The Development of a Mobile Application in a Collaborative Banking System

Cristian CIUREA
Economic Informatics Department,
Academy of Economic Studies, Bucharest, Romania
cristian.ciurea@ie.ase.ro

This paper presents a taxonomy of mobile applications with accent on collaborative mobile applications. The development of mobile applications is described in comparison with the other types of informatics applications. Collaborative banking systems are presented in order to create the context in which the Collaborative Multicash Servicedesk (CMS) application will be integrated. The mobile applications are analyzed as auto-adaptive applications in order to reveal their advantages. Some metrics are built for evaluating the security and quality of Collaborative Multicash Servicedesk application.
Keywords: *Mobile Application, Collaborative System, Banking, Agents, CMS, Development*

1 Mobile applications

In [1] is considered that actual enterprises are adopting mobile technologies for numerous applications in order to increase their operational efficiency, by providing employees greater access to real-time information.
Mobile applications provide the advantage that can be accessed from anywhere and anytime. The nowadays companies have many branches in different locations from the world. Their employees need to move from a location to another, in order to fulfill the company needs. They are using mobile applications in order to access resources from different locations.
Other enterprises, like banks [2], offer to the employees the possibility to spend some of their time away from the office, to work anywhere using mobile telecommunications and computer technology. The tele-working is another factor that contributes in the development of mobile applications.
Mobile applications are defined as internet applications that fit very well in the mobile computing environment. The mobile computing can be viewed as an extension of distributed computing types adding mobility to host computers [3].
In Figure 1 is presented a new taxonomy of enterprise mobile applications, in which mobile applications are classified into five categories:

- mobile broadcast (m-broadcast);
- mobile information (m-information);
- mobile transaction (m-transaction);
- mobile operation (m-operation);
- mobile collaboration (m-collaboration).

Applications in the last three categories are rich and complex and pose different requirements and challenges than applications in the first two categories [1].

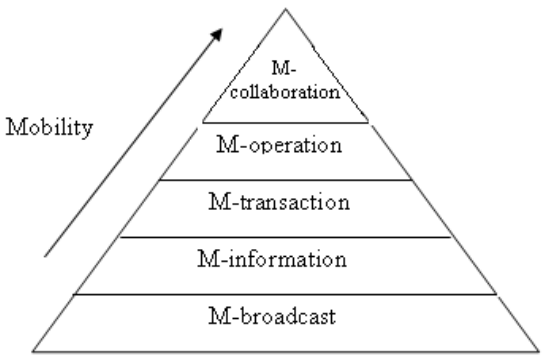

Fig. 1. A taxonomy of mobile applications [1]

Applications in the upper categories are richer and more complex than those in the lower ones.

Starting from the classification in Figure 1, a very important place in the banking field takes the collaborative mobile applications. These applications increase the collaboration between employees and various departments in a bank. Furthermore, they facilitate collaboration with other banks, customers and business partners.

The development of mobile applications is different by the development of a normal application, because mobile applications are designed starting from the mobile devices on which are used. In [4] is described the mobile version of IEEE Xplore website, the development of this mobile application being motivated by the growing popularity of using mobile devices for internet access. The difference between a mobile application and a normal one is that the mobile application provides the opportunity to answer of users' requests wherever they may be.

Google Apps, including Gmail, Google Calendar, Docs, and Contacts, want to provide access to their information regardless of location or device. These applications can be accessed from most common types of mobile devices, like BlackBerry, iPhone, Nokia S60, using operating systems such as Windows Mobile or Android [5].

In [6] is considered that the development of mobile applications can be simplified by appealing to the open-source market, where are some solutions for sustaining on-demand collaboration anytime and anywhere.

Section 2 presents the collaborative systems in the banking field and the role of agents in developing mobile applications. Section 3 describes the Collaborative Multicash Servicedesk (CMS) application as an auto-adaptive system and the role of neural networks in the automatically adding of new categories in the list of problems categories reported by the bank customers. In section 4 are defined some metrics for evaluating the security and quality of the CMS application.

