

On Design of Secure E-Services for Public Authority in the Russian Federation

Anton Makarov, Andrey Shabunin

St. Petersburg State University

St. Petersburg, Russia

a.a.makarov@spbu.ru, shandr@pisem.net

Abstract—We analyze some foreign and Russian e-government development practices and propose the creation of the structured policy based on the PMI project management standards. We offer the IDEF0 standard as a methodology for public authority project management. Also, we suggest the workflow class notation for the lower levels. However, the current notation tools are not enough to reflect all the business processes of the e-services for public authorities. We propose a methodology for the project management development with some extra elements (objects and subjects) designed to describe the process types and the corresponding e-services more precisely. The additional task which was successfully solved thanks to the proposed e-services design technology is that the data security requirements were accomplished. We also describe how to use the offered approach to design the information systems and secure e-services for providing the citizens and the legal entities the land which is in the state possession.

I. INTRODUCTION

Electronic government (e-government) is a way to automate some state activities with the information systems (see details in [1]). E-government systems development in Russia has a connection with the federal purpose-oriented program called “Electronic Russia”. The purpose of this program is to improve the quality of the state management. This project is the result of the signing the Okinawa Charter by the G8 leaders in 2000. According to this document, each country must develop its own strategy of building the information society. Work on the e-government systems development in the Russian Federation has begun in 2002 and it still goes on at present. In 2001 the Russian government made a decision to elaborate the Federal purpose-oriented program “The Electronic Russia 2002–2010” (E-Russia). The main aims of that program were announced as “creation of the conditions to develop the democracy, improve the functioning of the economy, public administration and local self-government by the introduction of the information and communications technology (ICT) designed to provide the mass distribution and the rights to seek, receive, transfer, product and disseminate the information” [2]. In this context, the “E-Russia” program, which was among the first Russian initiatives in the implementation of e-government concepts, can serve as a positive factor. Unfortunately, this project has failed [3]. After 2010 the Federal purpose-oriented program “Information Society 2011–2020” became the successor to “E-Russia”. The key project of this program is “System Project of Electronic Government in the Russian Federation 2020” [4]. It was presented at “IT Government day 2016” and was organized by TAdviser portal. The suggested goals of all these programs were consistent with the global trend –

improving the quality of life with the using of the ICT. Note that in the official Russian documents, there is no definition of the term “the information society”, but there are references to the United Nations documents (since the Okinawa Charter) and comments to the effect that Russia proceeds from the commonly held understanding of the term.

In 2016 the Russian Federation takes the 35th place in the ranking level of the United Nations E-Government Survey [5]. The Survey tracks the progress of e-government development via the E-Government Development Index (EGDI). The EGDI, which assesses the e-government development at the national level, is used to measure the readiness and capacity of national administrations to use ICT to deliver public services. It is based on the data collected by the International Telecommunications Union (telecommunications infrastructure index), the United Nations Educational, Scientific and Cultural Organization (human capital index), and also, by the national online presence questionnaire from all 193 United Nations Member States (online service index). The Fig. 1 shows the evolution of the Russian Federation position in the United Nations E-Government ranking.

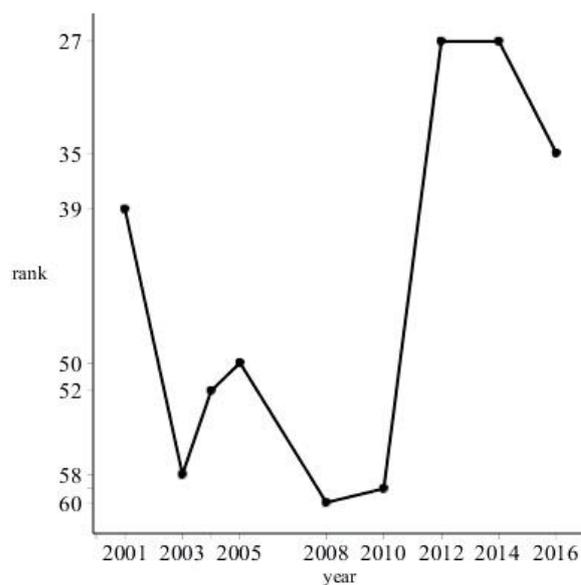


Fig. 1. The evolution of the position of the Russian Federation in the United Nations E-Government ranking

The general concept of e-government and public e-services are described in the books [6]–[8]. The Russian practice of building e-government architecture supports the concept of a self-developing system using the legal and regulatory frameworks and the technological resources (the concept of administrative reform in the Russian Federation, the federal target programs, the accumulated international experience of creation of the individual components of e-government) [9]. However, the presence of the designated regulatory frameworks and technological resources does not guarantee their effective use. It still lacks methods for formal specification of e-government services [10]. The classic unstructured approach to building the architecture of the electronic state is reduced to the “implementation of the measures”. So, it is designed just to achieve some discrete results without any synergy effect. The approach which does not represent the clear e-government implementation model is definitely do not correspond to the state policy. This problem is a consequence of the lack of a project management system that is critically dependent on management. None of the information systems (even the most complicated ones) will function well if the project manager does not have the requisite authority and the power, and the decision-making system will not provide for the speed of control actions.

