

ORGANIZATION PERFORMANCE MEASUREMENT AND QUALITY INFORMATION SYSTEM IN SERBIA - QUALITY MANAGERS' ESTIMATES

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Abstract

This study represents a research carried out on a sample of organizations from Serbia with a certified quality management system (QMS). We made an attempt to explore impacts of information system (IS) quality on measuring management system performance in an organization. The study is based on subjective estimates of quality managers. According to experiences from developed countries, the quality of the information system has, in all its dimensions, very strong influence on measuring system performance (as well as on the performance itself). In Serbia, we found only one among the observed dimensions of IS quality to have a weak impact on measuring organization performance. We also found no significant variations of the dependent variable by observed objective organization parameters (number of employees, type of ownership and maturity of the system in an organization). Results were discussed and it is believed that submitted information could be useful both for professionals and for the researchers in a struggle for gaining better organization performance, since we did not find similar research carried out in Serbia so far.

Key words: *quality of information systems, management system, measuring of process performances*

1. INTRODUCTION

Information systems generally provide useful basis for measuring performance indicators of an organization. Many sources report strong impacts of information system (IS) quality and the effectiveness of measuring performance. As these impacts have not been an object to research in Serbia so far, we attempted to reveal some useful information on how IS quality in organizations affects measuring their performance. Having in mind that an organization with certified quality management system had an opportunity to put the organization management in appropriate order using requirements of ISO 9001 standard, we expected to find above described relations within the observed sample.

1.1 Literature review

Study [1] explores interrelations between quality of information system (IS), information quality, product/service quality and organization as a whole, using a sample of 90 organizations from Hong Kong. Results show that higher quality of the information system positively affects the organization. In the research, authors operationalize the organizational impact through supplier switch cost and market research of suppliers, products / services improvements, market information support, product cost control and internal organization efficiency. These parameters can be considered as performance indicators of the organization.

Study [2] is the empirical research on the determinants of an information system quality. Based on a sample of over 450 organizations, authors found that the determinants of the quality of information are accuracy, completeness, currency and format, while the determinants of information system quality are accessibility, reliability, response time, flexibility and integration. Authors report significant impacts of these parameters on a system performance.

International Organization for Standardization issued the standards series ISO / IEC 9126 [12] in 2001. This series is called "Software engineering - Product quality" and is related to the software quality. ISO did not issue any standard (or standard series) so far that is related directly to the quality of an information system (although a number of standards are related to the topic). In standards [12] the determinants of software quality are: functionality, reliability, usability, efficiency, maintainability and portability. Besides these, there are standards that deal with various organizational aspects, such as [13], but they do not deal with research information. They usually set requirements for management or other systems, which falls within the practical, not the academic domain.

[5] is a study of the influence of exchanging information on supply chains. The results say that the exchange of both strategic and operational information intensively affects the quality of supply chains. Today, the effective exchange of information is not reachable without the use of computers. The authors of the study did not explicitly take into account the dimensions of quality information systems as in [1] or [2], but the quality of information is taken into account, and is operationalized by the dimensions that practically coincide with those in [2].

Research [6] reports perhaps the strongest link between parameters observed by our study. The study treats interrelations of management system practice, information flows in the management system, information technology for quality and quality performance. The study was conducted in 34 organizations using the sample of more than 600 employees. Among other issues, author found a very strong relationship between quality practice and the quality management system information flows from one and organizational performance on the other side.

The group of studies treating the impact of information system quality and quality management system includes [7]. This research has the opposite direction compared to ours. Authors found that using the practice of total quality management (TQM) improves the application of IT processes. This impact was tested in the case study treating hotel services. Similar results were achieved by the authors of the study presented in [10], taking into account that for an effective IS it is advisable to reach maturity of the TQM implementation. The research described in [8] operationalize impacts on the quality of services through a set of parameters, most of which relate to the application of information technology or similar elements (quality of information, the characteristics of IT services, employees' IT characteristics and technical support). A significant

effect of information system on service quality is registered, both direct and indirect.

