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The Quality Metrics of Information Systems

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Abstract: *Information system is a special kind of products which is depend upon great number variables related to nature, conditions during implementation and organizational clime and culture. Because that quality metrics of information system (QMIS) has to reflect all previos aspects of information systems. In this paper are presented basic elements of QMIS, carracteristics of implementation and operation metrics for IS, team-management quality metrics for IS and organizational aspects of quality metrics. In second part of this paper are presented results of study of QMIS in area of MIS (Management IS).*

Keywords: *quality, metrics, Information system (IS).*

1. INTRODUCTION

Information system (IS) is product generated through proces of development and design. During this process IS manager has to recognise expectations, needs and request from potential or real customers (i.e. contractual obligations). In each phase of life cycle of IS (problem definition, feasibility study, system analysis, system design, system implementation, post implementation audit) is needed to included elements of quality metrics. At the end of this process, with appropriate quality metrics manager can check the achieving of overal goals or, using procedure supported with special kind of software, monitor each phase of this process [1, 2, 3, 4]. This concept is supported by great number of references related to holistic approach (i.e. 5). Autors analized relations between IS structure, performance and request of ISO 9001 standard [6, 7, 8, 9].

The main contribution for this subject commes from Zahedy [10]. Next contributions comme from papers related to B2B and e commerc applications [11, 12, 13, 14, 15] and e-learning [15, 16, 17].

Previos cited references is basic for understanding and modeling quality metries of IS. Autors selected appropooriate elements and analysed process of modeling of IS design and implementation from aspect of quality. Results of investigations are new quality metrics of IS proved by classes of Management Information Systems applied in Serbia.

2. QUALITY METRICS OF INFORMATION SYSTEMS

Between metric and measure is difference because a metric is combination of a measures designed for depicting an attribute of system or entity. Basic carracteristics of a good metric are:

- meaningful to customers
- containning organizational goals,
- simple, understandable, logical, and repeatable,
- unambiquosly defined,
- capable of showing a trend,
- economical in data collection,
- driving appropriate action,
- timely.

If we analyse of QMIS (Quality Metries of IS) very often we find wrong and traditional approach with concentartion only on quality of software.

However, almost all models of

software quality are traditionaly based on the quality assurance concept, in that quality metrics and tests are defined and performed at the end of software production. The new approach is to build quality aspects into design and implementation software products toward customers. Thus, quality metrics should be defined to capture the design as well the use of IS.

Many attributes are critical for QMIS, but we underline different aspects:

- responsibilities for satisfaction the customers needs,
- performance,
- service, and
- value.

During the process of analyse of quality metrics we find many aspects and impacts included and can focus on organization process, customer process, organization results and customer results (figure 1).

	processes	*results*
organization	▪ internal view ▪ design based ▪ leads to change and improvement ▪ vision oriented	▪ internal view ▪ implementation and operation based ▪ early warning signal ▪ value to the organization
customers	▪ external view ▪ design based ▪ leads to change and improvement ▪ customer oriented	▪ external view ▪ implementation and operation based ▪ early warning signal ▪ value to the organization

Figure 1. The Focus of QMIS

Using this theoretical view, in praxis we can find hibrid metries, Life Cycle metrics, metrics as Tooll for Improvement and change.

3. IMPLEMENTATION AND OPERATION METRICS FOR INFORMATION SYSTEMS

Overal Objective of information System is zero defects and satisfying of customers. Both sub objectives is very well investigated in literature in area of quality, performance measurement, six sigma etc. [18, 19, 20, 21].

Zero-defect of IS started with six-sigma initiative by Motorola 1987, focused on reducing defects to zero. This can be accomplished during design process and using appropriate methods and tools. This concept include Taguchi approach in reducing variability, as the mean (or expected value) and standard deviation of quality metrics are very important in tracking the quality of system. Each metric value should be computed as the number of standard deviation that is above or below the mean (or expected value). We expect to see only 0.27 percent of metric values to fall outside three sigmas each side of the mean.