At the moment, there is a limited number of the information system projects development examples for public authorities. Also, at the moment, they do not formulate the notation design requirements for the e-services. This limits the technological possibilities for comparison and comprehensive analysis of the models, including by subject specialists who have not received specific training in the field of design management processes. Basically, the development of projects carried over existing technological solutions for the private sector without analyzing the suitability of their use for the purpose of e-government. It does not take into account organizations involved in the provision of public e-services, for instance:

- the strict hierarchy of employees of any government agency;
- compliance with applicable regulations of the functioning of departments spread throughout the Russian Federation;
- the strict compliance with the rules of procedures of passing and execution of all types of documents;
- strict observance of the law (in some cases commercial information system does not affect the principles of legality because it is an “internal affair” of the company, it is not for public authorities);
- monitoring the financial statements (for public authorities the error in financing involve much more serious consequences than for commercial organizations).

Creating a unified methodology, notation and the use of effective tools for the development of projects for public authorities unifies the process of developing information systems in different regions. Note that the unification of design simplifies the subsequent process of code generation. By the way, the similar systems that may use some tools to generate code automatically can save finances significantly.

Our work continues the research of e-services development for e-government in the Russian Federation, presented in [11] and [12]. We analyze the European practice of e-government development, and propose the creation of a structured policy based on the standards of the PMI project management. We offer the IDEF0 standard as a methodology to create the projects for public authorities. Also, we suggest the levels of descriptions of the algorithm (the script) execution process workflow class notation for the lower levels. Unfortunately, the current notation tools are not enough to reflect all the business processes of the e-services for public authorities. We propose a methodology for the project management development with some extra elements (objects and subjects) designed to describe the process types and the corresponding e-services more precisely. The additional task which was successfully solved thanks to the proposed e-services design technology is that the data security requirements were accomplished. We also describe how to use the offered approach to design the information systems and e-services for providing the citizens and the legal entities the land which is in the state possession.

II. FOREIGN PRACTICE

Modern project management system originated in the United States in the development of US Navy programs “Polaris”, and later NASA’s space exploration. In the late 1960s, several professionals involved in project management in the pharmaceutical and construction industries, created a professional association — Project Management Institute (PMI). Further PMI’s departments were established in other countries. It was developed project management standard — A Guide to the Project Management Body of Knowledge (PMBOK Guide).

This standard is recognized around the world, including the Russian Federation, where project management as a kind of administrative activity is not regulated by official state documents. According to the standard, project management — is the application of knowledge, skills, tools and technologies to meet project requirements. Its core processes include initiation, planning, execution, control, and completion.

For the analysis of the European practice in the field of e-government OECD reports (Organization for Economic Co-operation and Development) [13] were taken. This organization has established e-government in the European Union, analyzing the experience in the field of all developed countries (Finland, Norway, Germany, USA, China, Australia, and others), and reports to the European Union on progress in the establishment of e-government.

As follows from the analysis, there is an alternative model for the Russian practice that is the model used by Capgemini company (Fig. 2) which evaluates the progress of the countries in the European Union in e-government development. This project has been implemented since the beginning of the century under the instructions of the European Commission. The Capgemini Benchmark has a long tradition and constitutes a valuable source of information regarding the e-government concept.

The Fig. 2 shows the model, which shows not only the structure but also the “road map” of the creation of e-government projects. It is understood that one can not “jump

