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PROBLEMS AND WAYS TO SOLVE DIGITIZING
OF SPATIAL DATA IN THE REPUBLIC OF KAZAKHSTAN

Abstract: This work has brought to light main problems faced in setting up and forming the National Spatial Data Infrastructure of the Republic of Kazakhstan (NSDI of the RK). The major ones are a proper formation of the executive structure; a short list of standards in force for setting up of the NSDI of the RK; casual generation and inappropriate development of spatial data; low levels of technology; a necessity for an advanced training of specialists. During the organization of the NSDI of the RK, it has been suggested to turn attention to the executive structure of the Federal Geographic Data Committee which has been mentioned as an example in a schematic format. It has been suggested to formulate new standards for the NSDI of the RK or arrangement of statutes and regulations tested through the practice of developed countries; to apply the recent advancements in spatial data generating and disseminating technology. The level of readiness and the development level for each of five spatial data groups of the NSDI of the RK such as fundamental, basic, industry, thematic and metadata group have been assessed. Lack of its own open coordinate system in the country that makes it impossible to set up the NSDI of the RK has been identified. It was noted that the structure of basic spatial data for the national spatial data infrastructure of the country has not been defined to this day. Casual generation and development of industry spatial data in the country by fewer than all government establishments and bodies have been acknowledged. In Kazakhstan, generating thematic spatial data was evolved very massively. However, there is no civilized control and follow-up exchange mechanism in the thematic data generation. This resulted in a situation where thematic spatial data often becomes a property of geodata producers and is not included in the general storage and dissemination system. In the area of technology, the authors believe that it is necessary to use the technologies of spatial data infrastructure 2.0 in order to set up, build and develop the NSDI of the RK.

It is suggested to improve the Automated Information System of State Land Cadaster (AIS SLC) as one of the ways to generate and build the NSDI of the RK by adding SDI 2.0 thereto. The AIS SLC is quickly developed and has already had more than 12 sub-systems and cartographic framework for the whole territory of Kazakhstan. The AIS SLC can integrate with other information systems relatively easily and has vertical and horizontal structure and defined professional staff in each region of the country. To use fully the AIS SLC for setting up the NSDI of the RK, it is certainly necessary to solve in advance organizational, technical and technological problems identified by the authors.

Keywords: digitalization, spatial data, complex information technology platforms, national spatial data infrastructure, collective mind, creating content by users, problems, solutions.

Digital spatial data being synonymic with geodata and geo-resources makes 80% of general digital information throughout the world [1]. Hence the developed countries being sensible of the fact that this 4/5 of digital information largely plays a pivotal role in economic growth and development of the country, the efficient activity of business entities and social satisfaction of the citizens, in particular, take a good care of own geodata. As a result, the National Spatial Data Infrastructures (NSDIs) have been set up by the developed countries as a high-priority measure for successful achievement of main goals of digitalization.

Kazakhstan has also fully acknowledged the necessity to enter the Digital Era, and to actively implement the complex IT Platforms for this purpose [2], one of which is the NSDI of the Republic of Kazakhstan (NSDI of the RK). Thanks to, mainly, our efforts [3], the NSDI of the RK, upon active discussions, was included into the Activity Plan for the implementation of the State Program "Digital Kazakhstan" [4,5].

The NSDIs of the developed countries have been built in such a way as to support, via collective intelligence of their participants, the innovative technology trends directed at generation, building and development of spatial data and the conditions in which business activity is developed to the fullest, at the levels such as Government to Government (G2G), Government to Business (G2B) and Government to Citizen (G2C) including Business to Business (B2B). Furthermore, the examples of particular countries suggest that a proper setup and formation of organizational structure and IT platform of the NSDI can be repaid quite quickly. In addition, a snowballing digitalization growth takes place and eventually leads to a digital transformation of the country's economy.

However, for a variety of reasons, some NSDIs are not always generated, built and developed according to requirements imposed to the modern SDI [6].

The purpose of this work is to present the most effective ways to generate, build and develop spatial data at all three government activity levels, G2G, G2B and G2C, using the National Spatial Data Infrastructure. The objective of the work is to identify the most serious problems faced in generating of the NSDI of the RK and the ways to solve them.

NSDI components. The NSDI generally consists of five main components: infrastructure, policies & institutional arrangements, technology, spatial data and people (specialists) who generate, build and develop geodata [3].

