# Risk and Resource Management in the Development Process of Citizen Oriented Applications

Bogdan VINTILA
Academy of Economic Studies, Bucharest, Romania
vb@vintilabogdan.ro

*The paper focuses on the risk management in the development of citizen oriented informatics applications. These focus on the citizens' needs and requirements and special risks arise from this approach. Citizen oriented applications' general concepts are presented. The resource management process for the project of developing citizen oriented informatics applications is presented. Risk categories are defined for this category of applications. Risks that appear in the development process for such applications are identified. Solutions to control risks are identified and described. Costs of uncontrolled risks are estimated through a model. Directions of research regarding risk management in the development process of citizen oriented informatics applications are presented.*
***Keywords:*** *Risk Management, Citizen, Applications, Control, Costs*

## 1 Citizen oriented 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 [1]. 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 [2];
- 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; the advantage of this structure is its simplicity; the disadvantage is that the user can't go to previous steps;
- 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; the structure has the advantage of being simple and easy to follow; a disadvantage is the inability to have more branches;
- 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; the structure is well fitted for simple applications, but the lack of multiple branches doesn't recommend it for more complex ones;

- 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; the advantage of the structure is the simplicity of use; the disadvantage consists in the inability of using this structure for complex applications as it allows advancement only in one direction;
- 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; the structure is suitable for informing applications for which it is important 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; it allows navigation in every direction on logical basis; the main disadvantage is the high complexity; this structure is suitable for 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.

The e-governing applications are used in the relation of the state with the citizens for solving different situations in which they are partners [3]. 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.

## 2 Resource management

The development of applications assumes the usage of resources that are used in the development process with the aim of reaching objectives. Resources, regardless their nature, are finite and must be managed during the development cycle to ensure the set objectives are reached.

Depending on the type of project there are many types of resources that are used:

- raw materials are used in the creation of finite products through different processes; the quantity of raw materials an activity needs depends on the quantity of finite products desired, the quality of the raw resources, the quality of the finite products, the manufacturing process, the equipment used; for each finite product a quantity of raw materials is necessary; the total quantity of raw materials needed is given by the number of finite products desired to be manufactured multiplied by the quantity needed for a product; the

quality of the raw materials is an important factor in the manufacturing process; in order to be successfully processed the raw materials must meet quality standards; the materials that don't meet the quality standards of the manufacturing process are directed towards activities with lower quality standards or are disposed; thus, if the quality standards of the manufacturing process are higher than the quality of the raw materials, a part of the raw materials don't enter in the manufacturing process and they must be replaced; the quality of the finite products also influences the quantity of required raw materials; no manufacturing process is perfect and imperfect products result; the percent of rejected products from the total production depends on the quality standards imposed to the final lot; the higher the imposed quality level is, the larger the number of rejected products; the equipment used for manufacturing the raw materials has different characteristics and, thus, different efficiency; if the efficiency of the equipment is high, the loss of raw materials during the manufacturing process is low;

- materials are parts of larger structures; these are not processed, but manipulated, combined, resized in order to obtain a complex structure; materials are obtained from raw materials in a manufacturing process, so they are actually finite products of a process; materials are characterized by quality characteristics and, just like raw materials, can be unsuitable for reaching some aims;
- equipment are used for processing raw materials and combining materials by human operators or computer systems; the types of equipment used in projects differs from a project to another; large projects for infrastructure creation use heavy equipment, while regular software development projects use lightweight equipment; equipment are critical elements for projects as in their lack most of the projects can't finalize at deadline or can't finalize at all;
- human resources consist in all people implied in the project; each person has a certain role and during the project fulfills tasks; the tasks each person must do depend on the role that person has in the project; the roles are ordered in a hierarchical system and they have only one direct higher role and many lower roles they coordinate; the highest role in a project is the project manager; this is the highest position and has the highest coordination power; the project manager sets the responsibilities for each of the roles directly underneath it; the success of a project is in a great measure related to the skills and experience of the project manager;
- communication is a resource even if the costs are very low in the present; due to the development of the communication technologies the costs have decreased continuously while the quality of the process and the transferred data volumes increased; as all costs in a project add to the final balance, the communication costs are to be minimized while maintaining a certain level of the process; the communication process must be fast enough so that persons implied in the project can transmit and receive information in a time period that is much smaller than the time period the information is valuable; information is valuable as long as it presents interest for the person receiving it and is not obsolete; critical situations require, for quick contra measures, instant communication between the persons implied in the project so that all know their tasks and start them as soon as possible;
- auxiliary consumables consist of electricity, water, gas, air; these are used in the manufacturing process but are not a direct part of the finite product; even software development projects need electricity for operating the computers, but the consumed energy is not found in the resulting piece of software; all these have