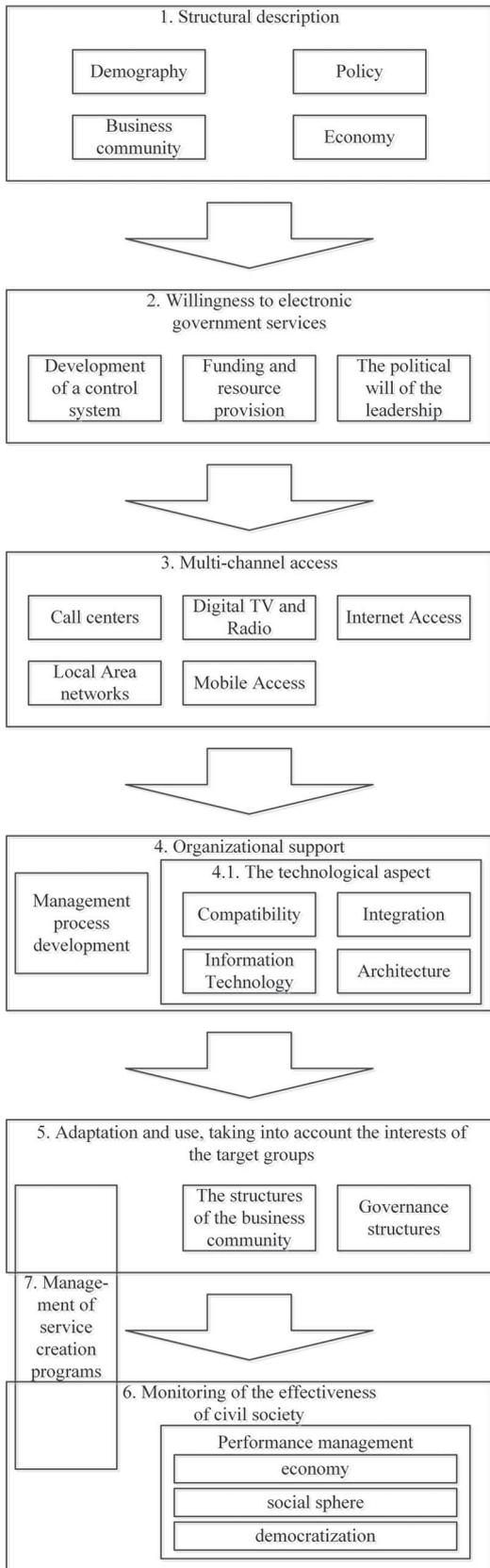


Fig. 2. Capgemini model for e-government projects evaluation

over a step”, success at a certain stage of development (in the conditions of limited resources) can be achieved only if the objectives of the previous stages have been reached. What is laid in the architectural design of e-government, it is necessary to reflect in the event management system to achieve the objectives of e-government projects. PMI standard is the management of activities focused on the end result.

International experience shows that the most effective way to manage the construction of e-government is clearly thinking through actions and fulfilled (at the initial stage of construction) model. One should not rely on the technology of the IT industry, but on the restructuring of the existing business processes of public authorities, that is, the control technology. This is reflected in the creation of a model of management of e-government (see Fig. 3), provided for projects in the framework of the Electronic Europe Action Plan. The first e-government action plan, also known as iEurope2010, was launched in 2005, providing a strategic framework to drive sustainable economic growth and inclusion through ICT by addressing the main challenges and developments in the information society up to 2010 [14]. The second the European Commissions e-Government Action Plan was launched in 2010, and covered actions for the period 2011 to 2015. Also in 2010, the European Commission proposed a new 10-year political strategy, Europe 2020: A strategy for smart, sustainable and inclusive growth [15].

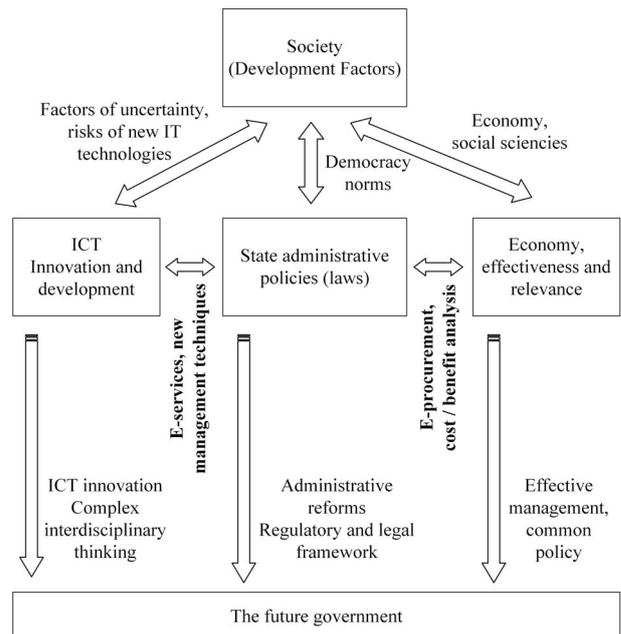


Fig. 3. The management model of e-government provided by iEurope2010

The shown in Fig. 3 model is characterized by a significantly higher level of generality than the Russian model, shown in Fig. 2, and, above all, it does not contain a description of the financial flows that are directed to implementing individual activities. It is well understood that the European model cannot be simply adopted to Russian reality due to the huge difference in sociocultural traditions but the core principle of the model construction (that seems to be quite clear to all) still can be used.

