Citizen oriented informatics applications' development cycle

Ion IVAN, PhD Professor Economic Informatics Department,
ionivan@ase.ro
Bogdan VINTILĂ, PhD Candidate Economic Informatics Department,
vb@vintilabogdan.ro
Cristian CIUREA, PhD Candidate Economic Informatics Department,
cristian.ciurea@ie.ase.ro
Mihai DOINEA, PhD Candidate Economic Informatics Department,
mihai.doinea@ie.ase.ro

Abstract: Knowledge society assumes the generalization of citizens' access to the resources of the global computer networks. National databases are created and used. Informatics applications targeting all the citizens of a country are designed, realized and implemented. The paper defines the concept of citizen oriented informatics application. Starting from this, the particularities that determine the redesign of the development cycle from software engineering are identified. Each stage is presented and the inputs and outputs are defined as a process of allocation and levelling of resources. For the citizen oriented informatics applications a quality characteristics system is built, indicators that form a metric are defined and different methods of measuring quality during the stages of development cycle are described. The user's requirements are tested and the measure in which the application's security is being assured. Also, a cost model is built for citizen oriented informatics applications, so that the optimum choice from a set is made, ensuring though a controlled performance level for the applications.

Keywords: software engineering, development cycle, quality, metrics, cost.

1. Citizen oriented informatics application

The knowledge based society is the new form of organization and functioning of the society. The explosive development of computing and communication technologies made the evolution to this new type of society possible. In the knowledge based society the base role is assigned to information of all types and to knowledge. This new society is characterized by [ROGH06]:

- a new product, the informatics product;
- the base entity is represented by the individual and the community;
- the characteristic merchandises are computing equipment, communications, informatics applications, informatics services;
- the majority of technologies are ecological and have reduced power consumption;
- working remotely;
- borders are eliminated, activities are unfolded over the Internet.

In the terms of the evolution of the knowledge based society, the quality demands for informatics applications grows. The new informatics applications are no longer instruments of organizations for which they were created, these applications must be orientated to satisfy the citizens. Considering the fact that geographical boundaries do not apply in the new society to informational streams, the new applications must address a broader segment of users with diverse characteristics and demands.
With the evolution of technology, the number of services which migrate from the traditional form to the online form grows as well. For these specific services an adequate providing form must be found in the online environment, using the proper technologies, guaranteeing the access of large number of users, fast and secure payment services.
All of these impose a revaluation of quality demands of informatics applications in the online environment. Developing the application based on the old quality requests makes it non-competitive in the new society.
Informatics applications corresponding to the new society are citizen oriented. They have the target group, citizen as a central element. COIA are designed for citizens, to solve their problems quickly and the highest satisfaction degree. Compared to the traditional applications they are characterized by:

- the large number of simultaneous users;
- the mandatory update to correspond to environment changes;
- total adaptation to offer the highest degree of satisfaction to the citizens;
- null, or very small use cost;
- permanent access to online resources;
- coverage in the target group of all citizens that want to solve a class of problems;
- the need to solve problems for the citizens not for the organization;
- direct citizen interaction, without previous training.

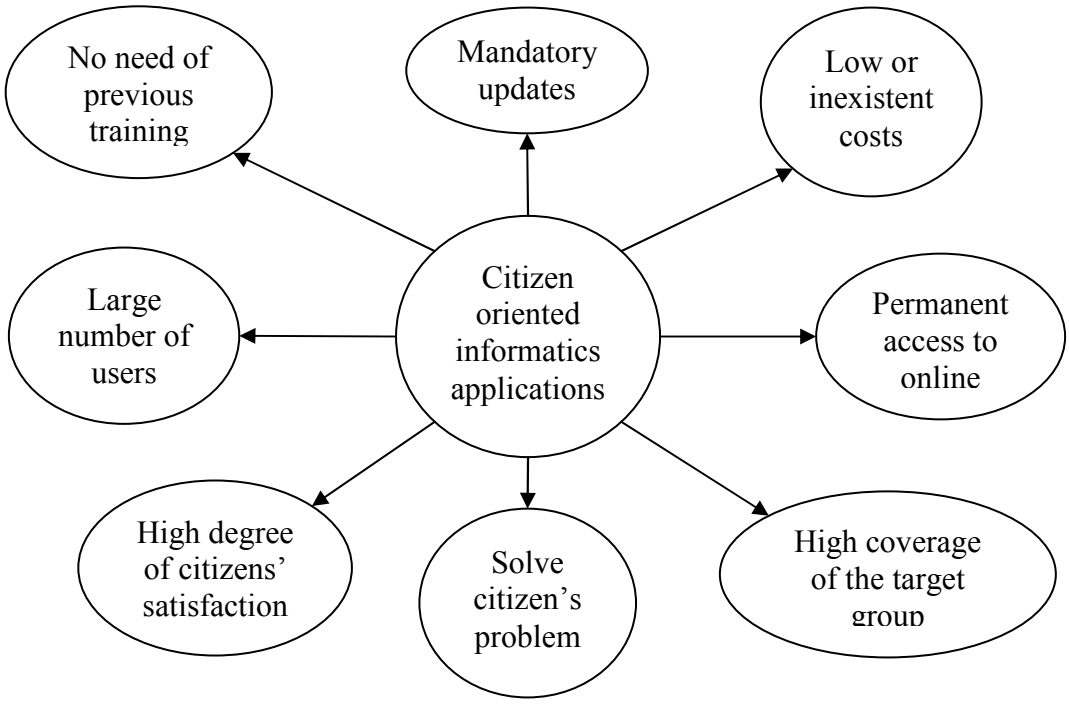

Figure 1 - Citizen oriented informatics applications' characteristics compared to traditional ones

(Figure 1) shows the additional characteristics of the citizen oriented informatics applications compared to traditional ones. The higher the degree these characteristics are fulfilled, the higher the citizen oriented applications' quality is.
In the new society the application evolution is vital because the pylons of the knowledge based society are the citizens, their community compared to the organizations which are placed in the background. The reorientation of applications to meet the citizens' needs is required.

Citizen oriented applications are realized to solve their problems. Considering that the target group is large and diverse, the citizen oriented applications are very diverse in order to solve a multitude of problems. These applications are classified according to several criteria:

The interaction criterion assumes the classification of informatics applications according to the degree in which the users interacts with the applications. Following this principle the applications are divided in:
- applications in which the user does not input data;
- applications in which the user selects the input data from predefined lists;
- applications in which the user inputs data.

