

UDC 004.045

The registry principle and SMART documents as conditions for the digital transformation of technical building operation

The transition to "Industry 4.0" or the "Fourth Industrial Revolution" is a difficult step, within which automated technologies are being introduced into all areas of production industries. The aim of this introduction is to provide the exchange of data between devices, databases and systems of varying difficulty level without human intervention. This transition is also a transition to formalization and standardization, and therefore requires the use of new formats of regulatory and regulatory-technical, organizational-technical documents. It becomes obvious that these formats should be not only human-readable, but also machine-readable. They will allow documents to be systematically and effectively formed, applied and adjusted at all stages of the building's life cycle. The technical operation of buildings does not stand aside. Effective operational activity is impossible without effective management of its regulatory and technical documentation and regulatory requirements for operated buildings, their elements and systems. The same applies to improving the efficiency of all organizational, production, and technological processes of operation.

Keywords: SMART document, a register of regulatory documents, a register of regulatory and technical requirements, technical operation, automation, digital tools, unified information system

FROM DOCUMENTS TO REQUIREMENTS

The technical standards base regulating the issues of technical operation of civil buildings and structures in our country is characterized by the absence of a systematic approach, the presence of prescriptive norms, a significant number of duplication and contradiction cases. This situation does not contribute to the development of innovative processes not only in operation, but also in construction, creates administrative and technical barriers, and prevents the rapid introduction of new materials and technologies into practice. This has led to the appearance of field-of-use restrictions on the areas of application of codes of practice [1]. However, on February 23, 2021, at a meeting of the Council of the International Organization for Standardization, the project of "SMART" standards (Standards Machine Applicable, Readable and Transferable) was approved, which becomes one of the priorities for the development of international standardization until 2030. The SMART standard assumes a substantially new format for the presentation of a document — the so-called "machine-readable" text (text whose content is easily perceived, processed and transmitted by computer systems). It is assumed that information systems will be the main user of such a standard, but at the same time, the work of a human operator will also be available. Documents in the new format can be used at all stages of the product life cycle in order to automate and consequently optimize and increase the efficiency of all organizational, technical and production processes. The core of the new format of the regulatory document is the requirements, i.e. a single documented necessity to be met by a specific design, product or process. Accordingly, in order to translate regulatory documents into a so-called "smart" format, require-

ments need to be extracted from the texts and formalized, and in order to create a standard that is already "smart", requirements orientation is again required. Modern experts define a SMART-standard as a complex digital structure that can contain text, graphic and numerical data, as well as digital models [2].

Requirements related to specific constructions, elements, systems, operating measures, works and processes are extracted from the regulatory documents and entered into internal documents of the enterprise in order to be guided by them at each stage of the life cycle. And since the responsibility for the operation of facilities in the social sphere, for example, is mainly assigned to state customers, then this task turns out to be a state one [3]. Nevertheless, in most cases, these requirements are used in isolation from the external document. Meanwhile, checking the relevance of a requirement is a more resource-intensive process than checking the relevance of a standard [4]. There are several reasons for this:

- the document may contain a different number of requirements;
- one document may contain requirements for different processes;
- the document may contain both mandatory and recommended requirements;
- the document may continue to be valid, but the requirements may change;
- the document may continue to be valid, but the requirements may be cancelled;
- new requirements may be added to the text of the document;
- the text of one document may contain requirements related to other requirements in other documents.

Zvonov I.A.
Kashirina N.V.



Zvonov Ilya Alexandrovich,
senior lecturer of the Department of Construction Organization and Real Estate Management, director of the Scientific and Educational Center "Digital Construction and Operation"; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RISC: 820141, ORCID: 0000-0002-4854-9903; ZvonovIA@mgsu.ru



Kashirina Natalia Vladimirovna,
leading marketing specialist; Kodeks; lit. X, 3 Instrumentalnaya st., Saint Petersburg, 197376, Russian Federation; SPIN-kod: 2752-6270; ORCID: 0000-0003-1787-441X; kashirina@kodeks.ru

► The allocation of requirements from regulatory and technical documents and regulatory legal acts and the creation of registers of requirements will solve the above-mentioned problems and, as a result, will improve the quality of work performed by optimizing the compliance verification process. The effective structure and correct algorithmization of the system of requirements in regulatory and technical documents and regulatory legal acts can solve these and other tasks.

