The Digital Model of the Noosphere

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1. Introduction

143 million people live in Russia today, half of them live in cities with populations over 100,000 people. When Russia moved from a centrally planned Soviet economy to a market economy, the development of urban areas has changed dramatically. There are rapid development of trade and entertainment spheres, splitting of large enterprises, emergence of private business, and development of housing construction. These processes, together with the privatization of state assets, with total inventory and registration of land rights, have formed an intricate and complex system of state and municipal management of the territory and land resources.

While working on the automation of one of the largest Russia's territorial planning institutes and at the same time implementing automation solutions of the current activities of the regional government bodies and local authorities, which are responsible for managing the development of the territory, you should be ready to deal with the series of paradoxical situations for IT professional on a daily basis. These situations may cause such phenomena typical for Russia, such as:

– The percentage of changes to the documents of strategic and tactical planning is very high at the time of their harmonization prior to approval. Trying to consider interests of different departments, investors and citizens, this process extends over tens of months and goes through several iterations. Resulting in the initial solutions lose their relevance and become overgrown with contradictions. The average period of development and approval of the strategic document for the big city is 3-5 years, with a planning horizon of 20-25 years, the need for adjustment arises within just 5-10 years after the plan's approval (see Figure 1).

Figure 1: The lifecycle of strategic planning documents in Russia (estimated).

– There is enormous amount of harmonization processes (tens to hundreds, depending on the region) at registration of land plots, obtaining building permits and permits for the facility to operate, and as a consequence of this there is huge duration (3-5 years) of the construction cycle. It's delay the initiation of the investments.

As a result, today we have a low percentage of strategic territorial planning documents implementation (10-15%) and low efficiency of the territory development management. Actually it's carried out manually. Tomorrow it will be clear that the speed of decision-making on territory management, which is needed by society, is unattainable with the use of modern approaches. I wonder if we need to sacrifice quality management. But it in turn leads to the accumulation of entropy.

2. Issues in IT

Let us consider the specific situations mentioned above. These are examples of inefficient use of IT technology in managing the development of the territory:
Example 1. In 20109-2012, the inventory of paper archives of the Urban Planning Department of Tyumen city (600 thousand people) was performed for the creation of information system providing planning activity (ISOGD). Local authorities have to establish and maintain the system since 2006 in accordance with the Town Planning Code of Russia. During the 3.5 years engineering networks, the results of geodetic surveys, archives of permitting and project documentation, which reflect the adopted solutions since 2000 have been made to Database from papers. However, the process of updating this information could establish just for 20 % of the data types. Only 15 % of the employees of the Department re-use the data from the Database in their work, and even less among other local government units.

Example 2. In accordance with federal law from July 1, 2012 any agency in Russia has no right to require the applicant's documents and data if it already contained in the archives and databases of other agencies and local authorities while provision of public and municipal services. To realize this task, a lot of money has been invested in the creation of an e-government's technology and system of interagency electronic interaction. However, the advantages of standardized communication protocols and broadband communication channels established between the agencies do not solve the problems within the individual departments. A document flow is still with a paper, and existing information systems use for registration and storage, but not designed for rapid transfer in response to an inter-ministerial inquiry. Many information systems do not have the necessary legal status. Together with the strict requirements to the process of the applications' processing, these innovations do not leave enough time to analyze data and make good decisions (see Figure 2).

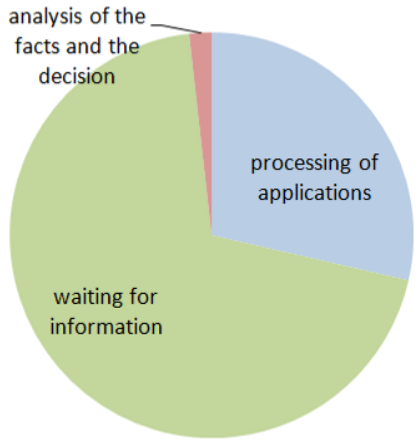

Figure 2: The distribution of time allocated for the provision of state (municipal) services (usually from 14 to 30 days).

