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IMPACT OF REALIZED IMS SYSTEM IN PRODUCTION AND DISTRIBUTION OF WATER ON QUALITY OF LIFE

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Abstract: *In this paper from the assessments: the satisfaction of the citizens with the services PUC "Waterworks and Sewerage" and the total time interruption in water supply, appreciating their importance, we carried out the assessment of the implemented IMS PUC "Waterworks and Sewerage" in Kragujevac.*

Keywords: *quality of life, production of water, distribution of water, IMS*

1. Introduction

The development of societies has to follow everything that encourages development and that can contribute to the improvement of each member of society. The need for exchange of information has always existed in all spheres of human life and work. That need is particularly evident in the water systems in which important decisions are made based on obtained information, so that the accuracy and timeliness of information in this case is of great importance.

As an example of one of many such systems may be specified a production type company in which you need to enable a better exchange of information between the individual services within the company in order to achieve business goals. For management of production, control of products' quality, finance and accounting and other functions, you need data from the

manufacturing process. In the production process it is also necessary to handle certain pieces of information needed for its smooth functioning which come from other parts of the company.

In order that an organization can function, it must have all the things mentioned in the definition, i.e. it must operate as a unique business system (Filipović, 2008).

Integrated Management System is a management system that integrates all organizational systems and processes into one generic system, enabling the organization to function as a unit with united objectives (Arsovski et al., 2007; Arsovski, 2013). The paper presents the basic elements of a model for integration of standardized management systems, common requirements of the system as a framework for integration (PAS 99) including six common elements: policy, planning, implementation and operation, performance assessment, improvement and management review. Every management system has its own

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specific requirements, but these six elements are present in all of them and can be used as a basis for integration.

A set of performance indicators and system of objectives are built in the integrated management system PUC "Waterworks and Sewerage". They enabled the establishment of the performance within the system during the implementation phase of this system. The first analyses have indicated the significant benefits of development and implementation of integrated management system.

This paper presents the basic principles of this standard in terms of performance indicators and the practical realization of the PUC "Waterworks and Sewerage" in Kragujevac. It describes the identification of the key processes, as well as the system of performance indicators (Arsovski, 2006).

The paper describes the quality as a global phenomenon, its dimensions, the impact on the company management, the importance of quality as far as the market stability of the company is concerned, the quality aspect of business and social responsibility.

In a wide range of economic, social and political reasons, the quality of life is marked as the desired outcome of services in regular and special needs of education, welfare, social services (mainly for people with disabilities and the old) and more often the review of the policy of the public sector partnership at all levels.

The paper describes the development of the concept of quality of life, definitions, objective opposite the subjective approach to quality of life, as well as methods for measuring quality of life.

In order to accomplish the goal of the work, it was necessary to analyze the various aspects, especially quality, resilience and vulnerability, recycling, information technology, improving knowledge.

The aspect of quality is particularly analyzed in the works (Nestic et al., 2015; Arsovski et al., 2012; Stefanovic et al., 2015) through the analysis of the objectives, simulation,

optimization, management quality, selection of the suppliers and infrastructure.

The aspect of resilience and vulnerability is analyzed on the basis of papers (Tadic et al., 2014; Aleksić et al., 2014; Arsovski et al., 2015) through the analysis of organizational vulnerability and identifying the potential for improvement of the water supply resilience system.

The aspect of recycling is important because in the water supply system, through Environment Management System, it is necessary to provide recycling technology and deploy recycling centers away from the water supply system. To analyze these requirements are used works of Pavlović et al. (2011) and Gvozdenovic et al. (2012).

The aspects of the application of information technology and improving skills, as well as support implementation of IMS are analyzed on the basis of Bolognini et al. (2003) and Arsovski (2007).

In Arsovski et al. (2008) realized system of PUC "Waterworks and Sewerage" in Kragujevac is observed and the assessments are derived from estimates of the data of the total time interruption in water supply, which are considered as objective indicators and the satisfaction of citizens, which is considered as subjective indicator.

2. Realized system of IMS– PUC “Waterworks and sewerage”

Water is becoming an increasingly important resource and product. As far as the resources are concerned, it is required the rational spending and providing conditions to prevent its pollution. As a product, the water is produced in the process of collecting, processing and distribution to the consumer. In our country, it is entrusted to the public utilities.