REQUIREMENTS FROM THE STATE

In recent years, the Ministry of Construction and Housing and Utilities of the Russian Federation has been systematically working to reduce excessive and irrelevant standards. To date, more than ten thousand requirements have already been transferred from mandatory to voluntary application in the construction industry. Mechanisms are being prepared and formed to implement optimal solutions with shorter deadlines and uniformity of procedures. Instead of the exhaustive list of documents, materials, information and approvals required for construction and subsequent operation approved by the Russian government, a draft law aimed at digitalizing the legal, regulatory, and technical regulation of the industry through the introduction of the state information system “Sroykompleks.RF”, implies the introduction of a Digital register of documents, materials, information and approvals¹. It is planned that the register will be maintained by the Ministry of Construction and Housing and Utilities in the “Sroykompleks.RF” system, which will ensure its openness and the possibility of operational updating.

An organizational and managerial algorithm has been prepared, according to which digital registers, construction information classifier (CIS), information on issued permits for construction or reconstruction and commissioning, as well as many other documents, information, materials established by the Government of Russia will be included in the unified information system “Sroykompleks.RF” based on the State Information System for Urban planning activities of the Russian Federation².

The register format, adopted in accordance with the Decree of the Government of the Russian Federation dated February 6, 2021 No. 128, is a federal state information system created in order to ensure the systematization of mandatory requirements and to inform interested persons about mandatory requirements that have established their regulatory legal acts, about the duration of their validity, as well as in order to ensure the maintenance in electronic form of the register contained in regulatory legal acts of mandatory requirements and databases on regulatory legal acts containing mandatory requirements.

The purpose of creating a register is to automate processes:

1. Formation, maintenance and updating of the register of mandatory requirements contained in regulatory legal acts.
2. Allocation of mandatory requirements from the texts of regulatory legal acts.
3. Informing interested parties about mandatory requirements [4].

The formation of a modern, coherent system of regulatory and regulatory-technical documents establishing uniform requirements for capital construction projects at all stages of the life cycle and eliminating possible contradictions in the system will be

accelerated by the introduction of the registry principle of development, adjustment and application of regulatory and technical requirements.

In December last year, under Federal Law No. 541-FZ of December 19, 2022, the Unified Information System (UIS) took shape, which, among other things, will include registers of documents and registers of requirements in the field of engineering surveys, design, construction, operation and demolition. The UIS ensures integration with the Unified State Register of Real Estate, the unified information system of housing construction, other information system and resources determined by the Government of the Russian Federation. At the same time, the requirements contained in the documents included in the register of documents are included in the register of requirements [5].

REGISTER OF REQUIREMENTS

In the context of current development, the centralized formation of new types of requirements presentation in the form of a “register of mandatory requirements” is carried out in accordance with Federal Law No. 247-FZ dated July 31, 2020 “On Mandatory Requirements in the Russian Federation” and Decree of the Government of the Russian Federation No. 128 dated February 6, 2021 “On Approval of the Rules for the Formation, Maintenance and updating of the register of mandatory requirements”. The vast array of existing industry regulatory and regulatory-technical documentation regulating the stage of operation determines the need to create registers of requirements right now, without waiting for ready-made solutions from abroad or existing experience from other industries. This is also due to the fact that each organization in the field of construction or operation works with a different list of standards³. In addition to the mandatory requirements in the activity, recommended requirements are also used, which are included in the organization's Standard.

Supporting these sides of digital transformation, the Scientific and Educational Center “Digital Construction and Operation” of the NRU MGSU together with “Kodeks” have initiated and are implementing a project to create a register of requirements in the form of a “knowledge cloud” in the NRU MGSU for educational purposes. Modern professional reference systems, such as the Techexpert system of “Kodeks”, contain specialized services and functions that allow you to create your own registries and “knowledge clouds” right now, adjusting them to current tasks. The main condition for working with smart format documents is the classification of requirements, because without a single conceptual framework, the transition to global automation and digitalization is impossible, since different systems simply will not understand each other. The creation of ontological models of industrial and construction products does not exclude the formation of requirements management systems for software engineering, for the management of professional competencies, control and supervisory activities and collective work on documents [6]. It can be said that this is already a technology for managing the essential part of the document, which can adapt to the customer, while covering exactly his needs.

1

News of the Ministry of Construction and Housing and Public Utility Services of the Russian Federation. URL: <http://www.minstroyrf.gov.ru> (rus.).

2

Portal of the construction sector of the Russian Federation. URL: <http://www.stroi.gov.ru> (rus.).