Organizing of spatial data at government level can be exemplified by the structure of the US Federal Geographic Data Committee (FGDC) [7] (Figure 1).
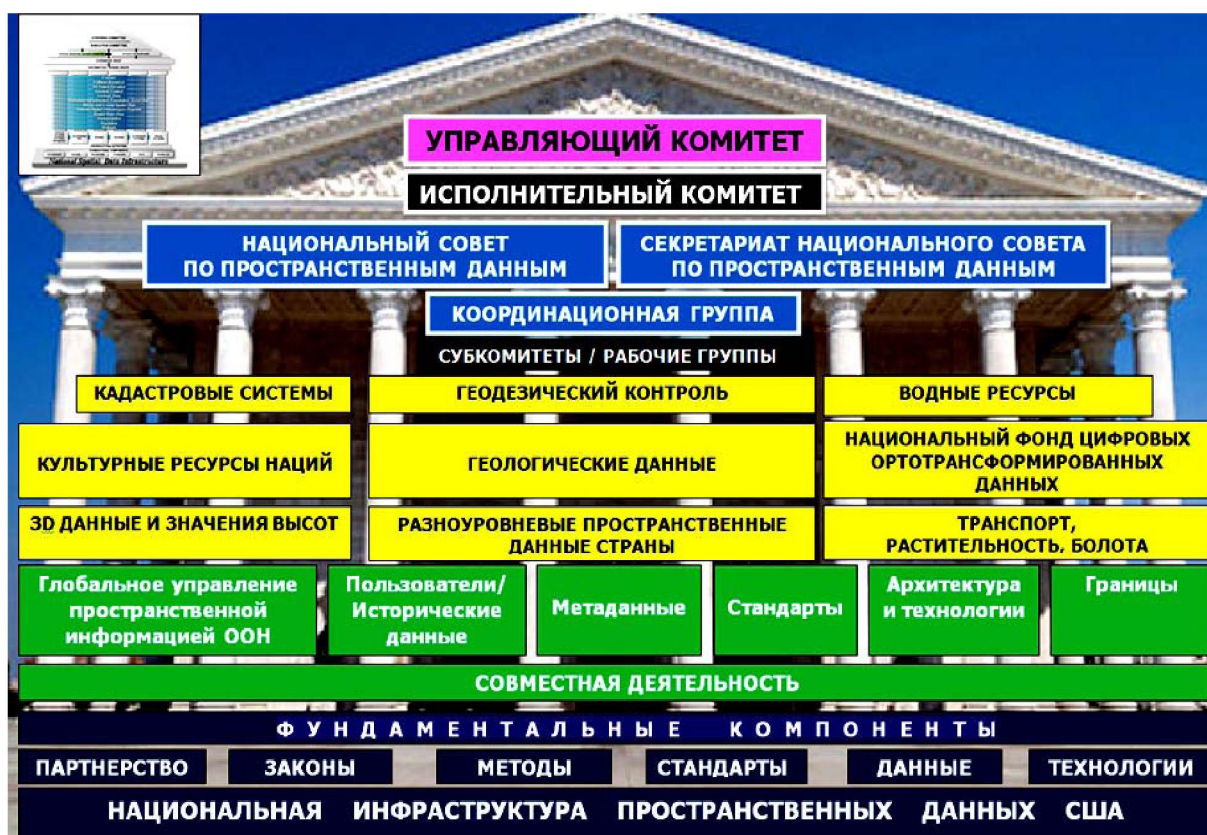

Figure 1 – The structure of the US Federal Geographic Data Committee [7]

The above structure consists of four large units such as control; spatial data; cooperation system; fundamental components intended to generate, form and develop the NSDI.

It is unfortunate that no organizational structure designed for maintenance of the NSDI of the RK has been set up in Kazakhstan. According to preliminary data, the responsibility for setup, formation and development of the NSDI of the RK will be placed on the Committee on Land Resources Management of the Ministry of Agriculture of the RK (CLM of the MA of the RK). The CLM is a governmental body responsible for generating and checking spatial data (cartographic and geodetic service); storage of spatial data (National cartographic and geodetic fund); registration, assessment, monitoring and zoning of the land fund of the country (The State Research and Production Centre for Land Management). Hence is perfectly reasonable to choose the CLM of the MA of the RK as a government body responsible for setting up the NSDI of the RK, according to the said functions: generation, check, storage, registration, assessment, monitoring and zoning of any and all spatial data.

However, during the setup of the NSDI, its authorization or provision of very determined existence conditions that should not fall under dilution of responsibility in changing the organizational structure of executive and political power in the country is a crucially important organizational point. The reliable existence of the NSDI is ensured by assignment of responsibility for its existence directly to the head of state or head of government. Such NSDIs are capable of being preserved and developed even in the acutest and critical situations (examples are the USA, EU countries, South Korea, etc.).

