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Concept of the Cloud Information Space of Regional Government

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Abstract: The article discusses the features of building the Information Space of St. Petersburg. It was stated that there is strong inefficiency of investments in the existing information systems in St. Petersburg. The reinvention of state information systems into cloud services with private partnership is recommended. Basing on the developed conception was described an approach to the problem of building an effective infrastructure of information systems and the choice of options for its cooperation to transform the information space into cloud information space. Results of this article can be used as a tool for transforming the variety of information systems into a single information environment and transforming them to cloud technology by reinvention of existing information and telecommunication infrastructure.

Key words: Informatization · Centralization · Datacenter · Integration · Innovation · Cloud computing · Information society.

INTRODUCTION

At the present time all levels of government are actively working to optimize information flow and control the information space on the criteria of efficiency and reliability of information infrastructure. The aim is to improve the validity, timeliness of decision-making, as well as to enhance the effectiveness of management system of the city.

Nevertheless, at this stage, according to the annual report on implementation and evaluation the effectiveness of the state program of the Russian Federation, "Information Society (2011 - 2020 years)" [1, 2], an efficiency indicator of information technology usage, calculated as the share of the information technology sector in gross domestic product of the Russian Federation does not exceed 3.2 %, which is almost 2 times lower than in Sweden [3]. Therefore, it is important to facilitate the rise of this sector to the world level and use information technology infrastructure as a factor that stimulates the development of other sectors of the economy [4].

Thus, in international practice of banking activity we can observe a trend of changes in the structure of supply and demand for banking products in favor of remote products. Among them are non-cash payments, card projects, internet banking, telebanking, mobile banking and national payment systems. A key factor in the transition to this segment of customers demand are information technologies and systems. Fact of dominance of innovative infrastructure elements manifested in the activities of Russian bank "Tinkoff Credit Systems". Moreover, the London Stock Exchange has noticed this activity after an initial public offering of this bank. The ratio of borrowed funds and equity of the bank was a record, even in comparison with the world's leading banks in the U.S and Europe and by October 2013 reached multiplicity equal to 7, which is not typical for any other bank [5-7].

It should be noted that socially important industries in St. Petersburg including science and education, social services and health care show inadequate equipment of information resources [8] that indicates the importance of developing a strategy in terms of implementation the information technology.

We should also note the fact that development of communication systems of the executive bodies of region often lags behind the needs of users that can be characterized as moderate growth in low-infrastructure development. Nevertheless, this area is one of the fastest growing [9-11] and therefore requires determination the vector of regional information

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infrastructure development at the level of decision-making and adequate measures for its implementation.

Deployment of information technology and development of information society in St. Petersburg is restrained, besides, by the differences in the depth of information technology and non-optimal structure of information resources in government, organizations, institutions and households [12-14]; it has fragmented, uncoordinated departmental resources, as well as duplication of information in different databases and information systems operating within the executive bodies of St. Petersburg. Typology of state information systems is characterized by a significant difference in platforms, industrial and territorial specificity; their design and implementation is very individual and, therefore, complicated and requires increased cash flow.

In this case, for implementation of the above directions considerable funds are spent. Only in 2013 the Committee on Information Technologies and Communications of Government of St. Petersburg spent more than 4 798 447.30 thousand rubles ($136 261 508) on this area. In addition, project of the program "Development of the Information Society in St. Petersburg for 2013-2016 years" provides predictive value in budget cash flow for this area during 2013 - 2016 years amounting to 44 841 022.45 thousand rubles ($1 273 350 510) [15].

The problem situation. We should note that existing objects of informatization are extremely inefficient. Therefore it requires a rethinking the structures of regional information resources, their rebuilding on the basis of invested funds performance, their matching to current problems to be solved in informatization and especially the requirements of the people by the "price-quality" criteria [16].

This situation increases the importance of re-engineering and rebuilding the information resources of regional executive bodies [17]. It is also important to note that private business in Russia is characterized by tending to use existing information resources on commercial terms [10, 14]. Transition to the cloud resources is a global trend. That is why Microsoft board demanded appointment as CEO Satya Nadella, ex-head of the cloud technologies department [18]. Consequently, the hodograph of the vector of IT technologies market in the coming years describes the trajectory to the Cloud Technologies.

