

PROSPECTS FOR THE DEVELOPMENT OF THE REGULATORY FRAMEWORK OF INFORMATION SYSTEMS FOR "GREEN" STANDARDIZATION

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Abstract: Standards of the profile "Methods and means of creating, maintaining and developing Informatization", the main principles and directions of "green" standardization are developed. These provisions include: the main directions for creating a regulatory framework for Informatization of green standardization and the main directions for creating regulatory support for information technologies of "green" standardization, which determine the directions of work in creating an information environment for "green" standardization.

Keywords: environmental technology, information technology, artificial intelligence, environmental safety, "green" standards, "green" innovative technology, "green" innovative products

ПЕРСПЕКТИВЫ РАЗВИТИЯ НОРМАТИВНОЙ БАЗЫ ИНФОРМАЦИОННЫХ СИСТЕМ "ЗЕЛЕННОЙ" СТАНДАРТИЗАЦИИ

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Аннотация. В статье представлены основные положения и направления развития нормативно-правовой базы информатизации "зеленой" стандартизации. Основной профиль стандартов зеленого направления выделен по базовой тематике: – методы и средства создания, сопровождения и развития информатизации зеленой стандартизации. По приведенному анализу стандартов профиля "Методы и средства создания, сопровождения и развития информатизации" разработаны основные принципы и направления зеленой стандартизации. К этим положениям относятся: главные направления создания нормативно-правовой базы информатизации зеленой стандартизации и главные направления создания нормативно-правового обеспечения информационных технологий зеленой стандартизации, которые определяют направления работ при создании информационной среды зеленой стандартизации.

Ключевые слова: технология среды жизнедеятельности, информационная технология, искусственный интеллект, экологическая безопасность, "зеленые" стандарты, "зеленая" инновационная технология, "зеленая" инновационная продукция

INTRODUCTION

Principles and directions of development of the regulatory framework for Informatization of "green" standardization. First, we need to answer the question: how can green standards for innovative products and innovative technologies be expressed in a clear form for artificial intelligence

(AI)? Before answering this technical question, it is appropriate to answer the ideological question: what does artificial intelligence have to do with it? Why convert green standards into computer programs? The answer is simple: recently, it has become possible and cost-effective to solve problems of improving the living environment and public health with the help of artificial intelligence

[1], [2], [3]. Modern information technologies (it) are characterized by the use of artificial intelligence methods in software. Currently, the process of "intellectualization of information technologies" is the main one. We are referring to the following trend: in the beginning, it performed the function of "big compute", and now it processes the knowledge presented in databases. Over the past 50 years, the total computing power of computers has grown more than 10^{10} times! [4], [5]. Recently, the results of AI application have gone beyond academic developments and are used in practical applications of environmental impact assessment (OS) of construction and other technologies [6], [7]. Artificial intelligence systems are usefully used in real life, from environmental diagnostics of the territories where objects are located to the management of construction robots and construction industry devices [8].

The report of the National intelligence Council of the United States (2017) from the series " Global trends "with the subtitle" Paradox of progress " [9], based on a survey of more than 2,500 experts from 35 countries, contains several alternative scenarios for the future. The Preface to the report emphasizes that the report does not claim to be final forecasts, but only a Preface to the discussion of the near future.

High risks require active cooperation of all countries of the world, involving the potential of artificial intelligence to prevent possible attacks of environmental terrorism and dangerous climate change.

Experts of the National intelligence Council of the United States note that the current situation is full of paradoxes: the progress of recent decades has contributed to the empowerment of a large number of people, but this same progress has generated the global financial crisis of 2008 and the growth of political populism in many countries of the world. They are confident that in the next five years, tensions will increase both within individual countries and in relations between countries. Competition at the international level will increase, and it will become increasingly difficult for countries to work together to solve

common problems. The reasons for the crisis of cooperation will be differences on issues of environmental safety, religion, and individual rights. Differences in values and interests between States will threaten international security [10].