Due to different requirements to be met by the water supply, integrated management systems (*IMS*) are increasingly used in this area.

Integrated Management System is a management system that integrates all organizational systems and processes into one generic system, enabling the organization to function as a unit with unified objectives.

There is no process in the organization which needs to be avoided and treated as unimportant (if it is unimportant then the justification for its existence should be re-examined). The processes that are well defined and well-run must meet the set objectives. With integrated management systems, objectives must be integrated, too. This is necessary to avoid a conflict in establishment of goals.

Regular supply of the necessary quantities of safe water is becoming increasingly important for the residents and organizations of water consumers. This requires that the system of management of water supply also designs and implements to integrate the requirements of quality (ISO 9001), environmental protection (ISO 14001), health and safety at work (ISO 18001), water safety (ISO 22000) and accreditation of laboratories (ISO 17020 / 17025).

Thanks to its business policy Public Utility Company "Waterworks and Sewerage" Kragujevac successfully provides:

- continuous production and distribution of necessary quantities of drinking water
- high level of quality and health safety of water
- collection, drainage and treatment of waste water
- maintenance of water and sewage network
- protection of the environment and
- the protection of employees' health and safety at work

The results that were achieved in more than a century have been examined in all relevant aspects of business management and confirmed by obtaining a certificate for the successful implementation of international standards (Arsovski, 2007; Karapetrović,

2007; Arsovski et al., 2008).

2.1. Identifying of the key processes

By using a top-down approach, starting from the established objectives of quality and critical factors of success, four key processes for achieving customer satisfaction are identified:

KP1: Production and distribution of water

KP2: Providing the quality and health safety of water

KP3: Collection, drainage and treatment of waste water

KP4: Support processes

These key processes are performed based on the following components of the macro process:

P1: Planning and management

P2: Water supply

P3: Development of capacity

P4: Processes of sewerage and treatment of waste water

P5: Resources maintenance

2.2. The system of performance indicators

The PUC "Waterworks and Sewerage" in Kragujevac has implemented and certified IMS, which consists of four management systems (in accordance with ISO 9001, ISO 14001, ISO 18001 and ISO 22000), and the accreditation of two laboratories (for testing water in accordance with ISO 17025 and calibration of the meter according to ISO 17020) is in the process, too. It required creating a system of goals at the level of organization, the objectives of the process, characteristics of the process and index of the performance.

3. Quality of life

3.1. Development of the quality of life concept

As an academic discipline quality of life appeared in 1970, and was confirmed and

examined in 1974 by the scientific journal Social Indicators Research. Another important academic publication is the Journal of Happiness Studies, a multidisciplinary journal that allows discussion on what are the two main starting points for the study of happiness: 1) the theoretical views of the good life, and 2) empirical research on subjective well-being. The International Association for Research Quality of Life (ISQOLS) serves as a forum for academic researchers working in this field, encouraging interdisciplinary research, methodological discussions and development (Kahn, 2004; Schalock, 2000; Schalock, 2004).

Searching the database for the period from 1974 to 2008, it was found that the quality of life in the year 1974 was mentioned only in 8 publications, in the year 1984 in 284 publications, in 1994 in 1209 publications, in 2003 in 3519 and 2008 in 66,592 scientific articles. Quality of life was processed as a central theme in 1974 in 2 studies, in 1984 in 93, in 1994 in 502, in 2003 in 1060 and in 2008 in 20355 studies.

In developed countries, nearly all areas of public policy and services are influenced by terms such as quality of life and well-being. Ager (2002) described the quality of life as "successful" "meme", a concept that is rapidly expanding as a response to favorable environmental conditions.

3.2. Definitions of the quality of life

Because of the way it is used, the term quality of life is multifaceted. Its common use in public life is very vague and it's based on the positive connotation of the term "quality". Contrary to the experts who focus more on the second meaning of the term "quality", to describe the main characteristics or essence of something that can be positive or negative. Considering the importance of the term and his "rhetorical power", Armstrong and Caldwell equal it with social, medical and technological progress. Keith and Schalock say that quality

of life can be used as a "sensitive concept that provides recommendations and instructions", as "social set", as "organizational concept" or "all of this together" as: "a systematic framework through which one can see the work directed to the improvement of the lives of individuals."

