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The Management of the Citizen Oriented Applications

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Abstract. *The context of the knowledge based society is presented. The new user requirements in the context of the new society are analyzed. Basic concepts regarding the citizen oriented applications are presented. Issues specific to the citizen oriented applications are presented. The development cycle of the citizen oriented applications is analyzed. The particular elements for developing citizen oriented applications are described. The quality concept for the citizen oriented applications is defined. Quality characteristics and the costs of quality are defined and analyzed. A system of indicators for the quantification of the quality of the citizen oriented applications is developed. Ways of increasing the quality of the applications are analyzed. Issues as improving the users' training level, implementing new development techniques, advanced testing techniques and the requirement of audit are approached. The concept of optimization is defined. Optimum criteria are defined and analyzed. Ways of optimizing applications are described. Security requirements are enumerated and described. The particularities of the security requirements for the citizen oriented applications are analyzed. Measures for ensuring the security of the citizen oriented applications are described. A citizen oriented application for the analysis of the structured entities is developed. The application collects data regarding the behavior of the users. The collected data are used for verifying the hypotheses regarding the quality characteristics if the citizen oriented informatics applications.*

Keywords: citizen; application; knowledge; development; design; development cycle; quality; indicators; security; optimization; management.

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1. Knowledge based society

Knowledge based society assumes the reorientation of the processes from the main valuing of the natural resources, the human factor and the informatics technologies to the valuing of knowledge.

Trends in the knowledge based society are:

- the appearance of knowledge workers; knowledge workers represent a new category of work force; these are persons that can interpret data from a certain domain very well (Huang, 2009, pp. 430-438); as they are very well prepared, they can find very good solutions for problems in a very short time;
- the development of the database technologies; in the context of obtaining various data both in structure and source, it is necessary the development of the database technologies to facilitate both the data storing and, mainly, the real time selections on complex criteria (Qinglin, Ming, 2009, pp. 439-442);
- the development of citizen oriented applications;
- online payments; the online payments systems have developed very much as the possibility of paying regardless the location is a necessity for virtual stores, companies and banks;
- the orientation of services towards the online form; many companies make the transformation of real processes in virtual processes.

The problem solving process in the knowledge based society is very complex and it assumes both the use of computing and communications technique and, mainly, of the previous gathered knowledge. The new approach in the problem solving process implies:

- the detailed analysis of the context assumes considering all the action possibilities on the studied problem;
- use of modern technology assumes adopting new instruments, techniques, methods for solving problems;
- making simulations on the basis of historical data is very useful for determining the causes that lead to certain problems and their effects;
- the project management is a very important activity for the good ongoing of the activities;
- consulting the domain specialists is an activity that brings many essential information for the problem solving process;
- automation of the processes is necessary for minimizing the time necessary for the problem solving;
- high quality results are the aim of every problematic situation;
- the low consumption of resources is an aim that can’t always be reached.

Figure 1. *Citizens' requirements*

The rapid evolution of technology and the approaching mode of events implies the appearance of new standards. The new society also leads to the increase of the users' requirements regarding the citizen oriented applications. Figure 1 highlights the users' requirements in the knowledge based society.

2. Citizen oriented informatics applications

In the context of the knowledge based society and of higher citizen requirements the appearance of a new category of informatics applications is necessary. The citizen orientated applications bring a new orientation as the citizen is considered to be the central element. These are different by the classic applications through:

- these are developed to solve the problems of the citizens, not the problems of the organization for which are developed;
- the target group is very large and very divers being formed by all the citizens;
- the applications are always available online;

- the citizen oriented applications aren't dependent on the hardware or software platform;
- the cost of use is very low or null;
- the quality requirements are much more strict than for traditional applications;
- localization assumes having the dialog with the user in his own language;
- the use of the applications doesn't assume previous training of the users (Yoon, 2009, pp. 471-476);
- are very often updated to reflect the changes in the environment;
- adaptation to offer the citizens a greater degree of satisfaction.

The structure of the citizen oriented informatics applications differ on the offered functionality and the domain they are created for. The citizen oriented informatics applications are with:

- simple linear structure; these are applications that, for problem solving, assume the following of a number of steps, in a preset order, without the possibility to go back to a previous step; the first step of the sequence starts up the processing and the last one returns the results for another application; for an informing application, the information is structured in a logic sequence of the steps that must be followed;
- linear structure and simple links between components; these assume the possibility of going back to the previous steps; these are applications for which the possibility of modifying data from the previous steps or repeating them is a must; for the applications with a high number of steps is inacceptable for the user to redo all the steps just because he made something wrong in the end;
- linear structure and multiple links; assumes the existence of links between components and the navigation is made between any of the connected components respecting limitations imposed for the correct functioning of the application; the navigation towards a step is not allowed without the fulfillment of the prerequisites; for the informing applications of this type, the navigation has no restrictions beside the logical links;
- tree structure and simple links; these are applications for which from a step the user can move in many directions; the simple links between modules allow the advancement only on vertical as the user is going away from the tree root; these type of applications is suitable for showing information on the basis of selection criteria;
- tree structure and double links; these assume the existence of bidirectional links between the components to browse the tree structure

both top-bottom and bottom-top; double links ensure the possibility to go back to previous steps;

- tree structure and multiple links; the pass from a component to another is made only in the limit of the good functioning given by the logic of the processing which the applications make; the tree structure with multiple links is the most complex of them all; this allows the development of complex citizen oriented applications.