The way out of the problematic global situation can be the artificial intelligence of the United Nations, which is not burdened with the feelings of living people, and which can find cardinal solutions without emotions, first of all on the problem of environmental safety of the planet based on green standards. We need a new regulatory climate, without which it is impossible to use green innovative technologies. Outdated standards are not adapted to solve the described problems [11]. The main feature of the development of the regulatory framework in the field of Informatization of green standardization at the new stage is the deep penetration of modern computer equipment and computer technologies in all areas of activity, including the educational process and the transfer of green standards and innovations in the industry. The legal framework for Informatization in the field of green standardization should establish the legal basis for the functioning of the information system at all stages of its development and implementation [12].

From the point of view of regulatory support, the green standardization information system is divided into two interrelated and complementary parts:

- legislative, including international, national and industry standards, as well as a set of legislative documents that define the basic principles of management in the field of industries (Rosatom, Rosstroy, etc.);
- regulatory and legal, including instructions, orders and orders, plans, norms, standards, etc., defining the mode, conditions and rules of operation of facilities and service personnel of industries (Rosatom, Rosstroy, etc.)

If the first set of documents defines the regulatory framework for creating and operating the information environment of green standardization, the second is the regulatory framework for implementing the transfer of innovative

developments of the green environment, green products and green technologies created in the educational environment through graduates sent to the relevant industries, in the practice of urban planning.

As a result of rapid development of social information networks innovation in the world has increased dramatically, there electroremote Autonomous cars appeared building robots and building robotic systems, there are software platforms that exist all of today's software applications and the smartphones gained rapid development, there are many other gadgets [13]. The accelerated development of it is increasing with the approach of the singularity era, when It will become an intermediary in all technologies and spheres of human activity. The educational sphere, including in the field of construction, should be rebuilt in a timely manner so that the University would adapt to the new conditions in advance, that is, it could be a locomotive for the development of AI, that is, corresponding to the green standards of the new natural environment of life. For example, today, thanks to the innovative achievements of digitalization, all financial organizations are concerned about their fate due to the emergence of digital blockchain technologies and cryptocurrencies such as bitcoin, and all transport companies are involved in the development of driverless cars after Tesla started this trend. Educational services may change unrecognizably in the near future in comparison with traditional processes in education [14], [15]. To achieve the goals of green standardization in the educational environment, it is necessary to create a unified automated system for processing information (information) about standards and regulatory documents based on modern computer technology and on the basis of widespread introduction of the latest methods of processing information materials and improving methods of analysis and synthesis of information.

With the development of an automated processing system, documentation must be provided for compatibility of all its systems. Such compatibility can be provided by the common organizational

structure, the unity of the information search language, the combination of technical means, the unity of software, a single procedure for collecting and processing information, the unification of documentation and information encoding [15].

Direct leadership and involvement of interested Departments, offices and divisions should be a prerequisite for effective and timely development of the regulatory framework.

1. FORMULATIONS OF THE PROBLEM

Basic principles of Informatization of "green" standardization. The main principle of work on green standardization in the field of Informatization should be the formation and implementation of a unified methodological approach to the creation, maintenance and development of information technologies in the educational environment and in industrial sectors.

The main goal of Informatization and standardization is to reduce the complexity, cost, and time required to create information technologies in industry and education, as well as to ensure their compatibility, portability, quality, and safety of operation.

Each specific project to create information technologies for green standardization should have a regulatory framework that covers all the required objects of standardization. The status of regulatory documents in this database may be different for different objects of green standardization: international standards, national standards of Russia, industry standards and guidelines, standards of enterprises and organizations for which green standardization information technologies are created.

The main stages and work on the design of information technologies are reflected in a set of international and national standards, as well as "de facto" standards. However, the existing standards do not disclose and regulate everything, but the most simple and traditional, available work unification. In addition, it should be borne in mind that during the development and approval of any ISO standard (usually about 5 years),

there are such significant changes in modern methods and tools for creating information technologies that they cannot be tracked in the "de jure" standards. The most advanced "de facto" standards become the basis for the next generation of ISO standards. In this regard, to regulate the methods and processes of creating, maintaining and developing information technologies for green standardization, it is necessary to create industry-specific guidelines and regulatory documents, taking into account all existing features [15].

Effective application of a set of industry-specific regulatory and technical documents should be supported by a comprehensive system of interrelated tools for automating the creation, maintenance and development of software for modern information technologies for green standardization. When choosing tools for automating certain types of work, it is necessary to provide for the possibility of their joint functioning and interaction with a single repository of project data, as well as to create a set of working methods for the use of tools that take into account the provisions of regulatory, technical and methodological documents.