costs and they must be taken into account when analyzing the project; aside from the actual cost of these resources the cost of transportation is also an issue; large consumers of auxiliary consumables must analyze at the start of the project what's the best location for it; for operating equipment that consume much power the best locations are near electrical power plants while manufacturing processes that rely heavily on water should be placed near water processing plants;

- financial resources are those that move all things around and that's true for projects too; they are finite and express everything in a project; the raw materials and materials have associated costs, equipment are bought or rented, human resources equal wages, communication is purchased as service or equipment, consumables are paid for consumption, information and knowledge also charge; there is a direct correlation between the financial resources available for a project and the time the project is finalized in; large financial resources give access to best materials, equipment, human resources and knowledge and these combined create the synergy effect; financial resources are usually equally distributed on all phases of a project and so is the financial income; there are projects for which a certain task or activity requires a large quantity of financial resources in order to finalize successfully; such situations must be treated with care as they might endanger the whole project;
- information are meaningful parts of data; data are recordings of facts, events, attributes, actions, states; data are of no use for the wrong person; in project management each role has associated data and information it must receive and analyze; if data and information is sent to the wrong person they are totally meaningless and can't be interpreted or their significance is too low; activities must be detailed by the ones performing them, but the project manager must receive only totalizing reports not thousands of individual ones; information is stored most often by using databases or files; databases have the advantage of allowing users to retrieve information on the basis of many criteria and also update and insert data with low effort; the overhead is that they require a database management system installed in the system; the files don't require such a management system and they depend only of the environment; they can be moved easily between machines; the retrieving, adding and updating operations are less optimized than the database counterparts, but through different techniques the performance level can be comparable under some environments;
- knowledge is what makes valuable assets out of people; knowledge is a combination of techniques, information, experience that makes the owner better of taking decisions than a person that lacks the right knowledge; people are container for knowledge and this makes them valuable for companies; if one knows how to do something well then he creates advantages for the company he's working in and the company is aware of that; people with great knowledge are aware of their value and they have many options in the domain they activate so they also have demands; financial benefits are motivating for them too, but they also require flexible schedule, trust, access to information, time for maintaining and improving their abilities, recognition, respect; in the knowledge based society the products and services improve through knowledge and also people are more or less valuable on the labor market depending on the knowledge they possess.

In Figure 1 resources implied in projects are presented. Depending on the nature of the project the resources are used in different proportions. All resources needed by and activity must be available in order to avoid delays and respect the deadline.