The content criterion realizes the classification of informatics applications regarding the content modifications. Based on this criterion the applications divide in:
- fixed content applications;
- applications whose content is modified by adding;
- application with content that changes over time;
- applications with content changed by addition, update and erasure assume recording of dynamic content.

The number of actions criterion classifies informatics applications according to the number of actions which can be made. Considering this principle the applications are divided in:
- one action informatics applications;
- multiple action informatics applications.

The complexity criterion oversees the number of solved sub-problems, the flexibility of offering alternate approaches, ways of generating selection criteria and the diversity resource allocation types and payment services.
In this context the following are identified:
- application with one specialized problem;
- average complexity applications;
- high complexity applications.

The completeness criterion oversees, helped by the application, the coverage degree of the specific citizen's demands. There are:
- partial coverage applications;
- full stream applications.

The instant result criterion classifies informatics applications considering the needed time to return the demanded result to the user. There are instant result and delayed result applications.

The security criterion divides informatics applications in safe and unsafe applications.

The cost criterions assume the classification of applications considering their use costs. According to this the following are identified:

- zero cost applications;
- individual session payment applications;
- subscription applications;
- paid applications.

The classification criterion insures an application division considering different criteria which directly regard citizens. As the classification is more clear the faster the citizen will choose an application from the set of existing ones.

Citizen oriented informatics applications – COIA must correspond to the citizen needs, in this purpose they must have the following quality characteristics:

- *maneuverability* is the capacity to easily manage the application from the outside by the administrator and at the same tine to have the capacity to administer the user resources and to have access to complete information about previous transactions;
- *availability* is the capacity of the applications to run continuously, resources must exist in order to store results and information belonging to each user;
- *scalability* represents COIAs' capacity to improve its performances upon new hardware installation;
- *functionality* refers to the quantity of processing made by the informatics application; any citizen orientated application must ensure total processing needed to solve the citizens' problems;
- *stability* is the capacity of the application to ensure variation proportionality regarding the input volume, processing volume and result complexity; small variations correspond to low volumes; large variations correspond to large volumes;
- *controllability* is the capacity to have its own adequate messages for each input message given to the user;
- *determinism* is the characteristic through which for the same input data the same result is outputted not depending on the user;
- *finite processing* which imposes that regardless of the processing type it should complete in a predetermined number of steps, and the number of selections is limited such that no cycles are created;
- *complexity* of the informatics application is given by the number of different structures used in the application and their appearance frequency;
- *reliability* represents the characteristic of the informatics application to run correctly and completely for all data sets inputted by the users;

- generality assumes solving the class of problems not solving the particular problem; generality is insured by avoiding variable hard coding within the application;
- *maintainability* is the characteristic of informatics applications which denotes fast updates at low costs;
- *reusability* defines the degree in which the application uses already developed components;
- *integrality* quantifies the extent to which the informatics application interacts with other informatics applications;
- *portability* establishes the measure in which the informatics application is independent from the hardware/software platform of the user.

Ensuring high levels of these quality characteristics of citizen orientated informatics applications leads to competitive applications which ensure high levels of user satisfaction.

The development cycle for citizen orientated applications differs significantly from the structure of the development cycle of classic applications, because of different pursued objectives and complexity differences.
The stages of COIA development are:

- selecting and studying the target group;
- defining the problem to be solved;
- developing the specifications;
- interface design;
- creating the product structure;
- elaborating the components;
- testing on the data sets from the specifications;
- implementation;
- maintenance.

The development of informatics applications following these stages leads to obtaining competitive applications which satisfy the demands of the target group. The processing costs of these applications are very low or null. Updating the applications is made often to increase the user satisfaction degree, but costs are low because of the modular design pattern.

2. CITIZEN ORIENTED INFORMATICS APPLICATIONS' DEVELOPMENT CYCLE STAGES

Distributed informatics applications are the result of a complex process which includes stages characterized by:

- specific objectives in each stage, defined through a phrase that highlights what must be pursued within the stage, such that the general objective of the project will be reached; it is very important to correctly define the specific objective because all efforts are concentrated in this stage on it; if the specific objective is in contradiction with the project general objective, stages must be repeated to

make necessary corrections caused by the low quality of components developed in the stage that was completed pursuing an objective that is not essential reported to what the whole project is pursuing;
- input represented by information, components resulted from previous stages, equipment, experts, standards, transferred documents from the previous stage;
- activities characterized by duration, precedence, procedures, correspondence with resources, identifying situations in which the component under processing is deteriorated, quality criteria that quantify the resulting component, requirements related to the experience of those who participate in the development, reports that have to be developed, ways of measuring duration, consumes, behaviour;
- resources that interfere with the factor interaction that concur to reaching the objectives and are formed of raw materials and materials, energy equipments, time availability; resources are planned quantitative and qualitative and the use way and the result obtained by using resources in the stage are closely followed;
- techniques, methods, technologies that are made up of knowledge possessed by the persons which interact within the stage, through used equipment and selected instruments;
- results for each stage consisting of output as parts, modules, documentation, quality reports, information regarding the work modality, evidence regarding resource consumption, comments on team members behaviour.

The stages of the citizen oriented informatics application development cycle are different compared to the same stages for classic applications because the focus is set on citizen orientation and the developed application must reflect the needs and preferences of the citizens.

Problem definition stage assumes specialists with rich experience in knowing the theoretical aspects and mostly the practical ones of the domain the distributed application is interacting with. Defining a problem means:

- specifying input data and who generates it;
- building computation formulas and models;
- identifying algorithms for indicator computation , expression evaluating, optimization, estimation, subset extraction, comparison and graphical representation of aggregated values;
- establish the presentation form of final results which in fact are most important for satisfying the requests of those that thought of the building the distributed application; the results take the form of a word, string, a matrix with lines and columns that contain words; the word is regarded as a succession of symbols; the integer part or number of decimals is a word; an element of the vocabulary of a language or name is also a word.