[9] presents a study of a process model which is a basis of the information system for quality management system aimed at improving the processes. The effectiveness of this model was investigated during the pilot test, which is also briefly described in the paper.

Today, studies treating relationships between technical aspects of IT application and organizational aspects (including management systems) are moving forward in various directions. For example, research given in [11] deals with shared information quality and its impact on the performance of interorganizational systems, i.e. systems which include more than one organization (for example, supply chains or clusters). The research also results in determining the significant influence of quality information on performance. Another example of a complex research in considered context, which includes various elements, is given in [1] (this source was commented earlier in the text).

1.2 Research problem

According to the literature review, it is clear that information systems and management systems are generally tightly interlinked. This information has a general character. Of course, we can not say that it is absolutely true in every case (mathematical induction can not be applied to the considered problem), but it does not decrease its value.

Referenced studies show that a research of the relationship of information systems and management system can be variously constructed.

It was found that studies were carried out treating impacts of IS quality on QMS and vice versa. This fact supports the general claim that these two systems are tightly interlinked.

Maybe, the easiest way to make a research about complex systems is through exploring system performance. System performance, in terms of system management, is the element technical in nature - what we determine as performance would direct the nature and technology of decision-making in order to implement the management system (of course, if we want to manage the system systematically). In the case of information systems and management systems, an absolute consensus on what the system performance elements are, has not been reached. It was found that IS researchers are closer in defining the general set of performance indicators than it is the case with QMS researchers. This fact is the result of higher heterogeneity of the QMS compared to IS by the number of elements and complexities of the interrelationships.

The absence of absolute definition of a set of general QMS or IS performances does not disable studies of the general relationship between these systems. Research may be based upon subjective estimates of employees which are held competent to make valid opinions about the performance and performance measurement in those systems. They can do it if the system has a consensus on a set of (QMS and IS) performance indicators, and, even if that consensus

does not exist (in that case, estimates are likely to be lower). Many studies (referenced in this paper, and others) treating performance in any way, use this fact and involve subjective estimates.

Presented facts direct the research towards exploring the interrelations of subjective opinions provided by competent employees. The researchers selected quality managers as competent personnel.

Below are presented some studies in the area carried out in Serbia.

[3] provides determining the models of goals and their interrelationships using structured modeling, but does not explore impact of IS quality on organization performance. [4] describes the nature of the relationship between the implementation of Enterprise Resource Planning (ERP) system (a system for implementing overall business aided by computers) and performance (the example treats purchase process).

A series of studies related to organizations in Serbia were found that describe various (general or specific) aspects of performance measurement and QMS/IS, but within the available sources results were not found treating the topics of this research.

The problem of this research is to determine how the quality of the information system (IS) affects the performance measurement in certified organizations in the Republic of Serbia. The answer to this question would certainly be useful in multiple ways for all those involved in systems management and information systems, although it might seem obvious.

Overview of referenced sources could, at first glance, point out to the conclusion: "Of course, management systems performance is tightly related to all dimensions of information system quality and the application of information technology supports quality management and business in general. Why should we, generally explore this?". Is it really so?

2. SURVEY METHOD

2.1 The sample

The survey was carried out by analyzing responses to a questionnaire that was sent to 204 quality managers in organizations in Serbia. 51 completed questionnaires (25%) were returned (each quality manager is employed in a different organization).

Among organizations the questionnaire is returned from, 12 are exclusively productive, 14 have combined process (both products and service), and 25 are exclusively providing services.

7 organizations have 1-9 employees, 17 organizations have 10 to 49 employees, in 23 organizations the numbers of employees range from 50 to 249 and 4 organizations have over 250 employees.

33 organizations from the sample are privately owned, 15 organizations are state-owned, and 3 organizations are in a mixed ownership.