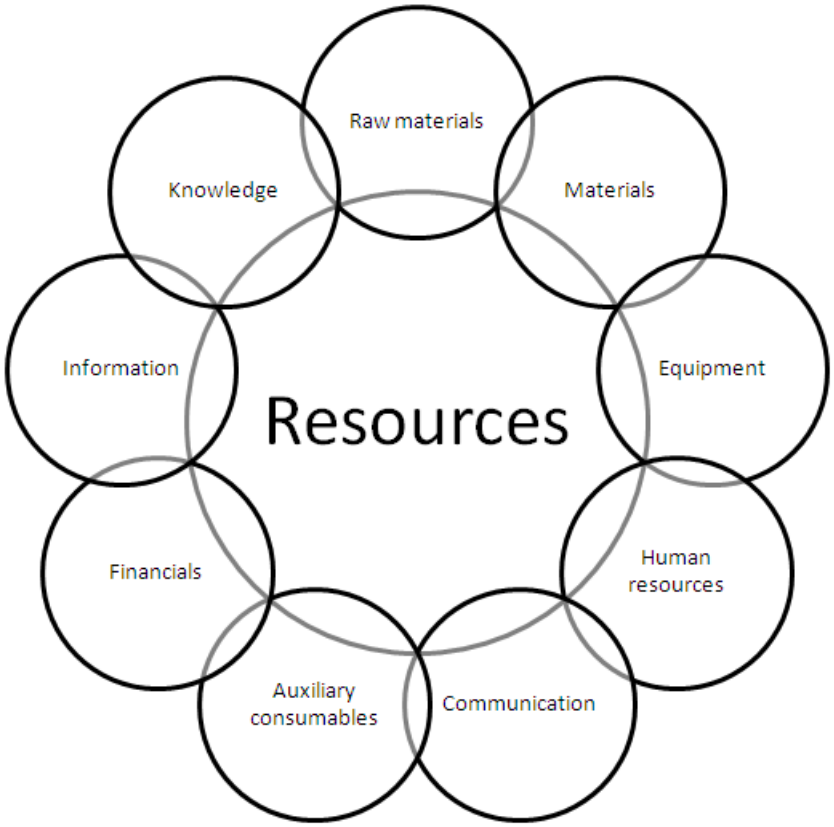


**Fig. 1.** Types of resources

The waste of resources is an important issue in project management. The wasting of resources happens when for an activity they are allocated in a larger quantity than the necessary one. Determining the necessary quantity of resources for an activity is a problematic issue. Even if, at first sight, the necessary quantity is the one without the activity can't finalize, the problem is more complex. For a project to finalize at the deadline it is necessary that the activities on the critical path finalize on time and the others don't cause delays. The optimum quantity of resources that must be allocated to an activity is the minimum one that makes the activity finish in time and achieve its aim.

In Figure 2 the process of optimum resource allocation is presented. The first step is the selection of the activity for which the resource allocation is done. The second step consists in the identification of all resources required by the activity. For each of these resources the optimum quantity is calculated. The resource in cause is allocated to the activity. If the allocated quantity is not equal to the optimum one the cause of the waste is identified and the optimum quantity is recalculated and the process repeats until the calculated and the allocated quantities are equal. If the current activity is the last one the process ends, otherwise another activity is selected and the cycle is repeated.

