The Question of Solving Municipal Economy's Problems using Electronic Service's Tools

Roman Lunev, Vadim Volkov, Alexei Stychuk, Anastasia Mitryaeva

Abstract: The purpose of research is to examine the current state of the urban environment in Russia, to analyze the satisfaction with the quality of housing and communal services and to suggest the mechanism for the formation of a comfortable urban environment. Electronic service use-case diagram was developed. The next step is developing of the logical scheme for building an electronic service network for the population based on the technology of mobile rapid response applications. To realize access to information operated by an electronic service, the database server interacts with file storage organized using the tools for creating file-based storage systems using cloud technologies. The software implementation of the electronic service has a complex composite structure, consisting of subsystems and modules interacting with each other. The prototype of the program interface was developed as the state transition network. Research's results: The proposed concept of mobile rapid response applications aimed at prompt notification of city services about the detected problem. This technology is an integral part of the "safe city". The definition of the responsible organization that needs to be sent to the application is carried out on the server for processing orders using a system of keywords or hash tags. Having in the mobile application a certain pre-formed, at the stage of launching an electronic service, a set of hash tags, with the possibility of its expansion and replenishment, the user can quickly and accurately describe the nature of the problem. The prototype of a system for solving urban problems was developed. Conclusions: The most promising approach is the use of distributed automated information centers, functioning according to territorial principles. In this case, it is proposed to process the geoinformation transmitted to the situational center (data from citizens and organizations appeals containing information about the location of the treatment object) in automatic mode, the person is included in the process only in case of emergency situations or when malfunctions occur. Scientific value of the research is the approach to the development of the situation center based on geo-service. Practical value of the research is the pilot operation of a system for solving urban problems, built with the use of a geosocial network was launched Orel in 2017 and has a positive feedback.

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I. INTRODUCTION

Nowadays, the majority of people both in Russia (74,4% [1], and in the whole world (53,5% [2]), lives and works in cities. The major part of economic, scientific and technological, social potential remains, builds and is being used by people living in cities [3, 4]. Areal, natural social and financial resources of the region accumulate here, conditions necessary for the process of socio-economic development of society and their effective use are being created [5]. All these defines the paramount meaning of making a modern comfortable urban environment [6].

An urban environment, which is rationally built, allows to reduce social strain, crime rate is lower in the streets with streetlights, if there's enough safe and modern playgrounds, people start do more sports, morbidity rate falls. Intellectual and creative clusters form in comfortable, modern and safe areas, new points of attraction for talented people appear, the demand for real estate grows, there's more call for personal services and it results into the appearance of new working places [7]. The most topical problem now is creating mechanisms for management of an urban environment, a special case of it is a smart city. [8, 9]

Municipal Economy is a total of different branches whose aim is to create conditions for people's and organizations', that are situated in this area, livelihoods [10]. Municipal Service consists of [11]:

- housing and utilities sector. This includes housing stock, organization for stock's handling, keeping in order, using and repairing, services needed for managing this activities (property management companies) and resource providers [12].

- city public transport of mass use: trams, trolleys, buses.

- complex of consumer's market, trade, catering and domestic servicing.

- educational, healthcare, cultural and social institutions.

- services of social safety, including environmental security of the municipal entity.

Nowadays, Russia uses the system of municipal service management, which was adopted in the USSR. This system has undergone minor changes. Here are its main points:

- the predominance of state and municipal property in the urban economy and the inhibition of a private competitive sector's formation;

- development of departmental monopoly and departmental centralization;

- increase of rates for services and products of the housing and communal services sector;
- departmental bureaucracy in management;
- departmental monitoring of performance;
- low efficiency and huge losses of used resources;
- subsidized financing.

