115 organisations, for JUS ISO 9001:2001 standard and the modules of that standard. If we consider that there are about 150(The number of certified organisations on the territory of Serbia and Montenegro for the period to March 31, 2004, or the transition period (period of transferring to JUS ISO 9001:2001) based on the regulation of Accreditation bodies of Serbia and Montenegro, this number refers to the organisations certified from two out of seven certificate bodies which possess the accreditation from the Accreditation body of Serbia and Montenegro.)

[10] certified organisations in Serbia and Montenegro according to the new standard model, than the number of 115 organisations account for 77% from the overall number, which indicates the significance of the sample for the analysis.

Also, bearing in mind that the nonconformities were collected from two certificate bodies with the largest number of certificates and bodies, which have extremely competent examiners who have finished mainly foreign trainings, then it can be definitely claimed that that data is real and significant.

For the needs of work and in the period to November 2008, a unique data base was created, and it consists of 911 nonconformities in the module ISO 9001 standard, identified in over 350 organisations.

In that manner, there was created a basis for implementation of analysis with a view to defining critical areas, specific qualities of the organisations and guidelines from improvement towards determining prevention measures and reduction of corrective action, which is in the spirit of ISO 9001 standard.

For the 2nd and 3rd period, it should be emphasised that, as in the previous case, it is the same approach and sources for data collection, and that makes them real and significant.

If we take into consideration that there are about 500 certificates regarding the most competent certificate bodies in Serbia and Montenegro, then the number of 350 accounts for 70% of the overall number, which indicates the significance of the sample for the analysis.

For the need of data collection and analysis as well as the needs of gaining information necessary for making decisions on priorities for improvement, a support system for decision-making was developed. It is based on MS Access data base and Visual Basic users' application [11, 12]. The data collection form of this system which was also used for the needs of this work is illustrated in the figure 1[13].

Figure 1. Data collection form

Within the form, as it can be seen in the figure, a simple collection of data is performed, in a very consumer-oriented and coordinated system, with the recognisable Windows elements. As the result of the system, there are

application forms with histogram illustrations of the schedule of appearance of the nonconformities according to item of ISO 9001 standards, and the activities of the firms, as it is illustrated in the figure 2.
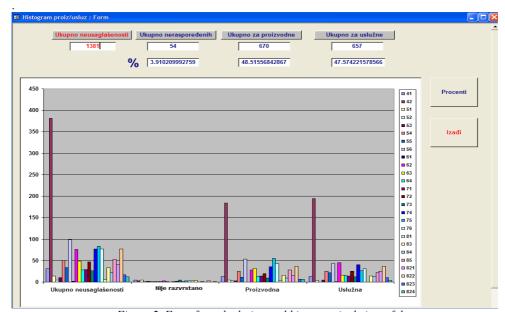

Figure 2. Form for calculation and histogramical view of data

The illustration of the appearance of the nonconformities according to the items of production organisations standards is given in

the Figure 3 in modules and years, and in tables 1 and 2 for production and service organisations in modules and years.
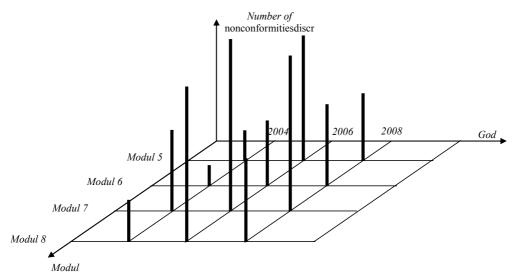
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Figure 3. 3D view of number of nonconformities

Table 1. Data presentation for production organisations

	MODUL 5	MODUL 6	MODUL 7	MODUL 8	SOMMES
2004	13	9	35	18	75
2006	54	28	74	67	223
2008	29	35	67	36	167
Sum	96	72	176	121	**465**