There is a very wide range of definitions and interpretations of quality of life – according to Schalock, over 100 of them. What should be noted is that the publication of the quality of life in the medical literature often do not define the concept of quality of life, and by the systematic review of 68 medical models of quality of life related to health, in the 16 of them, quality of life was not defined.

This common failure of defining what is measured and alternative giving definitions used anywhere without citing sources, undoubtedly leads to the confusion. Often researchers, avoiding a definition, focus on "approaches", or immediately discuss "measures" that indicate the type of the definition. Keith (2001) claims that it is not just avoidance, but the opinion of many researchers that quality of life cannot be precisely defined and that is why they often choose the study of different aspects and dimensions of quality of life instead of trying to give an explicit definition.

In a systematic review of the model of quality of life, Taillefer et al. (2006) identify three types shown in Table 1.

3.3. The objective opposite the subjective approach to quality of life

Early efforts for defining and measuring the quality of life use economic approaches or approaches based on objective social indicators. A study from 1970 showed that objective measuring of the life conditions takes into consideration the modest share of personal, subjective quality of life and/or well-being. Also, Cummins cites more studies from the early 70s onwards, which presented a personal level of satisfaction

with lives of individuals, regardless the objective scarcity of their environment. Studies of Andrews, Withey, Campbell and associates were crucial in the reorientation of quality of life research in the direction of subjective measurements. The widespread use of economic indicators as a measure of national quality of life began to divert the focus towards the subjective responses to the conditions of the environment. By accessing

social indicators, also called the "American," these studies adopted the concept of happiness, life satisfaction and well-being and tried to measure them according to the population level. Alternative hypotheses were in favor of the fact that the personal well-being was more related to personality or a predisposition than to the objective conditions of the environment (Taillefer et al., 2006; Cummins, 2005).

Table 1. Three types of model

Type model	description
conceptual model	Model which defines the dimensions and properties of the quality of life (little sophisticated type of model)
conceptual framework	Model that describes, explains and predicts the nature of the relationship between the elements or dimensions of quality of life.
conceptual model	The model includes the structure elements and their relationship in the context of a theory that explains them (the most sophisticated type of model).

Table 2. The basic dimensions of quality of life

Felce 1996.	Schalock 2000.	SZO 1995.	Hagerty 2001.	Cummins 1997.
psychology	psychology	Health	Social indicators	General population adult / student / intellect. disorders
6 size:	8 size:	6 size:	7 size:	7 size:
physical well-being	physical well-being	Corporal / physical well-being	health	health
materially prosperity	materially prosperity	The environment	materially prosperity	materially prosperity
social prosperity	affiliation community	social relations	The sense of belonging community	The sense of belonging community
productively prosperity			Jobs and production activity	Jobs and production activity
emotionally prosperity	emotionally prosperity	psychological prosperity	emotionally prosperity	emotionally prosperity
rights or Civic prosperity	rights			
	interpersonal relations	Level independence	Relationships with family and friends	Relationships with family and friends
	Personal development			
	Only-commitment	creed	Personal security	certainty

Many models include both objective and subjective domains of quality of life, because "the fundamental knowledge of subjective well-being requires knowledge of how the objective conditions affect human assessments of their own lives. Similarly, a complete knowledge of the objective indicators and how to choose them requires an understanding of human values and knowledge of the way objective indicators affect the experience of well-being. For these reasons, each discipline should borrow insight into the quality of life from other fields."

The debate about the relative importance of the subjective factors opposite the objective factors in determining quality of life continues so as the debate about the relationship between them. This has gained importance in public policy and discussions about national trust, in which is claimed that psychological factors (low self-esteem and self-esteem) can contribute many socio-economic problems (objective factors).

The subjective approach to the quality of life, in which personal experience or seeing one's own life are the main criteria remains the most valid for most researchers of the quality of life. This viewpoint is based on the ideal or the postmodern point of view that there is no objective "reality" outside of our subjective experience of the world. Then, the quality of life reflects the subjective values that an individual owns (Cummins, 2000; Diener and Suh, 1997).