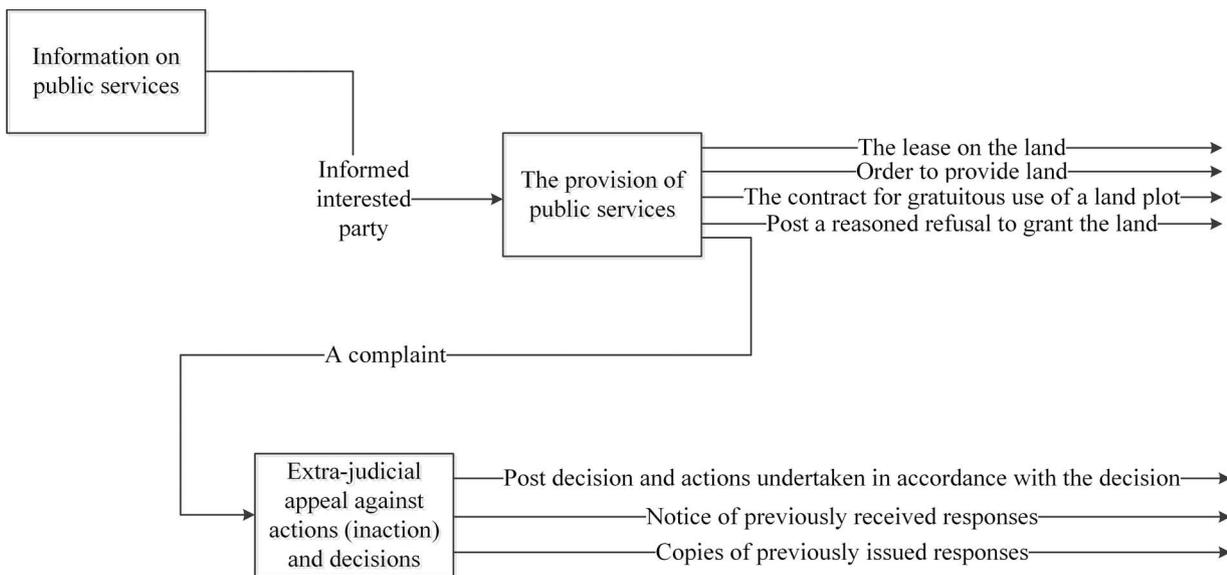


Fig. 4. The diagram of the process for providing of land to citizens and legal entities

III. MEANS DESCRIPTIONS AND NOTATIONS OF BUSINESS PROCESSES

Analyzing the practice of development of information systems for public authorities one can note the use of ARIS methodology, UML, and BPEL.

Using ARIS explained its leading position on the world market in a class of business process modeling and analysis tools [16], and a good advertisement. Despite its universality and statement of developers, ARIS application is limited:

- excessive formalization that is not only ineffective but even harmful;
- unfitness to describe the top-level business modeling due to a more detailed process of drawing. As a consequence of complex diagrams considering a performer who does not see “the big picture” view of their duties.

UML language [17] provides a set of tools, allowing to carry out a comprehensive analysis of complex projects as from a technical point of view and from the perspective of the needs of business. This language simplifies the design process, reduces its cost and increases efficiency. The approach taken by the developers of the UML (who created a modeling language, not programming language) allows effectively describe the classes, methods, and relations between them to system architect. The disadvantages of this approach are:

- preference for top-level diagrams, allowing developers to hide details and concentrate on functional features rather than sequences action. As a result, it is the lack of illustrations isolated parts of the process;
- it is not intended to document management processes.

Language BPEL (Business Process Execution Language) [18] is based on XML and is designed to support the implementation of business processes and description of their interfaces. BPEL extends the model of interaction of

Web-services, and this model includes support for transactions. BPEL does not consider how Web-services perform their assigned functions, it deals exclusively with the coordination of their work.

Each of these approaches has its advantages and disadvantages, but none of the notation does not allow documents to form a description of administrative regulations in the prescribed format, which puts a barrier between the administrative regulations as administrative document executive authority and electronic regulations as information technology solutions.

The basis of the creation of a methodology for public authorities projects are encouraged to use IDEF0 standard (Integrated Definition Function Modeling) [19] developed during the implementation of integrated computer aided manufacturing (ICAM) program, in which was revealed the need to develop interaction methods of analysis of processes in manufacturing systems. This standard is based on SADT methodology (methodology of structural analysis and design) [20] and has a number of important advantages. For example, a very high prevalence in the world in projects, related to the description, the development and changes in business processes. In this standard e-service (project within TESIS G2B) to provide citizens and legal entities of land owned by the state of the Republic of Karelia, is as follows (Fig. 4).

In order to arrange objects at the time of their occurrence, it is recommended to use UML sequence diagram and to represent the dynamic characteristics of the interaction of elements of the model to use a state diagram. An activity diagram is used to detail the features of the algorithmic and procedural implementation of the operations system.

Fig. 5 shows the diagram on the formation of a complete card of the applicant to the land. Fig. 6 shows the diagram of verification of personal data of the applicant for the formation of the applicant's card.