What has changed is: there have been transformations to strengthen departmentalism, weaken external control and increase tariffs for services and products without corresponding improvement in the quality of work. Still the administrative and departmental mechanism, based on orders, has priority in the management of urban economy rather than taking into account the interests of the subjects of the urban environment. Therefore, it is necessary to carry out profound transformations and transition to an indicative management mechanism that corresponds to the market conditions of management and focuses on the interests of city residents. It is necessary to form a new economic mechanism, oriented to the use of economic levers and the most complete consideration of consumers' interests. The most important goal of the new mechanism is full satisfaction of the population's needs for quality services, affordable environment, high quality of life. To achieve it need to solve the following tasks:

- taking into consideration the interests of the population in solving the problems of urban development;
- rational system of interaction between participants in economic relations;
- sustainable development of municipal economy, primarily financial support through the attraction of budgetary and extra budgetary sources;
- development of the material and technical base of the municipal economy;
- improving the training system;
- introduction of modern information technologies in the process of urban management.

The great changes in this sphere necessitate the use of modern information technologies to improve the efficiency of solving problems of the municipal economy.

II. RESEARCH BACKGROUND

A. Satisfaction with housing and communal services

Housing and utilities sector is the most important part of the municipal economy. It determines the conditions for the person's life, the comfort of his home, the engineering improvement, the quality and reliability of services, on which the state of health, the quality of life and the social climate of the urban environment depend.

In 2013, according to WCIOM, the state of housing and communal services was named the No. 1 problem in the country due to the high level of deterioration of communal infrastructure and housing stock, low level of service in the industry, lack of leverage of influence from the population and a number of other problems that historically were "accumulated" in this industry over the past 20 years [13].

The Accounts Chamber of the Russian Federation conducted a survey on quality assurance of housing and communal services from 01.02.2017 to 02.05.2017. 3,2 thousand citizens from more than 60 subjects of the Russian Federation took part in it.

The survey was conducted in the framework of monitoring and control of the development and implementation of priority projects and programs for the main direction of the strategic development of the Russian Federation "Housing and Urban Environment".

The survey participants were asked to answer a set of questions connected with the main problem areas. Among them were the following: how do you assess the quality of provision of housing and communal services; whether your home was undergoing major repairs and whether you are satisfied with its results; do you know about measures to support housing and communal services, undertaken by the Government of Russia [14].

According to the data from the survey, shown in Fig. 1, 47% of Russian citizens are dissatisfied with the quality of the provided public services [15].

Fig. 1: Assessment of the quality of provision of housing and communal services according to the survey of the Accounts Chamber of the Russian Federation. (Results of the survey of the Accounts Chamber of the Russian Federation "Ensuring the quality of housing and communal services", 2017)

Also, according to the survey, the overwhelming majority of residents consider the quality of the housing and communal services to be inadequate (see Fig. 2). According to citizens, the cost of services in the housing sector is overstated by the management companies. Despite the regular increase in prices, the quality of public services provided leaves much to be desired, staying at the same, rather low, level.

Fig. 2: Estimation of the ratio "Price / quality" of provided housing and communal services according to the survey of the Accounts Chamber of the Russian Federation. (Results of the survey of the Accounts Chamber of the Russian Federation "Ensuring the quality of housing and communal services", 2017)

In the framework of the project to assess the quality of life, the Financial University under the Government of the Russian Federation made another measurement of consumer estimates of the state of housing and communal services in large and medium-sized Russian cities.

It is based on data from a sociological survey conducted in the summer and autumn of 2017. In each of the cities, no less than 600 respondents were interviewed according to a sample reflecting the socio-demographic structure of the population [16].

During the survey respondents were asked the following questions:

1. Are you satisfied with the condition of the house in which you live (appearance, communication, condition of entrances, elevator facilities, etc.)?

2. Are you satisfied with the landscaping of your city?

According to the study, over the past year, the proportion of those who are satisfied with the state of their homes - appearance, communications, condition of entrances, elevator facilities, etc., has decreased. (2014 - 27%, 2017 - 24%). Also, the proportion of residents completely or mostly satisfied with the improvement of their city decreased (2014 - 70%, 2017 - 67%).