Table 2. Data presentation for service organisations

	MODUL 5	MODUL 6	MODUL 7	MODUL 8	SOMMES
2004	19	25	49	22	115
2006	41	27	48	45	161
2008	38	24	50	58	170
Sum	98	76	147	125	**446**

3. DATA ANALYSIS AND FERECASTING TROUGH APPLICATION OF APPROXIMATE TREND LINES
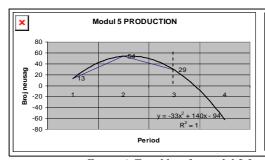
Different methods of forecasting are used as especially significant and useful methods for the needs of drawing conclusions and gaining scientific and expert knowledge [14]. Of course, there are various reasons for that, and the most important fact is that prevention measures aimed at improvement can be developed based on that knowledge.

Trend lines are used for graphical representation of trends according to which the data comport, and aimed at problem analysis and foreseeing. Through trend lines, and based on statistical analysis, a line which approximates the best is gained, or the line which reflects the contour created by items on the diagram which are being observed. For the needs of time foreseeing, time periods are tabled in the X axis, and a line which approximates the time from the beginning of the first to the end of the last period is added. Then, an option drawing the line for two periods the most is added, and in that manner the foreseeing is performed. According to the foreseeing theory, setting the trend line and foreseeing on its basis represents one of the most significant indicators of future conditions, and statements gained in that way are very important [15, 16]. Trend lines are one of the

most powerful concepts used for foreseeing the situation in the market as well as other kinds of foreseeing based on current and available data [13].Uniting of the trend line is followed by joining the R coefficient, called determination coefficient or sigma. It automatically joins the trend line in squaring form. The value of the R coefficient is the indicator ranging from 0-1 and shows how the estimated or joined trend line and its values correspond to the current data. The trend line will be more credible when the R coefficient is closer to 1. Thus, it is necessary to find such form or functional dependence of the trend line whose R coefficient value will be close or equal to 1. Also, if software for joining the trend line is used, then the trend line will automatically be followed by functional dependence which describes that line and which can have a linear, polynomial, exponential, logarithm or some other form. As for experimental data mentioned above, if the periods are tabled in the X axis in years, as it was previously pointed out, and the frequency of nonconformities are tabled in Y axis, then the data and their joined trend lines, their functional dependencies and R coefficients may be illustrated as in Figure 4, Figure 5, Figure 6 and Figure 7.
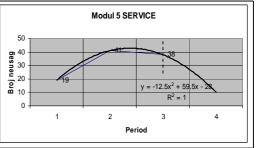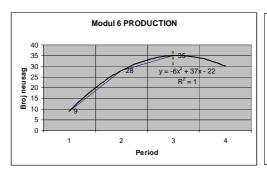

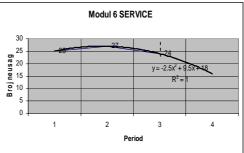*Figure 4. Trend line for modul 5 for production and service organisations*
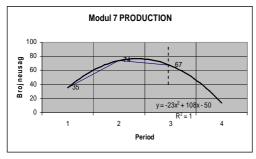

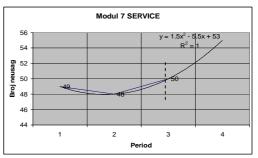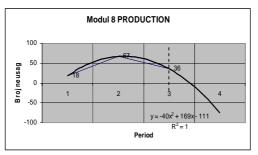*Figure 5. Trend line for modul 6 for production and service organisations*

Figure 6. Trend line for modul 7 for production and service organisations
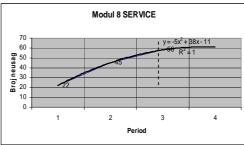
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Figure 7. Trend line for modul 8 for production and service organisations

As it can be seen in the diagrams illustrated, all the trend lines have a polynominal form of 2nd degree. They approximate the current data very well, since **the R coefficient was reached in all diagrams.** The joined trend lines are extended for one period and in that manner foreseeing 2 years in anticipation or to 2010 is achieved.