In addition the business processes are confusing and contradictory and we need to optimize and change it, also we need to establish legal mechanisms for monitoring its compliance before automate it. For example, while implementing an automated process control system in one of the largest Russian cities with populations over 1 million people, we are faced with the functions as, for example, "to lose a statement". Of course we can't automate it.
Another striking example of "successful implementation" of the interagency electronic interaction system is a situation where the agency enters the data into the system from paper and attaches the scanned image of a paper document to answer the request received in electronic form. In that case information system provides only the data

transfer, but the agency-receiver prints out the received data and scanned images and then attaches it to the paper file, based on an analysis of which the specialist makes a decision.

Example 3. In 2006 the Russian government approved the concept of creation and development of spatial data infrastructure of the Russian Federation, however, to date spatial data, whether the documents of territorial planning schemes or the development of transport, social and utility infrastructure is one of the resources, carefully protected by agencies, which is authorized to update it, but spatial data is not the subject of information exchange. The value of this resource is questionable in such status. For example, if you issue a permit for excavation work without the actual scheme of communication, you can leave the neighborhood without water, gas, or Internet network by one motion of excavator bucket. The development plans of various fields are not synchronized, we often face with cases where the same street can excavate and bury a variety of service up to 3-4 times a year, alternately changing the tram tracks, asphalt, pipes and cables.

The main causes of inefficient use of special software and digital data sources are:

- institutional and legal challenges to governments and municipalities to carry out its functions with the using of automated information systems and take them as the only relevant and legitimate source of information (the concept and status of the electronic document has not yet clearly defined);
- lack of coordination between agencies responsible for funding the implementation of information technologies and agencies that have to operate with the information system for resolving practical tasks;
- legislation of Russia (regulating the conduct of bidding for state needs) is oriented on the expenditure of budget, rather than on achieving a positive result of implementation. The consequences of this are the failure in the training of specialists and lack of adaptation of the expensive software to specific management situations.

3. Data Sources

It is equally important issue is the quality of the information, which we need for the decisions-making on strategic planning and tactical territory management: comprehensiveness, relevance, reliability.

The primary method of obtaining information by regional authorities and local self is filling in statistical forms and registration of territory parameters changes on the basis of documents received in the course of providing services to individuals and organizations (i.e., the declarative principle). There are rare cases of the regular work of the committees to verify the actual condition of the land and buildings. Many of the data obtained by this way in the absence of a reference data source (repository) is not used in decision-making. Or decisions are taking using numerous duplicates of data, which do not satisfy the criteria of quality.

Urban planners make projects are based on raw data, obtained primarily from government departments and local authorities. The using of remote sensing data, Internet, detailed survey of the territory is often limited by project budget. Different departments are usually not interested in providing complete and timely information for planning, because preparation of such data array is not part of their basic functions.

In addition to the above-mentioned shortcomings of official data, the information has another one a disadvantage – static. A lot of time passes since receiving raw information till the preparation of project design, which is ready to harmonization process. In this case, since there is no system of dynamic changes in the transfer of data from government to planner, the refinement of baseline data is not happening. During the period when the parameters of the territory are changing dynamically, it is almost always lead to the

need to make significant changes to the design decision at the consultation solutions stage with stakeholders and the public hearing stage.

A spatial data infrastructure (SDI) is new (in Russia) approach, which able to significantly increase the quality of data used in the urban planning and territory management by creating a standardized medium of exchange of information and metadata, quality control through feedback.

In accordance with the SDI ideology various departments and commercial organizations have to provide to each other spatial and attributive data created and updated by them on a regular (commercial or free) basis in the form of standardized electronic services. The implementation requires significant changes in legislation, or at least, we need a political will, "town-forming" man, who may force information's owners to sit at the table and create the conditions for the data owners of various sectors (transport, water, sewer, police, health care, landscaping, etc.) to provide their data for the effective territory management and planning, their integrated development and to handle complaints about the quality of data.