Portal of real estate Domofond.ru conducted a large-scale survey among Russians in the first half of 2017, according to which the rating of 100 largest settlements of the Russian Federation on the quality of housing and communal services was prepared.

The survey participants were offered to evaluate the statement "I am satisfied with the work of public utilities" on a 10-point scale. In total, more than 250,000 Russians participated in the survey [17]. According to the survey results, cities with a population of less than one million people received the highest ratings. Most of the top-rated cities are important economic and industrial centers, which probably allows local authorities to allocate funds to support the efficient operation of public services. Among the top ten leaders were two cities of the Khanty-Mansiysk Autonomous Okrug, the Republic of Tatarstan and the Krasnodar Territory. Moscow took 10th place, St. Petersburg - 11th place. However, the overwhelming majority of cities with a million population did not enter the list of leaders and were distributed throughout the list.

The average for the country respondents rated the utility work at 5 points out of 10 possible, which is 0.4 points less than the same indicator in 2016. This is a rather low figure. At the same time, the difference between the most and least attractive cities in terms of utility services was 2.7 points. Even the highest rated Nizhnevartovsk scored less than 7 points out of 10. This situation indicates that many residents of Russia are dissatisfied with the work of public services.

To this should add that in 2016, Federal Service on Customers' Rights Protection and Human Well-being Surveillance received 28% more complaints related to the provision of housing and communal services than in 2015 [18].

The above studies show that the housing and utilities sector is in a crisis, characterized by inaccessibility of basic housing and communal services, low quality and instability of their provision.

B. Comfortable urban environment

The need for reforms in the sphere of housing and communal services is obvious. Therefore, one of the strategic directions of Russia's development is the creation of a comfortable urban environment and the improvement of the housing and communal services sector. Within the framework of this direction, two priority projects for 2016-2021 are implemented: "Creating a comfortable urban environment" and "Ensuring the quality of housing and communal services."

The purpose of the project "Creating a comfortable urban environment" is to create conditions for a systemic improvement of the quality and comfort of the urban environment throughout the Russian Federation.

The project "Ensuring the quality of housing and communal services" is aimed at improving the quality of housing and communal services and improving the level of people's satisfaction with the quality of such services to 85% by 2020. One of the main objectives of this project is to create tools to improve the quality of urban resource management through greater involvement of residents in the adoption of key decisions [19]. Strengthening citizens' trust in government bodies by providing free access to information in the housing and communal services sector, obtaining the opportunity to send appeals to the management organization with the help of modern technologies, increasing the speed of decision-making and controllability of the housing and communal services sector at all levels of government will achieve the desired indicators [20]. The implementation of the activities of the priority project should ensure that all consumers receive a set of new modern unified services that will make their living comfortable, including ensuring the prompt elimination of identified violations in the housing and communal services sector.

The introduction of information technologies in all spheres of life is conditioned by the state program "Information Society" for 2011-2020, the purpose of which is to obtain the advantages of using information and telecommunication technologies by citizens and organizations and to create conditions for prompt and effective interaction of authorities with citizens with their use [21].

Having reviewed the state programs and projects, it can be concluded that the state's efforts are currently aimed at informatization of the housing and communal services sector, which will contribute to reforming the housing and communal services and its transition to a qualitatively new state.

The most promising approach, from this point of view, is the use of distributed automated information centers, functioning according to territorial principles. In this case, it is proposed to process the geoinformation transmitted to the situational center (data from citizens 'and organizations' appeals containing information about the location of the treatment object) in automatic mode, the person is included in the process only in case of emergency situations or when malfunctions occur.

III. METHODOLOGY

According to the purpose of the research to suggest the mechanism for the formation of a comfortable urban environment it is important to develop the software which allows to inform public authority about citiy's problems and to take the feedback.

