

Elena Romanova¹,
(Russia)

ELECTRONIC ENGINEERING AND TECHNICAL DOCUMENTATION: CHALLENGES AND SOLUTIONS FOR LONG-TERM PRESERVATION.

ABSTRACT

Electronic records management systems provide many benefits for organizations, but they also create difficulties for long-term preservation of electronic documents, require adequate consideration for the choice of appropriate procedures, systems and formats to ensure that the documents stay reliable and authentic, maintain integrity, and are usable over the required period of time. As for the engineering and technical documents, their creation in electronic form is one of the preconditions of the technical progress in general, because of the great possibilities that computerized modeling, interactive simulation, numerical calculation, virtual testing and other digital-based technologies are providing. This documentation is highly dependent on the system environment it is created and stored. Proprietary software programs and file formats are mostly used, and that is the big challenge to the long-term preservation purposes. This documentation is produced, stored and used according to the conditions fixed in the contracts between creators, customers, investors, and end-consumers. It is also the object of intellectual rights and is often confidential by various reasons. All these and other circumstances cause the necessity of proper normalization and regulation of the sphere of creation, exchange, preservation and use of electronic engineering and technical documentation, sufficient but flexible enough to serve the interests both of the state and of the organizations of different types. Recognizing the global scale of the problem of the long-term preservation of engineering and technical documentation, the author shares the experience of the Russian Federation in this area and formulates the questions which are still waiting for their solution.

Key words: technical documentation, electronic records, archives, long-term preservation, proprietary software, All-Russian Scientific Research Institute for Records and Archives Management (VNIIDAD)

INGEGNERIA ELETTRONICA E DOCUMENTAZIONE TECNICA: SFIDE E SOLUZIONI PER LA CONSERVAZIONE A LUNGO TERMINE

SINTESI

I sistemi di gestione dei documenti elettronici offrono molti vantaggi alle organizzazioni, ma creano anche difficoltà per la conservazione a lungo termine dei documenti elettronici, richiedendo un'adeguata considerazione per la scelta di procedure, sistemi e formati appropriati per garantire che i documenti rimangano affidabili e autentici, mantengano l'integrità e siano utilizzabili per il periodo di tempo richiesto. Per quanto riguarda i do-

1 Elena Romanova, PhD, Deputy Director, The All-Russian Scientific and Research Institute for Records and Archives Management (VNIIDAD), 82 Profsoyuznaya street, Moscow 117393 Russia, romanova@vniidad.ru, tel. 007 495 334 48 80.

cumenti ingegneristici e tecnici, la loro creazione in forma elettronica è una delle precondizioni del progresso tecnico in generale, a causa delle grandi possibilità che stanno fornendo la modellazione computerizzata, la simulazione interattiva, il calcolo numerico, i test virtuali e altre tecnologie digitali. Questa documentazione dipende in larga misura dall'ambiente di sistema in cui viene creata e archiviata. Vengono utilizzati principalmente programmi software e formati di file proprietari, e questa è la grande sfida per le finalità di conservazione a lungo termine. Questa documentazione viene prodotta, archiviata e utilizzata secondo le condizioni fissate nei contratti tra creatori, clienti, investitori e consumatori finali. È anche oggetto di diritti intellettuali ed è spesso riservata per vari motivi. Tutte queste e altre circostanze causano la necessità di un'adeguata normalizzazione e regolamentazione della sfera della creazione, dello scambio, della conservazione e dell'uso dell'ingegneria elettronica e della documentazione tecnica, sufficientemente flessibile per servire gli interessi sia dello stato che delle organizzazioni di diverso tipo. Riconoscendo la scala globale del problema della conservazione a lungo termine della documentazione tecnica e ingegneristica, l'autore condivide l'esperienza della Federazione Russa in questo settore e formula le domande che sono ancora in attesa di soluzione.

Parole chiave: documentazione tecnica, documenti elettronici, archivi, conservazione a lungo termine, software proprietario, Istituto di ricerca scientifica russo per la gestione dei documenti e degli archivi.