The applications for virtual campus training must satisfy the requirements of the persons that access the educational system. For this, these must be flexible, maintenance free, secure, accessible, platform free, without additional costs, always available, adaptable.

Considering the very dynamic character of the virtual campus training domain, the requirements of the users quickly change and the applications, in order to be competitive, must evolve to fulfill them.

E-commerce is a very popular form of commerce as it has some clear advantages on the traditional commerce:

- no more stocks; virtual stores don't have stocks, or, if they do, these are very small (Harrison-Walker, 2001, pp. 139-172);
- geographic borders are eliminated;
- very low running costs;
- users' comfort;
- automation.

The e-governing applications are used in the relation of the state with the citizens for solving different situations in which they are partners (Ong, Wang, 2009, pp. 498-504). Issue of certificates and forms is made automatically. The e-voting applications are also very used in the e-governing process. These must be accessible from as many geographical points as possible.

Informing applications are those that guide the users to obtain information regarding a certain domain, state, process, object, phenomena. This type of application must be characterized by a clear structure allowing the user to reach, in as few steps as possible, to the desired result. The informing applications must not have using costs.

3. The development cycle of the citizen oriented applications

The distributed informatics applications are the result of a complex process that includes steps characterized by (Ivan et al., 2009): specific objectives in each of them, input elements, activities, resources (Bjørnson, Dingsøyr, 2008, pp. 1055-1068), techniques, methods, technologies, results.

The steps of the development cycle of the citizen oriented informatics applications differ when compared with the same steps of the classical applications because the focus is on the citizen orientation as the application must reflect the needs and preferences of the citizens.

Problem definition step assumes specialists with high experience in the knowledge of the theoretical aspects and also, very important, of the practical ones, from the domains with which the application interacts. Defining the problem means specifying data input, building formulas and models, identifying algorithms for the computing of indicators, expression evaluation, optimization, estimation, subset extraction, graphical representation and comparing of the aggregated values and the establishing of the form of representation of the final results that are, actually, the most important for satisfying the requests of those for whom the application was built.

Establishing the target group is the step in which the categories of persons that interact with the application for problem solving is set and the number of individuals is estimated.

The study of the target group assumes, in addition to the knowledge of their physical and intellectual traits, the knowledge of their experience in the work with other applications. According to this experience, the new application will try to integrate as many elements from the interface of the most used applications as possible so that the users will already be used with the comportment of those components.

Specifications elaboration is the step that assumes the existence of specialists of high performance with rich experience because the specifications must be (Liu, 2009, pp. 1565-1572) exact, complete, correct, deterministic.

Project building is the step in which experienced specialists in results interpreting and code elaboration start identifying processing functions, setting modules and their links, defining data structures and storing format, building matrixes of initial data – modules and final results – modules, establishing software and hardware necessary resources, estimating the workforce, elaborating a calendar specific to the development of the application.

A competent team has the capacity of associating the exact resource requirements to the application as the whole development process assumes allocation and leveling of resources.

Code elaboration is an activity through which a project is materialized and competed by developers with great experience in the chosen technologies, which possess the capacity of taking information from specifications so that the written lines of code represent standalone products whose quality is measured exactly.

It is preferable that the specifications contain enough programming elements, as operands definitions, so that the programmers take them automatically without inserting variations from a definition to other.

Server loading is preceded by an analysis made by a small group of specialists of the developing team. These have a complete image of the distributed application and the technologies it has incorporated. In this step are created the conditions for the activation of the components from the tree associated to the application.

Technical testing is preceded by autotesting. This means that the product already fulfills the requirements from the specifications (Pocatilu, 2004). Starting from the test datasets from the specifications, the behavior of the application is observed. The differences between what should have been obtained and what is obtained are signaled. The technical testing imposes the realization of all modifications in applications to fulfill the requirements from the specifications.

Sample testing assumes the establishment of the persons that, with specialized assistance, solve real problems using the distributed application. Building the sample is essential as the set of problems the application is tested with depends on it.

