Development of automation and virtualization instruments for the housing and utility services system

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Abstract. The rationale of the research topic is determined by the importance of public administration instruments for the housing and utility services sector in the country. In this article, we considered theoretical and practical aspects of modern electronic technology used to improve the public administration of H&U and the principal trends in their development. We analyzed the “Smart H&U” system: its content, targets, value, advantages, along with the current practice of implementing this project and its results. We detailed the concept of the state information system for H&U (SIS H&U) and studied the legal foundations of the creation and operation of SIS H&U. We analyzed the importance of the state information system for ensuring the openness, accessibility and transparency of activities in the housing and utility services sector. The author listed the prospects and advantages of this system.

1. Introduction
In modern urbanized society, housing and utility services (H&U) is one of the most important sectors of the social tertiary area. Among the numerous problems requiring attention in H&U, special attention should be given to the quality of public utilities, as well as transparency, reliability and accessibility of information about the housing facilities and residents, energy consumption, accrued fees for utility services, the current condition of H&U facilities and networks [1]. We believe these problems can be addressed successfully only with the use of advanced electronic (information) technologies.

2. Materials and methods
The object of the study is public relations in the public administration of H&U, the interaction of management organizations and citizens.

The subject of the study is the legal instruments regulating the public administration of H&U, scientific works, Internet articles dedicated to the study topic.

The methodological basis of the study includes the following methods: dialectical, historical, systemic, logical, comparative-legal, formal-legal, etc.

3. Results
Within the national project “Housing and Urban Environment” and national program “Digital Economy”, the government is implementing the “Smart City” project, the purpose of which is to
digitally transform and automate the processes of resource management and services provision, along with the comprehensive improvement of the efficiency of urban infrastructure [2].

In March 2019, Russia Ministry of Construction approved the standards for “Smart Cities”. They are to be implemented within five years in all towns and cities with the population of 100 thousand and more. The “Smart City” concept focuses on an ordinary citizen, with their goals and requirements, as the center point of all processes [3].

Today, the level of urbanization is constantly growing, cities take up about 70% of the global economy [4]. These growing numbers make control of the processes running in cities more difficult. “Smart cities” provide for the integrated application of IoT solutions in H&U and transport infrastructure in order to ensure the safety of city residents and other areas.

“Smart H&U” is a part of the “Smart City” concept, consisting of 6 subsections:
1. Introduction of intelligent accounting systems for utility resources;
2. Reducing energy consumption;
3. Implementation of automated control of response to consumers’ requests and accident response;
4. Introduction of a digital management model for public utility facilities;
5. Introduction of the tool for holding a general meeting of premises owners in multi-apartment buildings by electronic vote.
6. Introduction of automatic systems for monitoring the condition of buildings, including noise level, temperature, serviceability of lifts, fire safety systems and gas equipment.

“Smart City” innovative technologies for the housing and utility services sector are aimed at improving the efficiency of utility and energy infrastructure, reducing the costs of resource-supplying organizations using concession, energy service and service models [6].

All the ideas of the digital transformation of H&U can be divided into two groups. First, those changing the system itself. Among the priorities of the “Smart H&U” concept, the Construction Ministry wants to introduce the modern technologies which will literally keep a “medical history” of every building. The idea is that one can track online all information about the technical condition of the premises, its engineering networks, all previous problems and their solutions.

“Smart H&U” is a special system, the main objective of which is full control over the automatic operation of housing and utility services. “Smart H&U” is able to have full control over the equipment operation, take readings from all meters at the right time, ensure efficient work of H&U employees and facilities, prevent accidents, etc.

The main goals of “Smart H&U” include [7]:
• reasonable use of energy and water resources;
• automation of the meter reading process with the subsequent data transfer to the respective authorities;
• facilitating the work of H&U employees;
• minimization of errors caused by the human factor;
• control over the quality of utility services through a system of special services and personal accounts;
• improving the efficiency of instrument control.

“Smart H&U” should reduce the monthly utility fee for tenants. This direction is being actively studied and developed. A number of studies are conducted in order to launch trial versions of the system in different cities of the Russian Federation. Today, such large companies as Vega, Matrix, Betar, etc. are engaged in the development and production of devices to support the “Smart H&U” system in the country.

“Smart H&U” has 3 main levels:
• Local: location of meters - houses, apartments.
• The level of readings collection: smart meters use wireless (and wired) technologies for data transfer: Wi-Fi, PLC, NB-IoT, LPWAN, LoRaWAN, etc.
The level of information processing and analysis: the user can view the final results of calculations on their personal account page upon authorization.