2 Collaborative banking systems

A collaborative system with high complexity is represented by a banking company, having a large number of components and a large variety of links between these components. The complexity of the banking system is given by the operations that are carried out, but also by the collaboration between different banks from different countries and by the alignment to standards imposed by the regulations in this worldwide field.

The information system from a bank is a collaborative system, because requires the cooperation, communication and coordination of many software applications in order to achieve a common goal. This common objective can be represented by the successful processing of a payment order or by the interest calculation of a term deposit.

Through the informatics applications that are integrated in a collaborative banking system, the share of mobile applications is reduced because the security reasons. The Banking Security Department gives very restricted access to system resources and only for the people with managerial positions. In order to check the status of night processing transactions, that is automatically executed, the people from IT department have mobile devices, on which run mobile applications.

In a bank, there are mobile applications that are used internally, only by the bank employees, and mobile applications that are offered to the customers in order to have access to their accounts straight from the menu of their cell phone. The mobile banking service offered by a bank is very restrictive and allow the execution of only few operations, like viewing accounts information, the last five transactions executed in a specific account, or the interrogation of a loan payments account.

In Figure 2 are presented the banking operations that can be performed through the mobile banking service offered by a commercial bank:

Fig. 2. Mobile banking simulator [7]

Field of application criteria classifies the collaborative systems in:

- collaborative functional systems;
- collaborative micropayment systems;
- collaborative planning systems;
- collaborative tagging systems;
- collaborative writing systems;
- collaborative medical systems.

The collaborative functional systems include collaborative banking systems and cross all the activities taking place in the economy, providing necessary information and overall coordination for production and finance management [8].

The information system of a bank is the main component of the banking system, because it includes all the information about customers and their accounts, helping to reduce the amount of data available on paper.

The transactions databases from a bank contains information about the user who performed the operation, the channel through was done, from which workstation, in which date and which hour. These databases are updated in real time and are consulted by the Banking Security Department to discover any fraud attempts. If you find that, from a workstation, an operator makes a lot of transactions compared to other operators, or amounts transferred are very high, then it is done thorough research regarding these operations.

Increasing the volume of information and improving the software products for exploit it have led to a new quality of data usage by analysis that reveal to the organization's management information difficult or impossible to obtain otherwise. In this way are obtained information on customer preferences, their profile or distribution. It provides the management data regarding the region of the country where a product sells well, and which are the preferences of a particular market segment.

Such information is obtained only by using certain treatments, such as multidimensional analysis, statistical methods of forecasting and other mathematical methods applied to a very large volume of data. Mathematical methods advertise the use of specialized computer software, very complex. This software is available also on mobile devices and its efficiency depends on the configurations and capabilities of each mobile device.

In a collaborative banking system there are many agents that works together in order to accomplish the bank objectives.

A collaborative banking system with four agents, represented by seller / beneficiary, buyer / ordering party, the beneficiary bank and the ordering party bank, is shown in Figure 3.