3

Requirements management system on the Techexpert platform. URL: <http://www.tehexpert.online> (rus.).

CREATING A REGISTRY

For a pilot project to create a digital register of regulatory and technical requirements for the operation of civil buildings, Techexpert systems were selected, which approaches regulatory documents as a “data container” [7]. This is a digital document that combines a whole set of data:

- different attributes intended for both human and automated systems;
- hypertext with the capabilities for contextual search, hyperlink placement, table of contents, as well as the ability to create various additional services based on verbal and textual analysis, which can later serve for machine analytics;
- graphics (including a scanned copy of the original);
- 3D models of the building, its systems, elements and other attached files of various formats. All changes and amendments, as well as all versions and revisions of the document with the possibility of their comparison;
- metadata;
- indices.

The main tasks that specialists face in real-world requirements environment (taking into account the use of “digital documentation” in reference systems) and the standard services and functions by which these tasks can be solved taking into account different conditions are summarized in Table.

The main block of work on the requirements register is undoubtedly the structure of the register with their connection to the system of automated control of the relevance of regulatory documents and further transition to the machine-readable format of SMART documents [8]. In this case, relating it to a specific practical task or a set of tasks — construction or operation quality management.

In order to create an appropriate register, the main processes were identified for which the primary selection of regulatory and technical documents regulating technical operation was made. After that, the documents were grouped by their status, and then the texts were searched for requirements, distributed into groups — mandatory, and recommended. Related requirements were marked with the appropriate designations in the text. In addition, the search was performed according to the requirements without reference to specific standards, and the “Knowledge Cloud” was formed in the folders of

Solving problems using services and functions

Main tasks	Standard services and functions
Search for requirements in systems (when a specific regulatory document is unknown)	4 search options and annotations to documents
Search for a requirement in the text of the document	3 types of search within the document
Selecting a requirement and moving it to a folder	Bookmarking, adding comments to a requirement
Creating a “knowledge cloud” or a requirements registry in system folders	Creating in user folders
Document status tracking	Putting documents for control
Tracking the status of the requirement (valid, replaced/canceled)	Comparison of norms and standards, comparison of editions, review of changes
Tracking the relevance of regulatory documents in the texts of materials	Integration with MS Office, AutoCAD, nanoCAD, etc.

users inside the “Techexpert” systems. This task is more promising to solve by downloading data from the building information model. After all, the application of information modelling in the process of construction and operation is intended to improve the quality of process management and improve the quality of control over compliance with existing norms and rules, the organization of interaction of participants in the formation of a digital twin of a building [9]. In turn, the methodological basis for the application of data from information models at various stages of the life cycle of the object, the formation of requirements for them is implemented within the framework of the set of UIMS standards (Unified Information Modelling System), which forms the terminological basis for the regulatory legal system of the Russian Federation in the field of information modeling [10].

The implementation of the project is progressive, starting with steps to introduce the practice of digital technologies in the educational process at the stage of checking student final qualifying papers for references to irrelevant regulatory documents. This is due to the fact that the automation of the process of working with documents is relevant and, at the same time, new for technical specialists. Meanwhile, for example, future lawyers devote a lot of time to the study of professional reference systems within the framework of a separate academic discipline “Information technologies in professional activity”. But it cannot be said that students of construction professions rarely use regulatory documents in their activities, rather, they need other methods of working with documentation of all stages of the building's life cycle in digital form. It is now obvious that real and tangible effects from the introduction of information modeling can only be achieved only if all stages are transferred to such a format [11].

In creating the algorithm, these reasons have been taken into account and step-by-step instructions are provided on how to ensure a clear binding of a specific requirement from the required regulatory document to a fragment of an organization's Standard, technological map or any other document. Clearly linking the requirement to the text also provides the ability to quickly check and monitor the requirements (cancelled, replaced, changed). Moreover, this solution does not require new IT-developments, but can be performed using standard services of professional reference systems. By integrating the systems with MS Excel, in addition to monitoring requirements, automatic calculation of the compliance of the actual values with the parameters of the standard has been provided.

CONCLUSIONS

The practice of mass use of information reference systems in the creation requirements registers defining digital transformation will allow specialists to acquire useful “digital skills” and will contribute to improving the quality of operational activities. In the future, this will ensure a rapid transition to SMART standards, which provide ample opportunities for accelerating, optimizing and automating the application of regulatory requirements. And without compliance with the requirements, it is impossible to imagine the operation of the future and ensuring its technical safety.