ELEKTRONSKA INŽENIRSKA IN TEHNIČNA DOKUMENTACIJA: IZZIVI IN REŠITVE ZA DOLGOROČNO HRAMBO

IZVLEČEK

Sistemi za elektronsko vodenje dokumentov organizacijam prinašajo številne koristi, hkrati pa povzročajo težave pri dolgoročnem hranjenju elektronskih dokumentov, zahtevajo ustrezen premislek pri izbiri ustreznih postopkov, sistemov in formatov, da se zagotovi, da dokumenti ostanejo zanesljivi in verodostojni, ohranjajo integriteto, in so uporabni v zahtevanem časovnem obdobju. Kar zadeva inženirsko-tehnične dokumente, je njihovo ustvarjanje v elektronski obliki eden od predpogojev tehničnega napredka na splošno, saj imajo veliko možnosti računalniškega modeliranja, interaktivne simulacije, numeričnega izračuna, navideznega testiranja in druge digitalne tehnologije. Ta dokumentacija je zelo odvisna od sistemskega okolja, ki ga ustvari in shrani. Večinoma se uporabljajo lastniški programi in formati datotek, kar je velik izziv za dolgoročno hrambo. Ta dokumentacija se izdelava, shrani in uporablja v skladu s pogoji, določenimi v pogodbah med ustvarjalci, kupci, vlagatelji in končnimi potrošniki. Je tudi predmet intelektualnih pravic in je pogosto zaupen iz različnih razlogov. Take in drugačne okoliščine povzročajo potrebo po ustrezni normalizaciji in ureditvi področja ustvarjanja, izmenjave, hrambe in uporabe elektronske inženirske in tehnične dokumentacije, ki je dovolj prilagodljiva, da služi interesom države in organizacij različnih vrst. Ob prepoznavanju globalnega obsega problema dolgoročne hrambe inženirske in tehnične dokumentacije avtor deli izkušnje Ruske federacije na tem področju in oblikuje vprašanja, ki še čakajo na njihovo rešitev.

Ključne besede: tehnična dokumentacija, elektronski zapisi, arhivi, dolgoročno hrambo, lastniška programska oprema, Vseruski znanstvenoraziskovalni inštitut za upravljanje dokumentacije in arhivov (VNIIDAD)

ЭЛЕКТРОННАЯ НАУЧНО-ТЕХНИЧЕСКАЯ ДОКУМЕНТАЦИЯ: ПРОБЛЕМЫ ДОЛГОСРОЧНОГО ХРАНЕНИЯ И ПРЕДЛАГАЕМЫЕ РЕШЕНИЯ

Системы электронного документооборота дают много преимуществ организациям, но они также создают трудности для архивного хранения электронных документов, требуют взвешенного подхода при выборе соответствующих процедур, систем и форматов для обеспечения аутентичности, достоверности, целостности и пригодности для использования документов в течение требуемого, часто довольно длительного, периода времени или постоянно. Что касается научно-технических документов, то их создание в электронном виде является одной из предпосылок технического прогресса в целом, поскольку существуют большие возможности для компьютерного моделирования (в том числе интерактивного), осуществления расчетов, виртуального тестирования и других цифровых технологий. Эта документация сильно зависит от системной среды, в которой она создается и хранится. Поскольку в основном используются проприетарные программы и форматы файлов, это является большой проблемой для целей архивного хранения. Эта документация образуется, хранится и используется в соответствии с условиями, установленными в договорах между исполнителями, заказчиками, инвесторами и потребителями. Она также является объектом интеллектуальных прав и часто содержит тот или иной вид конфиденциальной информации. Все эти и другие обстоятельства обуславливают необходимость надлежащего регулирования сферы создания, обмена, хранения и использования электронной научно-технической документации, достаточной, но достаточно гибкой, чтобы служить интересам как государства, так и организаций различного типа. Признавая глобальный масштаб проблемы организации архивного хранения научно-технической документации, автор делится опытом Российской Федерации в этой области и формулирует вопросы, которые еще ждут своего решения.

Ключевые слова: *техническая документация, электронные документы, архив, архивное хранение, проприетарное программное обеспечение, Всероссийский научно-исследовательский институт документоведения и архивного дела (ВНИИДАД)*

1 INTRODUCTION

The main challenges for the archives nowadays are in great measure connected with the tasks of acquisition, preservation and use of electronic records. As for administrative records management systems, especially those of government, state and municipal organizations, there are certain levers of influence, including normative and legal, administrative, procedural and technological measures, which permit to establish requirements to different stages of the e-records life circle and to create necessary conditions for their realization. Control over the records from their very creation is the guaranty of their reliability, authenticity, integrity, and usability.

The situation with private and non-government organization is more complicated, and it is much more difficult for archives to deal with electronic records of individuals.

As for scientific and technical documentation, there are many specific features in this field, which are showing up even more brightly in the modern conditions of digital transformation of all the processes.