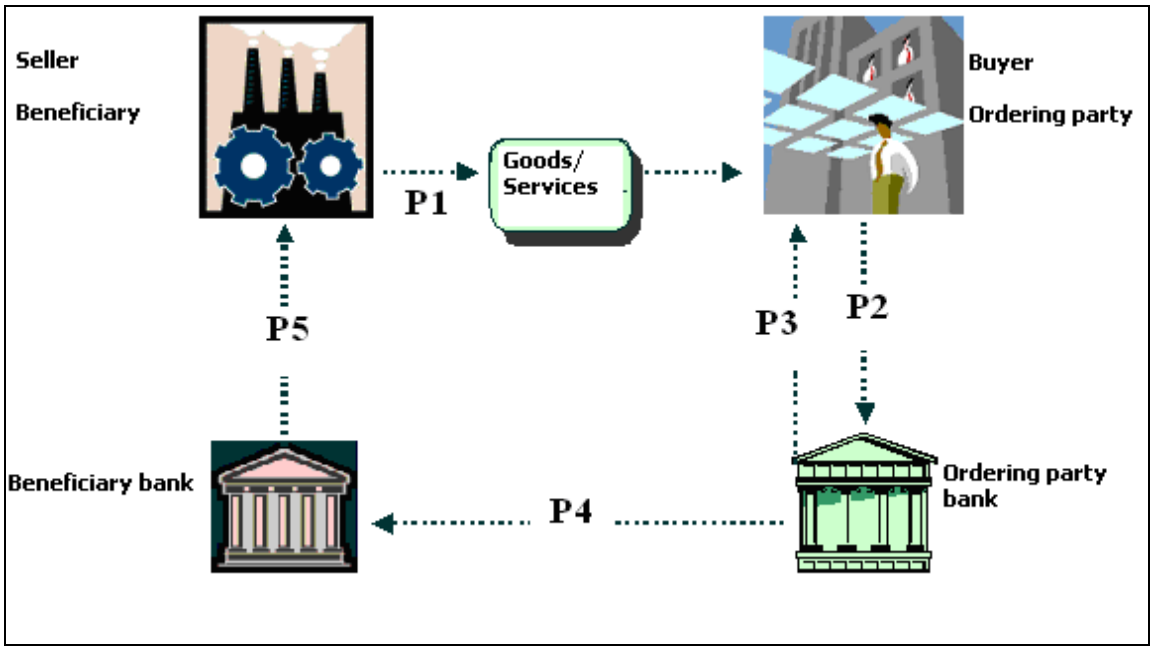

Fig. 3. Collaborative banking system

The interaction between the four agents is represented in five steps as follows:
P1. the seller delivers goods or services to the buyer;
P2. the buyer send a payment instruction to its bank;
P3. the ordering party bank debited the buyer account;
P4. the ordering party bank send the payment order to the beneficiary bank through the clearing company which runs all interbank transactions;
P5. the beneficiary bank credits the seller account;
One of most important characteristics of agents is the mobility. Starting from this characteristic, the agents are classified in stationary agents and mobile agents. The mobile agents are the entry points in defining and developing mobile applications.
The agents within a collaborative system are represented by any entity interacting or exchanging data in the system, be they people or software applications. Every agent's roles can be seen as a group of processes that an agent can execute. A process is one of the ways to use the collaborative system. The whole set of available processes define what the collaborative system is used for and demand a specific configuration [9].
Collaboration means more than two agents working together. It requires defining a shared goal and, in order to achieve this goal, the agents should create an agreement upon their courses of actions. Such an agreement is only achievable through negotiation [10].

3 Collaborative Multicash Servicedesk – an auto-adaptive mobile application

The goal of the Collaborative Multicash Servicedesk application is to store and process the customers' requests, solved by the Multicash helpdesk analysts within a commercial bank in Romania.
The Collaborative Multicash Servicedesk application is structured in two modules:

- the module for online registration of bank customers requests;
- the module for recording phone requests by Multicash helpdesk analysts.

In the module for online registration of bank customers' requests, each customer receives from the bank a username and password with which he will authenticate in the application. The associated customer interface allow the customer to send a written request to the helpdesk department, by framing the issue in the appropriate category and subcategory, but also to register a priority request in exchange of a fee.
In the module for recording phone requests

by Multicash helpdesk analysts, after authentication in the application, the analyst see the page from which is made the registration of requests in the database.
The fields to be completed or selected by the bank analyst are the followings:

- customer name, based on suggestions from a predefined list of Multicash customers;
- the contact person of the customer who made the call;
- the request category, which is a drop-down list with predefined categories and related codes;
- request description, which is a field for adding the details of the problem;
- the way to solve by selecting the appropriate option.

The CMS application is used effectively within Raiffeisen Bank, in its database being introduced over two thousands requests per month. Having the database of all customer requests, it is realized the analysis of the types of problems faced by Multicash service users and are determined the strategies to address each customer, according to the history of problems he encountered.
We consider the database of Collaborative Multicash Servicedesk - CMS application, in which are stored the requests of a bank customers, relating to the problems that they have in using the Multicash electronic payments service.
The situation of requests on categories, recorded in the period June 15 to July 15, 2010, is presented in Table 1:

Table 1. Number of requests on categories

Request code	Request category	Number of requests
901	Training on using the application	107
902	User blocked at logon	127
903	User blocked on the communication	248
904	Training on see rejected payments	56
905	Check payments status	795
906	Login with admin2 user	3
907	Index corrupted in database tables	27
908	Please repeat job with AC29	37
909	Communication initiated	254
910	Transmission interrupted	155
911	Signature error	233
912	Generate electronic signature	122
913	Add new users in the client application	95
914	Add new accounts in the client application	105
915	Change name / address of payer	15
916	Training of branches for completing annexes	52
917	Error on see statements	186
918	Delivery account statements	80
919	Delivery files for distributed signature	34
920	Move the application on another computer	70
921	Installing the application abroad	11
922	Confirm account balance	424
923	Deactivate payments file	11
924	Change communication channel	8
925	Setting print parameters	20
926	Reinstalling the application	54
928	Change number of approvals / amount limits	6

929	Error on starting the application	54
930	Statements export	20
931	Setting communication sessions	6
932	ROI or INT button disappearing from the main menu	2
933	Other requests	729
934	Delivery file with bank codes	83
935	Unresolved - BAS blocked	2
936	Check the import file structure	6
937	Check the validity of files sent for distributed signature	1
938	Payments cancellation	28
939	Change the customer status in LIVE/ TEST	3
940	Communication problems to the customer	17
941	Decryption error/ wrong communication password	7
942	Missing a bank branch	12
999	Intervention of service provider	9

Analyzing the data from Table 1, results that most requests were registered on *Check payments status* category, because the Multicash service allows viewing information on the settlement payments status and accounting balances updated every hour. Customers need the confirmation of certain payment processing at a certain time and they call the Helpdesk department to get these confirmations.

The Collaborative Multicash Servicedesk application is a collaborative auto-adaptive system that allows auto-configuration based on information entered by the users. The CMS application adapts to input data and change the components, so as to provide maximum utility and support to its users, regardless the category they belong to.

The auto-configuration elements of CMS application are:

- the automatically change of links position from the knowledge base, depending on the number of requests recorded on each category; the files that contain helpful information in solving problems are shown the first, in order of the most common problems reported by the users of Multicash service;
- the automatically creation of a vocabulary of terms specific to the problems recorded in the application database; in order to assist the users, so that they to provide the most accurate and complete descriptions of the problems raised, the application provides an auto-complete feature; the terms which appear as suggestions are taken from the vocabulary created dynamically, depending on what brought the current and previous users; there is made a parsing of words entered into the request description field and are introduced in the vocabulary only the words with a minimum length of four characters;
- the automatically adding of new categories in the list of categories of problems reported by customers; the application contains a predefined list of categories of requests, among which is the category *Other requests*; in this category are included all the requests that do not fall into any existing category; when the helpdesk analyst recorded a new request on the category *Other requests*, the application parse the words entered in the request description and creates a dynamic vocabulary with those words with at least four characters in length; there are calculated the occurrence frequencies of words in the vocabulary created, and when is identified a word that appeared at least ten times, the application automatically creates a new requests category; the name of that category is built with the first three words with the highest frequency

and a code automatically assigned to that category; as a new category is created the vocabulary resets in order to identify new words that will form another category.

The automatically auto-configuration through adding new categories is made from the module of phone requests registration by Multicash Helpdesk analysts. When registering a request on the category *Other requests*, a vocabulary of keywords is created, dynamically populated at each request assigned in this category:

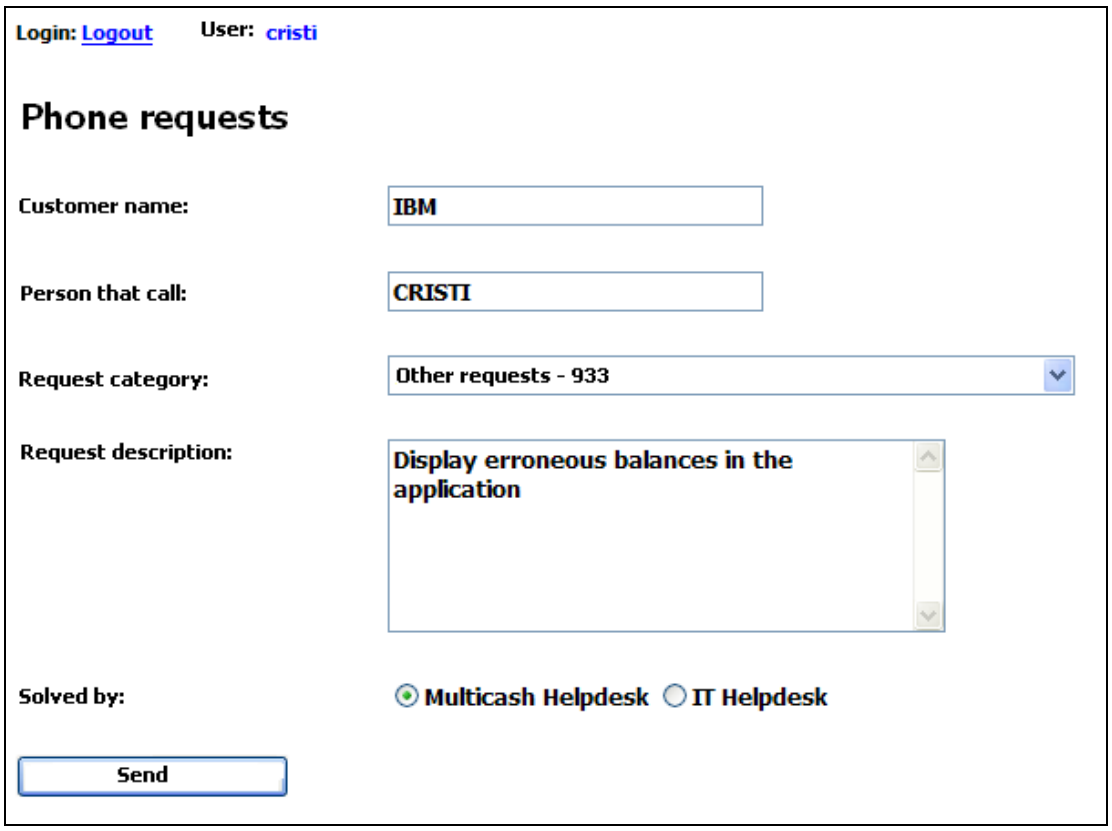

Fig. 4. Requests registration on *Other requests* category

In the case of the request in Figure 4, there are introduced in the vocabulary the words *display*, *erroneous*, *balances*, *application*. As new requests are introduced on the category *Other requests*, the vocabulary is populated with new keywords. If there are introduced at least ten requests containing in description the words *display*, *erroneous*, *balances*, then automatically is created a new category *Display erroneous balances - 142*, at which is assigned a unique code 142, consisting of the number of categories existing in the list, plus 100.

The process of creating new category is achieved by applying a neural network on the CMS application. The structure of neural network consists of:

- input neurons, represented by the lot of keywords recorded in the vocabulary;
- neurons on the intermediate levels, represented by the three terms in the vocabulary that have the highest frequencies of occurrence;
- output neurons, represented by the newly created category and its assigned code.

Figure 5 presents the neural network structure for creating the category *Display erroneous balances – 142*.