Documentation elaboration is an activity that is, erroneous, left for the end of the development cycle by the majority of the development team members. The documentation must be built simultaneously with the development process even if that is not the final form of it (Vinz, Etzkorn, 2008, pp. 813-825).

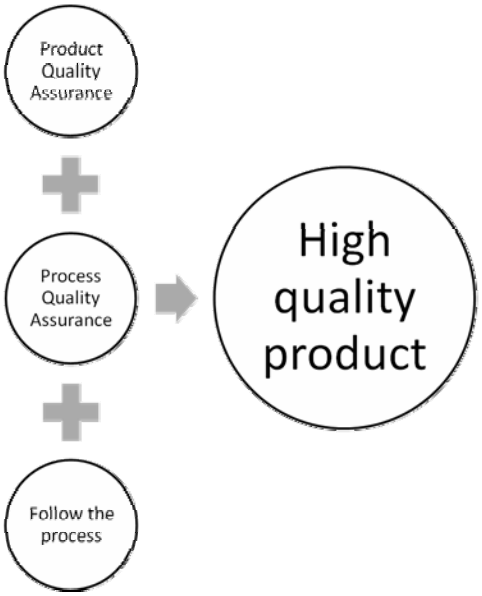

Figure 2. *Ensuring quality in the development process*

Implementation assumes the installation of the application on the client's server and the configuring for optimum functioning. The application server must support all the technologies that the citizen oriented application implements and offer enough resources to that the users don't wait for the results.

Maintenance is the process of updating the citizen oriented applications to reflect the changes from the economic, social and legislative environment and also fixing the defects that were discovered after the release. The modularity of

the application facilitates the updating process as the team members work in parallel on the modules leading to striking fast updates.

Software reengineering assumes the redefining of the application's objective so that it leads to increases of quality and performance, but the new objective is not totally different from the original one. The reengineering process takes place when the maintenance costs are very high or when the application can't solve a big part of users' requirements. Software reengineering affects all the components or only a part of them.

Removal from use is a rare process as many applications don't pass the maintenance and reengineering processes. Removal from usage is caused by the disappearance of the problem, very high maintenance costs, big difference between the features of the application and the users' requirements.

Figure 2 highlights the process of ensuring the quality of the development cycle of the software products.

Computer assisted development is very important for the software development companies. The software products for assisted development ensure automated reporting of actions and states leading to the creation of a central repository with all the situations that appeared during the projects the company carried on. The use of the central repository in solving the new situations, similar to the anterior ones, leads to the reduction of time for finding solutions. There are many informatics solutions for the automated management of the central information repository. A very important category of events for the developers is the central defect repository and their management. For very large projects the use of dedicated software for the management of defects is needed. Instruments like IBM ClearQuest or Bugzilla realize the automated management of defects. These go through different stages that represent the progress they have in the fixing process. These automated systems realize important time reductions as the testing process is one of the longest in the development cycle of applications. The defects can be reported many times, but using an automated system this thing is immediately detected and the defect is solved. In cases of similar defects the software highlights this thing and the already found solutions can be adapted to the new problem. Also, on the basis of this data repository simulations are made to forecast costs, risks, durations with immediate application in the company's new projects.

4. Quality characteristics system

For the citizen oriented applications the quality is an aggregated indicator of certain characteristics. The considered characteristics for the measurement of the quality depend on the correlation with the satisfaction of the final users.

There are characteristics that don't influence in a significant way the user experience.

Taking into account that the citizen oriented informatics applications mean resource allocation and work independent on owner and developer, these must have the quality characteristics from Figure 3 (Wu, 2009, pp. 1328-1332).

Figure 3. *Quality characteristics system*

The quality level reflects the measure in which these characteristics fulfill the users' requirements (Grigoroudis et al., 2008, pp. 1346-1357).

To get these characteristics to high levels, ensuring by this a high quality level, it is necessary to allocate resources. As the maximization of all characteristics leads to very high costs, usually, the minimum quality level of informatics applications is ensured through different levels of the aggregated characteristics.

For users the quality of the application must reach certain minimum levels. These minimum levels are also applicable for each characteristic. If the quality levels of characteristics don't reach the minimum values or the aggregated value doesn't reach its minimum value, then the users find different applications that fulfill the quality characteristics to solve their problems.

5. Quality metrics

To be able to make a hierarchy for citizen oriented informatics applications it is necessary to define some indicators that measure the quality characteristics (Ivan et al., 2008).

The indicators have three properties (Pakes, 2008, pp. 463-470):

- sensitivity;
- non catastrophic;
- non compensatory.

The estimation of the quality characteristics levels by using indicators is very important because it enables a comparison between applications and sets an evaluation system for these (Ivan et al., 2008). The calculus of the quality indicators during the development of the informatics applications reveals the deficiencies and allows their fixing with low costs. The citizen oriented informatics applications ensure automated data recording regarding the users' behavior. The information are recorded at preset time intervals or at the moment the users access nodes of the tree structure of application. On the basis of these data indicators regarding problem solving duration are calculated.