Average maturity of the management system was 4.07 years, and the standard deviation is 2.78. The youngest system is 1 year old and the oldest is 13.

Bearing in mind the diversity of organizations described in the sample, the sample may be considered as representative for the Republic of Serbia.

As this is the pilot study, we did not attempt to base the research upon objective data on organizations' performance. Today in Serbia it is difficult to acquire such information because managers are generally not willing to provide them (similar problem is reported by other studies, e.g. [14]).

Further, we could not rely on existing public information on financial performance of organizations since they reflect only one of a number of an organization performance dimensions. It was our intention to provide preliminary explorations on the subject and then, if it seems necessary, to extend the research and make more efforts to acquire additional information and gain more detailed results. Therefore, only quality managers' estimates are used in the study.

Valid register of organizations with quality management system certified still does not exist in Serbia. By some sources it is estimated that about 800 organizations were certified in Serbia in 2007 [18]. It is believed that sample of 51 various certified organizations can be held as representative for this pilot study.

2.2 Hypotheses

The hypothesis H1 is: *basic indicators of the information system quality are predictors of process performance measurement in the management system.*

Respondents' estimate of measuring the management system performance is considered to be the central parameter of the study (dependent variable).

It is expected to gain some additional information in the study from validating the second hypothesis H2: *the objective parameters related to organizations have no impact on the dependent variable.*

2.3 Research method

Basic indicators of IS quality are selected as follows:

- accordance of the IT application level and the work process requirements,
- training level of IS users,
- level to which applied software is suitable to the work process,
- operation stability of the software applied and
- operation speed of the software applied.

Data were acquired by questionnaires from which 8 questions presented in the appendix of this paper were separated for the purposes of the research. Respondents were asked to indicate their subjective estimates of each item, according to the Likert scale - providing ratings from 1 to 5, whereas 1 stands for "absolutely disagree", while 5 stands for "fully agree".

The reliability of the questionnaire was determined by calculating Cronbach α factors for the entire questionnaire and for each question separately.

Multiple linear regression method is used to determine predictors of measuring performance and reliability of

regression model is determined by using analysis of variance.

One-way analysis of variance is used to explore impact of independent parameters on the dependent variable.

2.4 The Questionnaire

This section provides explanation of the questionnaire by elements. Acronyms of questionnaire items used in discussion are given in the following text next to the item in parentheses.

Items "accordance of the IT application level and the work process requirements" (ADEQAPP) and "every relevant workplace has a computer" (HAVECOMP)

Accordance of the IT application level and the work process requirements is included in the study bearing in mind the situation in Serbia, where often may be the case that appropriate investments in information systems can not be supported in unstable business environment.

Some needed investments in information systems may be suspended (or, even, not started) for various reasons, so the parameters ADEQAPP and HAVECOMP are likely to show some variation. The descriptive analysis findings show that the respondents estimate these elements rather high, which leads to the conclusion that computers, in spite of described reasons, are mostly adequately used in certified organizations' processes in Serbia (according to estimates of quality managers).

Item "training level of IS users" (TRAINING)

Link between training effectiveness and quality of the information system is quite logical. A study [1] reports that for effective implementation of IS adequate training is required. A study [8] considers this element as a dimension of quality within scale "characteristics of employees". The level of training for the IS is included in this study as one of the dimensions of information system quality because, according to the authors' experiences, it is often critical element in Serbia.

Item "level to which applied software is suitable to the work process" (APPLJOB)

In [1] the operationalization of information quality indicators includes the completeness, conciseness, benefit in daily jobs, simplicity, relevance for decision making and similar elements. Here they are combined into a single item. Taking into account that information is provided by applied software in the IS, the question is adequately reformulated.

In study [2] this dimension is not mentioned directly, but, by combining the dimensions of information quality "accuracy" and "completeness", as well as element of quality information system "integration" (referring directly to decision support), we can get a synthetic indicator "suitability of applications".