Proposals and Tasks: Basing on the above, we propose restructuring the information infrastructure of the region by transforming it into deployable state cloud services with private partnership for subsequent transferring the existing information resources to the cloud technologies basis.

Highlighting the most important tasks in modernization process of regional information resources into the cloud structures:

In Terms of Information Support:

- To identify information support for territorial authorities of St. Petersburg and the order of information exchange with industry authorities of St. Petersburg and its subordinate organizations using document that systematically takes into account the requirements of all users in the region;
- To provide access to the unified multiservice telecommunications network in real time to the following city-wide information resources: real estate, legal persons, population;
- To develop a model to ensure the accuracy of the data due to the regulation of data sources and achieve reliability of the information in regulated data sources expected as the results of data validation algorithms approval;
- To ensure the update of traffic exchange being implemented with related systems; to bring it into compliance with the legislation related to use the basic information resources and eliminating redundant data and streams.

In Terms of Software:

- To establish an adequate compliance of subsystems of government information systems to management processes (subject to automation in the system) in the provision of public services and providing public functions basing on the business process reengineering in regional system and bringing subsystem functions in accordance with applicable law;
- To develop software components forming and maintaining the citywide information resources and regulating access for industrial executive bodies and subordinate organizations, to provide regulated access to the citywide system resources;

- To develop and implement information processes for citywide access to resources for executive bodies and subordinate organizations;
- To develop and implement information processes providing the ability to push e-reports to related information systems.

In Terms of Organizational Support:

- To develop a list of administrative regulations of public services and public functions in district administrations, automated as a part of government information resources;
- To develop and adopt regulations that define information exchange between information systems during e-reports generation.

MATERIALS AND METHODS

Development of information resources of St. Petersburg is offered to be produced both on the basis of modernization and deployment of cloud-based structure and, respectively, transition to a new level of information technology architecture. This requires the implementation of large amount and a wide range of activities from the formation of the concept to design, development, testing and implementation of new information systems in various areas.

In order to deploy a cloud infrastructure, we propose the creation of a regional data processing center (RDPC), providing the consolidation and development of effective information resources integrating the single cloud-based multi-service telecommunication network, information systems, electronic system of interdepartmental interaction, information security systems and other ones.

RDPC provides the cloud system of centralized storage and data processing, aggregation of state information resources, including information on the public services provision, statistical and analytical data, consolidated from common sources (information systems). In particular, it will provide an opportunity to make decisions on the basis of data formed through systems aggregation in terms of available indicators on the basis of their relationship with each other [12, 19].

Russian experience shows the evolution of information resources, first, from the possibility of restructuring the regional infrastructures to cloud resources [20]. During 2011 and 2012, Russia's leading private companies that have deployed cloud infrastructure (My Warehouse, Megaplan, Softline, Korus Consulting, Mango Telecom, Bars-Group, SKB Kontur) received income from the provision cloud services (Software as a Service, SaaS) from 100 million rubles ($2 836 900) to 3.75 billion rubles ($106 488 750). It is also notable that high demand for cloud services (SaaS) and adequate ability to pay presents not only in Moscow and St. Petersburg, but also in other cities of the Sverdlovsk region and Tatarstan. Moreover, leaders in revenues are Yekaterinburg and Kazan. Secondly, it is important to state the fact of the positive dynamics in the profitability of cloud infrastructures: it shows average annual revenue growth of 15% [21, 22].

Deploying the cloud services. Priority project in our model should be implementing regional cloud data center in St. Petersburg that is appropriate while taking into account international and domestic experience. This will allow:

- To automate management activities at the level of the Governor and the executive authorities of St. Petersburg;
- To provide cloud centralization of information resources at the regional level in a single location on single principles of data collection, storage, processing, presentation, actualization and dissemination;
- To increase the effectiveness of cloud computing resources usage within RDPC, storing data using the world level standards;
- To reduce the cost of maintaining an engineering support for centralized city information infrastructure;
- To improve reliability of the information infrastructure and its resiliency while reducing operating costs;
- To replace obsolete electronic and telecommunication equipment to modern technological infrastructure.