In this paper, the term "technical documentation" is understood in the wide sense, as any type of documentation with product-related data and information, including product definition and specification, description of features, functions, interfaces and architecture; design, manufacturing, quality assurance; service and repair, safe disposal [electronic source, 1]. As for the "products", these are results of design and architect-engineering, software engineering, etc. In this paper the special attention is given to design and architect-engineering technical documentation, though the main findings are applicable to other types of scientific, technical, technological documentation too.

All the engineering processes and their results require special related documentation. The whole development lifecycle needs to be documented in a proper way, which will allow for discussing all significant questions arising between stakeholders and developers in the future. There can be several interacting organizations, which are interested to have a complete set of technical documentation or a part of it (related to one or another part of the whole engineering object or the certain stage of the project). These are contractors and subcontractors, customers, developers, investors, providers, quality assurance inspectors, supervisory authorities, etc.

For these interacting organizations technical documentation is essential for several purposes: to be an official confirmation of the contractual obligations fulfilled (technical documentation as annexes to the contracts, or delivery and acceptance certificates); to be used as intellectual right object by providing licenses, permissions, etc.; to serve as a basis for further development of technologies and methods applied; to provide further support for the operation, maintenance and modernization of an object (maybe for many years or decades, depending on the object).

As the commercial interests are involved, they play the role of the best regulators and the major premises for the proper long-term storage of scientific and technical documentation. From the other side, the state or the municipality can also perform the role of one or another interacting party, and in this case it's important to create conditions for further use and appropriate storage of documentation in the interests of citizens and society in general as the end consumers.

2 DEVELOPMENT OF NORMATIVE LEGAL REGULATIONS

Even if it is impractical and beyond the purpose to settle rules on technical records management for private companies and organizations that are guided by commercial interests and considerations, it is important that state and local government bodies, state corporations, state and municipal organizations follow certain common general rules in their activities connected with the storage, acquisition, recording, and use of scientific and technical documentation. This will allow to insure proper conditions for proper administrating and preserving of records in state and municipal bodies and organizations and their transfer to state and municipal archives in complete sets, sufficient for comprehensive use (for historical, restauration, reconstruction, educational and scientific/technical purposes).

The project of this normative and legal act was developed by the All-Russian Scientific Research Institute for Records and Archives Management (VNIIDAD) [*electronic source*, 2] in 2019. The institute performed the task formulated by the Federal archival agency [*electronic source*, 3]. The necessity of elaboration of regulations was emphasized in the decree of the Government of the Russian Federation within the framework of the Plan ("Roadmap") on improvement of legislation and elimination of administrative barriers in order to ensure the implementation of the National technological initiative in the direction of "TechNet"(Advanced production technologies) [*electronic source*, 4].

Why the establishment of new regulations was perceived as "elimination of administrative barriers"? The history and the background of the question is that after the disintegration of the USSR many previously accepted normative legal acts still stayed in force, even if they were not viable anymore. Among them – the "Basic rules on work with scientific and technical documentation in organizations and enterprises" of 1988 [*electronic source*, 5]. These rules were describing all the processes of technical records management and archives systems in detail, in a way which is not applicable anymore. They were intended to use by all types of organizations but they weren't observed in practice, and they didn't touch upon the questions connected with electronic records.

The authors of the new Draft had to take into account big changes in the legal framework which took place the last decennaries, transformation of practical needs of organizations, latest modifications of national and interstate standards.

The draft was approved by the Scientific and Methodical Commission of the Federal Archival Agency and was published at the official portal <https://regulation.gov.ru> for public discussion in November 2020 [*electronic source*, 6].

3 MAIN PROVISIONS OF THE DRAFT RULES ON ORGANIZATION OF STORAGE, ACQUISITION, REGISTRATION AND USE OF SCIENTIFIC AND TECHNICAL DOCUMENTATION IN STATE AUTHORITIES, LOCAL SELF-GOVERNMENT BODIES, STATE AND MUNICIPAL ORGANIZATIONS

The project includes 9 parts: aside from general principles, there are regulations on the current storage of different types of technical documentation, including the order of introduction of modifications in them and the preservation of all the parts changed during their current storage, conducting quality assurance and reliability checklist and control measures, requirements for the inventories and other descriptive and control forms, organization of archival storage of records in organizations, and the order of their transfer to state and municipal archives for permanent storage.