3.4. Measuring quality of life

There are many different approaches to measuring quality of life. Of that he was "measured" depends on the definition of quality of life and what is measured. Depending on the object and purpose of the research measuring or assessing the quality of life can be quite different. Key problems associated with measuring the quality of life in connection with the discussions on the definitions of quality of life. Schalock gave useful methodological review (Table 3).

Table 3. Schalock, methodological review

system level	measuring the focus	Measurement strategy
Microsystems	The subjective nature of quality life ("personal assessment")	Measuring customer satisfaction Measuring happiness
Mezosistem	The objective nature of the quality of life ("functionalestimates ")	Scales (level of functioning) Observation of participants Scales (level of functioning) Observation of participants Self-determination and self-control Status roles (education, employment)
macro-system	External conditions ("Social indicators")	Standard of living The employment rate literacy rate mortality rate Lifespan

Although the subject of his researches is the assessment of the quality of life of people

with intellectual disabilities, principles which he emphasizes have a broader

significance. He supports a "pluralistic" methodological approach by pointing to the multidimensional nature of the quality of life with the claim that the different dimensions of the quality of life can best be measured by a variety of techniques. In this way the quality of life can be measured at the same time both from the objective and from the subjective point of view, including the subjective and objective evaluation of objective factors. The combination of multiple research approaches to the same object of observation, known as "triangulation", overcomes certain shortcomings and problems of independent research methods, giving better research results.

The quality of life of the population is based on the traditional "social indicators". This usually involves identifying indicators and measures related to a set of dimensions/domains, in order to calculate a single index of quality of life. These indicators can be both subjective and objective, drawn from socio-economic statistical data collected by the government or the census.

For the quality of life of individuals, including ethnographic studies and observation of behavior, the dominant approach of measuring are the instruments of self-evaluation i.e. questionnaires. This is the case for each of the two groups of Schalock's "measuring focus": personal and functional assessment.

Today there is a "whole industry" that has been measuring the quality of life, which has developed around 1275 different instruments for assessing the quality of life, especially in the last twenty years.

Certain degree of subjective assessment is included in the choice of the domain. So, the group of quality of life WHO was criticized for the choice of six domains i.e. for omission of the dimensions which were a part of the previous scale for assessing the quality of life, such as the material well-being or productivity/employment.

Alternative approach involves examining the attitudes of the individuals about the things that contribute their quality of life and the choice of "significant" domains of the quality of life through this process. This kind of approach of introducing subjects, Rapley described "emancipatory", contrary to "mainstream" researches of the quality of life, which impose models to the individuals in potentially "restraining" way.

As for the discussion on the subjective-objective quality of life, depending on the methodology, the subject of research is often: (a) a subjective perception of the external conditions of the quality of life (b) subjective perception in relation to objective indicators, (c) subjective perception and objective indicators combined within a single index of the quality of life or (d) only objective indicators of living conditions. It is a common view that social indicators represent good objective indicators, but there is a little about how individuals really "feel" their lives. Since the subjective indicators of the objective conditions of life are under the influence of personality traits and expectations of the individuals, we cannot get a real insight into their real quality of life. For these reasons, Diener and Suh (1997) support the use of a combination of social indicators and subjective well-being, saying that "these estimates represent an alternative projection of the social quality and it is unlikely to be hit by common errors in the measurement."

Similarly, Schalock (1996) claims that in the set of dimensions of the quality of life, both objective and subjective aspects are of great importance, i.e. each dimension has its own purpose and can be used whether it is subjective or objective assessment. The advantage of this approach is discarding of the former false dichotomy between objective and subjective quality of life.

Those who study life satisfaction should indicate that they are interested in studying the aspects of well-being or subjective quality of life. Those who question the

quality of life must provide evidence of subjective and objective indicators. If they don't establish it, they need to emphasize which aspect of the quality of life was investigated.

4. Quality of life and realized IMS system PUC "Waterworks and sewerage"- Kragujevac

4.1. The quality and life satisfaction

Expression of the quality has been present mainly at the level of the organization so far. Since the life is one and only, every man wants to perceive his own quality of life, which has a life satisfaction as one of components. Therefore, the starting point of research of life and quality of life must be individual estimates which then should be classified at higher national and regional level. According to the EQLS methodology, out of four components of life satisfaction (access to material resources, social support, belonging to the company, the workload), only the first is directly related to the economic sphere and thus linked to the quality at the level of organizational system. Other components are more social category, except partly for the fourth component which is related to the standard of living and to the need for additional engagements (Bolognini et al., 2003; PAS 99:2006).