The kind of client software able to meet the all requirements is mobile application. First of all it is necessary to determine users and services. Use-case diagram is the best way to do it. The first step – make the list of users (actors). The second one – to specify the integrated services, next – detailed ones and to set relations between it. Use-case diagram is developed by the means of UML (Unified Modeling Language).

The implementation of services is built on the architecture of distributed information system. It consists of the front-end and back-end parts and the database as the link. Front-end includes mobile application as user interface and the situation center. Back-end is the set of the servers and the services. The database is the relational one providing the access to the information according to the integrity constraints. The system's structure presented as the set of interconnected subsystems and modules. The correct user interaction with the system is provided by the development of the state diagram.

The proposed concept of mobile rapid response applications, first of all, is aimed at prompt notification of city services about the detected problem using an application for a mobile phone or smartphone. This technology is an integral part of the "safe city". In the conditions of the modern city, such a mechanism for warning city services is the simplest and least expensive way that will allow you to quickly get information about the existing problems of the city, involving the population in the process of solving urban problems [22]. For example, we can consider a fairly common situation, when an open sewer hatch on the road or a faulty traffic light, hamper the traffic, thereby complicating the lives of city residents. In this case, using a mobile rapid response application, residents can notify the responsible authorities about the problem, simply by taking a picture of the detected malfunction [23]. This electronic service, through existing technical solutions, will deliver this information immediately to the information center for further processing and elimination of the malfunction. The development of technologies makes it possible to transfer information from smartphones via the Internet in the city without special problems [24].

IV. RESULTS

The software implementation of the electronic service has a complex composite structure, consisting of subsystems and modules interacting with each other, presented in Fig. 5.

The developed electronic service consists of six basic subsystems: the authentication and authorization subsystem, the user profile subsystem, the application submission subsystem, subsystem for working with applications, the subsystem of the work on the application, the application processing subsystem.

Subsystem for authentication and authorization implements the functions of registration, authorization and authentication, as a result of which it consists of the modules of the same name. It is necessary to form and delineate user access rights to the functions in the system.

The user profile subsystem with personal data consists of a module for entering personal information and a module for editing personal information. As the name suggests, this subsystem is responsible for working with personal data and can be modified depending on what kind and to whom applications are sent. This is due to the fact that the application for the problem in various departments should contain different identification information about the user.

The application submission system at the moment consists of a single module for the formation of an application, in the future it is possible to change the application process in order to comply with the existing legislation.
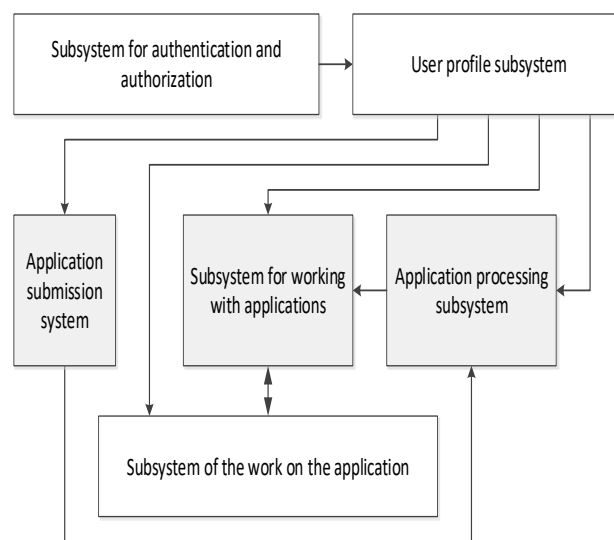

Fig. 5: Structural diagram of the electronic rapid response service for solving urban problems on the basis of a situational center (developed by the authors)

Subsystem for working with applications provides a review of submitted applications and consists of the following modules:
- module for viewing the text of the application;
- module for viewing the status of the application;
- module for confirming the execution of the application;
- feedback module with the management company.