The medium duration for solving the step *i* from the problem is given by the formula:

$$TMS_i = \frac{\sum_j^n t_{ij}}{n}$$

where:

TMS_i - medium duration for solving step *I;*
t_{ij} - solving time for step *i* by user *j;*
n - total number of recorded users.

The indicator is important as it reveals which are the steps in the solving cycle that the users find hard to use.

For the citizen oriented informatics applications there are very important issues regarding:

- initial data characteristics; data correctness is a very important aspect and a module for validating the input data must be implemented by the application thus ensuring the correctness of the processing results; data completeness is also a very important characteristic; the correctness and completeness indicators are given by the formulas:

$$I_{cr} = \frac{NDEC}{NDET}$$

$$I_{cm} = \frac{NDEF}{NDEN}$$

where:

NDEC - the number of correct elementary data;
NDET - the total number of elementary data;
NDEF - the number of given elementary data;
NDEN - the number of necessary elementary data.

Taking into consideration that both the correctness and completeness of input data are of the same importance, the aggregated quality indicator for the input data is given by the formula:

$$I_{ACDI} = \frac{I_{cr} + I_{cm}}{2}$$

The closer the indicator value is to 1, the higher the input data quality is.

- characteristics of software applications; these are quantified by defining indicators regarding the correctness, completeness, reliability and portability.

The correctness indicator for applications is given by the formula:

$$I_{CRA} = \frac{NRCC}{NRTC} \times 100$$

where:

NRCC – the number of cases for which the application returned the correct results for the test datasets;
NRTC – the total number of test datasets used for the testing of the application.

The obtained indicator is given as a percent value; any application for which the value of the indicator is less than 100% must be rejected; the correctness degree of the citizen oriented informatics applications must be 100%.

The completeness indicator for applications is given by the formula:

$$I_{CMA} = \frac{NRSI}{NRSP} \times 100$$

where:

NRSI – the number of processing situations solved by the application;
NRSP – the total number of possible processing situations.

As in the case of the correctness indicator, citizen oriented informatics applications must be characterized by a degree of completeness of 100%; it is unacceptable that a citizen oriented informatics application doesn't implement all the processing situations the users can meet with.

The reliability indicator is defined by the formula:

$$I_{FA} = (1 - \frac{NCD}{NTC}) \times PMO - PEO$$

where:

NCD – the number of defect computers in the network the application runs in;
NTC – the total number of computers from the network the application runs in;

PMO – the maximum performance obtained in the conditions when NCD=0; it can be measured as necessary time for a processing unit or as number of processing units made in a time unit;
PEO – the effective performance for the considered NCD.

The indicator expresses the additional time or processing losses caused by the defection of a number of computers in the network; the closer to 0 the value of the indicator is, the more reliable the application is being less sensitive to the defection of the computers from the network;

The portability indicator is given by the formula:

$$I_{PA} = \frac{NPR}{NPC}$$

where:

NPR – the number of platforms the application runs on;
NPC – the number of platforms considered for the calculus of the indicator; to calculate a relevant indicator, the number of the considered platforms must cover over 98% of the target group.

If the value of the indicator is in the interval [0.78; 0.92] the covering degree of the platforms is good and the application is good. If the value is found in the interval [0.92;1] the covering degree is very high and the application is very good. For values that are not in these intervals the covering degree of the platforms is low and the application must be developed further to run on more platforms.

Let us consider the set *P={Windows, Linux, Solaris, BeOS, Mac OS}* made up by the platforms that cover more than 98% of the users' computing platforms. For the citizen oriented application for the analysis of the structured entities available online at the address www.vintilabogdan.ro the portability indicator is calculated on the basis of the data from Table 1.

Table 1

Platforms supported by the application for the analysis of the structured entities

Platform	Windows	Linux	Solaris	BeOS	Mac OS
Support	x	x	x	x	x

The value of the indicator is:

$$I_{PA} = \frac{NPR}{NPC} = \frac{5}{5} = 1$$

The value of 1 of the portability indicator shows that the application can be accessed by all users regardless the platform they use. The maximum value of the indicator allows no improvements for the application. If its value were lower than 0.78, the application should have been improved in order to support new platforms that increase the degree of user platform coverage.

- characteristics of the results defined through completeness, clarity and precision; for each of these characteristics quantifying indicators are defined;
- citizens' characteristics; the belonging of the users to the target group and the degree of satisfaction of the users are two of the most important characteristics.