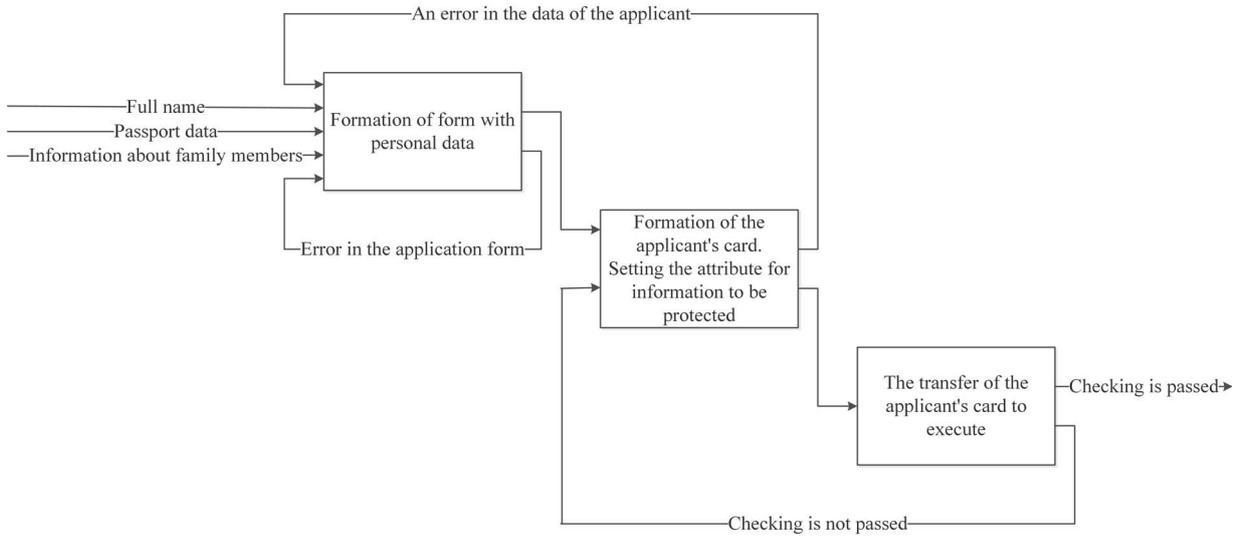


Fig. 5. The diagram on the formation of a complete applicant card

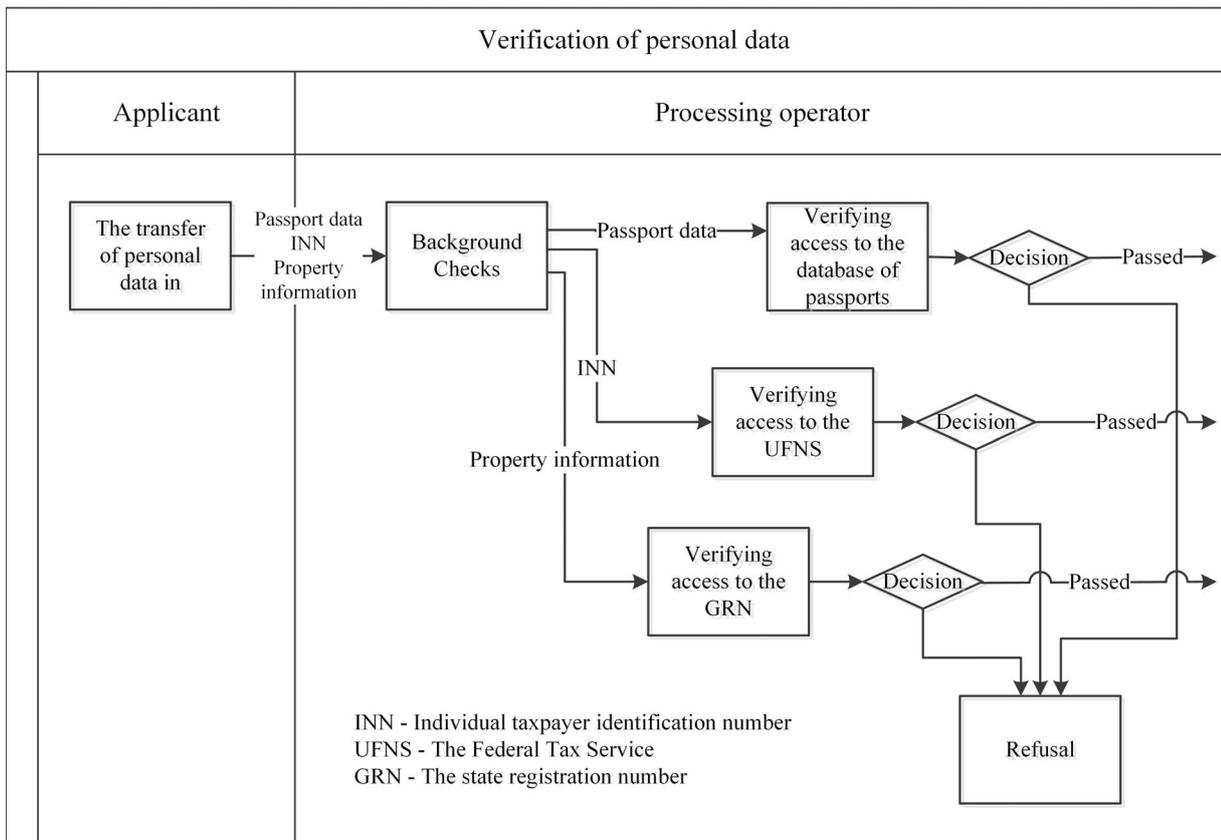


Fig. 6. The diagram of verification of personal data of the applicant

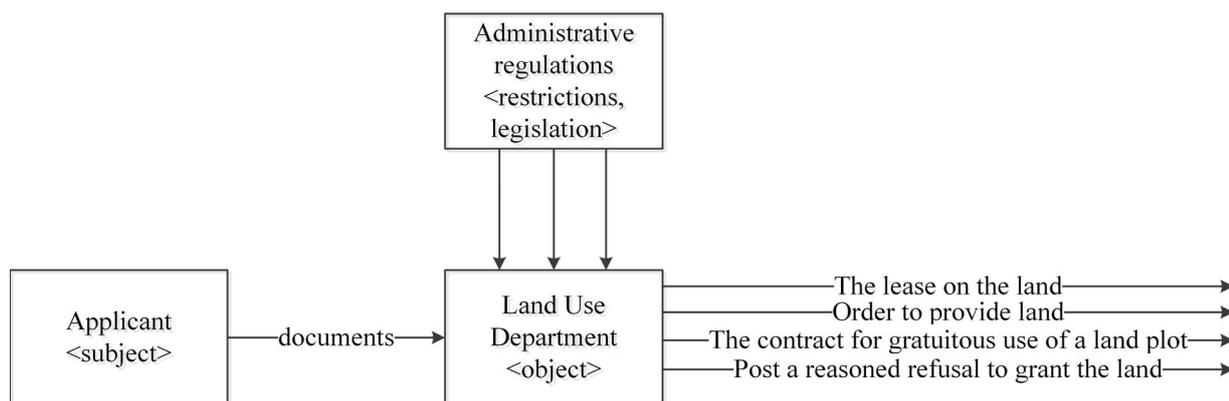


Fig. 7. The diagram with subject, object and administrative regulations

IV. THE CONCEPT OF SUBJECTS AND OBJECTS

The analysis tool in question was not designed for a detailed description of the processes specifications and therefore is not able to document all business processes of the public authority bodies e-services fully and properly. Therefore, the concept of subjects and objects have been added to the notation.

Note that the subject-object concept has been introduced in such notations as resource description framework (RDF) [21] based on subject-predicate-object triples, subject-oriented business process management (S-BPM) [22], and others. However, these notations have been used for commercial projects and do not take into account the specifics of the Russian public authority bodies. We introduce the appropriate definition of the subject-object concept that has been added to the notation. Thus, the proposed notation is whole (united) and sufficient for the realization of any government's projects.

Under the *subject* we understand the essence of some effect, it can be both the applicant and the Office. Under the *object*, we understand the essence on which the action occurs. The examples of actions are the submission of an application to the Department for the provision of the land, the transfer of documents, verification of documents, sending documents further down the chain. We add one more element to the notation. This is the administrative regulations (it is not a subject and not an object), i. e. it is certain restrictions, for which we can not go out and that will be present in all diagrams. We understand the process as the interaction of subjects, their influence on objects by means of their actions. Fig. 7 shows that the subject is the applicant (the person), it acts on the object (the Department for the provision of the land), feeding its application for land.