Standardization and legal framework for the NSDI of the RK have not been developed enough. Due to scientists' efforts, the notions of "spatial data" and "spatial data infrastructure" were introduced for the first time into the Law of the Republic of Kazakhstan "On Space Activities" [8]. But the Law "On Spatial Data of the RK" and respective by-laws, standards, rules and regulations and guidelines that properly ensure the implementation of regulatory standards of such legal document have not been established yet. Basically, these components of the NSDI of the RK can be provided without great effort since the standards of NSDI underwent long tests in more than 100 countries. Generally, these standards should be reset for an environment of Kazakhstan. Then, great opportunities can be opened for legal exchange of spatial data, with all that it implies.

Spatial data. The fundamental benefit of the NSDI is generation, building and development of spatial data on systemic and analytical basis [3]. They incorporate five types of spatial data.

1. Fundamental spatial data is the geometry of the country. Kazakhstan has not had open state geodetic coordinate system. To solve the problem it is impossible to proceed to set up the NSDI of the RK.

2. Basic spatial data are nonvolatile and typically medium-scale geodata (the borders of the country, regions, districts; large water bodies and rivers; roads of republican subordinance, etc.) that are always publicly available. By now, the structure of basic spatial data of the NSDI OF THE RK has not been defined yet.

3. Industry spatial data are usually large-scale geodata. They are compiled and updated on a systematic basis for the purpose of solving production industry problems. For now, the Automated Information System of State Land Cadaster is a unique and operational information system in the field of spatial data using [9]. The other information systems are in different stages of development [10].

4. Thematic spatial data are geographic information systems of different scales, designed for site of interest, with different complexity and orientation for all interested principals. In the country, they are mainly generated through budgetary funds. But despite this, systemization and storage of thematic data has not been established at an adequate level.

5. Meta-data is data that describes other data which specifies format, location and other information about spatial data. The country has not had meta-data to spatial data, systemized in a unified way.

The NSDI geoportal is the window to the world of users and producers of Digital Spatial Data (figure 2). Geoportal is designed to visualize systemized geodatabase and support the entire system. The next

function of geoportal is to carry out an elementary spatial analysis which will ensure data dissemination, data exchange between the participants and elementary analysis of visualized spatial data. For instance, expanded analyses of spatial data involving attribute data are not always available on geoportal. Hence one cannot either overestimate or underestimate the role of SDI geoprtal.SDI setting-up and formation *technology* underwent very serious changes over last 10 years. For example, the first NSDIs (NSDI 1.0) were set up completely at the expense of the government, from top to bottom, i.e. vertically. Now NSDI 2.0 are formed and developed, mainly, via collective intelligence of the whole geo-industry community for the country, regions and even the world [11]. Appropriate use of NSDI 2.0 highly facilitates digitization of the country.
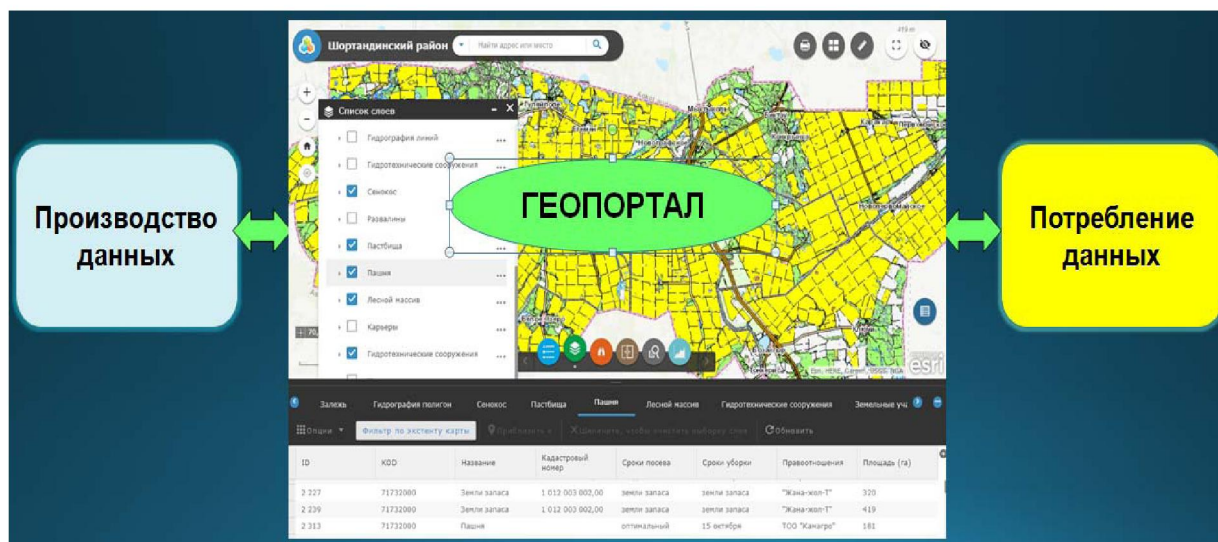