The set of risks $R=\{r_1, r_2, ..., r_n\}$ is considered. Each risk from the R set has associated a probability of occurrence. The probabilities are defined in set $P=\{p_1, p_2, ..., p_n\}$. Also, each risk has associated a cost from the set of costs $C=\{c_1, c_2, ..., c_n\}$. In this context the priority of solving the risks is given by the formula:

$$RS = \min_{i=1,n}(\frac{p_i}{c_i})$$

where:

RS - the risk selected for solving from the existent set of risks;
p_i - the occurrence probability of the risk *I;*
c_i - the solving cost of the risk *i.*

To be able to create hierarchies and comparisons between the citizen oriented informatics applications it is necessary to use an aggregated indicator at the level of the informatics application that aggregates the other aggregated indicators. This indicator must reflect the importance degree of each partial indicator. For this, the aggregated indicator uses weights.

6. Ways of increasing the quality of the citizen oriented applications

The increasing of the quality level of the citizen oriented applications is made through the close analysis of the applications in current use, the identifying of defects and their fixing, fulfilling additional users' requirements, integration of modern technologies.

Although the citizen oriented informatics applications don't have as prerequisite the users' previous training, their experience with the application is greatly improved by it. Users' training for the use of the application must be logical, general and easy. The training process must be interactive and ensure the setting of elementary knowledge regarding the use of the application. Through the training process the users get new abilities (Krause et al., 2009, pp. 158-170).

The modern software development techniques are high performance instruments that shorten the time needed for developing an application and increase its quality level. Experienced developers benefit at the maximum of the possibility to use these instruments. Also, their use increase the value of the development team members.

To ensure the correct functioning of the informatics application, it is necessary that it is tested a long time to identify and fix the defects (Cai et al., 2008, pp. 1406-1429). Automated testing uses databases with datasets that are automated checked against the application and thus there are covered all the paths of the application with many test values (Cai et al., 2008, pp. 1558-1597).

The audit process assumes the testing of the application by an external to the company entity and the responsibility transfer from the developer to the auditor. If the application passes the audit process, the auditor takes on himself the responsibility for the errors that are discovered in the use of the application by users. In the case of the citizen oriented applications it is very important to do the audit process. In the opposite case, the developers make a low quality application that is patched after it has been used by users and problems were discovered. The audit process eliminates this approach and at the same time the risk of having an application that doesn't work correctly or doesn't fulfill the users' requirements.

7. Quality optimization for the citizen oriented applications

The optimization is the process of increasing the level of an entity in report with a considered criterion (Rosso, 2008, pp. 1-19). For the citizen oriented informatics applications many criteria for optimization are taken into consideration:

- cost; cost optimization assumes reaching a minimum quality level with the lowest costs;
- functionality; functionality optimization assumes offering as many functionalities as possible;
- performance; the optimizing of performance assumes the minimizing of necessary time for the application to make the processing and return

results; performance optimization usually assumes the increase of resource consumption;

- interface; optimizing the interface assumes the inclusion of the important elements and the elimination of the ones with low importance;
- database; databases must be built so that the access is as rapid as possible; using domain specialized databases increases the speed of data access;
- the user path; represents the number of selections that the user must realize in order to finalize its problem;
- users' satisfaction is represented by the degree in which the users feels satisfied after using the application to solve his problem.

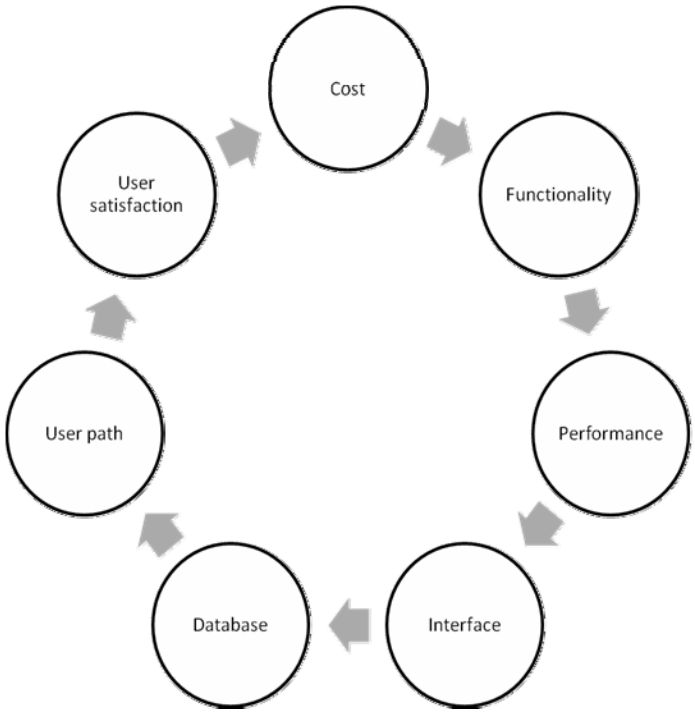

Figure 4. *Optimization criteria*

Informatics applications are optimized in report to many criteria simultaneously (Barreto et al., 2008, pp. 3073-3089). The applications optimized in report to a single criterion are not as successful as the ones optimized in report to many as the high quality regarding a criterion don't pay for the low quality of the others.