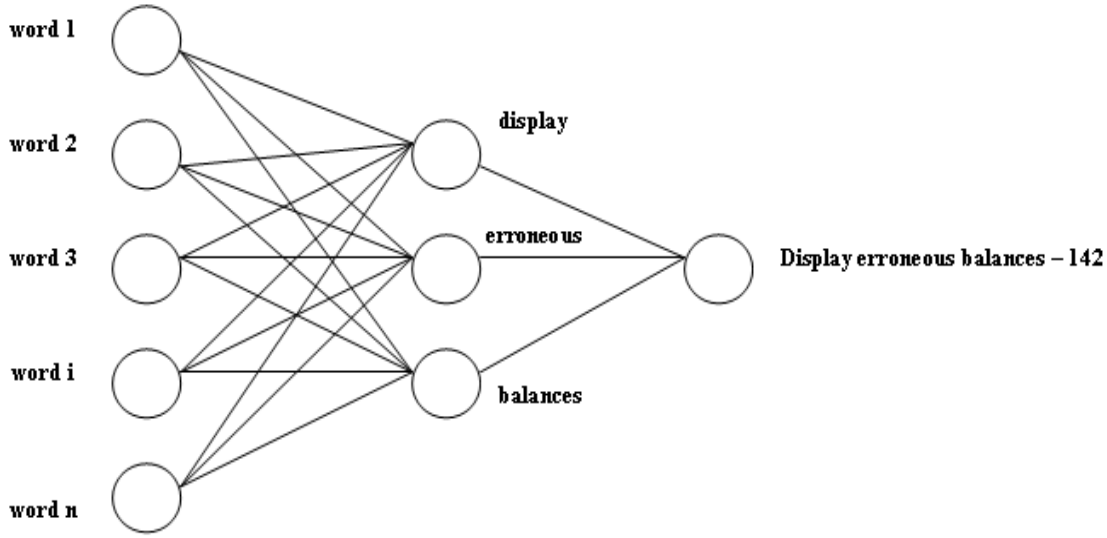

Fig. 5. The neural network structure for adding new category

If the user has not checked the solutions proposed by the application, when adding additional details about the problem he indicates, the application gives him a new suggested solution, according to the selected requests category (Figure 6).

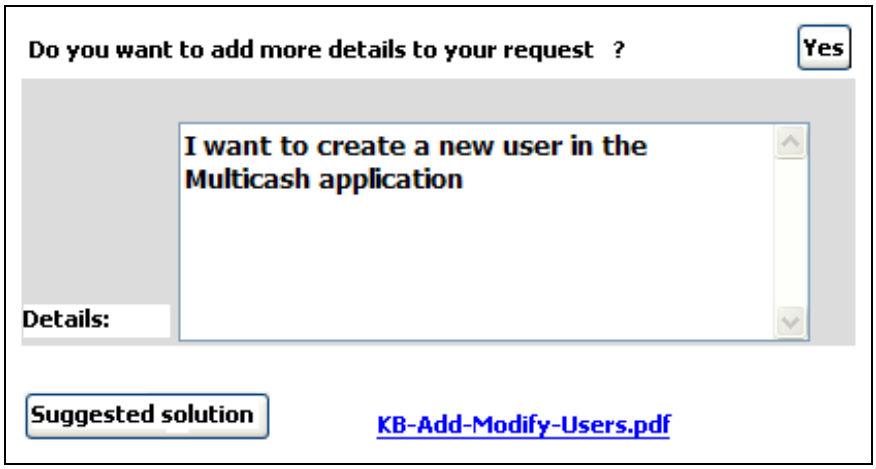

Fig. 6. Suggested solution according to the request category

The automatically creation of a vocabulary of terms specific to the problems recorded in the CMS application database is made also from the online page for requests registration by the bank customers. In order to ensure an accurate and complete description of the request, the application suggests to the user keywords from the vocabulary of specific terms.

The vocabulary is dynamically populated with words introduced by the current user (Figure 7).

Because is a service desk application, CMS automatically send emails to the users involved. When a customer registers a new request, he will receive a confirmation email that provides him the details of the problem, including the request number necessary for further identification. If the request is taken by an analyst in order to be solved, then the customer is informed by another email. Finally, when the problem is solved, the customer receives an email which contains the solution and the name of the analyst that solved the request. If the customer is satisfied with the solution received, he has the possibility to enter in the application and provide a feedback and a score to the analyst giving the solution. According to the sum of these scores received by the analysts, the

application automatically realize a classification of the best analysts.

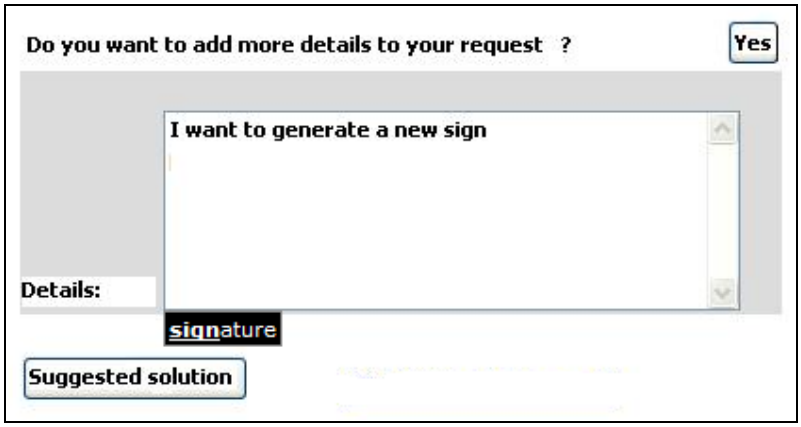

Fig. 7. Auto-complete facility

In Figure 8 is presented the application form used by the customers to provide feedback to the bank analysts.