Defining the problem assumes establishing a list of messages the users input and based on which processing options are selected, as well as the messages that the application is displaying for the user informing on the processing status but also on new information requirements that the user must supply to the application. In case the lack of experience, misunderstanding the domain and absence of using advanced techniques determine **sub defining the problem**. Sub defining the problem is represented by some input data absence, lack of some computation formulas, incomplete processing algorithm

information and extremely severe absence of components form the final results structure which the application must supply to the clients. Solving the sub definition aspect implies more costs as closer it is done to the end of the development cycle, the cost excess derives from the increased efforts and mostly because of the large volume of modifications that must be done when repeating stages.

Over defining the problem corresponds to the situation in which because of a low systematization and filtering level the input data receives in the processing part an in the final results structures either similar components but with a different presentation form, either, even worst contradictory components which shed doubt upon the consistency of the whole definition. The first effect of over defining is including different components in the application structure which cancel the effects of other components that were activated beforehand. All of this is fixed by eliminating components and thus by simplifying the distributed application's structure. Eliminated components mean costs thus loss.

When putting together the development team to build a citizen oriented distributed application individuals must be included with the help of their experience, interaction abilities have all the resources to completely and correctly define a problem. A correct problem means correct specifications, correct project, correct modules, correct testing processes and finally pleased users. Any other approach in the defining stage of the problem creates the premises that the IT project which aims to develop a citizen oriented distributed application will be placed in the over 90% unviable projects.

Establishing the target group represents the stage through which the person's categories are established, their number is estimated and the persons witch will interact with the application in solving problems. When establishing the target group the following must be highlighted:

- territorial arrangement of persons specifying rural environment, urban environment, communication modalities, the persons territorial mobility, existing resources to access computer networks, existing computing machines;
- age categories and training level of the persons for which the application is developed as well as modalities to accept working with a computer to solve problems online by stimulants that accompany human-computer interaction;
- the frequency with which persons activate resources of the distributed informatics application to solve their problems;
- the vocabulary used by the members of the target group such that designing the application interfaces to use messages that exclude using supplementary documentation and which through their direct nature don't leave place for interpretation and determine concrete actions that lead surely to solving problems.

Starting from the idea that target group members are never wrong in the interaction processes with the informatics application, the study of the target group must point out clearly the persons characteristics, their habits, action routines, such that the application interfaces will strictly respect the competences and limits of the target group members.

Studying the target group assumes along side knowing the physical and intellectual traits of the members and also knowing their experience in using other applications. According to this experience the new application will seek to incorporate the interfaces of most accessed applications such that the members of the target group will be already familiar with the requirements of the new application. It is observed that in the target group

definition stage is the one that decisively imposes how the following stages in the development cycle must me regarded.

Specification elaboration is the stage that presumes the existence of high performance specialists with rich experience because specifications must be:

- exact, meaning to capture the demands of the distributed informatics application owner with regard to the fact that the objective is to fully satisfy the exigencies of the persons that make up the target group such that his profits depend on the access frequency of the application in the target group members and the value of transactions made using the application;
- complete which captures the totality of nuances tied to the exigencies of target group members, totality of input data, computation formulas processing types and totality of final result structures such that each user will find one self in the application, like it was written especially for him; by questioning members of the target group a hierarchy will result according to the solicitation frequency of actions that must be developed using interfaces; message exchange becomes natural and is not the product of the imagination of an interface designer for an abstract client created by him; even more, in the case the client's profile is defined through the parameters entered by him the distributed informatics application must adapt its interface structure to the user's abilities;
- correct considering the fact that it must contain coherent logical constructions pursuing the existence of input data to evaluate the expressions, the existence of defined expressions to obtain the demanded result structures; correctness is demonstrated but in most cases must be observed; to this purpose the specifications will contain test data sets, intermediate results and final results; the testing process will highlight the differences between the intermediate results in the specifications and the ones provided by the application respectively the differences between the final results in the specifications and the final results provided by the application ; the application is correct when after the audit process it is established that between what is in the specifications and what the testing process is offering is in perfect agreement;
- deterministic meaning that more development teams undertake these specifications and develop informatics applications independent form one another, the respective applications must not be significantly different in terms of interface structures and especially as result structure; differences appear in technical construction elements, processing speed, used technologies in application development.

Building the project represents the stage in which specialists with experience in interpreting specifications and in equal measure code elaboration move to:

- identification of processing functions;
- establishing the modules and the connections between them;
- defining data structures and storage data format;
- building matrices of initial data-modules, final result-modules;
- stating the software and hardware necessary resources;
- estimation of the necessary work force;
- elaborating the calendar specific to citizen oriented distributed informatics application development.

A competent team has the capacity to associate the exact needed resources to the application, the whole development process being a process of resource allocation and levelling. There are situations in which starting from the available personnel, instruments, software components in exploitation with no regard to the particularities the new application has the process moves on to using existing resources. The application requirements are adapted to the available resources in the software development organization. If until the appearance of distributed citizen oriented informatics applications non-performance of solutions was propagated with a multiplication factor equal to the number of utilizations of the application, now the multiplication is accelerated due to the very large number of persons which access the application. Further more the development of the project includes imagining alternatives, alternative performance estimates and selecting the best performing alternative from the set.

Code elaboration is an activity through which a project is materialized and it is completed by developers with a strong grasp on the chosen technology, who posses the capacity to take information from the specifications such that the written lines of code represent self standing products of whose quality is exactly measured.

Code elaboration is a team activity and assumes:

- the existence of an unique style which means that simultaneous and independently the team members must develop a procedure using the same specifications such that the source code lines that they write are not significantly different from programmer to programmer;
- using the same programming language to provide homogeneity to the informatics applications and to implement the data and control structures in an identical manner;
- developing the same level of auto documentation through comments associated to variables and processing sequences;
- following the degree to which the developed software components fulfil the planned quality requirements; an auto testing process is considered, necessary to move the developed component to the assembly stage;
- perfecting the content of each procedure, following the reach of the optimum criterion established in the programming specifications, by using checked sequences as being better then other sequences that bring supplemental machine cycles, large memory zones or unjustified instructions that do not activate.

Code elaboration is the stage that produces what is in reality the software an is undergoing analysis fact that mandates that all the efforts of individuals involved in development process management must be focused here All the differences between what is established to be developed and what is effectively developed are highlighted in this stage. Procedures are developed here that make supplementary processing reported to what is defined in the specifications. More procedures are aggregated here in only one without doing all the processing established initially. Distortions between data defining from the specifications and the ones in the instruction sequences happen here. It is preferable that the specifications contain enough programming elements including operand definition such that the programmers will take them automatically without introducing variations form one data definition to the next.