It should be pointed out that in this analysis, the appearance of nonconformities was not taken into consideration in Figure 4 of the standards. The reason for this is that a important number of nonconformities described often only declaratively appear in that segment, and they do not have value nor character of significantnonconformities, according to the authors.

In the direction of proving the hypothetical view, a comparison by diagrams and foreseeing illustrated is performed, for production and service organisations, as well as by modules separately.

In the module 5 – obligations and responsibilities of the management, a trend indicating "significant reduction" of the frequency of nonconformities in the following period can be seen. By "significant reduction", the importance of the trend and its explicitness are indicated, because the angle in which the trend is achieved is **close to 45^0.**

It is an encouraging trend for both production and service organisations, which shows that the module of responsibility and authority with all the requirements defined within it, is finally understood and accomplished in a proper or more correct way. It is very significant since the earlier research [18] has shown that this area appears as a critical one, especially regarding re-examinations performed by the management for both production and service organisations.

Also, according to the same research,

it was stated that the situation in this module, chronologically observed, has not changed, and thus the descending trend in Figure 4 encourages and suggests more significant improvements in this area for both production and service organisations.

Module 6, which influences the resource management, represents a module in which the situation, as in the previous example, is stable and the trends for the next period are descending. As in the last module, the previous research shows that the situation has not chronologically changed so the present foreseeing and trends can be seen as an enhancement which will bring benefit for organisations in production and service sector. It is foreseen that the organisations will finally meet the requirements which refer to the assessment of training efficiency in the better way, and will develop better infrastructure and better manage the working environment.

The situation changes in module 7, so that the production sector will, according to the foreseeing for the next period, have better conditions in this module and a reduction of nonconformities will occur. The earlier research shows that chronologically the situation has not changed, and according to the foreseeing of this research, the production organisations can expect progress. However, in the service sector, the situation is alarming, since according to the foreseeing, a significant increase in the nonconformities occurrence can be expected. Such trend may represent a consequence: according to the ISO 9001 model, the service organisations still do not have a good feeling and do not identify its product in the right manner, and thus they can hardly satisfy the requirements of module 7 referring to the implementation of the product.

Therefore, the organisations from production sector have significant advantage in

relation to service sector organisations in this segment.

Also, an important fall of nonconformities is expected in module 8 for the following period, regarding production sector. For those organisations, such foreseeing and expected progress is significant, for the previous research has shown that some elements from module 8 are placed in a critical zone, from the standpoint of nonconformities occurrence.

The foreseen severe fall of nonconformities occurrence provides for a progress of production organisations in the part of strengthening of their performance for the requirements referring to measuring, analysing and promoting. As for the service organisations, the situation is different and a slight rise of nonconformities occurrence is foreseen, which concerns since it is a very important module and requirements which provide improvement in the system of management through quality.

However, a slight rise of nonconformities occurrence does not point to the excessive significance of the trend, but we must be guided by the fact that the rise still exists. In compliance with the set hypothesis, the service organisations are in a weaker position in module 8 in comparison to production organisations.

As seen from the standpoint of improvement and prevention measures, it is necessary that the service organisations provide preventive measures which would reduce the foreseen rise in the occurrence ofnonconformities, particularly in module 7 for significant growing trend reasons, as well as in module 8.

In the sense of set hypothesis, it is proved that the production organisations have more favourable trends and foreseeing in terms of meeting the requirements of ISO 9001 standards, than the service organisations.

4. CONCLUDING DISCUSSION

Many scientific researches as well as the experience from practical implementation of the system of management through quality indicate that its application, efficiency and effectiveness do not reflect in production and service sector in the same manner. On the other hand, there is a growing tendency to achieve an absolute domination of implementation of prevention measures in relation to corrective ones. It is therefore, necessary to conduct the research which can foresee certain trends and define, in that manner, the areas on which the preventive measures should be focused on. In that sense, it is possible to use an increasingly applied theory of foreseeing and its most significant segment or joining the trend lines to current data and extending that line to the desired period in the future.