According to the methodology of European Foundation for the Improvement of Living and Working Conditions life satisfaction is a part of the overall quality of life. It includes determinants shown in the lower part.

Measuring of life satisfaction is done on the basis of the questionnaire.

The paper presents the processed results of the answers to the questions of the citizens of Kragujevac:

- 1) **Sample size**
 - 100 subjects (citizens) in the municipality
- 2) **The sample stratification**
A – Sex

- male – 50% of the sample
- female– 50% of the sample

- 1) In the Questionnaire, to the question (Table 4):

Please, describe the area where you live now – I mean close to your house/apartment. Do you have a lot of reasons, many reasons, some reasons or you don't have reasons to complain about any of the following problems – Quality of water?

Table 4. Questionnaire answers

The answer:	number of responses	mark	Middle grade
Very many reasons	12	1	3,34
many reasons	20	2	
I do not know	1	3	
Some reasons	56	4	
No reason	11	5	

- 2) In the Questionnaire 2 to the question (Table 5):

Are you satisfied with the existing infrastructure – Drinking water?

Decide for one of the answers: satisfied, partly satisfied, dissatisfied.

Table 5. Questionnaire answers

The answer:	number of responses	mark	Middle grade
displeased	38	1	2,055
partially satisfied	59	2,5	
partially satisfied	5	4	

3) In the Questionnaire 3, to the question (Table 6):

What is the quality of water supply?

*A – For urban water supply decide for one of the answers: very good, tolerable, bad.
B – For other supply sources say which source you use: rural water supply, spring, well.*

Table 6. Questionnaire answers

The answer:	number of responses	mark	Middle grade
bad	46	1	1,54
bearable	8	2,5	
Good	7	4	
rural water supply	21		
source	1		
well	17		

4.2. Analysis of the total time interruption in water supply

Total time of interruptions in water supply (Table 7):
 < 250 min, mark 5
 250-320 min, mark 4
 320-390 min, mark 3
 390-460 min, mark 2
 >460 min, mark 1

Table 7. Total time of interruptions

years	Weather cancellation of water supply	mark
2008	2873 h 28 min	2
2009	2624 h 28 min	2
2010	2918 h 32 min	2
2011	4699 h 58 min	1
2012	5950 h 02 min	1
2013	3804 h 11 min	3
2014	3082 h 35 min	4
Middle grade		2

4.3. The impact of IMS on the quality of life in the field of drinking water

Established IMS affects the characteristics of the production and distribution of drinking water. It affects the quality of water in the following ways:

- by consequent use of procedures for production, control and distribution of drinking water and
- by continuous verification of quality and health safety of drinking water done by independent control laboratories.

IMS affects the infrastructure for the production and distribution of drinking water over:

- the maintaining of existing infrastructure,
- the development of new infrastructure
- the promoting of knowledge about the new technological solutions to the infrastructure.

IMS affects the water supply over:

- the procedures for the improvement of the accumulation,
- the procedures and realizations of making the rural water supply and approving the use of water sources,
- continuous monitoring and rapid detection of inconsistencies in water supply.

Total time of interruptions in water supply is relatively high (2.800-5.950h year) on certain water supply lines. It usually included up to 10% of the population, so that the equivalent time of interruption in the entire water supply was about 10 times less. From the moment of IMS establishing, downtime water supply as an indicator was rated with the grade 2, which is considered relatively low. Reason is the obsolescence of the water supply network and the problem of microorganisms growth in the accumulation (especially in 2011 and 2012), which lead to the interruptions in water supply.

Based on the above, the quality of water supply was rated from the aspect of the quality of life of residents who use water in everyday life (Figure 1).

According to the methodology for assessing the quality of life of residents, the impact of the water supply is not significantly enhanced because it represents up to 5% of the total assessment of the quality of life. However, it is often decisive because it affects the health of people (an additional 5%), running of production and utility activities (additional 5-10%), etc. Figure 2 shows the assessment of the quality of life of residents in the function of the impact of

IMS and the quality of life in the field of water supply.