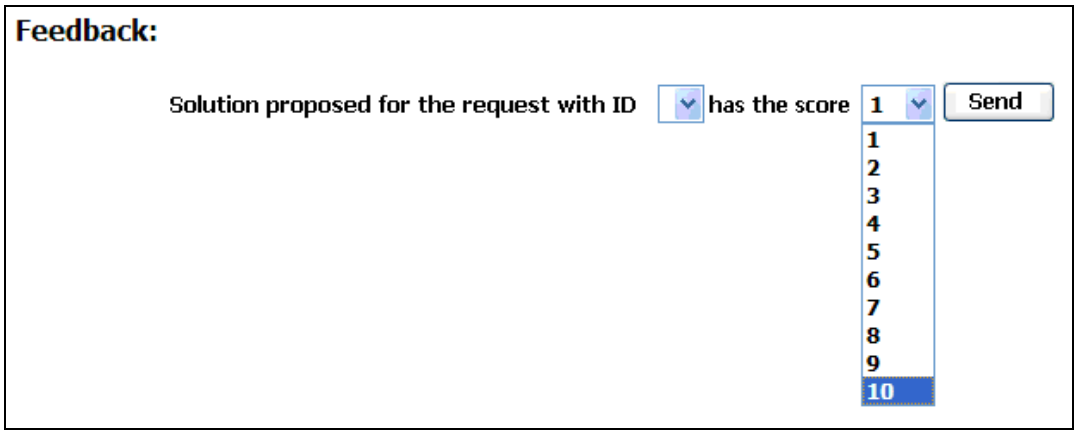

Fig. 8. Manner to provide feedback and give scores

Based on the total number of points received by each analyst, a classification of the Multicash Helpdesk analysts it is realized. The bank management checks this situation monthly in order to see which the best analysts are.

The CMS application can be accessed and used online with a mobile device. The Collaborative Multicash Servicedesk application has been designed also for mobile access. If the user wants to show a list with customers requests in a normal browser and you want to create the same list for the mobile application browser as well, you need to create two different views.

The first one will be supported by Internet Explorer and the second one will supported by a mobile internet browser. The user can also create customized views for mobile browser, as mobile and PDA screens can be small. In most of the scenarios, a developer would create customized views for mobile applications [11].

The first page of the CMS application, seen from an Opera Mini Simulator, is available in Figure 9.

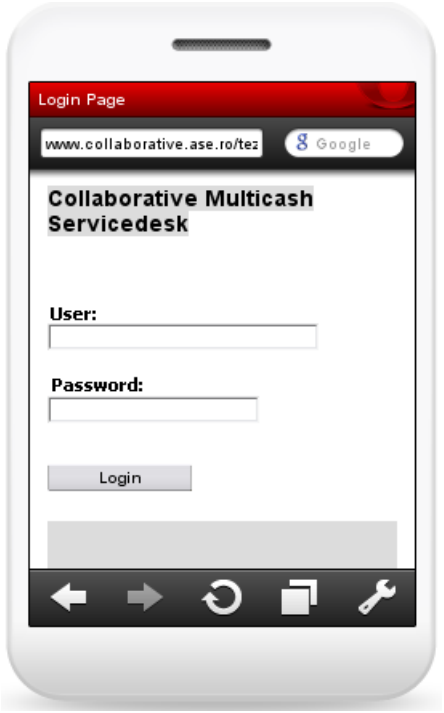

Fig. 9. CMS login page from a mobile browser

The page for phone requests registration by Multicash Helpdesk analysts, accessed from Opera Mini Simulator, is shown in Figure 10. The development of Collaborative Multicash Servicedesk application has required writing source code in languages C#.NET, Javascript, ASP.NET and HTML.