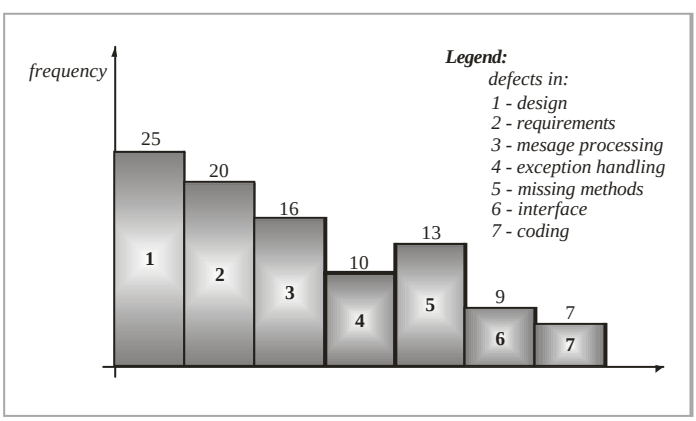

Figure 2. Pareto chart of Error categories in analyzed sample of IS

System implementation metrics is related to errors, faults, defects and rework of IS components by baying or making IS.
We can define fault metrics based on:

- Error and defect categorization (figure 2 for analized IS in Serbia).

As elements of quality often could us carracteristics:

- time between two failures,
- number of failures in a test period,
- number of errors in an implementation phase.
- number of defects in on implementation phase
- number of newly discovered errors or defects,
- weighted average of newly discovered errors or defects with using procedure:
  1. categorize errors or defects into categories,
  2. assign a severity rating to each categiry,
  3. for each time interval, collect data on the occurence of errors or defects in each category,
  4. compute the weighted average of the newly discovered errors, per unit of time or per module.
- average severity of errors or defects,
- average time interval for fixing on error or defect.

According methodology of Center for Quality in Kragujevac, we use combination weighted average of newly discovered errors with:

1. time between two failures,
2. number of failures in a test period,
3. number of defects in on implementation phase and
4. averge time interval for fixing on error or defect.

Software reliability metrics is related to partial or full software development. Therefore, it is important to investigate software quality metrics based on:

- counting the number of errors in a test interval and
- measurement the lenght of time between the occurence of two errors.

Most of software reliabity metrics are concerned with testing the software reliability after the design phase and coding. As elements used in software reliability metrics very frequently we can find different factors of: (1) inputs, (2) outputs, (3) logical files, (4) inquires and (5) interfaces.

System operation metrics has the following dimensions:

- timeliness,
- efficiency,
- consistency,
- continuity,
- correctness.

Timeliness of IS reflects the delivery of information to customers when they need it, using:

- time interval between two consecutive updates,
- time it takes for information to become available to users between two consecutive updates
- access time.

Efficiency of IS is measured using carracteristies:

- time it takes for a customer to access a needed information,
- number of commands, menus, or icons the user must know or access in order to get the needed information,
- easeness of updating and manipulating the IS,
- time it takes for a nouce user to learn to use the IS.

Consistency of IS services reflects whether the IS performance is predictable for customers.
Continuity of IS reflects uninterrupted nature of its service using availability performance.
Correctness of IS's service is to ensure that it deliveres the correct information to the customer using carracteristics:

- number of defects,
- lengh of time taken to fix a reported defect,
- number of defects remaing to be fixed,
- number of defects caused by fixing other defects.

4. RESULTS OF INVESTIGATION OF QUALITY OF IS

For analysis we discovered MIS in different areas and size of enterprizes (Table 1) with in total 46 analysed enterprizes

Table 1. Strucure of sample

MIS for:	Size of enterprizes (number of employment)					Total
	< 10	10-50	50-100	100-250	> 250	
number of enterprizes	10	10	10	10	6	46
▪ *Acconting and finance*	10	10	10	10	6	46
▪ *Purchasing, inventory and production*	2	3	4	5	5	19
▪ *Marketing and sales*	1	2	3	4	5	15
▪ *Technical (maintenance, CAD/CAM, CAPP, CAQ)*	1	2	3	4	5	15
▪ *Integrated solution*	-	1	2	3	4	10

Analysed enterprizes came from different areas (industry, food production, service, public sector), which is presented in table 2.

