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**INFORMATION
TECHNOLOGY IN
ACTIVITIES OF THE
WORLD'S LEADING
LIBRARIES AND THEIR
USE UNDER MODERN
COMMUNICATIONS**

Iryna Borodai,
*Deputy Director, Scientific Work,
National Scientific Agricultural Library,
National Academy of Agrarian Sciences of Ukraine,
DSc in History, Professor,
(Kyiv, Ukraine)
e-mail: irinaboroday@ukr.net
ORCID: 0000-0001-6639-9200*

Lyudmila Tatarчук,
*Deputy Director, Scientific-Informational
and Library Work,
National Scientific Agricultural Library,
National Academy of Agrarian Sciences of Ukraine,
PhD in History,
(Kyiv, Ukraine)
e-mail: tlm2017@ukr.net
ORCID: 0000-0003-4714-6958*

Tetiana Pidhaina,
*Scientific Secretary,
National Scientific Agricultural Library,
National Academy of Agrarian Sciences of Ukraine,
PhD in History,
(Kyiv, Ukraine)
e-mail: pidgayna2012@ukr.net
ORCID: 0000-0002-8896-8336*

The aim of the article is to highlight the main trends in the development and implementation of information and communication technology in the library service system of the world's leading countries.

The research methodology is based on the integrated use of general scientific and structural-functional methods. To clarify the evolution of information and communication strategies in library practice, there is a social communication approach, special historical methods.

The scientific novelty of the study lies in the comprehensive generalisation of new information and library services used in multiple countries.

Conclusions. Among the priority tasks of foreign libraries, there is the creation of their e-products, development of search information strategies, solving problems of digitisation of documents, and introduction of innovative means of information. Leadership in the development of communication technologies belongs to US libraries, which in the 1970s implemented the first projects to inform the library process, digitise holdings and create e-libraries. Among European countries, information and communication technology is being intensively implemented in libraries of Germany, Sweden and Denmark. The concept of the machinery of information flows has developed rapidly in the East, especially in libraries in China, Japan and Korea. Ukraine is actively using international electronic databases to build its strategy for library informatisation. At this stage, the task is to create integrated global information resources based on corporate activities of libraries for the accumulation, storage and dissemination of information flows, and development of effective search engines and information services for users.

Keywords: communication technology, information services, documentary resources, digitisation of library holdings.

INTRODUCTION

The current stage of social development is characterised by the globalisation processes intensification and a significant increase in the role of information and communication technology. The possibility of free dissemination of knowledge in the information space creates the preconditions for changing the conceptual paradigm of the documentary communication system. One approach to its development is based on the phenomenon of open content, which means any intelligent products (text documents, multimedia materials, computer programs) presented on the Internet. Open content emerged in the developed foreign countries as a movement for the distribution of intellectual products. It is based on a combination of methods of cooperative production of intellectual products using non-commercial values; products created based on this methodology (electronic libraries, books, articles, audio and video files, etc.) and made available to the public; cultural values and norms of cooperation and self-organisation that unite project participants (Horovyi, 2010, p. 13; Diehtiar, 2013). The set of open library content projects forms a self-organising network environment. It is a single system of production, processing, creative thinking and use of the bank of information accumulated by humankind throughout history. Information and communication technology includes all types of technologies used for information processing, making it possible to present any information – numbers, texts, sound, images – in a digital format suitable for storage and processing on a computer. The ability to transfer information from computer to computer using Internet technology provides access to any user to the global information space (Dratckaia, 2019; Kolesnykova, 2013, pp. 18–19).

The aim of the study is to analyse the concept of formation and implementation of information and communication technology in the library system of America, Europe and the East with the positioning of the achievements of Ukraine, highlight the main technological elements which have been developed in the libraries and their role in quality customer service.

THEORETICAL FRAMEWORK

Coverage of information technology in library practice was based on comparative analysis and generalisation of official materials of the websites of the world's leading libraries and professional publications of foreign and domestic scientists.

Many fundamental works have already been devoted to particular issues of the organisation of information activities of libraries in the system of modern communications (Lall, 2002; Lobuzina, 2012; Slobodianyk, 2009; Shemaieva, 2008; Vasylenko et al., 2017). Some publications have fragmentarily covered the main trends in the formation and development of information support in America (Chukanova, 2014; Krause, 2015; Filipova & Oliinyk, 2012; Semesko, 2015; Strishenets, 2000), Germany (Herasiuta, 2013; Polova, 2015). Some authors have summarised the features of the implementation of communication technology in Sweden (Pashkova, 2011a), Denmark (Pashkova, 2011b; Petrina, 2008), Poland (Lesniak, 2012), Turkey (Dolotova, 2015), outlined ways to use best foreign practices in the Ukrainian libraries. Some issues of developing the basics of information and library support are reflected in our previous works (Verhunov et al., 2019).