8. Security requirements for the citizen oriented applications

Citizen oriented informatics applications differ from the other informatics applications, determining a series of particularities because (Mellado et al., 2008, pp. 361-371):

- the applications are freely accessed because there are no more geographical borders and the users must be able to access the applications anytime without additional costs;
- the complexity of the citizen oriented applications is very high as these are distributed applications and their development overwhelms the classic approach;
- the users are many and diverse because the citizen oriented informatics applications reach their aim only if they are used by many persons;
- the processing fluxes are saturated given the large number of users and the complexity of the applications;
- the security level is uniform for all the branches of the tree associated to the application and there are no security breaches;
- the management of the database and the files of the application is made through procedures that exclude processing incidents.

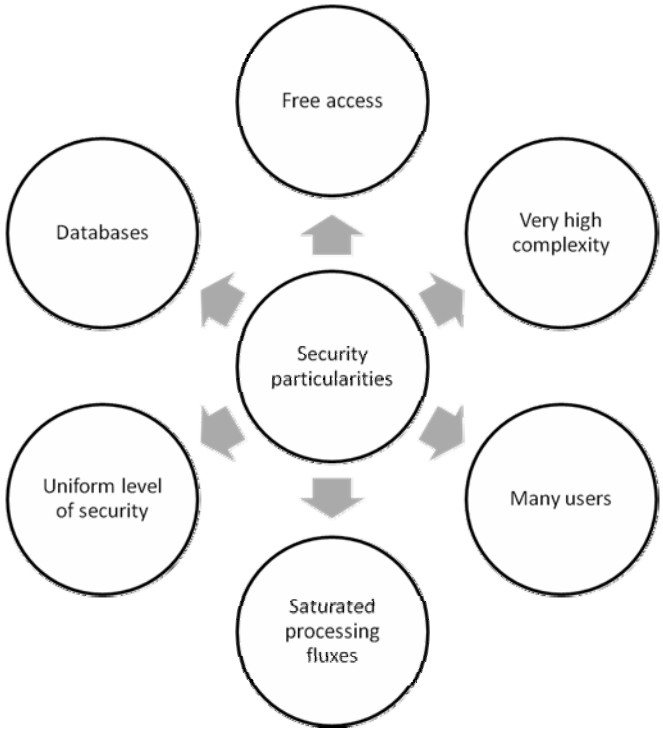

Figure 5. *Security particularities for citizen oriented informatics applications*

The security of the application is tightly connected with its quality. The quality characteristics are those that influence in a decisive way the security. The most important quality characteristics from the security's point of view are:

- reliability;
- maintainability;
- portability;
- integration.

If for classic applications these properties are not very important, for the citizen oriented informatics applications these have a special importance.

To ensure security, during the development cycle, for each component a special step is made. During this step the implementation of security techniques and technologies that are suitable for the considered component is made (Wolter et al., 2009, pp. 211-223).

The increase in security is made through:

- inserting components that eliminate vulnerabilities;
- inserting authentications; is made to give rights only to the users that prove they are part of the system;
- data restrictions are used to protect the data the application works with from the bad intended users and from the users without access rights;
- updates only by adding information are made to protect the data from the attacks made by system's users;
- developing software components that cover better the vulnerabilities through the training of the developers and awareness of the most frequent risks.

Increasing the security of the applications above a certain level is justified only if the costs implied by its lack are higher than the costs for implementation. Figure 5 highlights the main security particularities of the citizen oriented informatics applications.

9. The effects of the quality management of the citizen oriented applications

Considering the very high complexity of the citizen oriented applications, these have long development duration. The very high quality that these applications must possess increases the time necessary for the development. The project management must ensure the citizen orientation through the realization of adequate interfaces, complete testing, the study of the target group. For the calculus of the necessary resources for the implementation of the application are realized activity and resources lists. It is then realized the matrix activities-resources in which, for each activity, are marked the implied resources. The table activities-activities shows their precedence. In the case in

which there are activities that don't depend on others, these are made in parallel to save time. The matrix activities-persons shows which are the persons implied in each activity. The matrix persons-resources shows which are the resources needed by the persons. The calculus of the costs is made using many consumption possibilities: minimum, medium and maximum. Many version of developing the project are made: the realistic version, the optimistic version and the pessimistic version.

The management of the risks that appear in the process of implementation assumes the identification of the risks and countermeasures that must be taken to ensure a high level of quality (Söderholm, 2008, pp. 80-86). For each stage of the development cycle the risks are identified and measures of counteraction to eliminate them are found.