Fig. 10. Requests registration page from a mobile browser

The application has the form of a website and use connections with a Microsoft Access database.

4. Metrics for evaluating the security and quality of CMS application

The security is the main quality characteristic of a collaborative banking system. In order to ensure a high security level inside the information system, the banks have engaged real hackers to test and discover the vulnerabilities of every new application which will be launched in production, even if is a mobile application or a normal one. The banking applications are exposed to many attacks and it is less expensive to pay hackers to discover the vulnerabilities than to launch in real environment an application that is not tested enough. The loss for the bank will be bigger in the second case.

Regarding the metrics for evaluating the security effects, several indicators are defined to help give us a better view on the security level.

The attack rate, AR, upon the CMS application is:

$$AR = \frac{N}{TN} * 100$$

where:

TN – the total number of accessed IP addresses;

N – the number of IP addresses from which a different type of attack was launched.

The total loss, TL, that a bank support for security vulnerability is represented by:

$$TL = IF * NAA$$

where:

IF – impact factor;

NAA – number of applications affected.

The number of security vulnerabilities, SVCS, per size of CMS application can be calculated as:

$$SVCS = \frac{SVDS}{CSS}$$

where:

SVDS – security vulnerabilities detected in the application;

CSS – the size of application, usually expressed in lines of code (LOC or KLOC)

of function points (FP).
The cost for testing security vulnerability, CT [8], is:

$$CT = \sum_{i=1}^{NC} CCTC_i$$

where:
NC – number of security vulnerabilities in the application;
$CCTC_i$ – cost of testing i^{th} security vulnerability;
The efficiency of testing method is given by:

$$ET_i = \frac{NEi}{NTE} \times k$$

where:
ET_i – the efficiency of testing method *i*;
NEi – number of security vulnerabilities found using method *i*;
NTE – number total of security vulnerabilities found;
k – coefficient depending on the application type; it has values from 0 to 1 and it is calculated based on empirical data.
In order to analyze the impact of mobile users on security, the degree of mobile accesses (MA) using mobile devices can be calculated as:

$$MA = \frac{NAM}{TA} * 100$$

where:
NAM – the number of system access using mobile devices;
TA – the total number of applications requests, regarding the client type.
In order to measure the quality of a collaborative system, represented by Collaborative Multicash Servicedesk application, and assess its performance was used the indicator:

$$Q = p_1 * \frac{\min(x, y)}{\max(x, y)} + p_2 * \frac{\min(z, w)}{\max(z, w)},$$

where:
x, z – the planned values for two quality characteristics;
y, w – the realized values for two quality characteristics;
p_1, p_2 – the share of each quality characteristic ($p_1 + p_2 = 1$).
It must be reached equilibrium between the model dimension and its capability to give significant results. The metrics must be not too complicated because it will use lots of resources when implemented and also it must be not too simple because the measured levels will lose relevance.

5 Conclusions

The mobile technologies and applications offer a lot of new opportunities for enterprises, they also present development and implementation challenges [1].
The collaborative banking system can support the mobile agent paradigm, and then can efficiently support the mobile application service [3].
All the mobile applications introduced into the market have some environmental impacts during their life cycle. Therefore, it is important that applications designers have access to relative environmental information so that they can make appropriate decisions and de-offs with other design requirements [12].
The CMS application is an intelligent auto-adaptive system. When the number of monthly requests recorded on the *Other requests* category is greater than 100, then the application automatically analyze the description of each request in order to recommit some of them from *Other requests* category in the existing categories or to create new categories. In the application database is permanently kept the number of requests registered on each category at a time moment.

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Cristian CIUREA has a background in computer science and is interested in collaborative systems related issues. He has graduated the Faculty of Economic Cybernetics, Statistics and Informatics from the Bucharest Academy of Economic Studies in 2007 and the Informatics Project Management Master in 2010. He is currently conducting doctoral research in Economic Informatics at the Academy of Economic Studies. Other fields of interest include software metrics, data structures, object oriented programming in C++ and windows applications programming in C#.