Analysis of the foreign and domestic scientific publications on specific topics, on the one hand, confirmed its relevance among the scientific community, on the other –

made it possible to clarify the lack of comprehensive study of foreign experience in implementing information and communication technologies in library practice, outline prospects for the use of best practices in libraries of Ukraine.

RESEARCH METHODOLOGY

The research methodology is based on structural-functional and general scientific methods: analysis and synthesis, generalisation and systematisation. The social communication method led to the study of the evolution of information and library services from the standpoint of user needs with the development of innovative technologies in leading libraries worldwide, justifying the potential of information and communication technology to improve customer service. The use of the logical method and the analysis method made it possible to consider information technology as an effective tool for expanding the forms and methods of library work. The genetic-constructive method of the research results was used to substantiate the approaches to the organisation, relevance and prospects of use by Ukrainian libraries in information technology maintenance. Special historical methods were also used to study the main stages of formation and development of information and communication technology in library practice.

The source base of the study is represented by publications of foreign and domestic scholars, reference and statistical materials, as well as electronic resources that cover issues of library and information services.

SCIENTIFIC NOVELTY

The scientific novelty of the research is a comprehensive generalisation of new information and library services, as well as technological elements used in different countries, comparing the priorities of foreign libraries, which focus mainly on creating their e-products, developing search information strategies, solving problems of document digitisation, implementation innovative means of information.

RESULTS

The leadership in creating communication technology belongs to US libraries (Filipova & Oliinik, 2012, p. 36). In particular, the informal date of the formation of electronic libraries is 1971, when the Gutenberg Project was launched. In the same year, M. Hart from the Illinois University manually typed into the computer the “Declaration of Independence” and the Constitution of the United States of America, the text of the Bible and some other sources that belonged to the category of eternal values. This project covers several thousand publications, including well-known works of art, scientific treatises and public works. Digital Libraries Initiative (DLI) US National Research Program was launched in September 1994. It was funded by the US National Science Foundation (NSF), the Agency for Advanced Research Projects (ARPA) and the National Aeronautics and Space Administration (NASA) and was planned until completion in September 1998. It should be noted that this program is a significant part of the National Information Infrastructure (NII) program, the ultimate goal of which is to establish a system of information services for various structural strata of American society (Schatz & Chen, 1996, pp. 23–24).

Modern communication technology and the development of network infrastructures have allowed raising information services to a qualitatively new level. In the DLI

project, an electronic library is seen as a library that stores information on electronic media and efficiently manipulates extensive collections (Krause, 2015, p. 61). While real e-libraries need to focus on the cost of accessing information sources and technologies for converting information into electronic storage, DLI research focuses on how to develop the necessary information structure and what is needed mechanisms for effective information retrieval on the network (Schatz & Chen, 1996, pp. 24–25).

The Working Group on Information Infrastructure Technology and Applications (IITA), as the Technical Committee for the Establishment of the NII, held a seminar in May 1995 to identify the main areas of research on the creation of electronic libraries, which were seen as a network of distributed repositories, indexed collections in which the objects of any type can be found, despite the differences in existing network protocols and storage formats. As a maximum task, they considered the achievements in the creation of the electronic libraries of deep semantic interaction, i.e. providing the user with the ability to logically consistently search among autonomously defined and supported classes of the objects and services distributed in heterogeneous repositories based on software that would merge such repositories or acted as an intermediary in accessing them, despite any inherent repository differences. To achieve this, breakthroughs were needed in describing the information and the development of protocols for information retrieval, exchange of objects and its retrieval (Schatz et al., 1996, pp. 29–30).

As a result of the competition from the 73 submitted projects in the DLI program, the projects of the Carnegie Mellon University, University of California, Berkeley; University of California, Santa Barbara; University of Illinois, Urbana-Champaign; University of Michigan; Stanford University were selected. All six participants used different approaches to solving problems related to creating and developing the electronic libraries and set themselves different tasks. All projects had large-scale collections for basic research in the e-library building. Among all aspects of the study of the problems of creating and developing electronic libraries, the developers singled out indexing and federating because the search for information in the e-library is a search in an indexed collection of the objects, often distributed in the network. Thus, a repository is an indexed collection of objects. The process of its combining is to establish links (mapping) between similar objects stored in the different repositories. The end-user perceives them as belonging to the same collection repository. Both the indexing process and the process of merging repositories rest on the problems of semantics. Bruce Schatz, one of the leading experts at the University of Illinois in the field of information network search, in one of his speeches, said that the development of information retrieval in the network he would divide into the following stages: 1) the 1970s – 90s – searching for the text the priority attention was paid to the syntax of presenting information; 2) the 1980s – 90s – searching for the documents, the main attention was paid to the data structure; 3) late 1990s – 2010 – conceptual search and attention to the semantics of data (Schatz et al., 1996, pp. 31–32).