Item "operation stability of the software applied" (STAB)

In study [1], this element is treated as a dimension of the information system reliability. In [2], this element also appears as reliability.

Item "operation speed of the software applied" (SPEED)

Study [1] used request response time for operationalization of information quality, as well as authors did in [2], so this dimension is included in the research as relevant.

The operationalization of measuring organizational performance (MEASUREPERF and IMPROVE)

Part of the questionnaire which is related to measuring management system performance has two items:

- MEASUREPERF - "*Organization measures performance of all the processes*" is the questionnaire element included in the questionnaire with intention to extract respondents' estimates about to what extent there is a systematic approach in identifying "where the organization is" so that management could guide processes towards "where organization should be" and
- IMPROVE - "*The organization improves business processes to achieve better performance and maintain the process in line with the needs and objectives of the business*" is an element included in the questionnaire with intention to extract respondents' estimates on how the results of performance measurement are actually used for determining the course of leading and/or improving the process in organization.

Dependent variable of the study is, according to hypothesis H1, MEASUREPERF, but the information provided by the parameter IMPROVE is also important and have their role in the discussion.

Information system maintenance

An attempt was made to include elements regarding the maintenance of information systems in the study, but it was unsuccessful. The elements such as "effectiveness of reaction to IS failures", "communication with the IS administrator" and "administrators' reaction rate to failures" were not answered in a manner that would ensure their reliability. Still, the study [1], covers IS maintenance with a scale of 5 similar elements.

3. RESULTS

3.1 Questionnaire reliability

For the entire questionnaire Cronbach α is 0.8135. All issues are also reliable. Items and α factors are given in Table 1.

3.2 Descriptive statistics

Descriptive statistics of observed parameters is given in Table 2.

Table 1. Questionnaire items and Cronbach factors

Elements of the questionnaire and Cronbach α values	Acronym
In my organization the IT application level is in accordance with the work process requirements ($\alpha = 0.7847$)	ADEQAPP
In my organization every relevant workplace has a computer ($\alpha = 0.7987$)	HAVECOMP
In my organization training level of IS users is adequate ($\alpha = 0.7937$)	TRAINING
In my organization applied software is suitable to the work process ($\alpha = 0.7722$)	APPLJOB
In my organization the software applied operates stable enough ($\alpha = 0.7881$)	STAB
In my organization the software applied operates fast enough ($\alpha = 0.7870$)	SPEED
My organization measures process performance ($\alpha = 0.7985$)	MEASUREPERF
My organization improves work processes to gain better performance and maintain the process in line with the needs and objectives of the business ($\alpha = 0.8131$)	IMPROVE

Table 2. Descriptive statistics

Variable	N	N*	Mean	SE Mean	StDev
ADEQAPP	51	0	4.33	0.12	0.89
HAVECOMP	51	0	4.53	0.13	0.92
TRAINING	51	0	4.24	0.11	0.82
APPLJOB	47	4	4.49	0.11	0.72
STAB	47	4	4.26	0.1	0.71
SPEED	44	7	4.36	0.09	0.61
MEASUREPERF	51	0	4.04	0.13	0.89
IMPROVE	51	0	4.41	0.1	0.7

N* - number of respondents who did not provide estimates of an element

All the means of observed parameters' estimates are quite high (mean scores are above 4).

One of the worst estimated elements is the dependent variable APPLJOB - estimate on whether the organization measure performance of all processes (the lowest estimated parameter is SPEED).

The highest mean, but the largest dispersion of observed elements has the element HAVECOMP ("each relevant workplace has a computer").

The lowest dispersion has the estimate of speed of applications in the IS (SPEED).

3.3 Predictors of measuring performances

Regression model is reliable for the 95% confidence level (Table 3, $p < 0.05$).