Through estimated synergistic effect of water supply for increasing the intensity of use of the 25%, by using the simulation it was determined that the increase in QoL could be expected for 10%, which is a very significant amount.

In other words, through IMS the resilience of the water supply system can be affected and with a relatively small investment in the effectiveness of the IMS, a significant increase can be achieved.

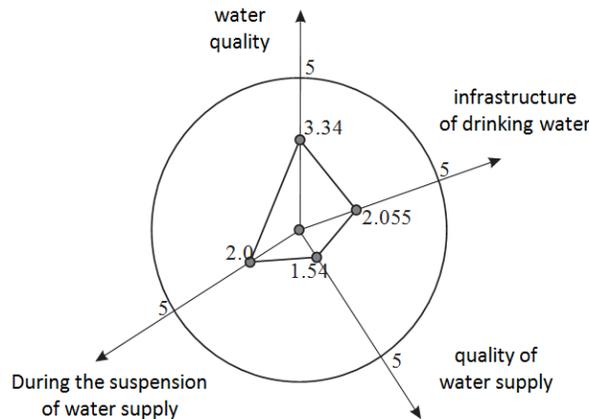


Figure 1. The quality of life in the function of the quality of water supply

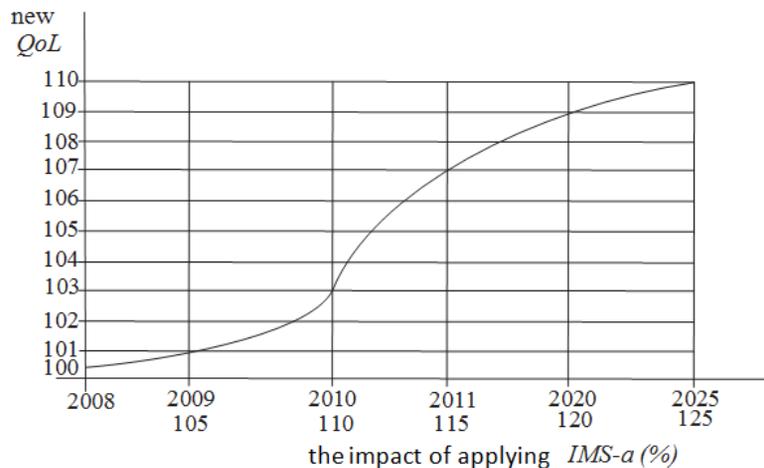


Figure 2. The effect of IMS usage on QoL

5. Conclusions

In this paper, by using the indicators for the quality objectives, the key processes and their related processes are presented with a more extensive point of view, and from their assessments, appreciating their significance, we concluded the evaluation of realized IMS PUC "Waterworks and Sewerage", Kragujevac.

Standards for management systems, as far as the quality is concerned, are standards of the ISO 9000 group which are expressed to help organizations of all types and sizes to implement and operate effective management systems with quality that facilitate mutual understanding in national and international trade.

PUC "Waterworks and Sewerage" realized, with its management, that the introducing a new way of thinking into the system management and market operations at the time when funding to the craft can only be found on the market, achieves exceptional savings through modernization of existing facilities and has a vision of expansion of the distribution network with the development of the city economy and population migration.

The integrated management system is very difficult for designing and implementation;

By using the indicators for the quality objectives, we can highlight the key processes and all their related processes with a more extensive point of view of quality;

The expected profit is more developed environment with reduced costs, better utilization of resources and increased satisfaction of customers;

Between the quality and life satisfaction there is a direct ambiguous relationship, life satisfaction emerges as the difference between expectations and fulfillments of basic needs, the overall sense of satisfaction with life includes life satisfaction in the narrow sense, happiness and alienation, by measuring satisfaction with life in the EU is indicated unevenness of the overall level of satisfaction with life and, in particular, the areas in which the satisfaction with life is presented.

By using the indicators for quality objectives, key processes and their related processes are presented with a more extensive point of view of quality.

From the assessments: citizens' satisfaction PUC "Water Supply and Sewerage" services and total time interruption of water supply, appreciating their importance, we carried out the assessment realized IMS PUC "Waterworks and Sewerage", Kragujevac.

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