The current stage of information retrieval development is aimed at the semantic analysis of information and the creation of the systems that allow for finding related parts in many distributed sources of information (Chukanova, 2014, p. 51). This approach is implemented based on the *Standard* Generalized Markup Language for textual information, i.e. only the most studied part of information resources. DLI projects are designed to create new information retrieval technology based on large-scale data

collections and partnerships, wherever it can be stored, taking into account its versatility (Schatz et al., 1996, pp. 32–33).

The most extensive library in the world, which is particularly careful to study the impact of new information technology on library processes, is the Library of US Congress. Users outside the library can get free access to its online catalogue. The library's foremost exhibitions and selected publications, photographs, historical films, and political speeches are available online (Semesko, 2015, p. 17). More than 20% of all copies stored in the library have already been digitised, and between one and two thousand documents are digitised daily. Copies written in 420 languages, including Russian, are stored there. The library creates projects that are of interest to business structures. These are, in particular, joint projects with Google to digitise the library's funds, with Sony Music Entertainment to digitise gramophone music, and a project to create the John Kluge's training centre (Strishenets, 2000, pp. 43–44).

In recent decades, the Canadian libraries have become government priorities to promote informatisation and information training. In particular, the main directions of the state scientific and technical policy at the beginning of the 21st century include active support of general informatisation by ensuring the broadest possible access of the population to modern means of communication and sources of information; development of university science and its transformation into an "export product". It is important to create integrated mailings with the catalogue, informing users of changes and updates in the directory. The e-catalogues of Canada's leading libraries are integrated with social networks so that the user can send a link to a catalogue or other library resource to their colleagues (Verhunov et al., 2019, pp. 45–46).

The top libraries in Europe pay no less attention to creating communication technology. Information and communication technology development primarily affects library websites, including central database management. As a rule, the sites of the European libraries perform the functions of marketing and distribution of the national bibliographic services (Dykha & Molchanova, 2016). For readers' needs, information can be obtained by choosing one of the most convenient languages. It is worth noting that the National Library of France is the only European library that allows the reader to work with the website in nine languages: English, Spanish, German, Italian, Portuguese, Russian, Arabic, Japanese or Chinese. Each European library has a free remote reference service that provides information on documents on any topic and informs the reader of factual data (biographical, events, figures or dates) (Herasiuta, 2013, pp. 29–30). Suppose the reader needs to get a copy of a document. In that case, this problem is helped to solve by the so-called commercial service, which prepares copies of documents stored in the library in various formats and on many types of media (Polova, 2015, pp. 46–47; Lesniak, 2012, p. 39).

The Swedish libraries offer their readers 92–93% of information via the Internet, and only 7–8% is stored in libraries on paper (Pashkova, 2011a, pp. 27–28). Danish libraries are quite active in project activities to introduce innovative technologies to create new types of services for users. For example, "Transformation Laboratory" is a project that changed the very idea of the library. Every 5–6 months, the space of the reading room changes. It is filled with new thematic content. For the development and implementation of laboratory projects, library readers are actively involved and are given the opportunity to self-realise (Pashkova, 2011b, pp. 44–45). Such joint creative projects

have already become a music studio and a literary cafe. For example, the reading room has been transformed into a “Newsroom”, which is equipped with modern technological equipment: an information column, plasma panels, touch monitors, making the library services more informative and accessible. To attract users’ attention, they have developed an information gallery on the displays in the reading area to give constantly updated information to visitors (Petrina, 2008, p. 45).

We find the experience of information and library services in Slovenian libraries useful to study. For example, the University of Maribor Library has created the catalogue “Codex+”, which combines bibliographic catalogues with databases and offers a variety of search tools. The mobile version of the databases has a “My Library” setting, which allows you to extend the document use, view the history of the books, reserve materials stored in other libraries. There are many useful communication library services in Slovenia. Thus, the “UM.NIK” service provides a simultaneous search of electronic and printed sources, and access to full texts and information about library sources. The “DKUM” service is combined access to e-information sources and doctoral dissertations. “BASE” is access to academic documents of research institutions. The depository provides the ability to view digital materials and special collections, and access to e-books in English. E-books can be downloaded to readers for a while via wireless access, order materials from libraries, print texts from microfilms. The National Library of Romania has a website with catalogues and databases: BN online catalogue; standard virtual catalogue – Book-a-Book, National bibliography, CIP bibliography, collective catalogues, scientific databases, ROAD – Catalogue of open access resources (Verhunov et al., 2019, pp. 54–55).