If we have a standardized medium for data exchange which is filled with resources of the data providers about the territory, we can automate tasks such as the automation of drawing a development plan of the land plot (the permission on the design of capital construction object, see Figure 3), or the rapid calculation of the change loads on utility networks, depending on the parameters of the planned object.

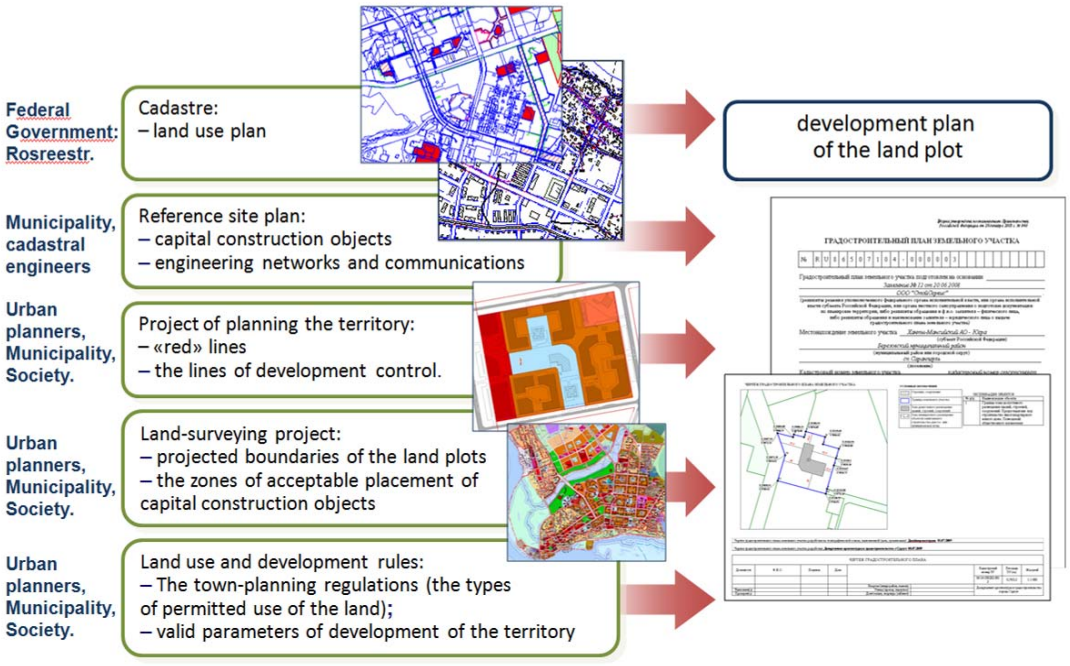

Figure 3: Automated creation of urban development plan of the land plot based on SDI principles.

Certain Russian regions have begun to establish the regulatory framework to create SDI in 2012 (Republic of Tatarstan), but to eliminate the lag of the development planning and territory management by consistently borrowing of successful foreign approaches and transferring them to the reality of the Russian administration is extremely difficult.

4. New Approaches to Data Mining

Of course, the life of a city in Russia is not governed by a 100 % by state or local government. High rates of economic growth and democracy are largely driven the evolution of the territory of the city by the citizens and subjects of local and corporate business within the territory of the permitted use and market relations. When in Russia we are talking about development of small business, the authorities imply different tax incentives, subsidies and other financial instruments primarily.