The quality-cost correlation is made by considering a project database. For these quality characteristics are identified. The level of the characteristics is analyzed correlated with the cost level and also the correlations of the variations. A statistical analysis is made to determine the correlation between each quality characteristic and the cost level.

The audit of the project management of the citizen oriented informatics applications is imposed by its high complexity and the implied costs. By doing the audit process the quality of the project management process is ensured.

To contribute to even better results in the future, the project of the citizen oriented informatics application is included in the project database (Thomas, Mengel, 2008, pp. 304-315). This thing is made in time from the starting of the project to document all the elements regarding its ongoing. Elements regarding the quality and complexity are analyzed. For these are calculated indicators that are insert in the project database.

10. Software structure for assisting the process of developing the structured entities

Structured entities are those that have a fixed structure defined by internal building rules (Ivan et al., 2009a). These can have a variable number of components, but only if they respect the base structure. The entities are verified using a series of rules and indicators that measure the degree in which the entities respect the rules are calculated. According to the information from Figure 6 the messages given to the users are:

- localized; localization allows users from different geographical locations to access the application and the messages they receive are in their own language;
- clear; the messages indicate the mature of the problem that appeared so that the users know what they must do to improve the situation;

- concise; shows the location of the problem that appeared and indicates ways of improving quality to the users;
- give suggestions on modifications to be made on the analyzed entity to satisfy the quality requirements.

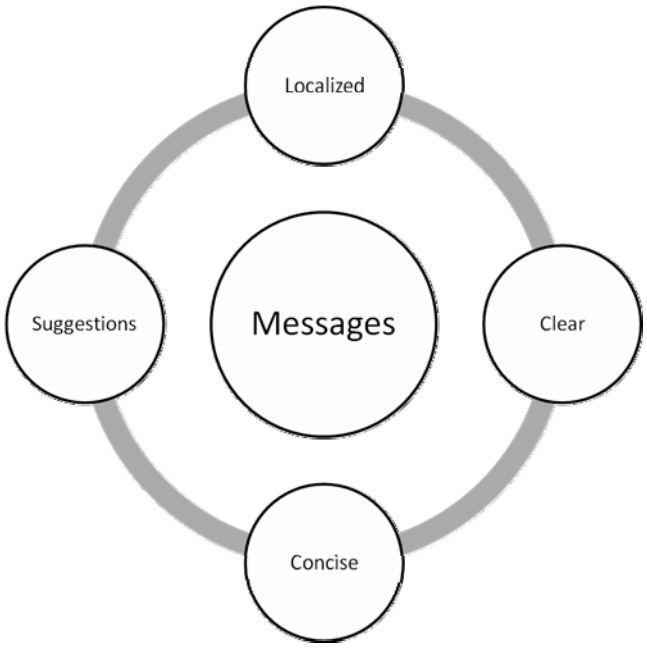

Figure 6. *Messages characteristics*

It is also offered the possibility of saving the messages and entities. The application implements a mechanism for data collection regarding users' behavior measuring durations, frequencies, actions. On the basis of the collected data improvements are permanently made to the application consisting in restructures, completing functionalities, completing incomplete modules, modifying or adding messages.

The application uses the class structured entity that stores the user's entity and ensures all the methods and functions necessary for the analysis. The graphical interface of the application allows the transfer of data between the user and the structured entity class. Also, after analyzing the input data, the structured entity class gives the user messages through the graphical interface. The application gives a score from 0 to 10. The score is obtained after the analysis of the following factors:

- the lexical density is defined as a report between the number of different words and the total number of words; the lexical density has

average values in the interval [0.4, 0.6]; for a value greater than 0.5, the application gives the maximum score for this component; for smaller values, the score is weighted;

- the number of citation in the text reported to the size of the text is also a very important component; the application gives the maximum score only if all the entities from the bibliography are cited in the text; in the contrary case, the score is weighted with the number of cited works;
- the relevance of the keywords reported to the text of the entity is also analyzed; the keywords are the ones synthesizing the essence of the entity and thus, these must be relevant for it;
- the correctness of the entity is determined through the comparison of the entity's words with the standard dictionary of the language it is written in; as the entities can have elements defined by the users, a degree higher or equal to 80% is accepted for the maximum score; if the correctness level is in the interval [0.5, 0.8] the application gives a weighted score; if the correctness of the entity is lower than 0.5, the application gives the score 0 as the entity is not correct;