Subsystem of the work on the application provides the activity of the service organizations in the system and consists of the following modules:
- feedback module with the applicant provides an opportunity to inform the higher authorities of improper, substandard or untimely performance of work to eliminate problems;
- logging module of the actions of serving organizations allows you to see the history of all transactions performed on the application. This will make it possible in the future to be able to analyze the activities of service organizations in order to increase the efficiency of their work, to optimize the regulatory framework.

This will also in the future allow forming criteria for assessing the quality of work and maintaining the rating of service organizations with the aim of further interaction with them;

- module for the execution of work on the application is designed to change the status of the application and track the responsible executor of this stage of work to eliminate the problem. The basis of this module is the algorithm for confirming the execution of the application.

The application processing subsystem implements categorization of all submitted applications and consists of the following modules:

- module for the formation of the status of applications is intended to change the status of the application when performing any action on it, in order to increase the transparency and openness of the actions of management companies and service organizations. The change in the status of the application, in addition to allowing the applicant to keep up to date with the work on his application, will also allow other users of the electronic service to note the responsiveness and performance of work on the application by certain responsible organizations. This will also allow to formulate the criteria for assessing the quality of work and maintaining the rating of service organizations with a view to further interaction with them;

- module for categorizing submitted applications distributes applications on problematic topics, which allows you to automatically redirect the applications of the responsible organization;

- module for redirecting requests to servicing organizations realizes the possibility of manually redirecting the request of the service organization, if the category of the problem is incorrectly indicated;

- module for acceptance of completed work - review of completed applications and their transfer for confirmation to the applicant;

- module of journalism actions of the MC allows you to keep the history of actions of the management company on the application. Keeping the history of the actions of the MC can be used both to improve the efficiency of its work, and to resolve possible disputes, with regard to not timely or poor performance of works;

- module for working with repeated appeals is designed to reject secondary applications for the same problem, indicating the reason for rejecting the application, or adding the importance and urgency of the work on the problem. If a large number of applications have been received about the same problem, then this problem is probably the most uncomfortable and requires an early solution.

Forming an application for a problem occurs as follows:

First of all, the applicant must specify the address of the problem. This can be done in two ways:

1. Manually mark the place on the map.

2. Automatically.

When the location of the problem is automatically indicated, the built-in GPS tracker of the smartphone is used, if the application is generated using a mobile application or a geocoder after entering the address. After that, the label with the application for the problem appears on the map.

After the appearance of a label on the map, it is necessary to fill in the mandatory "Problem description" field, select from the list a suitable category of this fault and attach a photograph confirming the presence of the problem. After making all the information on the application, it is necessary to keep it. If, after saving the application, it is displayed on the map, then all the actions are performed correctly, and the system is operating in normal mode. Otherwise, the system displays an internal error message. After creating an order, its content can be viewed.

Also, the electronic service provides an opportunity to view the application on an interactive map, which shows all submitted applications.

After the problem is eliminated by the service organization, the resident is given the opportunity to evaluate the work performed.

If the application is not properly implemented, the application will be re-sent to the responsible organization to eliminate the shortcomings. To perform this action, the user must select a specific application. If the applicant is satisfied with the performance of work on the application, then he confirms its implementation, as a result of which the system changes the status of the application from "Requested confirmation by the applicant" to "Done".

In the event that, in the applicant's opinion, the work on the application was not completed completely or poorly, and the problem has not been resolved, then the applicant has the right to mark the application as unfinished, send it for revision, indicating the reason, as a result of which the system changes the status of the application from "Applicant's confirmation is required" on "Required corrections".

One of the main functions of a dispatcher in an electronic service is the distribution of applications for service organizations. This occurs if the user incorrectly indicated the category of the problem in the formation of the application. In other cases, the electronic service, when specifying the required configuration, independently distributes the applications automatically, depending on the areas of responsibility of each serving organization, problem categories and specifying hash tags. If a utility receives a new application, but this problem is not within the scope of the company's obligations - a "conflict situation", then the application is rejected and returned to the dispatcher to select the responsible organization.