The objects of standardization listed in this section, existing international and national standards, as well as "de facto" standards should be used as input data when forming the regulatory framework for each project.

The application of the principles of functional standardization in the creation, maintenance and development of information technologies for green standardization allows you to develop and include in the documentation of each specific system a set of standards that define solutions for the architecture and structure of the system, as well as regulated rules for performing work throughout its life cycle [15].

2.ACCEPTED PRINCIPLES AND METHODS

The principle of building and applying profiles of automation objects of "green" standardization.

The definition of "profile" according to GOST R ISO/IEC TO 10000-1-99 as a subset of mandatory

and optional features, requirements and parameters of one or a set of basic standards selected for inclusion in the profile is very strict. In this sense, profiles are used to specify the architecture and structure of automated systems of all types that are part of the automated green standardization management system.

When considering the regulatory framework governing the development, operation, maintenance and development of an information system for "green" standardization, the following standard profiles should be highlighted:

- methods and tools for creating, maintaining and developing green standardization information systems;
- software tools in the client-server architecture;
- user interfaces as an architectural component of the computing environment;
- telecommunication environment;
- information security methods and tools;
- legal issues of creating software tools.

Building and applying profiles requires a clear construction of basic standards that specify objects such as function sets, interfaces, and interaction protocols.

In addition, you may need to add specific processes, activities, and tasks related to the specifics of automated systems and their components to the selected subset of lifecycle processes. A number of works, especially at the most creative stages of software development, are not regulated by the standards. This does not allow you to develop and apply life cycle profiles for automated systems, as well as a number of other profiles based only on standards. It is advisable to additionally regulate such work with industry-specific regulatory and technical documents or enterprise standards.

The main obstacle to the creation of a regulatory framework in the field of green education that regulates the development, operation, maintenance and development of an information system for green standardization is the lack of a program and work plan in this area. And the lack of an up-to-date automated database of international and national standards in the field of Informatization and standardization makes such developments imperfect.

The list in the field of Informatization considered in this paper, consisting of more than 500 names of current international and national standards, as well as their analysis, is the basis of the article.

Life cycle of green innovative products

In General, the life cycle of green innovation products, consisting of the life cycles of the components, can be illustrated as follows.

CALS technologies are information support technologies for the life cycle of green innovative products.

The object of CALS-technologies is including information relating to impacts on the environment during the lifecycle of the product, impacts the production environment and impacts of manufacturing technology, impacts of logistics, impacts sales impacts operation impacts maintenance and repair of the product, and the technology is understood as a continuous information support of life cycle, meaning that every moment of life cycle data on environmental impacts from products authorized to share it with stakeholders.

Currently, CALS is understood as Continuous Acquisition and Life Cycle Support – continuous information support for the product or product lifecycle. At its core, today CALS is a global strategy for improving the efficiency and environmental safety of business processes performed during the product lifecycle through information integration and continuity of information generated at all stages of the life cycle. The means of implementing this strategy are CALS technologies, which are based on a set of integrated information models – the life cycle itself and the business processes performed during it, the product (product), the production and operational environment, and so on. The possibility of sharing information is provided by the use of computer networks and standardization of data formats, which ensures their correct interpretation.

BIM design and green construction of facilities

BIM technology is the organization of flows of project-building and project-technological information [5]. There are almost no environmental impacts at the planning and design stage of green

products. The impact on the environment appear at the moment of the beginning of the project. In the UK, there is a standard BS1192 "Joint production of architectural, engineering and design information" (BS1192: 2007). The standard allows you to quickly systematize the requirements for design documentation and automate the verification of their implementation. If the project does not meet the conditions of BS1192, the system did not accept it, which meant that the contractor did not finish the work and could receive penalties instead of payment [5]. In contrast to the concept of BIM technology (it is the organization of flows of project-building and project-technological information) and the concept of iasu (integrated production management system), the CALs concept includes not only the impact of green production, but also all other stages, without solving applied design and planning problems.