Server uploading is proceeded by an analysis made by a small group of specialists of the development team, specialists that have a complete image of what the distributed citizen

oriented informatics application must be. The received components are analyzed in detail if they meet the requirements they are taken in and integrated step by step to obtain the application as a whole. In case of differences being noticed, especially lacking, the specialists elaborate a finding report and if there is enough time this mandates the rerun of activities from proceeding stages else in case of tight deadlines immediate force corrections are implemented making known the failures for each procedure and each programmer involved. Server uploading is the step that allows the behavioural analysis of the application by those who have password access to its resources. To this scope users and passwords are created. The users are in fact the application testers. In this stage conditions are created for activating the corresponding components of the tree structure associated with the application. In order to facilitate the testing process, the application server and the application are configured such that detailed error messages that are generated during the use of the application are recorded.

Technical testing is proceeded by auto testing. This means that the product already completes the minimum processing required through the specifications. The testers know the objective for which the distributed citizen oriented informatics application is developed. They are educated to direct the human-computer interaction to the citizen's exigencies, exclusively.

Firstly starting from the test data sets from the specifications the application behaviour is seen.

The differences between what must be obtained and what is obtained are signalled.

Technical testing imposes making modifications in the applications to bring processing to the level stated in the specifications, in order to trigger actions with direct effects in owned and connected data bases. Certitude must exist that the results, after making the modifications in procedures are correct, complete, consistent, precise and obtained fast by the application.

Sample testing assumes establishing persons which with specialty assistance move to solving real problems using the distributed application. Building the sample is essential as the diversity of problems tested in the application depends on it. In case the sample is erroneously built only several branches of the application will be tested, the others remaining untested and when launching in effective execution there is a risk of triggering erroneous actions with negative effects on the application, on the citizens and on other applications with which the new application interacts. Sample testing imposes making real time corrections on the components of the application showing only programming errors, which come from design errors or specification definition errors. Starting from the idea that the user is in the center of the distributed application development activity, sample testing is meant to observe the necessary durations to the user to localize, to enter data, to verify and to make corrections. The application must contain variables that record start and ending moments for interactions as well as storing them in the data base. The quality of the application is given by the duration study, the numbers of runs and the types of errors the users make. Here begins the measurement of the user satisfaction degree, satisfaction degree influenced by:

- the number of users that end an interaction without finalizing because the application does not contain the procedures necessary to solve the problem; in this case the procedure elaboration, integrating them in the application and rerunning processing with the same users is mandatory;

- the number of users that retake certain steps of the application due to the inconsistency of messages and due to the imprecision of given indications; if there are mandatory fields and optional fields and there is no exact specification which are the mandatory fields that the user did not fill, this will lead the user to re-entering the data repeatedly with the risk of stopping processing because the cause of repetitive data re-entering is not obvious; it becomes even more serious when in the interface the fields are considered optional but in the procedures they are mandatory; this lack of concordance is of a stressful nature;
- the number of users which see the lack of concordance between initial inputted data which are numerous reported to the result;
- the number of users that input data, select options and get the desired effects.

It is important to make modifications in the application such that most of the time users fall in the last category.

Documentation elaboration is an activity left to the end of the developing cycle in an erroneous manner by all the team members. The documentation is built simultaneous with the developing process even if not final form. Specifications are a form of documentation. At the project's design structure schemes are built, modules are described, parameter lists, matrixes are built, diagrams are created, code sequences are written to define operands, and details regarding the programming rules are given. In the stage of program elaboration, comments are a great source for documentation. Programmers elaborate detailed schemes, notes regarding the sequence generalities, note the auto-testing results and show the flexibility elements they incorporated in the procedures allowing thus an efficient maintenance process. For the testing step specific elements are included in the documentation to show the application's comportment for common problems among users.

The documentation includes information regarding the application's performance obtained through the testing process.

Implementation assumes the application's installation on the client's server and the configuring for optimum functioning. Before the installation it is necessary to prepare the server to accept the distributed citizen oriented informatics application. For this an analysis regarding the resource and technologies requirements must be done. For applications that work with databases the database server must be prepared. The application server must support all technologies the citizen oriented application implements and offer sufficient resources so that the users are not forced to wait. After the application's installation on server it is configured to answer the client's requirements and to realize the connection with the database. Test data sets are eliminated from the application's database before launching it to current use.

Maintenance is the process of updating the distributed citizen oriented application to reflect the changes from the economic, social and legislative environment. As citizen oriented informatics applications are used by a very large number of users it is necessary that the changes of the environment are reflected by the application after of a very short time from their occurrence. In order to be maintainable the citizen oriented informatics application must be modular. Each module is updated depending on necessities so that the sum of changes leads to the total reflection of the reality in the informatics application. Application's modularity facilitates the update process as the team members work in parallel on the modules realizing the updates in a very short time. The distributed

citizen oriented application's maintenance process is realized only as long as the costs implied by it are very low and don't justify application's reengineering.

Software reengineering assumes the redefining of the application's objective so that it leads to raises of quality and performance, but the new objective does not differ fundamentally from the original one. The reengineering process takes place when the maintenance costs are very high or when the application can't deal with a large part of the users' requirements. Application's reengineering affects all the component elements or only a part of them. The reengineering process deals with many difficulties:

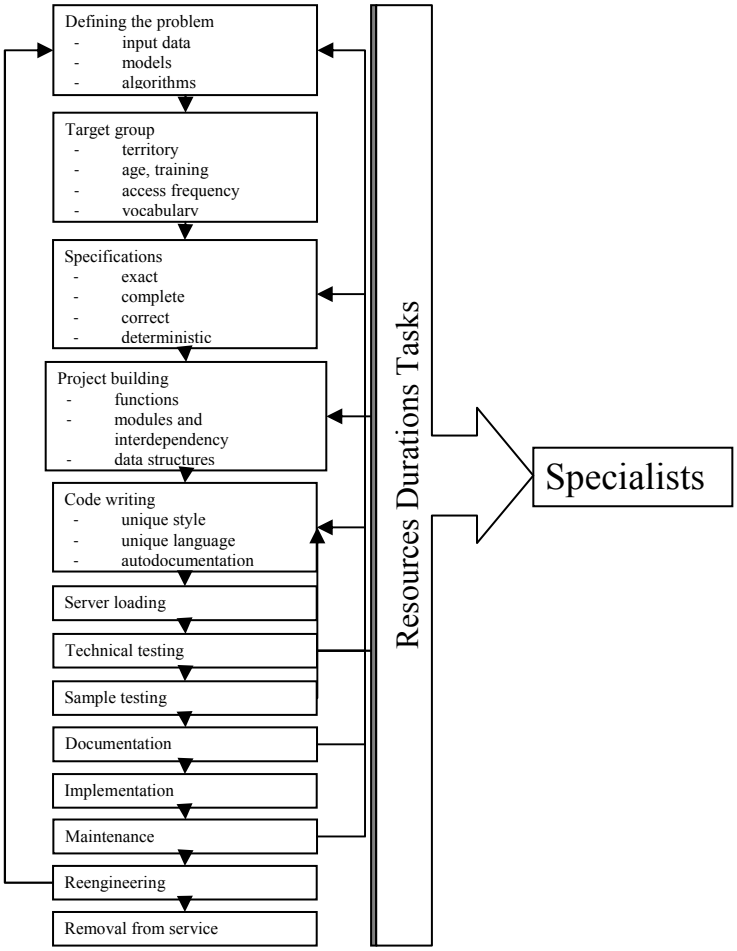

Figure 2 - Distributed citizen oriented applications' development cycle steps

- inexistent of insufficient documentation of the existing system;
- application's components are not organized by logical criteria;
- the existing application doesn't have a modular architecture; the tight link between the components leads to a slow evolution of the product;
- source code duplication;
- high redundancy of the system;
- wrong use of classes' inheritance;
- the lack of classes' inheritance;
- lack of cohesion between the modules;
- unduly high number of classes.

After the reengineering process the distributed citizen oriented informatics application fulfils all the users' requirements, has improved performance and provides new features. Otherwise, the reengineering process is a failure and the decision of removal from service of the informatics application and the design of a new one that ensures the users' satisfaction is justified.

Removal from service is a very rarely process as many applications don't get through the maintenance process and the reengineering process. The removal from service is caused by:

- the disappearance of the problem that generated the application through legislation update, by natural causes, through the disappearance of the cause that the problem based on or through the appearance of new advanced technologies for information intake;
- very high maintenance costs as repeated updates lead to a such complex structure of the application that the heterogeneity generates multiple uncontrollable self propelling effects;
- the discrepancy between what the application offers and its users' requirements as at the its' design time some technologies existed, some requirements were specified, and with time, the new technologies generates new users' requirements and the application can solve them only with very high costs though leading to the decision of removal from service and design of a new application that uses some components from the current one.

Removal from service is similar to the problem of replacing the physically spent equipments, only that in the application's case we talk about moral spent with much deeper effects on the report application-users.
In (Figure 2) we note that all the steps of the distributed citizen oriented informatics applications' development cycle imply resource consumption, execution durations and tasks. All these are managed by specialists after running complex analyses.

3. National databases

The developed information society involves the creation of databases at national level for the homogeneous treatment of some sets of issues for each citizen.
The population database contains information describing in detail the characteristics of people living in a precisely defined area, country, county, city, common. When designing such a database are taking into account the particularities that appear in:

- building the words string for name, surname;
- building the words string for complete describing the parents;
- structuring the unique identification code so that regardless of demographic dynamics, each person should be associated with a unique code;
- taking over from other databases of the elements for spatial localization of the person;
- establishing the elements that define the first record related to the person through time and place of birth;
- defining the elements of training, pre-university education, qualifications;
- information relating to identification documents - identification card, passport, voter card;
- identification elements on marital status - married, with who, divorced, by who, unmarried, widower;
- the descendants situation present interest for the succession process;

- elements regarding the criminality situation make interest to all institutions who come into contact with the person concerned;
- elements regarding the individuals properties;
- elements on people occupation; are important for statistics development on employment in different activity fields.

The car park database concern:

- unique identification elements of the car, the number, the engine series are elements that uniquely identifies a car;
- the machine type is important for determining the tax which the car owner must pay;
- identification elements of the car owner; he must pay all taxes related to the car;
- the data regarding the technical status involves carrying out periodic inspections to ensure the proper functioning of the vehicle;
- the data on the pollution rules that the car respect; these are very important for calculating taxes.

The car licenses database contains:

- the identification key of the person; it is very important for the connection with other databases and information extraction regarding the car license holder;
- the date when has sustained the exam; it is important for determining the person age like driver, establishing the terms for license change and periods for the holder medical review;
- the test that the holder had for examination to obtain the license car;
- with who gave the exam; such information is important for the assessment of the person who make the evaluation; if the person which receive the permit is involved in many road events, the evaluator must be penalized;
- which scores had for promoting the exam; the auto license holder is likely to face problems related to traffic issues on which he was penalized at the examination; at the production of road events should be analysed the causes; if they are related to the wrong subjects at the exam is necessary to increase the lower limit for passing the exam;
- the contraventional events history record all driver contraventions, penalties imposed, the dates on which it occurred;

The diplomas database:

- concerns information about the diplomas that the educational system award to the people; on these are directly interested all the companies operating in the market to hire staff;
- each diploma has unique identification elements; issuer, location, series, number are elements that uniquely identifies a certificate issued so that are no more diplomas with the same identification elements;
- identification elements of its owner; each certificate is awarded to a single owner; the diploma is nominal and is valid only for the right holder thereof; the identification elements of the owner must be accurate and complete so that there is no doubt regarding the diploma right holder.

The diplomas retrieving will be made by the owner. At the education database, the lowest level is the school, university where are kept the notes. At the next level are taken aggregated data in the form of average and aggregate scores.