At the moment, there is no consensus on how to automate the process of working with regulatory documents in construction using digital solutions. Most often, companies work as it is convenient for their employees or develop their own algorithms, and the implemented format of operation requires, among other things, skills in working with application software, information databases and reference systems [12]. Therefore, if the project of NRU MGSU and “Kodeks” will have a real application in the industry, by incorporating these practices in the educational process, it is possible to improve

- the quality of construction and operation of works, as well as to optimize the costs of specialists at their workplaces.

REFERENCES

1. Development strategy of the construction industry and housing and public utility sector in the Russian Federation for the period up to 2030 with a prognosis up to 2035 : Approved by the Decree of the Government of the Russian Federation dated October 31, 2022, No. 3268-R. URL: <http://static.government.ru/media/files/AdmXczBBUGfGNM8tz16r7RkQcsgP3LAm.pdf> (rus.).
2. "Techexpert" responds to the Industry challenges 4.0. URL: <https://sunt.d.ru/publications> (rus.).
3. On the establishment of a case in which the developer, the technical customer, the person providing or carrying out the preparation of the investment justification, and (or) the person responsible for the operation of the capital construction object, ensures the formation and maintenance of an information model of the capital construction object (with amendments and additions) : Decree of the Government of the Russian Federation No. 331 dated March 5, 2021. URL: <http://government.ru/docs/all/133174/> (rus.).
4. On approval of the Rules for the formation, maintenance and updating of the register of mandatory requirements : Decree of the Government of the Russian Federation of February 6, 2021, No. 128. URL: <http://publication.pravo.gov.ru/Document/View/0001202102090035> (rus.).

5. On Amendments to the Urban Planning Code of the Russian Federation and Article 18-1 of the Federal Law "On Protection of Competition" : Federal Law No. 541-FZ dated December 19, 2022. URL: <http://publication.pravo.gov.ru/Document/View/0001202212190034> (rus.).
6. On mandatory requirements in the Russian Federation : Federal Law of July 31, 2020, No. 247-FZ. URL: <http://publication.pravo.gov.ru/Document/View/0001202007310002> (rus.).
7. Construction management : textbook. P.G. Graboviyy, A.A. Lapidus (ed.). Part 2, Ch. 17. Moscow, 2022. (rus.).
8. Zvonov I.A., Kuzmichev V.A., Kashirina N.V. Organizational and technological objectives of construction in the conditions of digital transformation of the industry. Information Technologies in Construction, Social and Economic Systems. 2022; 2:54-58. URL: <https://elibrary.ru/item.asp?id=49593665> (rus.).
9. SP 328.1325800.2020. Information modeling in construction. Rules for describing the components of the information model. URL: <https://docs.cntd.ru/document/573514518> (rus.).
10. Industry 4.0: criteria for digital maturity and the transition from documents to requirements. URL: <https://www.connect-wit.ru/industriya-4-0-kriterii-tsifrovoy-zrelosti-i-perehod-ot-dokumentov-k-trebovaniyam.html> (rus.).
11. Manin P. A digital twin object for the operational stage. URL: <https://www.sodislab.com/ru/blog/petr-manin-digitaltwin> (rus.).
12. Online conference "Machine-readable standards: perspectives for industrial applications". February 25, 2021. URL: http://rgtr.ru/data/events/2021/маш_стандарты_25.02.2021/МАШСТАНДАРТЫ_отчет_буклет.pdf (rus.).

Реестровый принцип и СМАРТ-документы как условия цифровой трансформации технической эксплуатации зданий

Переход к «Индустрии 4.0» или «Четвертой промышленной революции» — это сложный шаг, в рамках которого во все сферы производственных отраслей внедряются автоматизированные технологии. Целью этого внедрения является обеспечение обмена данными между устройствами, базами и системами разной степени сложности без участия человека. Этот переход является также переходом к формализации и стандартизации, и, следовательно, требует применения новых форматов нормативных и нормативно-технических, организационно-технических документов. Становится очевидно, что эти форматы должны быть не только человекочитаемыми, но и машиночитаемыми. Они позволяют системно и эффективно формировать документы, применять и корректировать на всех этапах жизненного цикла здания. Не остается в стороне и техническая эксплуатация зданий. Эффективная эксплуатационная деятельность невозможна без эффективного управления ее нормативно-технической документацией и нормативными требованиями к эксплуатируемым зданиям, их элементам и системам. Это же касается повышения эффективности всех организационных, производственных, технологических процессов эксплуатации.