Special attention is paid to electronic scientific and technical documentation and the systems they are stored in. Taking into account the close connection of documents related to the same issue or project, it is prescribed to use batches (packages) for transmission and storage of electronic technical documents in the integral sets, while preserving all the linking elements and the description of the electronic structure of the workpiece or another object. Requirements to control cards are stated based on combination of metadata of the records produced or acquired and registration of the basic actions towards the records (modifications, converting, etc.).

It is appropriate at this point to recall that storage of technical documentation in the organization is accompanied by their constant or possible changing, after receiving the appropriate official notifications. For traditional paper documents, it is possible to replace a sheet or a part of the document, and the replaced parts are to be preserved at the archive. As for electronic technical documentation, the project provides for their complete replacement or replacement of their independent components when making changes in their content. In this case, all previous versions should also be preserved. Batches (packages) of electronic records are signed by electronic signature of an authorized official after being changed, before and after being transmitted.

The Rules comprise the requirements for electronic scientific and technical documentation storage systems, including requirements for metadata structured on several levels and groups. The principle of compatibility or interconnection of electronic archival systems with the CAD-systems is stated.

The new Rules are intended to become an integral part of the normative legal base in the sphere of documenting and documentation support of engineering processes. One of their important features is that they don't come into collision with the acting standards (national and interstate), but create certain conditions to follow during further standardization process which is developing now. It should be mentioned though that Rules will be in force only in the territory of the Russian Federation, while the most part of the standards for engineering and technical processes are international and provide conditions for international scientific, industrial and business cooperation. So it's important to stay integrated into the common processes but to establish the strict system of archiving for state purposes.

The Rules are also harmonized with the provisions of the "Standard functional requirements for electronic records management systems and electronic records storage systems in the archives of state bodies" (2020) [7].

The Rules are stating only basic requirements. Methods, procedures and technology applied are left to the discretion of organizations.

So not all the questions received univocal answers. There are still many difficulties concerning long-term and permanent preservation of electronic technical documentation. Challenges are rather serious.

4 CHALLENGES FOR LONG-TERM PRESERVATION

4.1. Proprietary nature of software and formats used

Nowadays engineering technical documents are created and supported mainly in electronic form. Digital-based technologies, such as computerized modeling, interactive simulation, numerical calculation, virtual testing and others, provide great possibilities for the development of higher technology industries and are widely used. At the same time there are certain side effects, one of them for the archives and records management sphere is the dependence of technical documentation on the system environment where it is created and stored. Proprietary software programs and file formats are mostly used, and that is the big challenge to the long-term preservation purposes.

Computer-aided design (CAD), or computer-aided design and drafting (CADD), is technology for design and technical documentation, which replaced manual drafting with an automated process. 2D or 3D CAD programs are widely used nowadays, such as AutoCAD, BricsCad, etc. There can be used free and open source CAD software (such as FreeCAD, NanoCAD, etc.), but in big companies are mostly used proprietary CAD software programs.

The formats used for creation and exchange of technical documents are also rather specific and can often be used only inside various CAD-systems. Proprietary nature and inadaptability for preservation purposes are among their disadvantages. The data in these formats can be ordered and stored only according to a particular encoding-scheme, which is mainly a commercial secret of the organization, or the encoding is published but restricted through various licenses. So the organizations which use these formats are very dependent on the software companies or other right holders. That is not only about spending finances on the licenses or service contracts, but also the inability to prevent risks of termination of the activities of the software company in general or in the certain direction, which will cause the end of the program maintenance and support. The exchange of documents without loss of data is also possible only inside the certain net of organizations.

There can be some political and security reasons to be cautious with foreign software products as well, for example, in defense industry. For these reasons import substitution policy in the strategically important areas is implemented, but there is still some technological dependence on the world leaders in the field.

Most of the file formats used within CAD-systems are proprietary formats. There is no single solution for converting from proprietary into open formats, and visualization programs can solve the problem only partially.

As for the recommended open formats, one of them is PDF/E defined in the standard ISO 24517-1:2008 Document management—Engineering document format using PDF—Part 1: Use of PDF 1.6 (PDF/E-1) [*electronic source*, 8]. This standard defines a format (PDF/E) for the creation of documents used in geospatial, construction and manufacturing workflows. The format reduces requirements for expensive and proprietary software, promotes trustworthy exchange across multiple applications and platforms. ISO 24517-1:2008 does not define the following: method of creation or conversion from paper or electronic documents to the PDF/E format; method of electronic distribution; specific technical design, user interface, or implementation; required computer hardware and/or operating systems; methods for validating the conformance of PDF/E files or readers. The first part of the standard does not address 3D, video or other dynamic content, integrated source data.