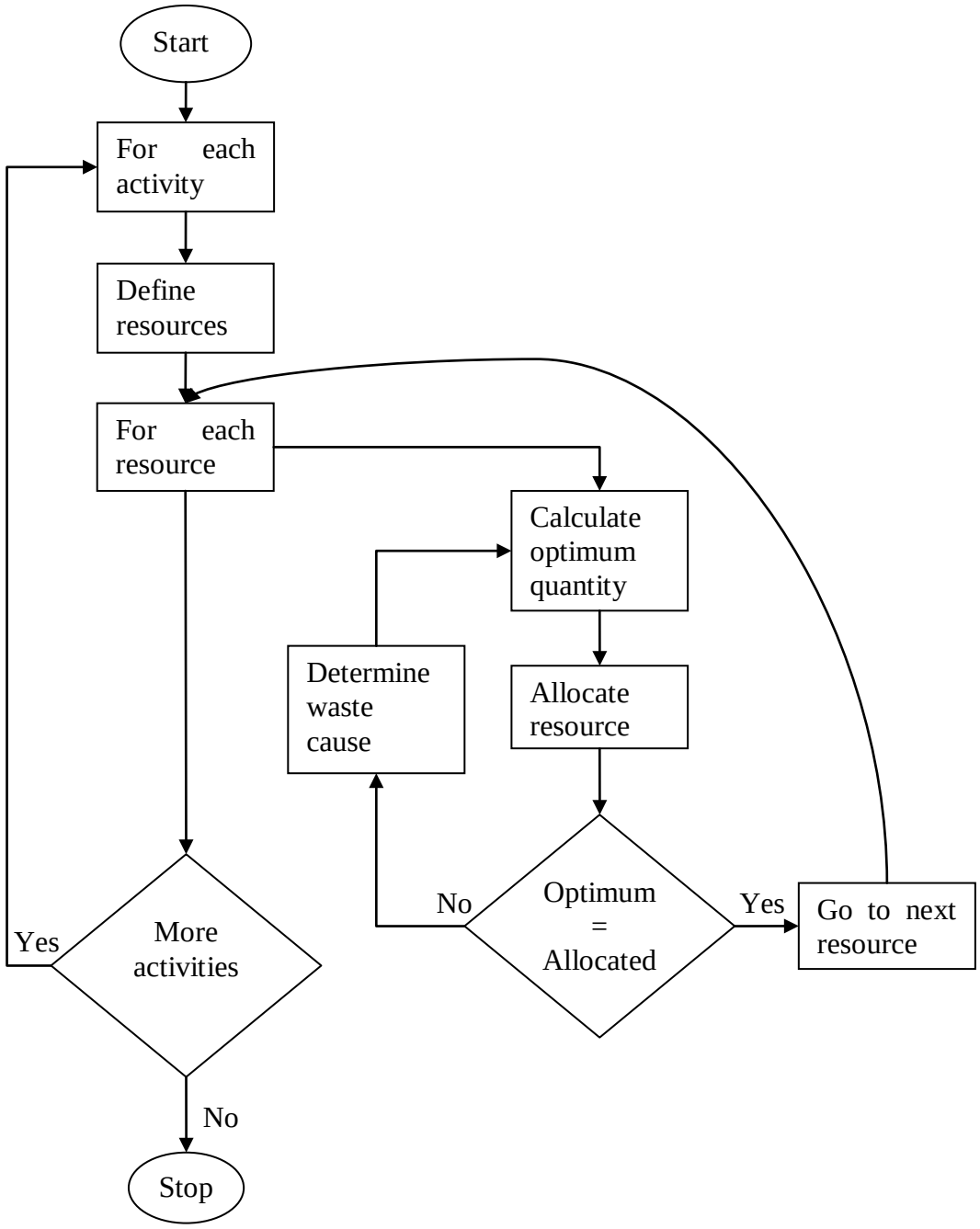


**Fig. 2.** Optimum resource allocation process

The development of the application for the analysis of structured entities implies the use of various resources. Table 1 shows the resources that are used in the development of the application for the analysis of the structured text entities.

The information represents all the data needed for the development of the informatics application. It is considered that it has no cost of its own as it is obtained for free through the use of the Internet connection. Information is used in the whole project in every stage of it. The quality of the used information influences the ongoing of the project and the resulted product.

For the development of the application for the analysis of structured text entities (AETSO) a computer for the source code editing and the storage of files is needed. This is used on the whole project's duration. The source code takes shape in the form of source code files and the application in the form of application files that are loaded on the web server.

**Table 1.** Resources used in the development process

| Resource | Cost (RON) | Time of use |
|---|---|---|
| Information | - | Whole project |
| Computer | 3500 | Whole project |
| Software | - | Whole project |
| Internet connection | 50/month | Whole project |
| Web domain | 150 | Whole project |
| Web hosting | 400/year | Whole project |
| Technic support | - | When problems arise |
| Developer | 2000 | Whole project |
| Tester | 1000 | Testing stage |

The operating system and the integrated development environment are vital instruments for the development of software. For AETSO the programming language C# is used along with ASP.NET. The Windows 7 operating system has been installed on the computer and, for development, the Microsoft Visual Studio 2010 IDE. The database support is ensured by SQL Server Express. The management of the development project was made with the assistance of Microsoft Project Professional. The software products are used on the whole duration of the project.