Through the system of personal account pages (cabinets), users can track all information in the form of tables or graphs, which greatly facilitates the perception of digital data, allows predicting the consumption of water, electricity and gas in the future, notifies about changes in utility fees, notifies of emergencies and events.

In Russia today there are several large organizations developing the dispatching of energy resources. All dispatch companies have their individual approach to organizing a business structure. Some companies produce and implement their own devices, which means that their software can only be used by a limited number of devices manufactured by them [8].

Other organizations, such as NEKTA, operate with a universal system, focusing on the development of targeted software systems [9]. These complexes support the work of most existing metering devices, while the number of supported equipment is increasing on a daily basis. Some companies have a narrow-focused specialization (one type of energy resource), while others are engaged in the integration of software for various devices (meters, sensors).

In 2017, the comprehensive “Smart H&U” solution was successfully implemented by Megafon in Innopolis residential buildings in Kazan. This is the first project in Russia to implement Internet-based tools in H&U based on NB-IoT technology. The “Smart H&U” solution combines an automated system for collecting and transmitting data from utility meters, a convenient web application for users, an extensive library of drivers for various models of digital metering devices, and numerous tools for integration with external systems. The solution allows metering and controlling the consumption of power, heat, gas and water.

In addition, the entire range of fire and security sensors, such as leakage, movement, break-in, etc. can be connected to the system. Using the appropriate meter models, MegaFon’s solution also allows you to program and manage metering devices remotely.

The solution transmits data using NB-IoT technology. It is characterized by small amounts of data exchange, the ability to use autonomous power and flexibly manage the power consumption of devices. Up to 80000 IoT devices can be connected to one base station, which is in large excess over the range of existing mobile communication standards. The technical data from the devices are stored in a secure cloud storage and are accessible to the user through a web interface and a mobile application.

The Smart H&U solution allows the supplying and managing organizations to ensure transparency of mutual payments, proper control over the supply and distribution of resources, remote control of meters, as well as reduction of energy loss and consequent financial loss [10]. “Smart H&U” can be integrated with commonly used systems 1C and SIS H&U. It ensures automatic data collection, without obliging the employees to walk door to door, and the compilation of a clear picture of resource consumption based on such data. At the same time, residents no longer need to manually submit H&U data and pay for the actual consumption of the resources.

“Smart H&U” will undoubtedly be actively implemented nationwide, contributing to the convenience of process management and reducing the loss, which are currently a serious problem for this sector.

We expect a forthcoming transition to the new standard in many urban and consumer services, such as power metering systems, city lighting, road infrastructure and intelligent H&U systems. We believe that NB-IoT will take up a serious position in the market in the nearest future. Many organizations in the industry, such as water utilities, power suppliers etc., striving to improve their service and reduce their labor costs, have long been introducing various automated control systems and technological and commercial accounting solutions.

The activities of managing organizations are gradually digitalized, promoting introduction of advanced technologies into their work: mobile applications for communication with house residents and services are being developed in order to simplify the work of H&U organizations. Residents of apartment buildings are involved in the process of managing their houses using mobile applications.
They can communicate with the managing organization, evaluate the quality of the works it performs, and solve problems in apartment buildings.

For example, management company “H&U League” (Yekaterinburg) successfully applies new technologies in its work: it communicates with residents of apartment buildings online through its own mobile application and repairs entrances and stairwells using a special block material.

Special calendars tell the management company when it is time to make repairs in the building, help to meet the deadlines for responding to requests. A mobile application also works for employees: it solves the issue of internal communication and work organization within the team. Through the mobile application, employees see all tasks received during the day, for each of them they can correspond with colleagues or with residents. The application works offline. This means that even without active connection, an employee can leave comments and change the status of the task. When the connection appears, it will automatically synchronize with the server and everyone will see the updated description of the task.

The IT system of the “H&U League” has a recognizable interface, it is based on the chessboard principle. This is a kind of house map, showing the number of floors and the number of apartments on each floor. The icons indicate which apartments have unresolved issues.

The internal quality control system is an important part of the work of a managing organization. “H&U League” asks its customers three questions to find out if they are satisfied with the company:
1. Do you like our work?
2. Do we like our work? Interestingly, the residents of the building are encouraged to check the work of the managing organization, so the company receives unbiased assessment.
3. Do we have enough money for this?

These three simple questions will help management organizations to promptly resolve any conflict situations.