The description of new settings contributes to the generation of detailed specifications with which one can transfer the created project to another federal subject, or other agency, which corresponds to the main principles of creating projects for public authorities. Also, there was a need for a new approach to the description of the specifications by which significantly increased the information content of the project. As the design platform one can use almost any software tool for visual design, the main requirement for that is the presence

of high-quality IDEF0 editor and the possibility to describe the procedures of Workflow class. Using IDEF0 greatly simplifies the process of understanding of a business process model and helps to carry out the development strategy of the department. For lower levels, the levels of descriptions of the algorithm (script) of a process, this notation is not appropriate and one can use the notation of Workflow class.

Thus, proposed methodology includes subjects, objects, action, administrative regulations, IDEF0 (for a description of the processes at higher levels for executives) and Workflow (the sequence of execution of operations). Recall that Fig. 4 shows the top-level diagram for the executive, it set up in notation IDEF0. There are no objects and subjects. In this diagram, we show that our methodology useful for top-level use of IDEF0. Workflow is useful for developers. The activity diagram is used to detail the features of algorithmic and procedural implementation of the operations system. Fig. 8 shows the activity diagram of the application process in the UML notation.

V. INFORMATION SECURITY

Information security is one of the most crucial issues for the development of e-services for public authority and e-government.

A separate task, which was successfully solved in the framework of the proposed design technology of e-services, is to ensure information security requirements. The technology provides synchronized control of the use of each attribute in the descriptions of information objects used in the model. Centrally assigning the status of "secure" attribute and installing and / or editing the rules for processing, the user is able to control and synchronize the processing of attributes throughout the model. The proposed methodology and tools with which was carried out one of the many possible projects for the creation of secure e-services for public authorities in the Russian Federation is a new element of the design of information systems for the public authorities. During the project, various forms of documents were designed, as well as registration forms used by users when they using services provided by public services.