Table 2.

area	Size of enterprizes					Total
	< 10	10-50	50-100	100-250	> 250	
Industry	1	3	2	3	3	12
Food production	2	3	2	2	1	10
Service	2	2	2	2	-	8
Construction	-	1	2	2	1	6
Public sector	1	-	1	1	1	4
Tourizam	4	1	1	-	-	6
Total	10	10	10	10	6	46

Quality metrics of implemented IS is measured according methodology of Quality Center (Kragujevac) developed by authors (figure 3).

Table 3. Quality metrics

number of errors in impl. phase / year	*time between two failures / year*	*average time for fixing an error*	*software reliability*	*timelines*	*efficiency*	*estimation*
< 5	> 360 days	< 1 min.	10	10	10	10
5-10	301-360 days	1-60 min.	9	9	9	9
10-50	101-300 days	1-2 hours.	8	8	8	8
50-100	50-100 days	2-4 hours.	7	7	7	7
100-200	10-50 days	4-8 hours.	6	6	6	6
200-500	5-10 days	1-2 days.	5	5	5	5
500-1000	1-5 days	2-5 days	4	4	4	4
1000-2000	1-8 hours	5-10 days	3	3	3	3
2000-5000	1-60 min.	10-50 days	2	2	2	2
> 5000	< 1 min.	> 50 days	1	1	1	1
0.15	0.2	0.15	0.2	0.2	0.1	weight

Results of investigation of quality of IS for:

(1) accounting and finance,
(2) purchasing, inventory and production,
(3) marketing and sales,
(4) technical support and
(5) integrated solution are presented in figures 3 of new products and knowledge improving.

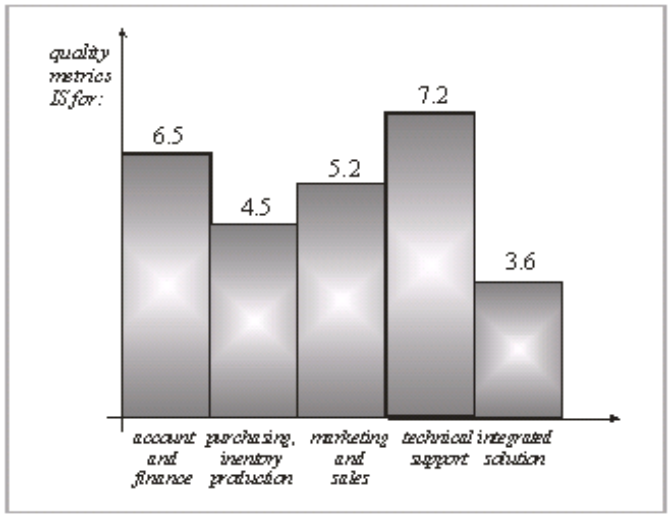

Figure 3. Quality metrics of different kind of IS

If we analyse distribution of IS quality metrics on different size of enterprizes (figure 4) we could conlude that the great values has medium enterprizes. Reason for this conclusion is old IS in big enterprizes and partialy implementation and dominantly selfdesign and maintenance of IS for smaller enterprizes.

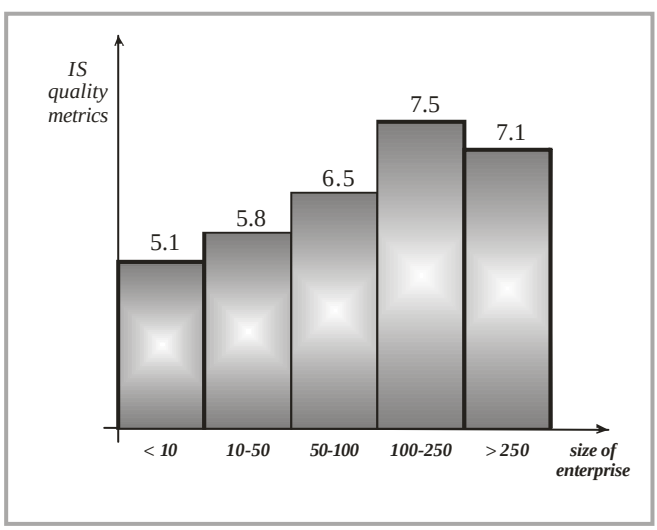

Figure 4. Distribution of IS quality metrics

If we analyse distribution of IS quality metrics for different sectors, we can conlude that the highest value of quality is in area of tourizam and public sector because those processes are mostly high structured and cover with standard and relative cheap and friendly use software solutions.