The process of creating a complex object is characterized by an intensive exchange of results between organizations, divisions of the organization and specific performers involved in the development of the project. Joint, cooperative design and production of an object can be effective if it is based on a single green information model of the object. This task is relevant not only for stable production structures, but also for structures that are temporarily created for the purpose of implementing high-tech projects and fulfilling large orders, including research institutes, design bureaus, main contractors, subcontractors, suppliers, etc., geographically remote from each other, using incompatible computer platforms and software solutions. The lifetime of such a structure is determined by the time the order is completed or the life cycle of the product being created (buildings, structures, territories, etc.). In BIM terms, such a structure is called a virtual object. A virtual construction site is characterized by a common "information space" that provides, subject to appropriate standards, the sharing of information. The design and technological information model developed at this stage should be based on the use of the ISO 10303 step standard [1], [2]. Once created, the product

model is used multiple times. Additions and changes are made to it, and it serves as a starting point for modernization. Compliance with the standard ensures correct interpretation of stored information.

ISO 10303 STEP is an evolving standard. Currently, the greatest progress has been made in the field of description of engineering products (ISO 10303-2203). The ideology of the ISO 10303 standard is that in addition to the basic elements (integrated resources), it includes so-called application protocols that define the specific structure of the information model for various subject areas (automotive, shipbuilding, construction, electronics, etc.). All application protocols (applied information models) are based on standardized integrated resources. This ensures continuity with existing solutions when creating a new application Protocol.

In accordance with ISO 10303, the object information model includes:

- > Structure and composition of the product, including versions (modifications);
- > Geometric models of object components (Foundation, enclosing structures, roof, part, Assembly unit, product) and their relationship based on TEI classifiers;
- >> Design text, drawing and graphic documentation for the object as a whole and its components (technical tasks, sketches, work projects, design notes, drawings).
- > Data about changes, approvals, and approvals.

Using a standard method for presenting design and technological data allows you to solve the problem of information exchange between different divisions of the enterprise, as well as cooperation participants equipped with heterogeneous design systems. Standardization of the data format makes it possible to quickly transfer the functions of one contractor to another, which in turn has the opportunity to take advantage of the results of the work already done. This feature is especially important for objects that have a long life cycle, when it is necessary to ensure continuity of information support for the object, regardless of the current market or political situation.

The vast majority of modern computer-aided design systems (Unigraphics, Computervision, Euclid, ProEngineer, etc.) support working with data in STEP format. In addition, there are a number of commercial software products that provide data conversion from various data formats to STEP format, which creates objective prerequisites for building integrated information systems.

Modeling of life cycle of green innovation products in quality systems

Taking into account the complex structure of most enterprises, it is important to identify the main processes, as well as simplify and rank the processes depending on the management goals.

Where people need to manage multiple processes and their interactions, especially complex processes that may involve multiple operations, problems are likely to occur. One of the possible ways to identify these places and smooth out negative factors is to use the technology of business process analysis and reengineering BPR (Business Process Reengineering).

It should be noted that the quality system is implemented through processes that occur within the framework of functions that are combined and intersect with each other in the process of product life cycle. For a quality system to be effective, these processes and their associated responsibilities, powers, procedures, and resources must be defined and applied in a consistent manner. To be effective, a quality system requires coordination and compatibility of the component processes and the definition of their interfaces. The international standards of the ISO 9000 series are also based on the concept of LC products.

Impact of green innovative products on the environment

Creating eco-friendly products is the imperative of the times all over the world. The reference point for developers of new construction projects, first of all, should be national standards with the application of international standards ISO 14000. To meet these regulatory requirements, it is necessary to conduct an analysis and assessment of the object's housing and utilities from the point

of view of environmental impact and, based on the results of the analysis, implement certain rules and regulations in order to minimize or even completely eliminate waste and garbage generated over the entire period of the object's existence, dispose of containers and packaging, etc., reduce energy and material consumption.

An important part of assessing the environmental impact of a construction project is to determine the environmental impact it causes. For such an assessment, it is necessary to provide developers with fairly simple and accessible methods for determining various types of environmental stress. Currently, such methods exist, in particular, to account for carbon dioxide emissions (which leads to global warming), sulfur and nitrogen oxides (which cause acid rain).

Environmental impact assessment is carried out for each stage of the life cycle of a construction object, including the purchase of raw materials, production, transportation and handling, operation, and disposal [6].

The solution of these problems is possible only with the help of effective information support, i.e., using CALS technology.