Another standard which may be applicable in some cases is PDF/X, a subset of the PDF ISO standard, formalized in ISO standards 15929 and 15930. The purpose of PDF/X is to facilitate graphics exchange.

However, the conclusion should be made that existing open formats, which are not encumbered by any copyrights, patents, trademarks or other restrictions, do not provide comprehensive solutions for creation, exchange, or storage of electronic technical documents in all their variety.

As CAD-systems are internationally used and are the most developed and targeted to electronic engineering purposes, proprietary formats are widely used and thereafter the most highly technological products exist only within such systems. The storage of this documentation is usually well organized in big enterprises and corporations, but there is no chance for state or municipal archives to receive them in electronic form,

or they obtain just some parts of it, visualized electronic or paper copies. As for paper copies, they are two-dimensional and static, the links between the elements are not evident, and therefore they are not sufficient to reflect all the particularities of electronic technical documentation.

Proprietary software and formats are maybe the biggest challenges for long-term preservation of electronic technical documentation and its data, and the obstacle for its transmission to state and municipal archives for permanent storage.

4.2. Trade secrets and intellectual property rights

The value of technical documentation is conditioned by its unique content. So the owners take reasonable measures to keep secret. In Russian jurisdiction trade secrets are referred to as confidential information. So the users and the employees have only limited possibilities to access electronic technical documentation and systems they are stored in. The special position of data controller often exists in the organizations. The current tendency is to spread this approach to the broadest possible space, and it's always rather hard to make it open.

The other juridical difficulty when we deal with technical documentation of great public interest, which we desire to be transferred to state and municipal archives for permanent storage, is that the conditions for its use are initially fixed in the contracts between creators, customers, investors, end-consumers, etc. So rather many sides can be involved and the procedure of gathering all the permissions may take too much time.

Aside for trade secrets, scientific and technical documentation contains objects of intellectual rights: inventions and designs (protected by patents), trademarks, know-hows, a copyright protected works, etc. It means that state and municipal archives will hardly get technical records before these rights expire.

4.3. Disinterest of organizations in maintaining documentation for the purposes other than practical and commercial

Technical, technological, and juridical obstacles are even less problematic for archivists than the disinterest of organizations in maintaining and preserving documentation for other, than practical and commercial, purposes. The most common situation that the archives meet in the organizations is their unwillingness to cooperate, accompanied by the awful state of technical documentation inside the premises and information systems of organizations. It's easier to destroy or erase records than to try to make any order or to permit others to do it for you.

The Law is making it obligatory to transfer records to state and municipal archives at least for state and local self-government bodies, state and municipal organizations, included in the lists of sources of acquisition of state and municipal archives. That is why it is so important to establish rules and to build an effective control system to make sure that the rules are observed in order to keep electronic technical documents reliable, authentic, integral, and usable for many years until they are transferred to the state and municipal archives. These rules will be recommended to follow for nongovernment organizations as well, but just as a general guidance, not as regulatory requirement.

5 CONCLUSIONS

In Russia the new Rules on organization of storage, acquisition, registration and use of scientific and technical documentation in state authorities, local self-government bodies, state and municipal organizations are in the draft. The draft Rules are being discussed by the experts and all those interested in this matter in Russia nowadays. As their

provisions create only general conditions for the development of systems of archival storage of electronic technical documentation in the organizations, it is obvious that a range of other regulations, instructions, technical and technological requirements, as well as methodic guidelines is still indispensable. The further standardization in this area is also extremely in demand. The next normative and legal act in the area that will be reviewed in the nearest future is the List of typical archival documents generated in the scientific, technical and production activities of organizations, with indication of the storage period [*electronic source*, 9]. The main aims are to identify currently existing types of scientific and technical documents, and to set their retention periods, which differ in different organizations depending on their role functions. One of the tasks is also to ensure that electronic technical documentation is deposited by complete sets in the state organizations, where the proper conditions for their preservation and transfer to the state and municipal archives, in accordance with the normative legal requirements, are being provided.

There are still many challenges, which should come into sharp focus, to be scrupulously studied by archivists, records managers together with technical specialists. State and public attention to the problem of proper preservation the results of human mind, scientific and technical activity should be among the priorities of development strategies of the governments and Mankind in general.

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