To determine strategies for creating cloud services in accordance with the above requirements it is necessary to carry out the grouping of information systems in accordance with the previously held classification [8, 10] and rank information systems clusters basing on the feasibility of placing them in the

cloud space, depending on the ratio of the maintenance costs of these information systems compared to placing them in RDPC. In order to do this it is required to use the indicator which calculates total cost for all information systems maintenance within one cluster during the year:

$$P_{\sum} = \sum_{i=1}^{n} \frac{P_C}{(1+r)^t} + \sum_{i=1}^{n} \frac{P_F}{(1+r)^t} + \sum_{i=1}^{n} \frac{P_V}{(1+r)^t}$$

where P_c means capital costs of the reorganization; P_F means fixed costs of operation and maintenance; P_V means variable costs of service; t means the number of periods over which the costs are calculated.

In order to assess the feasibility we can use the criteria measuring the appropriateness of transition into the cloud. The basis of this criteria is the ratio of the following values:

$$K = P_{\sum} / P_{cloud} ,$$

where P_{colud} is the average cost of placing this information system in RDPC.

Depending on the ratio of costs and the corresponding value K we can distinguish the following levels of appropriateness of transition to a cloud infrastructure:

- Highest level: $P_{\Sigma} >> P_{colud}$, $K > 1,5$. Maintenance costs of the system exceed the cost of placing this information system in RDPC more than 1.5 times.
- Average level: $P_{\Sigma} > P_{colud}$, $K = 1,1 \ldots 1,5$. Maintenance costs of the system exceed the cost of placing this information system in RDPC 1.1 - 1.5 times.
- low level: $P_{\Sigma} \approx P_{colud}$, $K \approx 1$. Maintenance costs of the system are approximately equal to the cost of placing this information system in RDPC.
- Inappropriate level: $P_{\Sigma} < P_{colud}$, $K < 1$. Maintenance costs of the system are smaller than cost of placing this information system in RDPC.

Strategy for transition to appropriate levels of cloud services is illustrated in Fig. 1. The number of arrows indicates the closeness of the relationship between indicators P_{Σ} and P_{colud}.

Practical activity while reorganizing the information space of St. Petersburg requires its formal submission in the appropriate notation, so we have developed a contextual model of transition to cloud services in St. Petersburg (Fig. 2) in the IDEF0 standard.

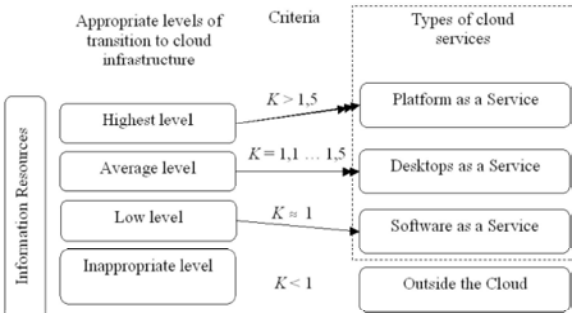

Fig. 1: Levels of transition to cloud infrastructure in RDPC Concept

In order to organize the interaction of control bodies and performers we have to provide decomposition processes of transformation of information resources into the cloud services in relation to the infrastructure of the city (Fig. 3).

Considering this model, it becomes apparent that at the moment the transition of information systems of St. Petersburg to the cloud requires optimizing both regulations and technical equipment. At the same time, an analysis of the technical infrastructure allows us to state requirement to develop integrated solutions for different clusters of systems that allows achieving the centralization and optimization of information flows that would eliminate the duplication of functional components and data between different information systems.

Decomposition model in Fig. 3 defines the basic activities required for transition to the cloud architecture. Components of the information space of the city are characterized by the structure and communication, i.e. they are reviewed as a system.