Table 4 presents results of the linear regression analysis. The only parameter found to be a predictor of dependent variable (APPLJOB) is highlighted in the table 4. Given the criteria, this parameter cannot be formally considered a predictor for the 95% level of confidence (p should be less than 0.05), but we can say that the weak dependence of system performance measurement by the applied software suitability to the work process is found (p is just slightly higher than 0.05). Measured by quality managers' subjective estimates, among other investigated parameters, no other predictors of the dependent variable are determined.

According to the findings from Table 4, we can say that hypothesis H1 was not confirmed, with the exception of estimates of the suitability of the use of applications in the IS (APPLJOB). This parameter is regarded as one

of the main indicators of the quality of the information system.

The positive regression coefficient (0.43) indicates that quality managers' estimates of performance measurement system is closer to "I fully agree", as the estimate of suitability of applied software is higher. This finding is additionally confirmed by the analysis of variance.

Figure 1 shows interval diagram of the parameter APPLJOB (established predictor) by the dependent variable values. The diagram clearly illustrates determined regression direction. Confidence interval for APPLJOB values in 4 cases where respondents did not provide estimates is marked by asterisk.

3.4 Analysis of independent parameters

Number of employees

Statistically significant variations of the dependent variable by number of employees are not found (p -value for one way ANOVA is 0.45).

Maturity of the system

Using ANOVA we determined that dependent variable does not vary significantly by the maturity of management system (p -value is 0.37).

Type of ownership

Dependent variable does not vary significantly by the type of ownership as well (p -value is 0.21).

Based on the last three results, we can state that there is no reason to reject hypothesis H2 at confidence level of 95%.

Table 3. Analysis of regression model reliability

Source	DF	SS	MS	F	P
Regression	6	7.86	1.31	2.59	0.03
Residual Error	37	18.69	0.51		
Total	43	26.55			

Table 4. Regression analysis results - by observed parameters

Predictor	Coef	SE Coef	T	P
Constant	0.91	1.06	0.86	0.4
ADEQAPP	-0.14	0.22	-0.62	0.54
HAVECOMP	-0.09	0.21	-0.44	0.66
TRAINING	0.31	0.21	1.53	0.13
APPLJOB	0.43	0.22	1.96	0.06
STAB	0.19	0.21	0.91	0.37
SPEED	0.04	0.22	0.17	0.86

Table 5. One-way ANOVA: IMPROVE versus MEASUREPERF

Source	DF	SS	MS	F	P
MEASUREPERF	3	7.537	2.512	7.02	0.001
Error	47	16.816	0.358		
Total	50	24.353			

3.5 Additional analysis

Additionally, we applied linear correlation and ANOVA with parameters IMPROVE and MEASUREPERF. It is found that positive correlation exists between these parameters (Pearson correlation coefficient $r = 0.55$, p -value = 0.000, Figure 2).

Further, by using one-way ANOVA, we determined that significant variations of estimates IMPROVE by estimates MEASUREPERF exist (table 5). Interval diagram (figure 3) shows that higher estimates IMPROVE provide quality managers with higher estimates MEASUREPERF.

4. DISCUSSION

It turns out that, according to quality managers in Serbia, dimensions of information system quality generally do not affect measuring management system performance of an organization.

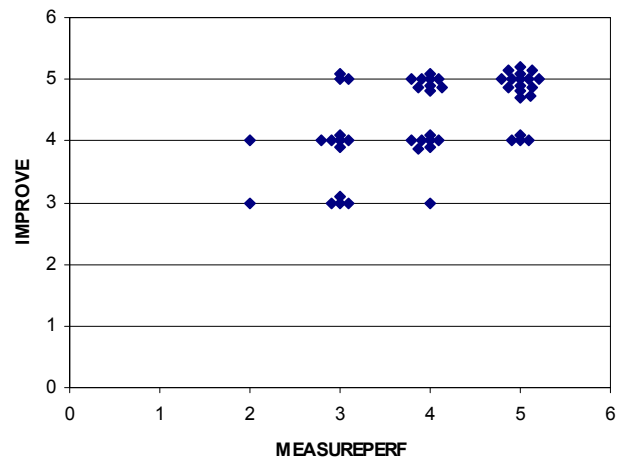


Figure 2. Scatter diagram IMPROVE by MEASUREPERF (group of ordered pairs are shown separately to provide the correct information of their number), $r = 0.51$, $p = 0.000$