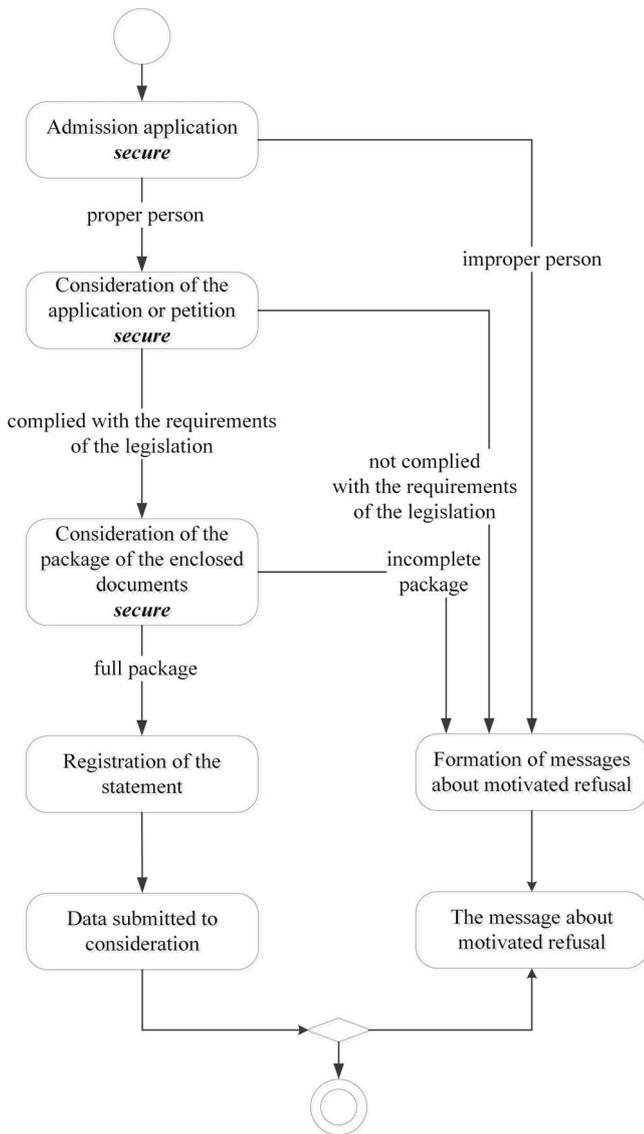


Fig. 8. The activity diagram of the application process

At each stage of work with the applicant data required to comply with the law on personal data, as well as increased requirements for information security. These have to be taken into account at the design stage of the state information system. If we look at the application stage, the generation of a number of processes necessary to provide for regulations that will be available to different categories of users. In this case, it is advisable to assign a specified process the status of “secure” attribute. Fig. 8 shows the delimitation of access control to the requested information. Subsequently, this status will be maintained throughout the process of designing the system. Request for information on it will be carried out according to certain rules, in accordance with the law.

The various techniques are proposed to protect the digital media from unauthorized use. Digital watermarking is used to protect intellectual property in e-government applications

and detect the illegal use of digital information. A digital watermark is a piece of information that is hidden directly in media content, in such a way that it is imperceptible to humans, but can be easily detected by computers or other devices enabled with special secure software and scanner devices. There are a number of digital watermarking techniques for different applications, such as robust watermarking, fragile and semi-fragile watermarking, steganography, and others. E. g. the watermarks for images in e-government applications should be invisible for human eyes and robust for possible attacks, such as compression attack (JPEG or other image compression formats), see details in [23]–[25].

VI. PRACTICAL TESTING

For practical testing was chosen task of developing e-services for citizens and legal persons of registration of land, owned by the state of the Republic of Karelia. The implementation of the public service took place in the framework of the project TESIS G2B (e-government services for small and medium-sized businesses). In this project, the specific tasks for the implementation of e-services of land have been solved using the developed methodology described above.

The project is a set of diagrams and their relationships, established in accordance with the developed procedure and the proposed methodology. The basic principle was to create strict adherence to hierarchy diagrams and sequence for their disclosure. Not only the business processes have been described, which can be machines, but human processes, such as signing a document. This need is due to the specificity of projects for the public authorities since each process must be strictly algorithmic and approved, and the implementation of a similar action takes place in a strictly approved order, including the signing of the document. The presented diagrams (Fig. 4–8) were used in the practical project of development the information system for issuance of land in the Republic of Karelia, the information system set up and running.

The project was developed with the special software “BusinessStudio” [26]. There are many business process modeling tools, including the open source tools. But BusinessStudio is the best for the proposed notation as a generation system. In this system, there are a lot of mechanisms for generation of the various diagrams. Other systems can generate the specific diagrams, but not all of them at the same time.

The proposed notation is useful for the design. The advantage of the proposed methodology can be evaluated by the design time and time saved during code generation. Implementing the pattern tasks in many different structures of the public authority bodies one can use already developed diagrams from another government’s project in this notation.