When you configure the electronic service to manually redirect requests for problems of the municipal economy, as well as in the event of a "conflict situation", the scheme of the application distribution is as follows:

- the dispatcher reviews a new application;

- if it is correct, i.e. meets the requirements for the application for this configuration of the electronic service, then he chooses the organization to execute this application, and assigns it responsible;

- as a result of which the system changes the status of the application from "Selecting the responsible organization" to "Consideration of the application by the responsible organization".

- if the application is incorrect or does not meet the moderation rules, the dispatcher rejects the application specifying the reason. As a result, the system changes the status of the application from "Selecting the person in charge" to "Rejected."

In general, the logic of the system operation is described using a simple State Transition Network (see Fig. 6).

With this version of the electronic service, dispatchers,

whose duties will include monitoring the progress of the electronic service, the health of the equipment and hardware used, the load of the communication channels and the need for personal participation in the event of abnormal situations and failures, are sufficient for its operation.
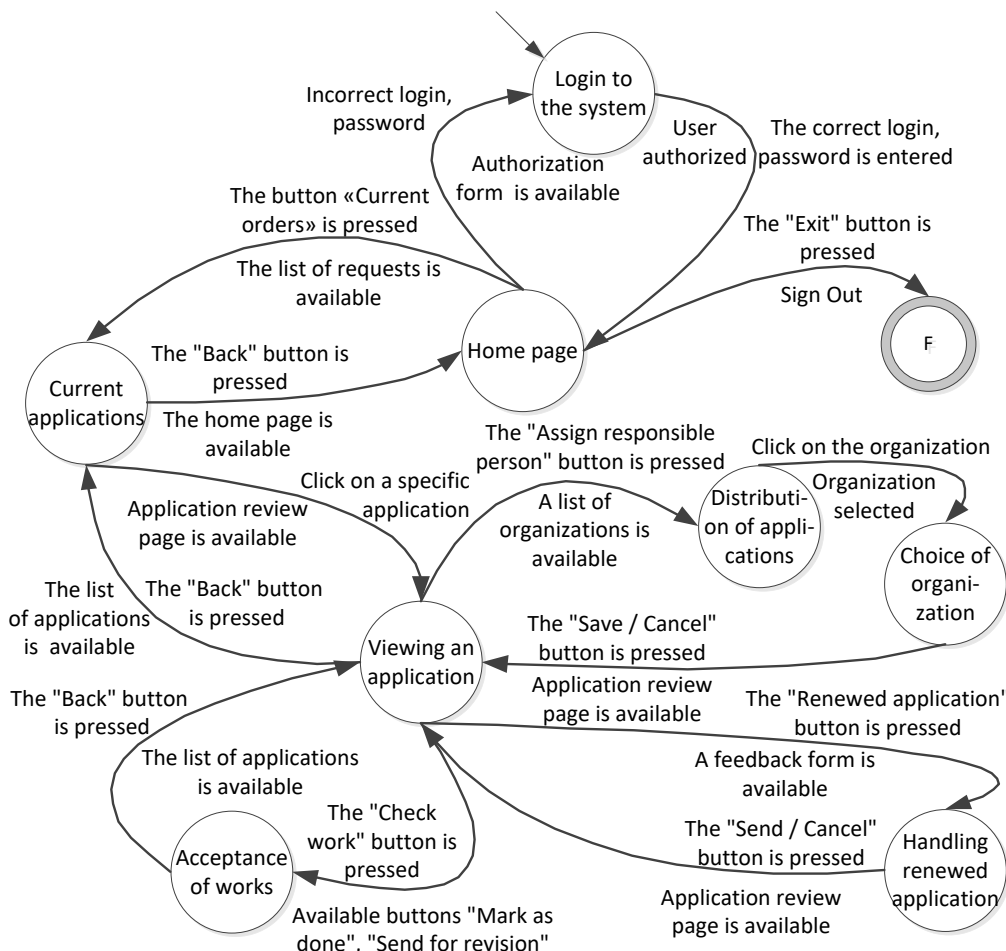