Ключевые слова: «SMART»-документ, реестр нормативных документов, реестр нормативно-технических требований, техническая эксплуатация, автоматизация, цифровые инструменты, Единая информационная система

СПИСОК ИСТОЧНИКОВ

1. Стратегия развития строительной отрасли и жилищно-коммунального хозяйства Российской Федерации на период до 2030 года с прогнозом до 2035 года : утверждена распоряжением Правительства Российской Федерации от 31.10.2022 г. № 3268-р. URL: <http://static.government.ru/media/files/AdmXczBBUGfGNM8tz16r7RkQcsgP3LAm.pdf>
2. «Техэксперт» отвечает на вызовы Индустрии 4.0. URL: <https://sunt.d.ru/publications>
3. Об установлении случая, при котором застройщиком, техническим заказчиком, лицом, обеспечивающим или

осуществляющим подготовку обоснования инвестиций, и (или) лицом, ответственным за эксплуатацию объекта капитального строительства, обеспечиваются формирование и ведение информационной модели объекта капитального строительства (с Изменениями и Дополнениями) : Постановление Правительства РФ от 05.03.2021 № 331. URL: <http://government.ru/docs/all/133174/>

4. Об утверждении Правил формирования, ведения и актуализации реестра обязательных требований : Постановление Правительства РФ от 06.02.2021 № 128. URL: <http://publication.pravo.gov.ru/Document/View/0001202102090035>
5. О внесении изменений в Градостроительный кодекс Российской Федерации и статью 18-1 Федерального закона «О защите конкуренции» : ФЗ от 19.12.2022 № 541-ФЗ. URL: <http://publication.pravo.gov.ru/Document/View/0001202212190034>
6. Об обязательных требованиях в Российской Федерации : ФЗ от 31.07.2020 № 247-ФЗ. URL: <http://publication.pravo.gov.ru/Document/View/0001202007310002>
7. Управление строительством : учебник / под ред. П.Г. Грабового, А.А. Лапидуса. Ч. 2. Гл. 17. М., 2022.
8. Звонов И.А., Кузьмичев В.А., Каширина Н.В. Организационно-технологические задачи строительства в условиях цифровой трансформации отрасли // Информационные технологии в строительных, социальных и экономических системах. 2022. № 2. С. 54–58. URL: <https://elibrary.ru/item.asp?id=49593665>
9. СП 328.1325800.2020. Информационное моделирование в строительстве. Правила описания компонентов информационной модели. URL: <https://docs.cntd.ru/document/573514518>
10. Индустрия 4.0: критерии цифровой зрелости и переход от документов к требованиям. URL: <https://www.connect-wit.ru/industriya-4-0-kriterii-tsifrovoy-zrelosti-i-perehod-ot-dokumentov-k-trebovaniyam.html>
11. Манин П. Цифровой двойник объекта для стадии эксплуатации. URL: <https://www.sodislab.com/ru/blog/petr-manin-digitaltwin>
12. Онлайн-конференция «Машиночитаемые стандарты: перспективы применения в промышленности» 25 февраля 2021 г. URL: http://rgtr.ru/data/events/2021/маш_стандарты_25.02.2021/МАШСТАНДАРТЫ_отчет_буклет.pdf

Об авторах: **Звонов Илья Александрович** — старший преподаватель кафедры организации строительства и управления недвижимостью, директор научно-образовательного центра «Цифровое строительство и эксплуатация»; **Национальный исследовательский Московский государственный**

строительный университет (НИУ МГСУ); 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 820141; ORCID: 0000-0002-4854-9903; ZvonovIA@mgsu.ru;

Каширина Наталия Владимировна — ведущий специалист по маркетингу; АО «Кодекс»; 197376, г. Санкт-Петербург, ул. Инструментальная, д. 3, лит. X; SPIN-код: 2752-6270; ORCID: 0000-0003-1787-441X; kashirina@kodeks.ru.

For citation: Zvonov I.A., Kashirina N.V. The registry principle and SMART documents as conditions for the digital transformation of technical building operation. *Real estate: economics, management*. 2023; 1:49-53.

Для цитирования: Звонов И.А., Каширина Н.В. The registry principle and SMART documents as conditions for the digital transformation of technical building operation // Недвижимость: экономика, управление. 2023. № 1. С. 49–53.



Л.И. Павлова. Рязань. Кремль. Рисунок, тушь перо.