For the first stage, the volume of materials purchased for the production of products is estimated. In the second stage determine the cost of electricity, water, fuel, etc. On the stage quantities of consumables and energy. Integrated emissions of harmful and toxic substances are taken into account for all stages of the construction project life cycle.

Special attention should be paid to the evaluation and modeling stage of recycling, which takes into account the costs and, accordingly, the environmental load is generally associated with the transportation of waste, their processing, possibilities of recycling in the waste of raw materials, consumable and received (e.g., from waste incineration) energy.

Stages of Informatization of "green" standardization

The choice of a life cycle model in specific methodologies and technologies that implement them sets the division of the process of creating IP

SOFTWARE into stages, stages (sub-stages) and operations. This allows you to plan and organize the process of collective development, monitor development progress and the management of this process, i.e. provides the manageability and predictability of the process of creating IP. Life cycle of IP is divided into stages, which are associated with the results of the core processes defined by ISO 12207.

The analysis of the life cycle models traditionally used in our country (GOST 34.601-90 for automated systems), and the most common in the West modern methodologies and models of the life cycle for IP, carried out within the framework of the system project, allowed us to form a life cycle model of green standardization, which combines our standardized development stages (with minor changes) and modern approaches to IP design, determining the current content of stages, works and results obtained at each stage.

Life cycle model defined by the methodology for the establishment OF green standards, includes the following basic stages of creation of IP:

1. System design: the analysis of the organization, analysis and adoption of the basic design decisions on architecture of IP, formation of information system requirements and tasks for the technical design and development of the IP, the formation of the business plan of the creation of IP (assessment of trudoemkost and other technical and economic indicators, a detailed schedule of the development);
2. Technical design: design of the is database, application software architecture, application interfaces, including with existing automation tools and other systems, and formation of requirements for applications and system-wide SOFTWARE;
3. Operational design: database creation, design, rapid development, testing, and application integration;
4. IP Testing;
5. Trial operation of IP;
6. Deployment, maintenance and development of IP.

3. CONCLUSIONS

Artificial intelligence is most relevant for use in the field of environmental protection and health.

In combination with mixed reality systems, cloud technologies and business optimization tools, it will become the basis for a large-scale transformation of the green innovative technological structure of the economy. Transparency and universal availability of green standards are engineering requirements for the development of innovative green technologies, as well as innovative green products.

The article defines the main methodological and organizational principles for creating and developing the legal framework for Informatization and standardization:

1. A system of basic principles of Informatization of green standardization has been Developed based on the analysis of international and national standards of Russia that regulate the conditions for building and functioning of the information educational environment and infrastructure for Informatization of green standardization.
2. The principles of building and applying profiles of green standardization automation objects based on the basic concept of the life cycle of green innovative products are Developed.
3. Systematized technologies for information support of the life cycle of green innovative construction projects of the energy industry and Rosatom Corporation, which are the basis for creating a regulatory framework for Informatization of green standardization.
4. The aspects of managing the impact of green innovative products on the environment and the most rational area of green design and green construction of objects are Considered.
5. The areas of technology for reengineering control systems for various processes in construction and the main stages and stages of Informatization, standardization and information system creation are Defined.

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scientific and educational center "Environmental safety, green standards and technologies" and the Technical Committee for standardization TC 366 "Green" technologies of the life environment and "green" innovative products" are created and operate. The regulations on the Center and TC 366 provide for their formation as divisions that are intended to jointly provide the industry with updated regulatory documentation [12], [14].

REFERENCES

1. **Telichenko V.I., Slesarev M.Yu.** Logistics of innovations of environmentally safe construction objects//Bulletin of the Department of construction Sciences. Russian Academy of architecture and construction Sciences. No. 4 M 2001 From 183–189.
2. **Telichenko V.I., Slesarev M.Yu.** Information support. Basic terms and definitions. Study guide M. Ed. Association of construction universities, 2005. – 272 p.
3. **Kazakov, P.V.** Fundamentals of artificial intelligence: textbook. Manual / P. V. Kazakov, V.A. Shkaberin. – Bryansk: BSTU, 2007. – 196 p. – (Ser.Information systems and technologies). ISBN 5-89838-302-6
4. **Novikov F.A.** Artificial intelligence: knowledge representation and methods for finding solutions: Textbook. – SPb.: Publishing house of Polytechnical Institute. UN-TA, 2010. – 240 p. ISBN 978-5-7422-1845-6
5. **Talapov V.** "Fundamentals of BIM: introduction to building information modeling" Recommended by the NRO UMO of higher education institutions of the Russian Federation for education in the field of construction as a textbook for students of higher educational institutions studying in the specialty 270800 "Construction" Moscow, 2011 UDC 721.01: 004.9 BIM BBK 38.2+32.973.26-018.2 T16 Novosibirsk February, 2011. – 392 p.
6. **Nevmerzhitsky V.A.** Information support of decision of ecological problems//Secondary vocational education. No. 2, 2013, Pp. 54–56.