In the absence of suitable for data processing analytical tools only the most enterprising business men can survive and develop own business. Tasks such as the availability of parking, catering, recreation, transportation, availability of various objects of interest etc could be solved by tools of spatial analysis, available with variety of geoinformation systems. There is only question of quality baseline data for analyzing and processing the request.
There are promising ways of obtaining data for such analysis, the results of which may be applicable not only to create a public information resource on the parameters of the urban environment, but also to improve the quality of input data for tactical control and strategic planning:

- information from the technical means of monitoring the environment - space (imagery in different ranges to determine the level of contamination, thermal anomalies, creating three-dimensional models of the territories), aerial photography and laser scanning (monitoring of territory beyond the highways), surveillance cameras (monitoring the intensity of human and transport streams);
- ground-based laser scanning, panning;
- information from the sensors installed on the technical means - energy consumption, the number and frequency of «social» mechanisms (gates, doors), and others;
- information from personal mobile devices (data about the movement, the results of express-pooling, data from a car computer to commit position, speed and violations);
- data collected and recorded by volunteers using a social-oriented services (OSM, pit road, unauthorized garbage dumps, etc.).

Many of the above methods of data collection are inferior to traditional methods of forming the source of data for urban planning (geodetic measurements, aerial photography office work, the collection of statistical information for updating rosters). However, this allows you to create dynamic arrays of information, reflecting the variability of the parameters of the territory in a short (within days, weeks) and longer periods. We can monitor the behavior and parameters of the objects, such as location in space and time and use it while planning in dynamics. Traditional methods of forming the planning data source cannot give such results and we use it only as an abstract setting (i.e. X cars per 1000 inhabitants).

Combining these data with the tools of spatial analysis and modeling software can significantly improve the efficiency of planning and management.

For example, a signal processing technology of satellite positioning mobile devices today have already been successfully applied in a taxi - on the basis of GPS, based from the position of the car, system automatically choose the nearest orders and provide selection among them to the driver. The geoprocessing system and traffic information provide automation for finding and tracking an optimal route. And if you have data on the parameters of traffic management and road, you can choose a route that is optimized in terms of speed, the minimum distance or ease of movement.

OCM maps (http://www.openstreetmap.org/) of inhabited territories often much more detailed than the official sources or maps of the commercial projects, such as Google or Yandex. We may not achieve millimeter accuracy, important in the construction, but with significant

probability we do not miss any one point of interest which is important for society, because the society itself creates and check data, and this is important for planning and strategic decision-making.

Many people have mobile phones with functions of locating coordinates, date and time and having a connection to the Internet. We may use advanced technology to inform citizen about joining him in any zone on the basis of a signal GPS, and cell phone towers. These data can be used, giving through mobile device a brief survey or information to a man who located certain places (socio-important institutions, key transportation hubs, recreation areas etc). This way we may collect actual information about the purpose of visit, the route, the mood and the other parameters of a man's intentions and make an on-line aggregation of this information.

Given the scale of social networking, with government support and wide advertising campaign it's possible to attract citizens to express own position about the development of the territory. It can be a significant audience in the hundreds of times more than audience of the standard sociological surveys. Also it's assist with creating active communities, which acts in the development and improvement similar technologies.

This form of information gathering is particularly interesting, given that today there are people operating outside specific area and beyond parameters of availability of a variety of urban benefits, they can move freely not only within a single city or state, but within the world and everywhere and elsewhere they will require a comfortable environment. The development of outsourcing services, teleconference, improve efficiency and automation in the traditional sectors of the economy and, consequently, reducing the number of people who has employed and has bound to places, has changed the requirements for transport and information infrastructure of the city. All of it requires new approaches to obtaining feedback about the effectiveness of planning and implementation plans for the development of territories.

We solve the problem of planning to create a comfortable environment for people. At the same time, a person's life depends on natural factors - day and night (light), seasons, wind direction and strength, the parameters of pressure, temperature, solar radiation and the magnetic, and also important abrupt changes in conditions caused by disasters.

It is very easy to register such information with sensors measuring the parameters of the environment in different parts of the city. Dozens of forecast systems employed on the basis of analysis of the data and their stories have been developed. The strategic decision in the planning of urban development is incomplete without taking into account these factors.

However, new and difficult challenge is to identify patterns and build relationships between the parameters of the environment and a dynamic model of human behavior and traffic flows. The intensity of life in metropolitan areas increased from year to year. There are questions of night and day infrastructure, of the difference in the pressures on cities in tourist season and "dead" season, consumption of resources and demand points of interest of the population in the hot and cold days. Handling and accounting of the natures' parameters will optimize many areas of human activity.