In accordance with the set hypothesis and aims, by implementation of previously mentioned methodology, it can be concluded that in module 5 for the period to 2010, it should be expected a significant performance improvement in both production and service sector and of similar intensity. The situation is almost the same with module 6: it foresees the improvement of equal intensity in both production and service sectors. In terms of chronology from 2000, and constantly weaker trends and situation in these modules, these statements are encouraging and they point to the possibility of an important performance improvement.

In modules 7 and 8, the conditions are changed. Production organisations have very good foreseeing for the following period and a significant rise of performance should be expected in those areas. It is an important statement, since those areas, as the earlier research shows, have always been in critical zone, from the nonconformities standpoint. However, as for foreseeing, the situation is disturbing with service organisations. They should expect a significant degradation and an increase in nonconformities in module 7, as well as a slight weakening in module 8. At the same time, it is the area to which special attention should be paid and prevention measures focused on.

From the standpoint of the basic aim of this work, and in accordance with the set hypothesis, it is proved that the production organisations have more favourable trends and foreseeing in the sense of meeting the requirements of ISO 9001 standards than the service organisations

REFERENCES

[1] Casadesus M., Karapetrovic S., *"An Empirical Study of the Benefits and Costs of ISO 9001: 2000 Compared to ISO 9001/2/3: 1994",* Total Quality Management, Vol. 16, No. 1, 105–120, January 2005.

[2] Vloeberghs D., Bellens J., *"Implementing the ISO 9000 standards in Belgium",* Quality Progress - 29(6), pp. 43–48.

[3] Lawler E., Mohrman S., Benson G., *"Organizing for high performance - Employee Involvement, TQM, Reengineering and Knowledge Management in fortune 1000",* The Center for Effective Organization, Jossey Bass, a Wiley Company, San Francisco, 2001.

[4] Hoerte A., *"Goals, actions and performance changes in manufacturing quality improvement approaches",* Proceedings of 1st International Conference of the European Operations Management Association, University of Cambridge, Cambridge, 1994.

[5] Šolaja V., *"Metod i organizacija naučno istraživačkog rada",* Mašinski fakultet, Beograd, 1970.

[6] Gluščević B., *"Metode naučno istraživačkog rada",* Poslijediplomske studije - Skripta, Novi Sad, 1985.

[7] Hilčenko S.,"Metodologija istraživanja", Visoka škola strukovnih studija za obrazovanje i vaspitanje, Subotica, 2008.

[8] Bacher E., Chassin M., *"Improving Quality Minimizing Error:Making It Happen",* Health affairs, Vol 20, No 3, 2003.

[9] Stein W., Miscikowski D., *"Failsafe: supporting product quality with knowledge - based systems",* Expert Systems with Applications 16, 1999, pp. 365–377.

[10] www.pks.komora.net

[11] Smith A. E., Whisler V., Marquis H., "*Visual basic 6 - Biblija",* Mikro knjiga, Beograd, 1999.

[12] Novalis S., Jones D., *"Mastor za Access 2002 VBA",* Kompjuter biblioteka, Čačak, 2002.

[13] Vujović A., *"Makroupravljanje neusaglašenostima kao osnova modela za poboljšavanje QMS - a",* Magistarski rad, Mašinski fakultet u Podgorici - Katedra za proizvodno mašinstvo, Podgorica, 2004. godine.

[14] Manganely S., "A New Theory of Forecasting", DG Research-Eoropean Central Bank"No 584, January 2006.

[15] Crane J. "Advance Swing trading/strategies to predict, identify and trade future market swing", Wiley trading, Iowa, October 2004.

[16] www.about.com

[17] www.sfera-station.com

[18] Vujović A., «Poboljšavanje performansi poslovnog sistema na bazi sistema menadžmenta primjenom vještačke inteligencije«, Doktorska disertacija, Univerzitet Crne Gore-Mašinski fakultet Podgorica, 2007. god.