In accordance with the model shown in Fig. 3 and on the basis of the data presented in the Law of St. Petersburg # 654-102 "On the budget of St. Petersburg in 2014 and the planning period of 2015 and 2016" clusters of information systems were ranked in accordance with the above-proposed criteria (Table 1). Mean values P_{Σ} and P_{colud} were determined for a period of 3 years, due to specific of budget planning in the current legislation. At the same time this budget law provides cash flow for RDPC direction for 2014, 2015 and 2016 as the amount of 23 862.28 thousand rubles ($676 949.0), 25 246.3 thousand rubles ($716 212.2) and 26 710.6 ($757 753.0) thousand rubles respectively, it means total funding of 75 819.18 thousand rubles ($2 150 914.2). Taking into account the amount of state information systems that are registered in the Register

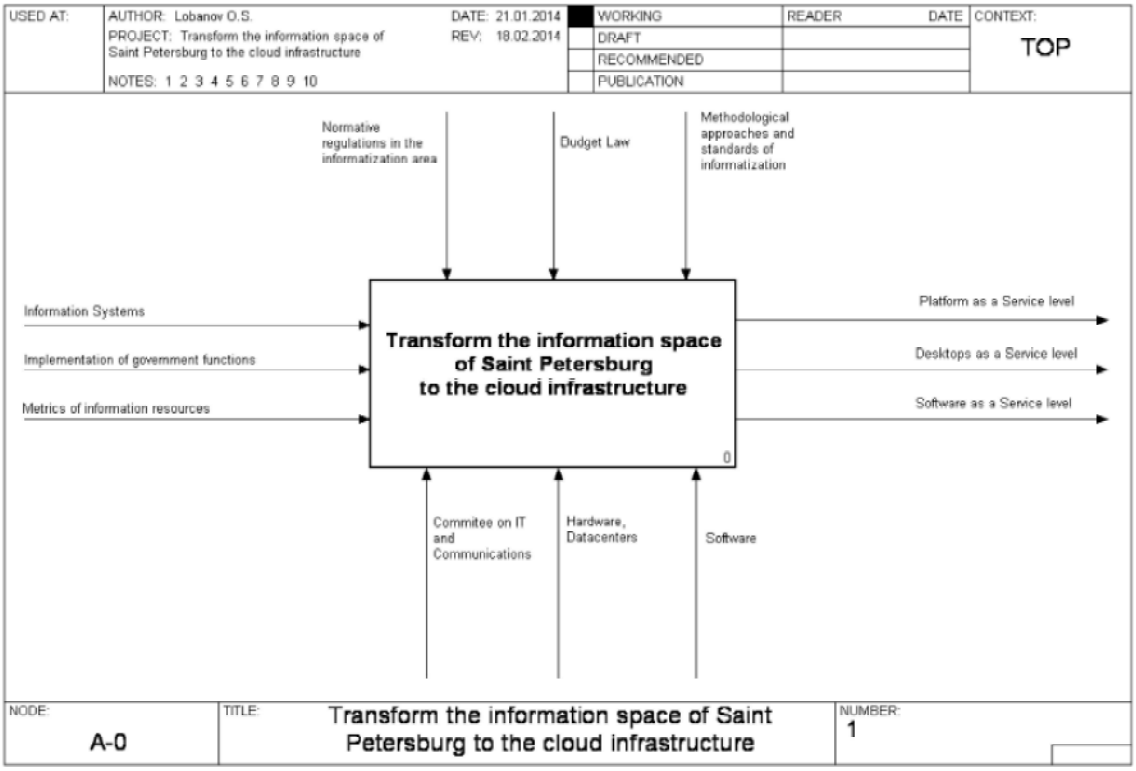

Fig. 2: Model of transition to Cloud services

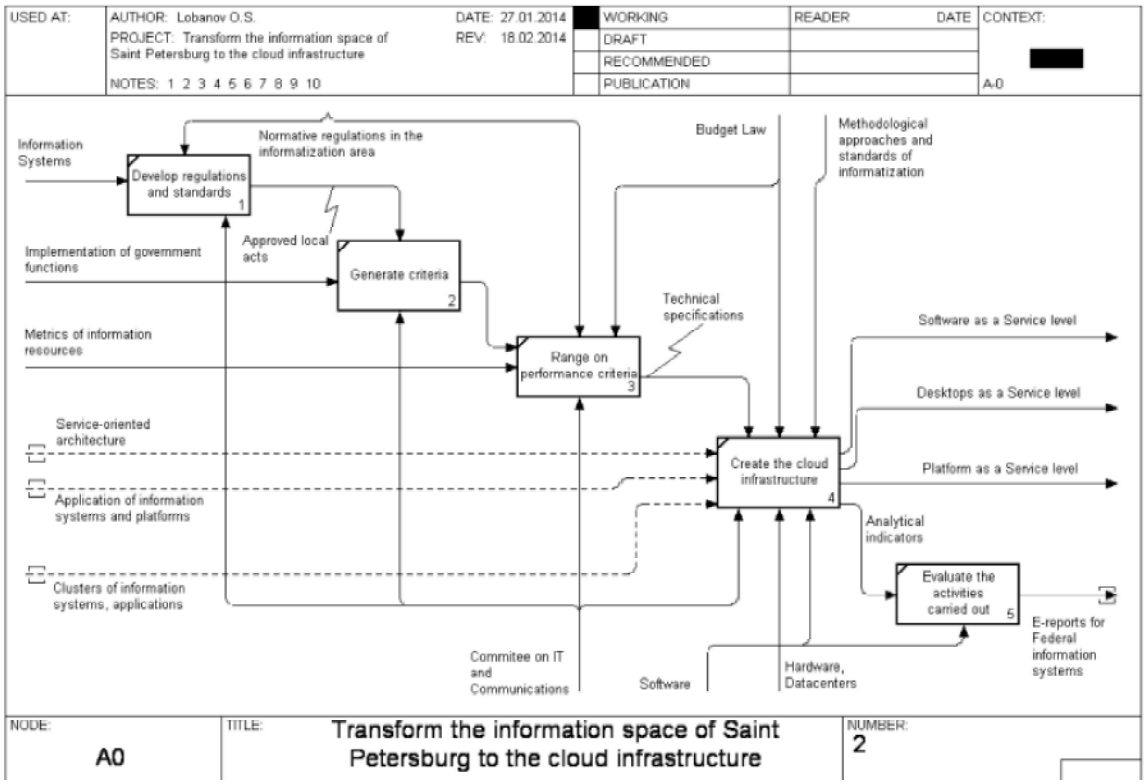

Fig. 3: Decomposition of the context model of transition to Cloud services

Table 1: Ranking clusters of state information systems basing on the level of transition to the cloud infrastructure

No	Name of cluster	Number of Inf. systems per cluster	Average value of P_{Σ}, $	Average value of P_{cloud}, $	K_i	Suitable level of service
1	Cluster of multiuser analytic decision support systems	11	$652 559.6	$34 692.1* 11 Inf. systems = $381613,1	1,71	1
2	Cluster of multiuser informational and reference functional systems	15	$759 758.4	$34 692.1* 15 Inf. systems = $520381,5	1,46	2
3	Cluster of multiuser official informational and reference systems	12	$437 121.1	$34 692.1* 12 Inf. systems = $416305,2	1,05	3
4	Cluster of multiuser infrastructure systems	14	$1 039 377.1	$34 692.1* 14 Inf. systems = $485689,4	2,14	1