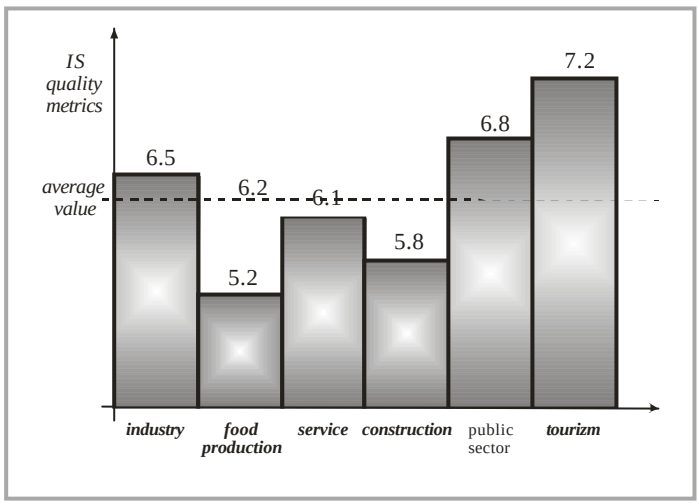

Figure 5. IS quality metrics for different areas

Each of elements of quality metrics in depended on varios variables from input (new request and ICT), proces of design and implementation and outputs (maintenance, skills and contracts).

If we account in analysis aspects of profit and investment in ICT, we could conclude that our basic asumption about impact of QMIS on quality is very high (figure 6).

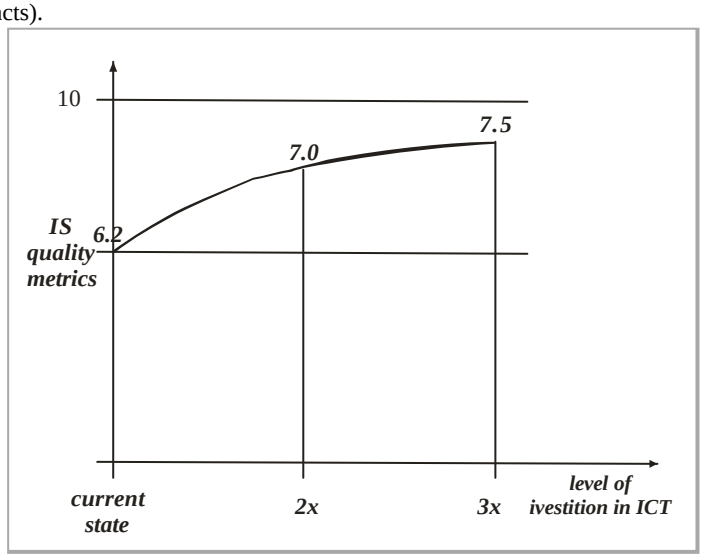

Figure 6. Expected impact of level of investition on QMIS

Reason for this trend is because QMIS depends, beside that, on carracteristics and knowledge, motivation and skills of employess.

5. CONCLUSION

In this paper we developed and analized quality metrics problem related to information systems. Based on results of investigation, we can conclude that:

- quality metrics of IS depends on size of enterprizes, areas of working, covering processes etc.
- designed quality metrics of IS compromises the high influenced carracteristics,
- the high value of QMIS is in tehnological IS (for technical support) because using of standardized CAD/CAM and other software products and big technical skils of users.
- the high value of QMIS is in medium enterprizes because it has optimal balance between skills, technology innovation and maintannace efforts.
- the high value of QMIS is in touriz, because in this area is dominantly used standard software products.
- with increasing of investition in ICT we can expact significant increase of value of QMIS.
- with simulatenosly improvement of IS and supported processes, exspectialy management of those process, we could expect great increase of quality of life.

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