An incredibly wide field of long debate and research is a global information field of the planet. Of course it has not a direct impact on the planning and management of territories. But ultimately the environment, urban areas and information field – a set of it creates the mood of each person and of people in general. And the mood of the crowd has a decisive influence on issues of national importance. The history of ancient Rome and the history of modern democracies teach us.

5. The Model

The above identified a number of issues affecting the speed and quality of management decisions that reduce the rate and effectiveness of strategic planning, negatively affect territory development plans according to the real needs of the population and its individual characteristics.

Present Level of hardware and software is an adequate to problem and allows forming a digital model of the modern state and the planned development of the city (provided the condition to address a number of organizational and legal problems), aggregating:

- the resources of state agencies and local authorities and private companies involved in the traditional areas of urban management, combined in a spatial data infrastructure (determined responsibility for the quality of data and the obligation to respond to complaints about the accessibility, completeness or quality of information);
- information resulting by crowd sourcing, parameters registration by environmental sensors and the data of citizens interacting online with the space of the cities (allows you to update the information about the territory in a much more dynamic mode, to obtain information about entities, the monitoring of which by the traditional way is difficult or impossible).

Creating a platform for collecting and sharing of information – a digital model of the Noosphere – open for viewing, as well as development and connection of a variety of analytical tools, the author believes will jump to an increase not only the quality of planning and management of cities, but also, perhaps, even more importantly, will catalyst for raising the level of social responsibility and civic engagement of the population in the territory development area, which is especially important for the Russian Federation, with its traditionally low people participation level in decision-making process.

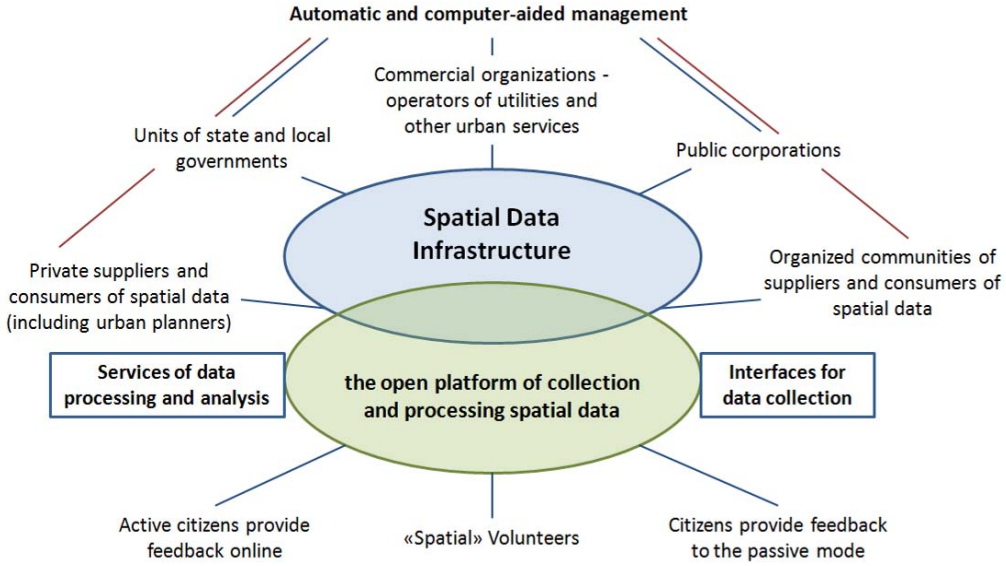

Figure 4: The Digital Model of the Noosphere.

6. Conclusion

The effect of the model in urban planning practice has not been investigated by author, until recently. The conclusion about the need to move to it has emerged in the process of monitoring the development, negotiation and approval of planning

documentation, as well as its use in real-world decision-making on management of cities in the Russian Federation.