The Internet connection is necessary for obtaining the information necessary for realizing the project and for loading on the server the application's files. The connection is available with monthly subscription.

The web domain is needed for the online use of the application for the analysis of structured text entities. This is a lifetime acquisition. After the domain is bought, it is registered at a web hosting provider.

The hosting of the application on a web server is compulsory. If the application is not hosted the users can't access it. The web hosting is available with and annual subscription. Free hosting is not an alternative as no ads must be shown in the application and also an SQL Server database support is required.

The technical support is included in the annual hosting subscription. The support is only necessary for problems that depend on the application's hosting service.

The developer is for AETSO the person that makes all the stages of the software development cycle. The process of developing citizen oriented informatics applications assumes special actions are taken in the stages of the development cycle with the scope of ensuring the citizen orientation of the application. One of the most important phases is the analysis of the target group that leads to the identification of the problem and implicit and explicit requirements for the application. AETSO is built to assist the development of structured text entities and ensure rules are respected.

The tester is the person that accesses the application and inserts test datasets in order to observe the behavior of the application. AETSO has been tested by the developer with test datasets and also by a set of users that reported the encountered problems. All problems identified in the testing process have been treated and the testing process has been repeated. The longer the application is used by users, the lower the number of problems gets. The satisfaction of the users when using the application increases in time as more and more problems are treated and the application reflects more and more their requirements.

All resources are used during the development of AETSO and without any of them the finalizing of the project would have been impossible.

## 3 Risk categories

The development of citizen oriented informatics applications assumes the detailed analysis of the target group and the modification of the development cycle so that it changes the focus on the citizens'

needs. The project of developing citizen oriented applications is large and complex and faces many risks[4]. These are grouped in three categories:

- pre-development risks are those that may occur before the actual development of the application; these are very dangerous as they may lead to very large wastes of resources due to the fact that all design of the application might be deficient; such risks are:
  - the incorrect identification of the problem to be solved is often made as the real problem is confused with another one; this situation leads to the development of an application that solves a problem, but not the one the citizens face; this is a very big problem as important resources have been wasted in the wrong direction with no use for citizens;
  - the incorrect identification of the target group is usually associated with the incorrect identification of the problem; as the group does not contain the members it should, the analysis results lead to an application that is suited for the identified target group, but it's unsuitable for the real individuals facing the problem;
  - incorrect or incomplete analysis of the target group leads to poor quality requirements; the analysis of the target group assumes the identification of the characteristics the members possess and their levels; if the characteristics and their levels are either incorrect or incomplete, the implicit and explicit requirements of the application will also be incorrect or incomplete and thus, the resulted application will be unusable by the members of the target group;
  - incorrect or incomplete specifications make the resulted application of inadequate quality or with important features missing.
- development risks are those endangering the actual code writing, testing and implementation of the citizen oriented applications; these steps of the development of the citizen oriented applications are influenced by the pre-development risks; if any of those happen, these steps will suffer accordingly; additional risks that appear for the actual development are:
  - incomplete implementation of the requirements is caused by omissions in the coding process or inadequate solving of the defined problem; the members of the development team implement some requirements before others and they may forget about some of them; this leads to an incomplete application;
  - inadequate performance caused by faulty implementation of algorithms makes the application loose points to the competition; even if the requirements are accomplished by number, not always they are meet by quality; the quality level of the implementation of the requirements is as important as the actual fulfilling of the requirement;
  - lag behind the schedule is caused by the overwhelming of the team members by the complexity and size of the project or by periods of inactivity; the size and complexity of the project cause lags behind the schedule if they are underestimated and not enough resources are allocated.
- post-development risks are those affecting the citizen oriented informatics application after it has been launched to the public; these affect the maintenance process and the functioning of the application; such risks are:
  - high maintenance costs are caused by non-modular design of the application and lack of documentation; the tighter the classes and modules are, the higher the costs of the maintenance; the effort of doing changes in such code with no documentation is very high and the maintenance team needs much time to perform minor changes;

- long time between the need of updates and their actual implementation is caused by a slow mobility and reaction of the maintenance team; the longer the maintenance team starts the update process, the longer the users will bear not having the desired requirements;
- the disappearance of the problem the application solves makes it obsolete; for the citizen oriented applications the risk is high only in the e-government area where the changes in the legislation are the factors of the high dynamics.