Publishing house: Union of Directors of secondary specialized educational institutions of Russia, Autonomous non-profit organization "editorial Board of the magazine "Secondary professional education"; (Moscow). ISSN: 1990-679X

7. **Schwab K.** The fourth industrial revolution / K. Schwab – "Eksmo", 2016- (Top Business Awards) ISBN 978-5-699-90556-0
8. **Shvab K., Davies N.** Technologies of the Fourth industrial revolution: [translated from English] / Klaus Shvab, Nicholas Davies": Eksmo; Moscow; 2018. – ISBN 978-5-04-095268-7
9. **Shlyapnikov V.V.** national intelligence Council of the United States on the paradox of progress// The fourth industrial revolution: realities and modern challenges. X anniversary Saint Petersburg sociological readings: proceedings of the International scientific conference, April 13–14, 2018, Saint Petersburg, Russia. – SPb.: Publishing house of Polytechnical Institute. UN-TA, – 2018. – 896 p.
10. Global Trends: PARADOX OF PROGRESS // A publication of the National Intelligence Council. URL: <https://www.dni.gov/files/images/globalTrends/documents/GT-Full-Report.pdf>(дата обращения: 21.01.2018)
11. **Telichenko V.I., Slesarev M.Yu.** "Green" standardization of the future-a factor of environmental safety of the life environment / / Industrial and civil construction, 2018, no. 8, Pp. 90–97. <https://elibrary.ru/item.asp?id=35418173> date of reference: 28.10.19.
12. **Telichenko V.I., Slesarev M.Yu.** Green standardization of technologies for the formation of a natural environment of life// MGSU Bulletin (issue 5, 2018, pp. 558–567) <http://vestnikmgsu.ru/index.php/ru/archive/article/display/186/1> accessed: 28.10.19.
13. **Gift Noah.** Pragmatic I. Machine learning and cloud technologies. – SPb.: Peter. 2019. – 304 p.: ill. – (Series "For professionals"). ISBN 978-5-4461-1061-2
14. **Slesarev M.Yu., Telichenko V.I.** Green standards of the life environment on the

examples of world leading innovative companies// System engineering of construction. Cyberphysical construction systems-2019 [Electronic resource]: collection of materials of the all-Russian scientific conference (Moscow, November 25, 2019) / Ministry of science and higher education of the Russian Federation, national research Moscow state University of civil engineering. – Electron. Dan. I progr. (17 MB). – Moscow: MISI – MGSU Publishing house, 2019. – Access mode: <http://mgsu.ru/resources/izdatelskayadeyatelnost/izdaniya/izdaniya-otkr-dostupa/> - title title. screens. ISBN 978-5-7264-2064-6

15. **Slesarev M.Yu., Telichenko V.I.** Review of norms, methods and models of Geoecology in aspects of problems of "green" standardization of construction// Geoecology. Engineering geology. Hydrogeology. Geocryology, 2020, no. 1, pp. 53-57 DOI: 10.31857/S0869780320010184

СПИСОК ЛИТЕРАТУРЫ

1. **Теличенко В.И., Слесарев М.Ю.** Логистика инноваций экологически безопасных строительных объектов//Вестник отделения строительных наук. Российская академия архитектуры и строительных наук. №4 М 2001 г. – С. 183–189.
2. **Теличенко В.И., Слесарев М.Ю.** Информационное обеспечение. Основные термины и определения. Учебное пособие М. Изд. Ассоциация строительных вузов, 2005 г. – 272 с.
3. **Казаков, П.В.** Основы искусственного интеллекта: учеб. Пособие / П.В. Казаков, В.А. Шкаберин. – Брянск: БГТУ, 2007. – 196 с. – (Сер. Информационные системы и технологии). ISBN 5-89838-302-6
4. **Новиков Ф.А.** Искусственный интеллект: представление знаний и методы поиска решений: Учеб. пособие. – СПб.: Изд-во Политехн. ун-та, 2010. – 240 с. ISBN 978-5-7422-1845-6