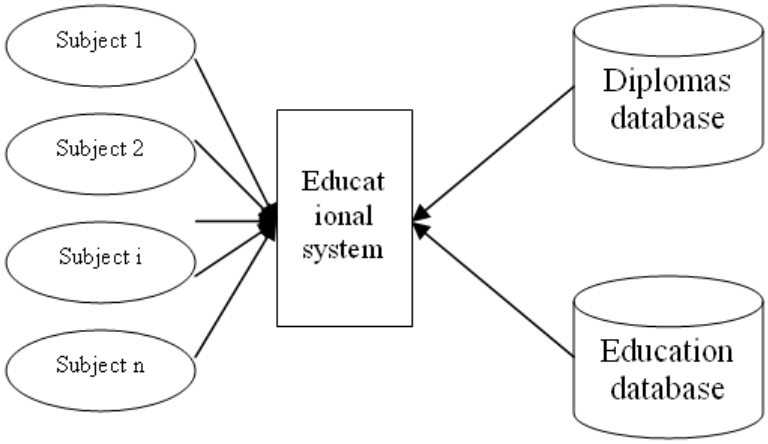

Figure 3 - The educational system databases

In (Figure 3) the education system databases' operating mode is showed. All subjects implied in the educational system have their data contained by the databases and their identification is made by the personal numeric code. All citizen oriented informatics applications must use the education system's databases to retrieve data and not require it from the user.

The health database suppose the existence of data about each individual receiving medical care. The health database must include:

- the unique identification key; after the personal code number, unique identification key, are found individuals in a single way, no two persons can be identified by the same code; the unique identification key is used for communication with other national databases;
- the description of the physical characteristics of the person to be identified if the unique identification key is not available;
- the description of physiological and anatomical characteristics;
- the detailed list of diseases for which the person suffers;
- the list of most likely diseases to affect the person;
- the detailed list of medications that the person using them;
- the results of a national set of tests established by experts;
- complete descriptions of medical interventions suffered by the person.

If a person needs medical services, the database is consulted and extracted all the information necessary to a quality medical service.

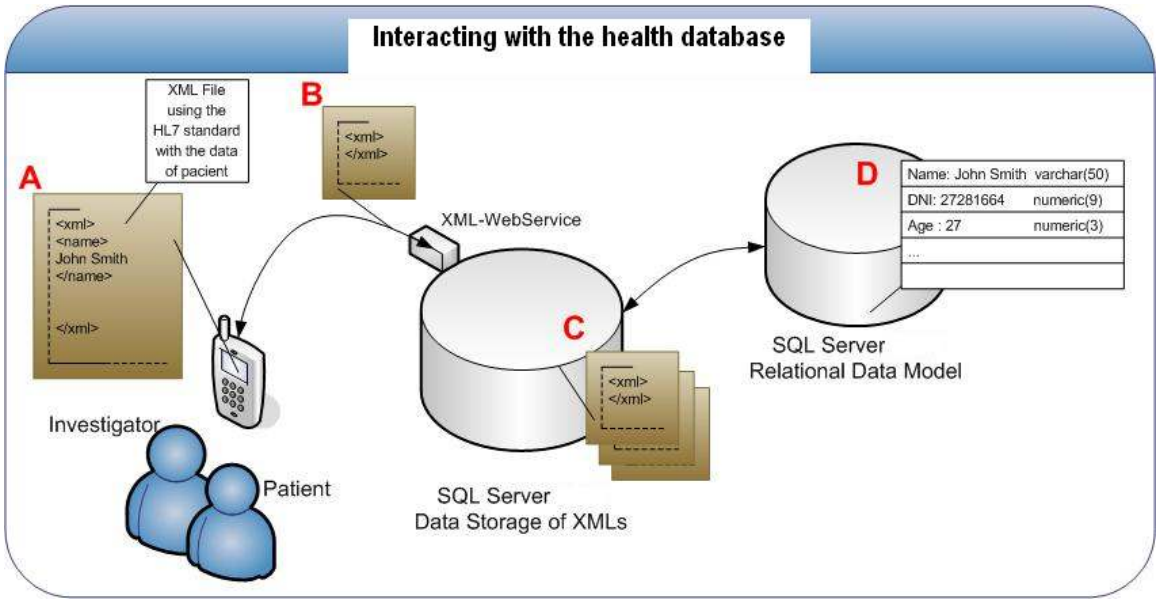

Figure 4 - Interacting with the health database [WEB2]

In (Figure 4) the way to interact with the health database is showed. The investigator makes data requests from a computer or mobile device to the database. The request is made using the XML language and thus it is redirected towards a server that reads the XML file and does the actual request to the database. The data is sent back to the investigator through XML and its device reads the file and shows the data in a graphical context.

The cadaster database:

- must be complete;
- use spatial data for defining the surfaces;
- contains information on land owners;
- is used to determine the persons affected by natural disasters and to warn them;
- is used for national projects;
- is updated when making transactions;
- contains data on natural resources related to stored areas;
- contains data on the flowing and still waters;
- contains technical data relating to buildings; the construction project, the used materials, the used standards are stored for buildings evaluation at any time.

The national database of institutions must include:

- the list of general interest institutions;
- valid addresses of the institutions;
- contact data for each institution;
- the activity field; the person which consults the database select the concerned activity field and receives information about only those institutions;
- digital content on the institutions or links to sites that offer this digital content;

The national databases are designed as a whole and:

- at the bottom level are stored high detail data on the described item;

- at the next level are taken aggregated data like averages by each year of study, group indicators, aggregated indicators by zones;
- at the next level increase the aggregation level and are taken more concentrated data, the process purpose is retained at that level; the diploma obtained, the indicators for whole population, aggregated indicators for the whole analyzed system are stored at this level, the system is so designed as to achieve crossing from the base to the top and vice versa.

The databases on the last level are built by the same template. There are unique procedures. Is built a virtual national database by linking the databases on the last level, work achievable if and only if the databases on the last level are:

- homogeneous, with the same template;
- use the same procedures;
- have the same quality level because the planning and quality control were made on the same procedure;
- there is a strong correlation between these databases.

People from the diplomas database should be found in the databases of the population.

Using national databases

Using national databases should be restricted so that only authorized persons can access them. Some information from national databases are available to all without requiring special authorization. The aggregated indicators at the level of counties, countries are data at which everyone has access.

The national databases should provide the whole necessary information at one time, the extensive search process being automatically conducted.

When a person is in a special situation of health, by the code number, unique key for national databases in which is stored information about individuals, is searched information in all the databases which have relevant information for the health status of the person, so that the first steps taken to be effective and grounded.

The information in the originally data set received should not be redundant, overcrowded, so that those who consult that information to find quickly what interested him. Initial data are detailed at the user request, but the process is automated.