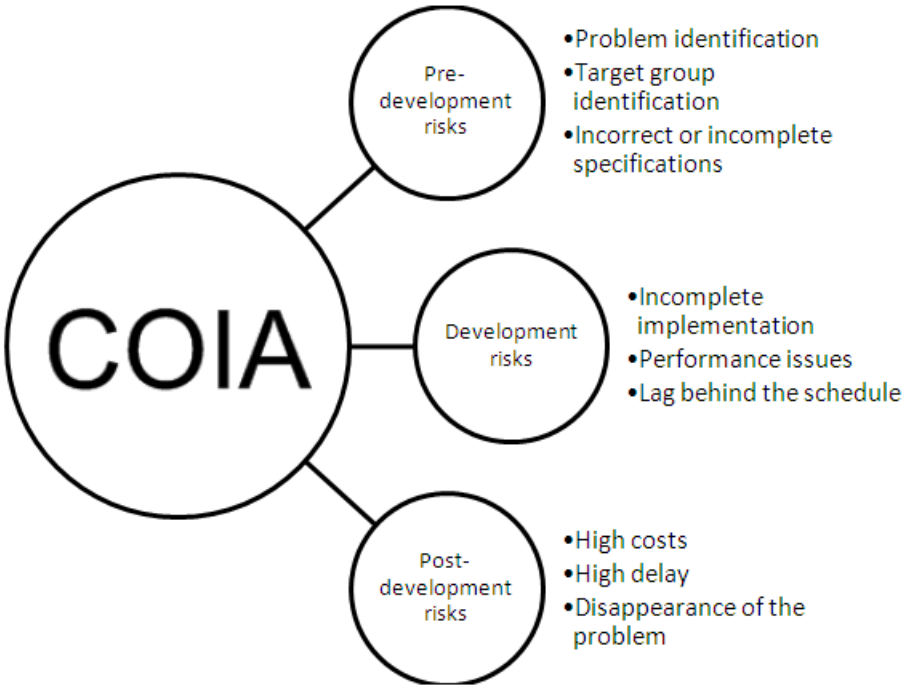


**Fig. 3.** Categories of risks in the development of citizen oriented informatics applications

Figure 3 shows risks and categories of risks in the development of citizen oriented informatics applications. The categories are created on the basis of the moment of time the risks affect relative to the development moment.

## 4 Risk control and costs

Risk control is done through measures that are meant to eliminate the risks or diminish their effects on the development of the citizen oriented informatics applications. In order to be effective the measures must be taken before the risk appears.

For the citizen oriented informatics applications the control of risks must follow the following steps:

- the identification of the risk and the moment it is most probable to appear;
- the identification of the effects it has on short term and on long term on the development process of the citizen oriented informatics applications;
- the estimation of the costs implied by effects the negative situation has on the development of the applications;
- identification of possible solutions and choosing of one or a group of highly efficient ones;
- the estimation of costs implied by the measures required by the chosen solution;
- deciding whether to take measures to eliminate the risky situation or just address the effects after the situation appears.