5. **Талапов В.** «Основы BIM: введение в информационное моделирование зданий» Рекомендовано НРО УМО вузов РФ по образованию в области строительства в качестве учебного пособия для студентов высших учебных заведений, обучающихся по специальности 270800 «Строительство» Москва, 2011 УДК 721.01:004.9BIM ББК 38.2+32.973.26-018.2 Т16 Новосибирск февраль, 2011. с.392
6. **Невмержицкий А.В.** Информационное обеспечение решения экологических задач// Среднее профессиональное образование. №2, 2013 г. – С. 54–56. Издательство: Союз директоров средних специальных учебных заведений России, Автономная некоммерческая организация "Редакция журнала "Среднее профессиональное образование"; (Москва) ISSN: 1990-679X
7. **Шваб К.** Четвертая промышленная революция / К. Шваб – «Эксмо», 2016 – (Top Business Awards) ISBN 978-5-699-90556-0
8. **Шваб К., Дэвис Н.** Технологии Четвертой промышленной революции: [перевод с англ./] / Клаус Шваб, Николас Дэвис»: Эксмо; Москва; 2018. ISBN 978-5-04-095268-7
9. **Шляпников В.В.** Национальный совет по разведке США о парадоксе прогресса// Четвертая промышленная революция: реалии и современные вызовы. X юбилейные Санкт-Петербургские социологические чтения: сборник материалов Международной научной конференции, 13–14 апреля 2018 г., Санкт-Петербург, Россия. – СПб.: Изд-во Политехн. ун-та, 2018. – 896 с.
10. Global Trends: PARADOX OF PROGRESS // A publication of the National Intelligence Council. URL: <https://www.dni.gov/files/images/globalTrends/documents/GT-Full-Report.pdf>(дата обращения: 21.01.2018)
11. **Теличенко В.И., Слесарев М.Ю.** "Зелёная" стандартизация будущего – фактор экологической безопасности среды жизнедеятельности // Промышленное и гражданское строительство, 2018. – № 8, – С. 90–97. <https://elibrary.ru/item.asp?id=35418173> Дата обращения: 28.10.19.
12. **Теличенко В.И., Слесарев М.Ю.** Зелёная стандартизация технологий формирования природоподобной среды жизнедеятельности// Вестник МГСУ (выпуск 5, 2018, с. 558-567) <http://vestnikmgsu.ru/index.php/ru/archive/article/display/186/1> Дата обращения: 28.10.19.
13. **Гифт Ной.** Прагматичный ИИ. Машинное обучение и облачные технологии. – СПб.: Питер. 2019. – 304 с.: ил. – (Серия «Для профессионалов»). ISBN 978-5-4461-1061-2
14. **Слесарев М.Ю., Теличенко В.И.** Зеленые стандарты среды жизнедеятельности на примерах мировых лидирующих инновационных компаний// Системотехника строительства. Киберфизические строительные системы – 2019 [Электронный ресурс]: сборник материалов Всероссийской научной конференции (Москва, 25 ноября 2019 г.) / Министерство науки и высшего образования Российской Федерации, Национальный исследовательский Московский государственный строительный университет. – Электрон. дан. и прогр. (17 Мб). – Москва: Издательство МИСИ – МГСУ, 2019. – Режим доступа: <http://mgsu.ru/resources/izdatelskayadeyatelnost/izdaniya/izdaniya-otkr-dostupa/> – Загл. с титул. экрана. ISBN 978-5-7264-2064-6
15. **Слесарев М.Ю., Теличенко В.И.** Обзор норм, методов и моделей геоэкологии в аспектах проблем “зеленой” стандартизации строительства// Геоэкология. Инженерная геология. Гидрогеология. Геокриология, 2020, № 1, – с. 53–57 DOI: 10.31857/S0869780320010184

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