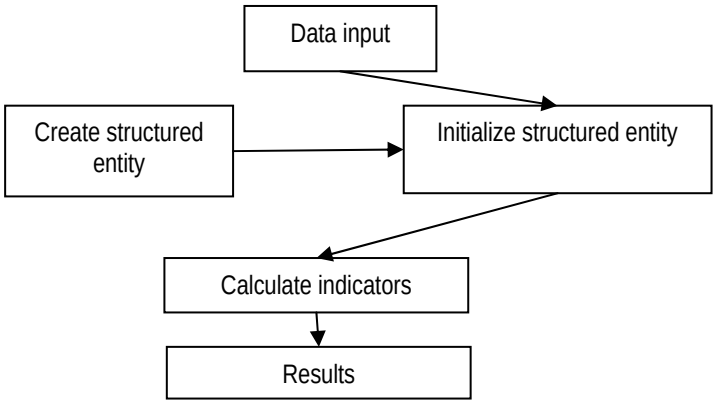

Figure 7. *The functioning of the application for the analysis of structured entities*

- the number of references reported to the length of the entity is very important to ensure that the author documented for its realization;
- the equality of the chapters is also a measure used by the application to ensure a unitary entity with parts relatively equal; for this it is used the medium value of the size of chapters from which these can derive with a predefined value;
- the figure and table citations indicate their necessity in the entity; if a figure or table is not cited in text, this means it is not necessary and it

can be eliminated; the application measures the degree in which the figures and tables are cited in text.

The score accorded to the entity is obtained as a weighted average of the influence factors. According to its importance, each factor has a greater or lower contribution to the final score. Figure 7 highlights the information flux and processing done by the application for the analysis of the structured entities.

The data processing durations are very important for the users. As the bandwidth is variable from user to user and the developer can't influence this aspect it is very important that the time necessary for the application to process data and show results to be very short. For the application for the analysis of the structured entities, available online, the durations necessary for different analysis are given in Table 2. All durations are given in milliseconds.

Table 2

Processing durations for the application for the analysis of structured entities

	Final indicator	Indicator 1	Indicator 2	Indicator 3	Indicator 4	Indicator 5
Minim	42	20	2	5	9	6
Maxim	105	68	7	9	12	9
Medium	55.7	28	3.4	6.8	10.5	7

The processing durations are automatically recorded by the application for the analysis of structured entities. The five considered indicators take part in the calculus of the final indicator. For the indicators the situations in which these can't be computed because of the data input or the logic of the algorithm are ignored. Only datasets for which the complete set of indicators can be computed are taken into account. The durations depend greatly on the dimension and complexity of the structured entities the users insert.

It can be observed that the lowest duration necessary for the application to compute the final indicator is 42 milliseconds. This response time from the server component is very small. The maximum time of 105 milliseconds is also unnoticeable for the client. The data are based on the information recorded after the analysis of 255 structured entities. It can be observed that the average duration for the computing of the indicators are low, as the final indicator has an average value of 55.7 milliseconds.

In order to improve even more the durations necessary for the computing of the indicators, it is necessary the optimization of the algorithms or the use of a programming language of higher performance. The improvement of these durations is not necessary unless an analysis of a very large set of entities is required. For a database with millions of records, a difference of a few milliseconds for each record can lead to hours for the whole operation.

Conclusions

In the knowledge based society is made the pass from the classic products and services to innovative products and services. Using knowledge in the process of production of products and services creates a superior level of quality necessary for market competiveness and satisfying the users' requirements (Ivan et al., 2009b). The citizen oriented informatics applications have new quality characteristics compared to the traditional applications. The citizen oriented applications for the virtual campus have a great importance in the training process. The success of the training program depends decisively on the application that plays the role of a teacher for the users. The business to business and business to consumer are also citizen oriented informatics applications in the context of the market globalization. The citizen orientation is a vital aspect for the applications of e-government and e-voting. Through the implementation of such applications permanent cost reductions are made and also an efficient work flux is obtained. The citizen orientation imposes changes in the development cycle of the applications (Ivan et al., 2009c). The high level of the quality characteristics, security and the citizen oriented interfaces are obtained through changes at the level of each stage in the development cycle. For the quality quantification there are necessary procedures to measure the levels of the characteristics and indicators that reflect the aggregated quality level. For these, there are defined measurement procedures that ensure the comparability of the results. The indicators are built so that they respect as many indicator properties as possible. As the quality is defined through many factors, it can be improved through these. The training of the users, even though it is not a prerequisite, is very important for using the applications. The increase in users' training leads to an increase of their satisfaction. The modern development techniques have an essential role in the increase of the quality of software products and the decrease of the time necessary for the implementation. The testing is a very important process as it ensures the identification of the logic and functioning defects. The audit process realizes the transfer of responsibility between the auditor and the owner of the audited product. The optimization of applications must be aggregated and realized on report to the most important two or three criteria. The security of the application is given greatly by its general quality. The citizen oriented informatics applications present security particularities compared to the classic applications. The project for the development of a citizen oriented informatics application must be managed by an experienced manager and audited.

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