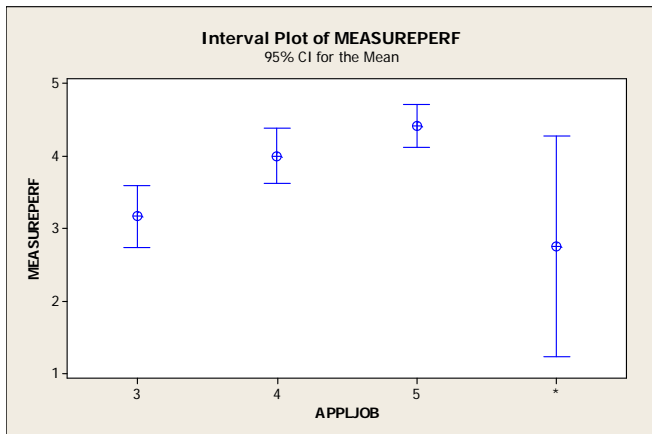


Figure 1. Interval diagram of MEASUREPERF versus APPLJOB

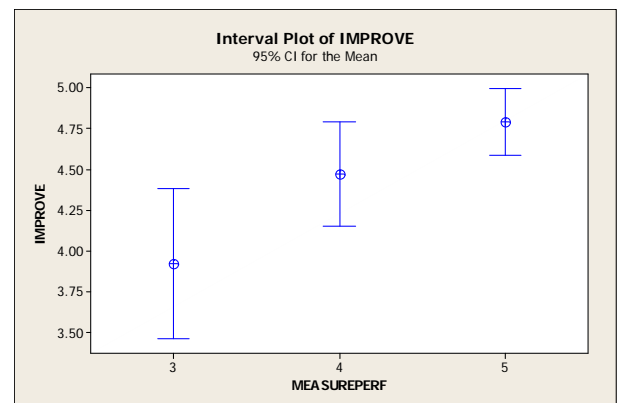


Figure 3. Interval diagram IMPROVE by MEASUREPERF (two cases in which respondents estimated MEASUREPERF with score 2 are omitted for clarity)

As referenced sources show, this finding is contrary to the experiences from the developed world.

Estimate of applied software suitability to job requirements was determined as the only predictor of measuring the performance of management system in organizations in Serbia among the observed parameters of IS quality. Taking into account additionally determined linear correlation between parameters IMPROVE and MEASUREPERF and finding that estimates IMPROVE vary by MEASUREPERF, we can say that organizations with higher estimates MEASUREPERF have more success in improving their processes. Thus, estimates of quality managers in Serbia say that IS quality improves the systematic application of improvement in organizations, but the relation seems insufficiently intensive.

According to authors' knowledge, applying ISO 9001 (and related standards) during a series of years made managers, in general, aware of the need for performance measurement and leading the process in accordance with measured values. Weak relation between the information systems quality and dependent variable in the research in Serbia today is likely a consequence of other circumstances.

More detailed insight of causes for such circumstances should be the subject of further detailed research. At this point it is possible to set some baseline assumptions. They should include: systematization of the ways information technology (IT) is used, the ways IS are maintained, and a willingness to invest in equipment, software and training for the use of IT. Management commitment to putting efforts in the development of performance monitoring systems and, generally, a stable, but flexible business system that could guarantee their survival and development also must be a subject to such research.

Most of the systems in Serbia today, as seen from authors' point of view, monitor only the basic (often exclusively financial) performance indicators.