Innovative technology of information and library services have found a place in the work of the libraries in Belarus. Its modernisation based on replacing traditional technologies with automated ones allows covering all aspects of activities to improve the quality of information services to users. In particular, I.S. Lupinovich Belarusian Agricultural Library of the Belarus National Academy of Sciences is the national information centre on agriculture and forestry, food industry, and natural resources. It is the main national repository of sectoral information resources, the National Centre of the United Nations International Information System on Agriculture and Food FAO, the centre of delivery of documents from foreign information centres of the International Network of National Agricultural Libraries FAO, the library-depository of FAO documents in Belarus, centre for coordination of information resources in the agro-industrial complex of Belarus. The library maintains and replenishes more than 40 bibliographic, abstract, factual, full-text and expert databases, which contain more than 20 million records and millions of pages of full texts. The library offers its users: a free service for checking electronic text documents for borrowings using the system “Anti-plagiarism”; access to the encyclopedic multimedia resource of the Horticulture Compendium CABI Publishing (Great Britain), which specialises in the production of scientific literature on agricultural topics and related fields; access to full texts of dissertations of the e-library of dissertations of the Russian State Library; access to the Polpred.com database and the Znanium.com electronic library system; access to the CAB Abstracts database – The World’s Leading Agriculture Database – an international information system for agricultural sciences and technologies; access to the electronic

database of Chinese scientific journals on agriculture – China Academic Journals Full-text Database (D – Agriculture) (Verhunov et al., 2019, pp. 55–56).

Since 2012 on the Central Scientific Library of the National Academy of Sciences of Belarus website, an information database “National Academy of Sciences in the Media” has been available, including publications in newspapers, magazines, and Internet resources. The e-catalogue allows remote access to information from personal computers outside the library. This library was the first in the country to provide such a service as ordering literature through an electronic catalogue in real-time from any automated workstation that has access to the Internet and at any time. In general, the following innovative services have been introduced in the libraries of Belarus in the last decade: electronic delivery of documents; organisation of virtual help services; creation of electronic libraries; sending information using the “notification function” (e-mail, RSS-feed); direct connection of scientific institutions of the National Academy of Sciences of Belarus to foreign information resources; launch of a virtual reading room project; system of selective dissemination of information (SDI). Regarding the SDI, the automated systems are created. Web technology is used, allowing for regular automatic distribution of notifications as the databases are restored according to the user-defined profile (Verhunov et al., 2019, pp. 56–57).

Under the development of communication technology, Ukrainian libraries are introducing new approaches to forming and disseminating information (Koval & Turovska, 2015, pp. 9–10; Mar’ina, 2009, p. 21). In particular, the National Scientific Agricultural Library creates its e-products: e-catalogue, bibliographic databases, full-text electronic collections, e-library. Almost all the documentary content of the library is presented through the UkrAgroteka e-catalogue, which now includes more than 400 thousand bibliographic records. UkrAgroteka has been formed since 2000 and includes annotated bibliographic records for books, brochures, magazines, electronic documents, online resources and other documents, as well as articles from collections, and periodicals published in Ukraine and directly related to the development of the agro-industrial complex (Borodai, 2020, pp. 102–103). “UkrAgroteka” is included in the international scientific and technical databases and reference resources on agriculture. Free access is provided, which ensures its effective use in the context of European integration. In addition, the library provides access to other online products presented in the format of electronic exhibitions, information-analytical, scientific, and library resources. At this stage, it maintains and replenishes more than 20 bibliographic, abstract, factual and full-text databases, which contain more than 20 million bibliographic records and millions of pages of full texts. First of all, these are Agros, Agris, Agricola, Agora, and others (Borodai, 2017, pp. 38–39).

Certain communication technology has been introduced into the information and library services system in Russian Federation resources (Elepov et al., 2000). In particular, one of the largest scientific libraries, the State Public Scientific and Technical Library of the Russian Federation, operates as a centre for electronic delivery of documents, fulfilling orders for literature on science and technology and, in part, agriculture, medicine, and medicine economics. They accept orders for domestic and foreign scientific and technical literature both in the traditional mode (issuance of originals, microcopies) and electronic (provision of electronic copies). The Library of the Academy of Sciences of the Russian Federation provides such information services as search

and selection of information using the resources of global networks; providing background information on working on the Internet; search for information on databases on different types of media; electronic mailings; execution of bibliographic and factual references of wide topics and different complexity of search, etc. Individual and group consultations on the basics of web navigation and Internet search engines, training in working with Netscape, Explore programs are also provided. The Federal State Budget Institution the Library of Natural Sciences of the Russian Academy of Sciences, unites more than 100 libraries that serve about 150 academic institutes, including the Pushchinsky, Chornogolovsky, Troitsky Research Centres, and the Research Institutes of Regional Research Centres. User registration is carried out in network mode in a single database. Library users have access to a large number of networked domestic and foreign e-sources.