Thus, taking into account the identity of the tasks of public authorities in other regions, and through the use of developed notation, we transferred the proposed methodology in other regions of the Russian Federation. E. g., the high-throughput inspection system for the unified automated information system of customs authorities of the city of Orenburg has been developed by the using the proposed notation. The full description of this project will be published elsewhere.

VII. CONCLUSION

The proposed methodology and tools, with which the project was implemented by the development of secure e-services to public authorities in the Russian Federation, is the new element of the information systems design for the public authorities.

Using this approach, it is possible to structure, unify and (thanks to automatic code generation tools in BusinessStudio technology) simplify the development of software for the public authorities in all regions of the Russian Federation. Distribution of created notation enables a clear awareness of the objectives and available mechanisms for their implementation, which will speed up the process of e-government creating and the use of the results will streamline management processes in the Russian Federation.

ACKNOWLEDGMENT

The reported study was funded by a grant of the President of the Russian Federation (MD-6766.2015.9). The authors would like to thank A. L. Badenko for valuable discussions which contributed to the content of this paper.

REFERENCES

- [1] B. W. Wirtz, P. Daiser, "E-Government. Strategy Process Instruments", *Speyer*, 2015.
- [2] L. Vidasova, A. Chugunov, E. Mikhaylova, "E-Governance in Russia: Toward New Models of Democracy", *Proc. The EGOSE'15 International Conference on Electronic Governance and Open Society: Challenges in Eurasia*, 2015, pp. 44-47.
- [3] N. Vasilyeva, "Special Aspects of Public Communication Development in Contemporary Russia", *Proc. The EGOSE'14 Conference on Electronic Governance and Open Society: Challenges in Eurasia*, 2014, pp. 109-113.
- [4] <http://www.minsvyaz.ru/uploaded/files/referat-ep.pdf>
- [5] "E-Government for Sustainable Development", *United Nations E-Government Survey*, 2016.
- [6] A. Mitras, P. Hengeveld, D. Polemi, J. Gamper, "Secure E-Government Web Services", *IGI Global*, 2007.
- [7] A. T. Al Ajeeli, Y. A. L. Al Bastaki, "Handbook of Research on E-Services in the Public Sector: E-Government Strategies and Advancements", *IGI Global*, 2010.
- [8] M. A. Shareef, N. Archer, S. Dutta, "E-Government Service Maturity and Development: Cultural, Organizational and Technological Perspectives", *Information Science Publ.*, 2011.
- [9] Y. E. Hohlov, E. M. Styurin, "E-Government in Russia: Strategies of Formation and Development", *Global Strategy and Practice of E-Governance: Examples from Around the World*, IGI Publishing, 2011, pp. 286-303.
- [10] D. V. Koznov, A. V. Azarskov, A. V. Samochadin, J. A. Chevzova, K. Yu. Romanovsky, "A model-driven approach for government services specification", *Vestnik St. Petersburg University. Ser. 10.*, V. 4, 2012, pp. 102-116.
- [11] A. A. Makarov, A. N. Shabunin, "Features of the design of electronic services for public authorities", *Proc. The 44th annual international conference on Control Processes and Stability (CPS13)*, St. Petersburg State University Publishing House, 2013, pp. 438-443.
- [12] A. N. Shabunin, "Design and Instrumental Means of Electronic Services Generation for State Authorities", *SPIIRAS Proceedings*, V. 7(30), 2013, pp. 301-313.
- [13] <http://www.oecd.org/>
- [14] COM (2005) 229 final.
- [15] COM (2010) 2020 final.
- [16] J. Hagerty, R. L. Sallam, J. Richardson, "Magic Quadrant for Business Intelligence Platforms", *Gartner research*, February 6, 2012.
- [17] <http://www.uml.org/>
- [18] B. Margolisand, J. Sharpe, "SOA for the Business Developer: Concepts, BPEL, and SCA", *Mc Press*, 2007.
- [19] <http://www.idef.com/IDEF0.htm>
- [20] D. Marca, C. McGowan, "Structured Analysis and Design Technique", *McGraw-Hill*, 1987.
- [21] <http://www.w3.org/RDF>
- [22] A. Fleischmann, W. Schmidt, C. Stary, S. Obermeier, E. Börger, "Subject Oriented Business Process Management", *Springer*, 2012.
- [23] I. J. Cox, M. L. Miller, J. F. Bloom, J. Fridrich, T. Kaler, *Digital Watermarking and Steganography*. ELSEVIER, Morgan Kaufmann Publishers, 2008.
- [24] E. S. Yakovleva, A. A. Makarov, "On properties of the block-based binarization algorithm of digital images", *Computer Tools in Education*, V. 4, 2015, pp. 26-36.
- [25] A. Makarov, E. Yakovleva, "Comparative analysis of halftoning algorithms for digital watermarking", *18th Conference of Open Innovations Association and Seminar on Information Security and Protection of Information Technology (FRUCT-ISPIT)*, 2016, pp. 193-199.
- [26] <http://www.businessstudio.ru/>