When a person violates traffic rules, based on the driver code number the agent receives all the data about it. All issues related to driving license shall be reported to the agent. Based on the unique vehicle identification elements is received information about the owner, the technical duties and taxes paid. Any inconsistencies with the laws in force shall be automatically reported to the agent. This grant, if is the case, penalties to the driver and they are immediately updated in the database system.

Data on population are consulted by anyone, not at the atomic level, but at the aggregate level on commons, cities, counties, country.

The data from the education database can be consulted at the atomic level only with authorization. The aggregate elements are accessed by anyone. Available to users are offered services of diplomas certification, so that employers can verify candidates diplomas for employment.

All transactions involving large sums of money must be processed only if the parties have paid all fees and taxes. For this, is consulted the population database when processing transactions that exceed a certain threshold.
For the release of permits, certificates, authorizations, also check if the applicant has paid all fees and taxes to be paid. If all fees and taxes are paid, the process is continued in order to solve the problem, if not is asking to pay them.
At the e-banking services offered by the banks, based on the personal code number of the account holder are extracted from national databases all payments that he must pay and they are displayed. Fees, taxes, fines and other payments are simply made and without effort from the user.
In relations with all the institutions, the citizen will be authenticated based on the personal code number and all the operations are performed based on it.
All of this must have a digital content whose management must be ensured so that the database content being complete, accurate, available, updated in real-time and interconnected.
In order to ensure the quality of databases:

- when loading, the operator is identified;
- there is the identification of the person which certify the accuracy;
- each field has associated the operation type and the operator;
- the consultation operation is restricted;
- are updated in real time, with the authentication of the operator who make the changes;
- are provided opportunities to return at the system state in a given moment of time.

Through these, is ensured a high quality level of national databases.

4. Project structures for citizen oriented applications

Citizen oriented applications are developed using projects financing. The owner, the one who gives money, first of all makes a business plan which includes:

- the resources used for the development of COIA;
- the time used for the implementation of COIA;
- COIA running period;
- estimated gained profit;

All these are based on a new vision in which in the centre of all things is the citizen who can access all the resources of COIA for resolving his problems. The owner, the organizations with which citizens interact by COIA means, all this are getting on second plan, making so that the citizen can obtain a maximum degree of satisfaction of his expectations accordingly to his objectives. The rules are changed, passing from the idea according to which the owners of COIA and organizations with which COIA interacts think that the citizen is constrained to use their services for resolving problems to the idea that the citizen it is viewed that the only person which can bring profit for the owners of COIA as well as for the organizations by means of:

- access number of COIA;
- transactions value;

- respecting payments due time;
- changing due date of payments;
- multiple training effects resulting in an increased citizen number;
- minimization of the expectation period.

Application market is studied. If a person which made project management for a couple of important IT projects, identifies a problem which through the implementation stage can generate advantage, then all which are affected will develop a project offer. Project structure is [WEB1]:

- general context;
- particular context;
- policy and domain legislation;
- mentioned problems;
- interested parts and beneficiaries;
- project justification;
- projects that concern the problematic discussed;
- comparative advantages;
- project impact;
- project output;
- durability;
- risks and assumptions;
- institutional work place and coordination;
- strategy and methodology;
- government participation;
- surveillance and knowledge change;
- communication and visibility;
- reports schedule.

For that person, project manager, which has the idea, selects specialists for the elaborating the project offer which must be:

- clear, the clarity is a characteristic which increase the chance of succeeding in the process of evaluation;
- concise, the characteristic of the proposal to make referring only to necessary elements, redundant elements or those who do not presents importance for the project are being eliminated;
- consistent, consistency is given by the degree in which in the project description appear all the elements necessary; if not, the project offer may not obtained the finance;
- correct, data correctness and operations made are vital for the good development of the project, if not the finality cannot be achieved;
- trustable, regardless the performance of the project, this isn't declared as a project winner unless they are presented in a convincing manner;
- realist, the projects must be finished in the declared period of time using only the resources declared as needed; a project on which the time period correlated with the demanded resources aren't real isn't financed; as well a project for which the result doesn't justify resource solicitation isn't financed;

- meaningful, the project offer must be easily understandable; for this a series of simple terms are used otherwise when specialty terms are needed they must be specifically explained as simple as possible;
- organized, this assure the visibility of important elements, of their structure, spatial separation of generic idea and good visibility of certain elements.

Project manager, for the identified COIA, try to determine who the possible candidates for financing the project are and try to get in touch with them. If the project offer is realist, well done, trustable regarding the positive effects that may occur and the profit that investors could gain then this will bring money to participate on COIA. In this moment, project manager and investors assumes the risk of developing the COIA and the risk concerning the citizens that wish to use the application.

The project is a complex solution and it involves the following:
- elaborating the offer;
- obtaining financing;
- activity process;
- project audit;
- project implementation;
- project granting.

Shifting the importance aspect to citizen demands that on project offering and during the implementation activity process, citizen behavior regarding the application must be measured rigorously. Project manager's high degree of expertise in the field, allow him to change his attitude concerning the citizen. If earlier IT projects were developed to resolve some informatics issues for assisting the decisional process, COIA radically change the way of designing projects. The profit ratio depends exclusively on the citizen. Organization must offer resources and services to citizens, serving them under very strictly procedures. This change of stand of investors and organizations in the same time determines that the risks concerning COIA as a business to be oriented to the project manager, investors and organizations. That's way the project manager, investors and organizations must interact consciously, knowing that only highly satisfying the needs of the citizens, the project implementation can be a total success. The risks concerning the citizen refer strictly to the manner in which this is interacting with the application. At the development stage, ways of minimizing these risks must be found. In this way the citizen is helped with additional information and decisions, not to produce errors that can contribute to resource consumption.

For the college enrolment activity, are analyzed the classical version of the events followed by the citizen oriented variant. In the classical variant, the citizen enters the internet and can see where to take the exam. He writes it on the paper. He goes and pays *n* number of bills if he wants to go to *n* faculties. Goes and makes the registration. He goes with the folder with the receipts and the photos at the operators. He receives n tickets. Then he goes to see when the exams are scheduled. He takes the exams. He goes to see the results. Takes the final option and follow the faculty.