5	Cluster of single user functional systems	10	$270 598.8	$34 692.1* 10 Inf. systems = $346921	0,78	4
Total		62	$3 159 415.0	$2 150 910,2	-	-

of State Information Systems of St. Petersburg [23], we determine the average cost of placing a single information system as the amount of 75 819.18 / 62 = 1 222.89 thousand rubles ($34 692.1).

Therefore, the appropriateness of the transition to a cloud infrastructure for at least two clusters of information systems is justified [24]. Given the amount of information systems the strategy of cloud infrastructure will provide significant savings in the budget that is necessary for development the information resources of regional government.

CONCLUSION

The solutions provided for restructuring state information systems into state cloud with private partnership will improve the effectiveness of investments in information technology. Using the proposed concept of reengineering the regional information systems is economically justified, as evidenced by the results of this research and during the analyze of tenders performed by Committee on Information Technologies and Communications of Government of St. Petersburg [12, 24]. Basing on these facts, we can draw conclusion about the importance of methodology in order to provide budget savings and efficiency management. Concept of cloud information space developed by authors provides centralized control of executive bodies and their subordinate agencies at various levels and offers planned, controlled development of the information space in St. Petersburg. Maturity level of cloud information resources and the effectiveness of budget investment required for their establishment and operation corresponds to standards of developed countries in the modern world.

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