Figure 2 - The general scheme of its operation of the SDI through the geoportal

People or specialists. A number and qualification of specialists in the field of generating spatial data in the country expand at a fast rate. Virtually, setup of geographic information systems in the country reaches the user-declared phase. So for the time being, software for setting up geographic information systems became available almost for every reasonable person. Some software is publicly available for establishing multi-purpose geoservices [12]. This promotes a heavy expansion of opportunity for digitization of the country by excluding financial costs for the purchase of software.

Ways to solve the problems. In our opinion, setup and formation of the NSDI of the RK can be performed by improving AIS SLC and adding SDI 2.0 thereto. The AIS SLC is developed fast and has already had more than 12 subsystems and cartographic framework for the whole territory of Kazakhstan. AIS SLC is capable of integrating with other information systems relatively easy and has vertical and horizontal structure and defined professional staff in each region of the country that is at work in subject field that is Land Cadaster Service. To use fully AIS SLC for setting up the NSDI of the RK, it is certainly necessary to solve in advance the said organizational, technical and technological problems.

Therefore, we have specified some problems and ways to solve them when organizing the National Spatial Data Infrastructure of the Republic of Kazakhstan. At G2G level, this is own organizational structure of the NSDI of the RK as well as a correct articulation of the problem of state agency-level cadasters, based on AIS SLC. At G2B level, this is the provision of business entities with all unclassified spatial data implemented at the expense of the government. At G2C level, this is an involvement of large numbers of citizens and specialists for setup, building and development of the NSDI of the RK. Main problems faced in setting up and building-up the NSDI of the RK and the ways to solve them.

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ҚАЗАҚСТАН РЕСПУБЛИКАСЫНДА КІҢІСТІКТІК ДЕРЕКТЕРДІ САНДАНДЫРУ ПРОБЛЕМАРЫ МЕН ШЕШУ ЖОЛДАРЫ

Аннотация. Еңбекте Қазақстан Республикасының ұлттық кеңістіктік деректер инфрақұрылымын (ҚР ҰКДИ) дайындау және қалыптастыру проблемалары анықталған. Басты проблемалар қатарына мыналар жатады: атқарушы құрылымды дұрыс ұйымдастыру; ҰКДИ-ға қатысты мемлекеттік стандарттардың толық еместігі; кеңістіктік деректердің жүйесіз дайындалып нақтылы қалыптастырылмауы; технологиялар дәрежесінің төмендігі; мамандар дайындауды жетілдіру. ҚР ҰКДИ-ін ұйымдастырғанда АҚШ ҰКДИ-інің атқарушы құрылымына мән бере отырып дайындау ұсынылып ол мысал схема ретінде көрсетілген. ҚР ҰКДИ-іне байланысты жаңа стандарттар дайындалуы екерек. Немесе, дамыған мемелекеттердің тәжрибелерін еске ала отырып, олардағы жасалған нормативтік-құқықтық құжаттарды ауысымдау да жөн. ҚР ҰКДИ-інің кеңістіктік деректерін дайындауда эконоимкалық тұрғыдан пайдалы технологиялардың соңғы жетістіктерімен жұмыс істеу дұрыс. ҚР ҰКДИ-ің бес топтағы кеңістіктік деректерінің дайындығына және даму деңгейіне баға берілген. Олар: фундаменталдық, базалық, салалық, тақырыптық және метадеректер. Республикада ҰКДИ құру үшін ашық координаттық жүйенің жоқтығы нақтыланған. Онсыз ҚР ҰКДИ-ін құруға болмайтыны басып көрсетілген. Бүгінге дейін ҚР ҰКДИ-іне қажет базалық кеңістіктік деректер құрамы анықталмаған. Республикада салалық кеңістіктік деректерінің дайындлуы жүйесіз жүргізіліп кейбір мемлекеттік органдар белсенділік таныта алмай келеді.Қазақстанда тақырыптық кеңістіктік деректер дайындау жақсы дамыған. Бірақ тақырыптық кеңістіктік деректерді дайындауда өркениетті бақылау және кеңістіктік деректер алмасу жүйесінің механизмдері жеткілікті реттелмеген. Бұл құбылыс тақырыптық кеңістіктік деректердің жалпы мемлекеттік сақтау және алмасу жүйесіне ілікпей оларды дайндаушылардың меншігіне айналуына әкеліп соғуда.