The citizen oriented variant involves other activities. The person enters the internet, selects the colleges, makes the payments and gives identification data. Automatic payments are recorded. With the identification data, from the Ministry of Education the BAC diploma is taken, from the Ministry of Health information on health and from the population database the existence. Photo used for the registration is the latest picture made by the citizen and stored in a national database. Is communicated the acceptance to data entry and the dates when you must be present at the examination and the halls also. With the identity card that has a chip or a bar code that passes through a reader at the entrance to the exam, enters room. He gives the exam and submits test grid when it is entered into a slot with an ID card inserted into another, it is scanned and the results are shown. He receives a password to sign. Using the password he can see the results. He selects the college where he wants to go. The result is displayed as a table in which the individual is highlighted. He registers. He takes the exams and the results are recorded into a database. At the end of the faculty, with the status in the database, a diploma is given. Data about the student go to the database of the Ministry of Education.

The duration of waiting times of the citizen are reduced substantially in the case of citizen oriented variant. It should no longer deal with obtaining of all necessary documents in physical form whereas the process is automated, based on the code number, or to move to the various headquarters of the institutions involved in the process.
Reducing the terms of waiting lead to a reduction of costs incurred in the process. Costs are reduced due to elimination of both physical components required and eliminating the citizen movements to solve the problem. It is also recorded a minimization of costs by the organization that adopts the citizen oriented model. Even though the income from tax registration should be shared with the owner of the citizen oriented application, the reduced costs of using the application is much larger than the transferred, and the satisfaction felt by the citizens is much greater. If there are made two offers of projects, one for each of the variants above, the second shows that the investors will take a part of the amounts paid by the applicants and students for using the application, and the organization of education will also take a part. All is played by the offering of the application. COIA coexist with the manual classic work. If the application is bad, creates discomfort to the citizen and it is not getting savings, the citizen will use the classic application and all will lose the profit. The organization can estimate a discount by the number of people who are not involved in the process.

In admission were involved 50 persons. Each cost makes 1000 Euro. 35.000 candidates were included. It results a cost of 50000/35000 per candidate. Through the application is expected to be enrolled 20.000 candidates. It means that only 25 people will work. It results a saving of 25 * 1000. If you take a discount from the result of (25-x) * 1000 and is divided to 20.000 it results that the economy of the salaries is reflected in the discount, but it is possible, in this context, that the number of users is not 20.000 but 25.000 and then the profit for both the organization and the level of the investors will increase. It is a matter of economic efficiency of investment by COIA.

5. Conclusions

The informatics applications oriented to citizen come to meet the needs of users in the terms of digital economy. These all meet the highest requirements of citizens and the digital economy. For these facts, citizen oriented applications have special features besides the classical applications. Completion of the highest degree of these features lead to increased satisfaction of the citizens who use them. Since the diversity of problems that people have to do is very high, citizen oriented applications know a great diversity. The criteria for the classification of the applications are diverse and specific to this type of applications. To ensure a high quality to the citizen oriented applications is required making changes in the cycle of development compared with classical applications. In all the stages of the development cycle, the actions are designed to achieve an application that serves primarily the citizen, not the owner. A very important stage of the development cycle of citizen oriented application is the study of the target group. At this stage the target is studied in terms of characteristics, requirements, problems and particularities. Thorough study of the target group and respecting the requirements of this in other stages of the cycle development ensure obtaining high-quality applications that meet the needs of citizens. To implement citizen oriented applications, data sources are very important. The principle that people should introduce as little data as possible is satisfied to a great extent only if the application uses national databases and, based on unique identification keys to the citizen and links between databases, all information necessary for citizens are extracted and used by application. Databases should be constructed to include all information relevant to the field for which they are constructed. The existence of national databases lead to the development of citizen oriented applications in which the degree of automation actions is very high.

This article is a result of the project „Doctoral Program and PhD Students in the education research and innovation triangle". This project is co funded by European Social Fund through The Sectorial Operational Programme for Human Resources Development 2007-2013, coordinated by The Bucharest Academy of Economic Studies.

REFERENCES

[ROGH06]	Ion Gh. RO□CA, Bogdan GHILIC-MICU, Marian STOICA – Informatica. Societatea informa□ională. E-Serviciile, Editura Economică, Bucure□ti, 2006, ISBN 973-709-266-X, 488 pg.
[POIV08]	Marius POPA, Ion IVAN, Drago□ PALAGHI□Ă, Bogdan VINTILĂ – *Quality metrics of citizen oriented informatics applications,* Forth International Conference on Applied Statistics – ICAS4, Bucharest – ROMANIA, November 20-22, 2008
[BOPO08]	Cătălin BOJA, Marius POPA, Iulian NI□ESCU – Characteristics for Software Optimization Projects, în Informatică Economică, vol. 12, nr. 1, Inforec, Bucure□ti, 2008, pp. 46 – 51
[IVNO05]	Ion IVAN, Gheorghe NOSCA, Sergiu CAPISIZU - *Auditul sistemelor informatice*, Editura ASE, Bucuresti, 2005, ISBN 973-594-638-6, 155pg.
[LURU05]	Luquan Jiang, Ruiming Wu, Ying Li, Huanchen Wang - Citizen-oriented community e-government service platform, International Conference on Services Systems and Services Management, Proceedings of ICSSSM vol. 2, issue , 13-15 June 2005 Page(s): 1434 - 1437
[GAMA04]	Frederick Gallegos, Daniel P. Manson, Sandra Senft, Carol Gonzales - Information Technology Control and Audit, Second Edition, Publisher: Auerbach Publications, 2004, ISBN-10: 0849320321, ISBN-13: 978-0849320323, 720pp.
[CAYE07]	James Cadle, Donald Yeates - Project management for information systems, Publisher Prentice Hall, 2007, ISBN-10: 0132068583, ISBN-13: 978-0132068581, 464 pp.
[EVMC07]	Gerald D. Everett, Raymond McLeod, Raymond McLeod - Software testing: testing across the entire software development life cycle, Publisher Wiley-IEEE, 2007, ISBN 047179371X, 9780471793717, 261pp.
[WILS05]	Graham Wilson - Six sigma and the product development cycle, Butterworth-Heinemann, 2005, ISBN 0750662182, 9780750662185, 234pp.
[WEB1]	http://www.fao.org/tc/tcp/docs/standard_project_en.doc
[WEB2]	http://lsc.dc.uba.ar/digital-inclusion/hl7.jpg
[WEB3]	http://en.wikipedia.org/wiki/Software_development_process