The "League" also has a special website "Entrance Constructions". On this site you can choose the materials and design for the entrance and stairwell interior decoration and immediately calculate how much the repairs will cost.

A resident of the house can use a special mobile application and a personal cabinet on the organization’s website for paying bills, leaving submitting requests for a specialist’s visit and evaluating the work of the management company.

The “State Information System of Housing and Utility Services” (SIS H&U) is an important electronic tool for public administration in the H&U area.

The State Information System for Housing and Utility Services (hereinafter - SIS H&U) is a comprehensive centralized federal information system ensuring collection, processing, storage, provision, placement and use of information on housing and utility services of the constituent entities of the Russian Federation.

The system contains the following information:
- management and resources supply contracts;
- regulations and municipal programs for H&U;
- readings of whole-building metering devices;
- planning and performance of maintenance and repair works for common property in apartment buildings;
- tariffs and payment documents for housing and utility services;
- citizens' requests on H&U issues and results of addressing such;
- financial documentation.

SIS H&U is posted online at: https://dom.gosuslugi.ru.

The activity of SIS H&U is regulated by the Federal Law No. 209-FZ dated July 21, 2014 “On the State Information System for Housing and Utility Services”, which establishes the requirements for creating the system, types of information it is to contain, and liability for the failure to enter information in the SIS H&U.
Effective July 1, 2019, all managing organizations in Russia are to enter data into the SIS H&U, including companies from Moscow, St. Petersburg and Sevastopol. Earlier, according to the Federal Law of July 21, 2014 No. 209-FZ, managing organizations operating in cities of federal significance could not do this [11].

SIS H&U is integrated with other federal information systems: Unified State Register of Property Title to Real Estate, Federal Information Address System and the “H&U Reform” portal, which accelerates and updates information flows.

SIS H&U is to facilitate the interaction between owners of residential premises and managing organizations, service providers and authorities: this system will help to receive payment documents for settling of housing and utility services, pay utility bills, hold general meetings of homeowners, execute contracts for utility provision, etc.

The implementation of this system will allow H&U to become more open and transparent, to eliminate data duplication and expedite its search, as well as increase its completeness, reliability, and relevance, as the citizens - consumers of H&U services will be able to use this system to access current information on the activities of managing organizations and authorities in this area, to control their expenses and the accuracy of charged fees for housing and utility services. This allows citizens to see the results of the management organization’s work, which promotes honesty and fair competition, contributing to the dynamic development of the economy and society.

SIS H&U will also make it possible to optimize the public control mechanisms by providing an opportunity to compare the cost of the works and services of various H&U organizations and the opportunity to review the results of inspections and audits performed by the authorized bodies.

SIS H&U contains H&U regulations, a list of licenses of managing organizations and housing facilities and the results of inspections performed by regulatory authorities.

This is but an example of the modern electronic technologies contributing to the improvement of the efficiency of public administration of housing and utility services. Competent application of modern electronic technologies in the government regulation system for H&U will make it possible to bring Russian housing and utility services to a new level improving the quality of public services ensuring significant energy saving and facilitating interaction between the homeowners, managing organizations and state authorities.

The introduction of electronic technology improves the public administration system for H&U along with the system of interaction between the homeowners, managing organizations and state authorities.

4. Conclusion
Based on the results of the study, the following conclusions have been made.

The state is implementing the “Smart City” project, which includes the “Smart H&U” system. The main objective of Smart H&U is full control over the automatic operation of the housing and utility services. The idea is to provide for online tracking of all information on the technical condition of the house, engineering networks, as well as the history of all previous problems and their solutions.

Nowadays, the digitalization of the management organizations activities is universal, the introduction of advanced technologies is highly promoted: mobile applications for communication with the residents and services which are to simplify the work of H&U organizations are being developed.

SIS H&U is an Internet portal for the collection, processing, storage, provision, placement and use of H&U information in the constituent entities of the Russian Federation.

The implementation of this system will allow H&U to become more open and transparent, eliminate duplication of information and expedite its search, as well as contribute to its completeness, accuracy and relevance.

Modern electronic technologies work towards improving the efficiency of public administration of housing and utility services. Competent application of modern electronic technologies in the government regulation system for H&U will make it possible to bring Russian housing and utility services to a new level. Competent application of modern electronic technologies in the government regulation system for H&U will make it possible to bring Russian housing and utility services to a new level improving the quality of public services ensuring significant energy saving and facilitating interaction between the homeowners, managing organizations and state authorities.
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