Технология саласында, авторлар, ҚР ҰКДИ-ін жасау, қалыптастыру және дамыту кеңістіктік деректер инфрақұрылымын 2.0 технологиялары бойынша жүргізілуін қолдайды.

ҚР ҰКДИ-ін жасау, қалыптастыру және дамыту үшін мемлекеттік жер кадастрының автоматтанды-рылған ақпаратық жүйесін (МЖК ААЖ) негізге алып, оны КДИ 2.0 технологияларымен толықтыруды жетекшілікке алу керегін мақұлдайды.МЖК ААЖ жақсы дамыған 12-ден аса қосымшалары және бүкіл республиканы қамтитын картографиялық негізі бар жүйе. МЖК ААЖ республиканың барлық аудандарын қамтиды, басқа ақпараттық жүйелермен оңай интеграцияланады, вертикалді және горизонтальды құрылы-мымен жоғары дәрежелі мамандары бар. Әрине, МЖК ААЖ-ды ҚР ҰКДИ-ін жасау үшін пайдаланардың алдында, алдын ала жоғарыда көрсетілген кемшіліктерді реттеп алу керек.

Түйін сөздер: сандандыру, кеңістіктік деректер, кешендік ақпараттық-технологиялық платформа, ұлттық кеңістіктік деректер инфрақұрылымы, ұжымдық ақыл ой, кеңістіктік деректерді пайдаланушылардың өздері құруы.

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ПРОБЛЕМЫ И ПУТИ РЕШЕНИЯ ЦИФРОВИЗАЦИИ ПРОСТРАНСТВЕННЫХ ДАННЫХ РЕСПУБЛИКИ КАЗАХСТАН

Аннотация. В работы выявлены основные проблемы создания и формирования Национальной инфраструктуры пространственных данных Республики Казахстан (НИПД РК). Главными из них являются: правильное формирование исполнительной структуры; неполный состав действующих стандартов для создания НИПД РК; бессистемное создание и неадекватное формирование пространственных данных; низкий уровень технологии; необходимость совершенствования подготовки специалистов. При организации НИПД РК предложено обратить внимание на исполнительную структуру Федерального комитета по геоданным США, которая приведена в качестве примера в схематической форме. Предложена выработка новых стандартов для НИПД РК или переложения нормативно-правовых документов, проверенных на практике развитых стран; применение последних достижений в области технологии создания и распространения пространственных данных. Оценены степень готовности и уровень развития каждой из пяти групп пространственных данных НИПД РК: фундаментальной, базовой, отраслевых, тематических и метаданных. Указано на отсутствие в республике собственной открытой системы координат, без которой невозможно создать НИПД РК. Отмечено, что до настоящего времени не определен состав базовых пространственных данных национальной инфраструктуры пространственных данных страны. Обращено внимание, что в республике отраслевые пространственные данные создаются и формируются бессистемно и не всеми государственными ведомствами органами. В Казахстане, наиболее массовое развитие получило создание тематических пространственных данных. Однако, в области создания тематических данных отсутствует механизм цивилизованного контроля и последующего обмена. Это привело к тому, что тематические пространственные данные часто превращаются в собственность производителей геоданных и не поступают в общую систему их хранения и распространения. В области технологии авторы считают, что для создания, формирования и развитие НИПД РК необходимо использовать технологии инфраструктуры пространственных данных 2.0.

В качестве одного из путей создания и формирования НИПД РК предлагается совершенствование Автоматизированной информационной системы государственного земельного кадастра (АИС ГЗК), дополнив её технологиями ИПД 2.0. АИС ГЗК динамично развивается и уже имеет более 12 подсистем и картографическую основу на всю территорию Казахстана. АИС ГЗК способна относительно легко интегрироваться с другими информационными системами, имеет вертикальную и горизонтальную структуру и сформированный штат квалифицированных сотрудников в каждом районе республики. Естественно, для полноценного использования АИС ГЗК для создание НИПД РК необходимо предварительно решить выявленные авторами организационные, технические, технологические проблемы.

Ключевые слова: цифровизация, пространственные данные, комплексные информационно-технологические платформы, национальная инфраструктура пространственных данных, коллективный разум, создание содержание пользователями, проблемы, пути решения.

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