In Serbia, a country in transition, where business conditions are far more difficult than in the developed world, the awareness of managers about the need for systematic building of business success based on research information, provided by both the business and the environment, is most likely poorly or not developed at all.

We could not claim, but also, we must not overlook the possibility, that the average manager in Serbia does not have enough knowledge and/or energy to apply a systematic approach to achieving business success. On the other hand, it is evident that business conditions do not provide enough stability, which is desirable for development of any effective strategy. In addition, it is necessary to take into account that some important information from the market in Serbia (for example, benchmarking analysis, market share and/or the similar analyses) is far harder to gain in Serbia, than in the developed world.

The experiences of the developed world in the field of systematic improvement of management systems for a

long time already have valid foundation as observed in a number of sources.

The management commitment is in [14] highlighted as one of the preconditions of success of quality management system.

Study [15] presents a tool called the Business Process Intelligence (BPI), which is made "to support business and IT users in managing process execution quality". This tool uses advanced methods for achieving process quality with encouraging results, as reported by authors. Study [16] gives an overview of advanced methodologies for optimizing the process of making business decisions and a description of various tools such as OLAP (online analytical processing), data-mining (the method of intensive search of data patterns aimed to provide information for decision making) or system decision support based on Internet technology (web-based decision support systems). The development of these systems was started back in the seventies of the last century. The application thereof is impossible without the use of IT. If it is true that referenced systems are not applied (or poorly applied) in Serbia, it would in a great deal clarify why in the developed world, unlike in Serbia, there is a stronger dependence on the parameters examined in this study.

A prerequisite for the application of BPI in business decision making is the management commitment to strategic leading of the organization and making it effective and more stable for a longer period. Experience tells us that this management component in Serbia is in a considerable extent (on average) suppressed by ruthless struggle for survival in uncertain environment and, probably to certain extent, by the lack of information about the nature and effectiveness of advanced BPI and the investments in the resources needed for its application.

Application of BPI in business decision making requires intensive data collection both from the process and the environment. On the other hand, it is conditioned by good knowledge of the interests and desires of the target user groups and other interested parties. Further, it requires knowledge about the selection and use of adequate systems in particular organization. We can say that researchers and experts in this field face a number of problems and a lot of work, but all this could be, according to experiences from the developed world, worth trying.

5. CONCLUSION

The study presents a research of the relationship between elements of quality information system and the application of measuring process performance, on a representative sample of organizations in Serbia with certified management system.

The study is based on subjective estimates of quality managers who are held competent to provide valid estimates of the basic dimensions of quality information system in their organization, the extent of performance measurement and use of results for improving their work processes.

According to findings from the referenced sources, in part of the world with a developed economy, there are strong relations between the parameters observed by the study.

According to findings of this study, in Serbia, only one of the considered dimensions of quality information systems of certified organizations is weakly related to measuring performance, while others do not show a statistically significant relationship to the dependent variable.

Significant variations of estimates on measuring process performance by observed objective parameters of organizations from the sample (number of employees, the nature of activities and type of ownership) were not found.

Absence of relationship between the observed parameters in Serbia was commented to the extent possible, and an attempt was made to partially clarify the observed differences between Serbia and the developed world. It was concluded that the subset of causes of this phenomenon could be found in poor (or lack of) use of advanced methods for supporting business decision making, based primarily on mathematical statistics, as the use of computer is a prerequisite for performing these methods. Confirming this claim, of course, would require a special research.

The findings and described implications are important for both researchers and professionals. Local experts and researchers (including experts from the scientific field these methods belong to, that is mathematical statistics) should provide more information about using advanced methods for decision making, while researchers and experts in the field of management should be more committed to find ways for implementing these methods for the benefit of businesses and society as a whole.

Launching the application of advanced methods for supporting business decision-making in the organization is not a simple type of improvement. Thus it is advisable first to plan the improvement carefully, and then carry through planned activities. For those who want to apply complex improvements, a range of useful sources are available in the field of project management (for example [17]).

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