Fig. 6: Logic of the dialog with the user (developed by the authors)

V. DISCUSSION

The organization of such an electronic service to the public from a technical point of view is quite simple and at the same time an effective solution. The use of such technologies to collect information on urban problems is already being tested and used in practice. An important obstacle to the widespread use of this technology is the organization of joint work and well-coordinated interaction of a large number of organizations. The content of operators, monitoring incoming signals around the clock and redirecting them to the appropriate authorities, also seriously increase the influence of the human factor on the operability of this electronic service.

Thus, the creation of e-services for the population based on the technology of mobile rapid response applications to solve the problems of the urban economy [26], will create a scalable solution that is oriented towards the use of economic mechanisms and taking into account the interests of end users as much as possible. This solution can be used, both in the

scale of the country, region, city, and a separate quarter. Such systems can be built into the hierarchy of systems, which will enable more efficiently to collect and process geoinformation. The prototype of a system for solving urban problems, built on the principles described above with the use of a geosocial network, was developed and a pilot project was launched in Oryol in 2017. This pilot project is designed to collect applications for the improvement of courtyards within the framework of the project "Comfortable urban environment" (http://gorodsreda.ru/gorodskaya-sreda/) and also to receive feedback from the public about the quality and timeliness of the work. Also in 2019 in Oryol the project http://сделайореллучше.рф was launched with the direct participation of the authors of the article, based on the authors' proposals to create a geoservice as an electronic service to the population to solve problems of the urban economy. The project http://сделайореллучше.рф is an automated information system for interaction between residents of the city and relevant organizations on garbage collection.

This system is aimed at solving the following problems:
- building and optimizing the schedule of garbage gathering, in order to reduce the costs;
- identification of places of permanent over-accumulation of garbage, from the identification of container sites requiring expansion;
- identification of places of unauthorized "dumping" of garbage by third parties in order to identify enterprises with non-concluded contracts for garbage collection.

The project works as follows: a person, using a mobile application can send a request to the situational center about the accumulation of garbage on the container site, taking a

picture of it; the application falls to the moderator, who carries out the correctness of the input data and either rejects the application or redirects it to the profile organization - the regional garbage gathering operator for execution. After reviewing the application, the regional operator makes a decision on its redirection to the company responsible for the area; the carrier company, having familiarized itself with the received application, implements a set of measures to solve the problem that has arisen, which the user is informed through the system.

The entire process of work with the application is logged, which in the future will help to identify "bottlenecks" in the work of relevant organizations and make the necessary managerial decisions to address them.

The project involves a phased connection of the categories of problems for which applications are accepted. In the future, other categories of problems will be included in the project, on which applications from the population will be accepted.

VI. CONCLUSION

A possible alternative may be the use of distributed automated information centers, functioning according to territorial principles. In this case, it is proposed to process and redirect the information of the serving organization in an automatic mode, without the participation of operators, which will significantly reduce the cost of the service and increase the reliability of its operation. The definition of the responsible organization that needs to be sent to the application is carried out on the server for processing orders using a system of keywords or hash tags. Having in the mobile application a certain pre-formed, at the stage of launching an electronic service, a set of hash tags, with the possibility of its expansion and replenishment, the user can quickly and accurately describe the nature of the problem. In the case of the implementation of the division of responsibility zones by territoriality, in addition to the list of hash tags, on the server for processing applications, it is possible to maintain a database with a list of servicing organizations, built on a territorial basis. This will automatically identify which specific service organization responsible for the area should be sent a message to.

The project passes the stage of pilot operation and harmonization of the regulations for the work of public utilities and profile organizations using this solution.

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