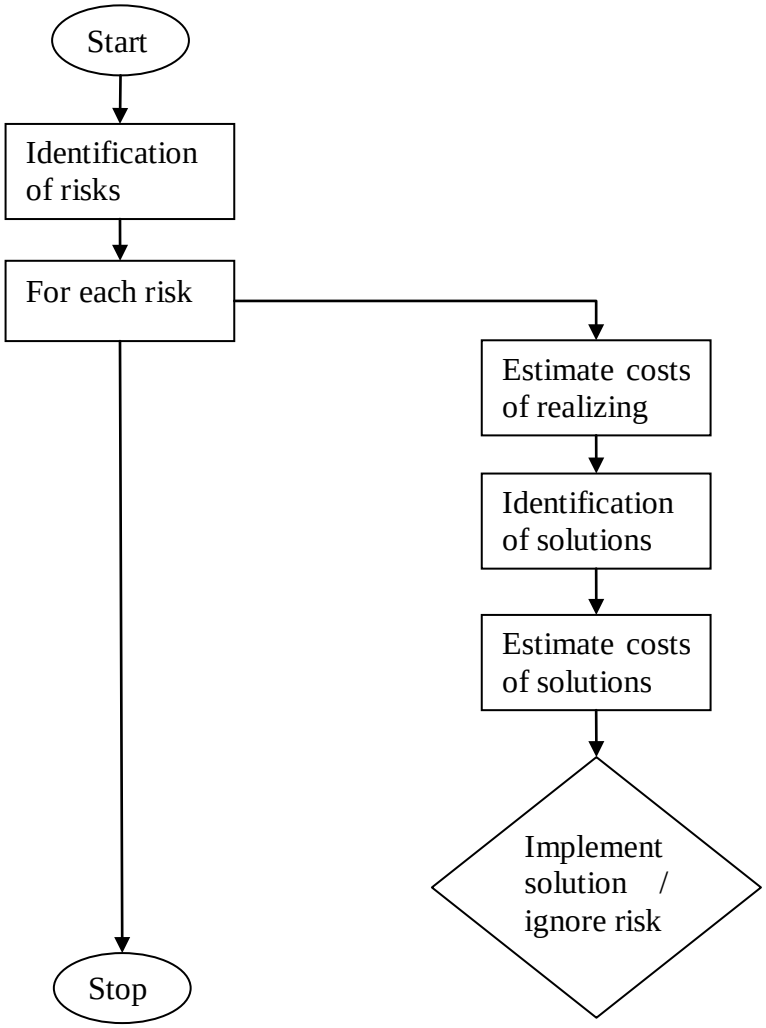


**Fig. 4.** Risk management process

Figure 4 presents the process of risk management. Risks are identified and for each of them a series of activities take place. The process finalizes when for all risks either a solution was implemented, either the risk was acknowledged and assumed.

This procedure must be followed for all risks. If the procedure is followed, it ensures the minimum costs implied by the risky situations are chosen.

The estimated costs implied by leaving all risky situations untreated, *CTRS*, is given by the formula:

$$CTRS = \sum_{i=1}^{NRI} p_i * CAR_i$$

Where *NRI* is the number of identified risks, $p_i$ is the risk's probability of appearance and $CAR_i$ is the estimated cost associated to the effects of the risky situation.

The total estimated cost associated to treating the risks, *TCTR*, is given by the formula:

$$TCTR = \sum_{i=1}^{NRI} CATR_i$$

where $CATR_i$ is the cost associated to all measures needed for treating the risk.

It is up to every project manager to decide if the safe road is better or not that the risky path. The safer path implies more costs on the short term but might save money on the long run[5].

## 5 Conclusions

Citizen oriented informatics applications are developed with the final user and his problem in mind. The resource management process must ensure that resources are not wasted and activities get enough resources to finalize. The developing project is complex and of

large size and thus it faces many risks. The three categories are designed considering the moment of actual development. Different risks are faced by the different stages of the development cycle. In order to control the risks one must take measures to eliminate the risks or to limit the effects. The cost control in the risk management process is made through evaluations and decisions of the project manager.

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**Bogdan VINTILĂ** graduated the Bucharest University of Economics, the Faculty of Cybernetics, Statistics and Economic Informatics and has a Master's degree in Project Management. He is currently a PhD candidate in the field of Economic Informatics at University of Economics. He is interested in citizen oriented informatics applications, developing applications with large number of users and large data volumes, e-government, e-business, project management, applications' security and applications' quality characteristics.