We studied the state and trends in the communication technology introduction in the information support system of the East (Dolotova, 2015, p. 28). One of the largest libraries in the world is the National Library in Beijing, which has diverse collections of printed and non-traditional media. In 1991, a powerful information retrieval system based on the NEC ACOS 630 computer was created, which allowed restructuring the organisation of the most labour-intensive processes of completing, cataloguing of holdings and book circulation. This work began in 1975, when the library, creatively using the experience of foreign countries, developed and partially implemented the automation of some library and bibliographic processes. Since 1979, a machine-readable catalogue on magnetic tapes, compiled by the Library of Congress (LC MARC), has been widely used. In 1983, with the acquisition of the Japanese computer M-150H, the multifaceted search and exchange of bibliographic information was mastered, the attributive dictionary of Chinese characters for editing national texts and its storing on floppy disks was developed, the Chinese MARC format was established, and access to Chinese books of more than 300 thousand titles was improved, computer processing of manuscripts and rare books of the Sun, Yuan, Min and Qing dynasties was began. The library has been performing the functions of the Chinese centre of International Serials Data System. Created an automated library information system is divided into four subsystems: search of information, service by the Chinese editions, the release of bibliographic indexes, and preservation of rare and valuable editions. It serves as a centre that unites the automated systems of the country's largest libraries, helps to open their book collections not only in Chinese but also in English, Japanese, Russian and some other foreign languages (Verhunov et al., 2019, pp. 59–60).

In 1997, the Ministry of Culture of China sent a proposal to the State Plan of the country on an important scientific and technical project, the Creation of a Chinese Experimental Digital Library. In April 2000, it was officially announced the beginning of its implementation. Other projects are also underway to create: the State Electronic Library of China, the Electronic Library of the Academy of Social Sciences, the Digital Library of Qing Hua University (Beijing), and the Electronic Library of the Shanghai City Library; Shanghai Transport University Digital Library; electronic library in Guang Dong Province. It is worth noting that the libraries of Ching Hua University and Shanghai Transport University are ahead in implementing the above projects.

The National Libraries of Japan and Korea have created nationwide digital libraries and metadata databases of articles, books, and manuscripts to help the public share

digital information over the Internet. Currently, about 800,000 books are stored in a manuscript database; they are available on library websites (Verhunov et al., 2019, pp. 61–62).

CONCLUSIONS

Thus, information technology is methods and means of obtaining, converting, transmitting, storing and using information. In the late 20th – early 21st century, there were positive trends in the spread of information and communication technology. First of it have taken an important place in information and library support. Analysis of modern libraries' activities revealed that among their priorities, there is a creating e-products, developing and improving search information strategies, solving problems of digitisation of documentary resources, and introducing innovative tools and methods of information protection while maintaining access efficiency. It is established that the most common technological elements of current information and library services are e-catalogues, e-libraries, information resources, virtual exhibitions, and selective distribution of information.

The analysis showed that the leadership in the development and implementation of communication technologies belongs to US libraries, which were the first to digitise their funds and create electronic libraries as the main elements of informatisation of the library process. Among European countries, information and communication technologies are most actively implemented in libraries in Germany, Sweden and Denmark. The concept of machinery of information flows has been developed in the East, and the leadership in the implementation of communication technology belongs to the libraries of China, Japan and Korea. Much later, Ukraine began digitising the library collections. At this stage, Ukrainian libraries form their own e-catalogues and full-text electronic collections and use international bibliographic, abstract, factual and full-text databases.

The future of informatisation of the library process is seen in the creation of integrated global information resources, corporate activities of the libraries in their efforts to accumulate, preserve and disseminate information resources, and develop effective search engines and information services for users.

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Ірина Бородай,

заступниця директора з наукової роботи
Національної наукової сільськогосподарської
бібліотеки НААН,
докторка історичних наук, професорка
(Київ, Україна)
e-mail: irinaboroday@ukr.net
ORCID: 0000-0001-6639-9200

Людмила Татарчук,

заступниця директора з науково-інформаційної
та бібліотечної роботи
Національної наукової сільськогосподарської
бібліотеки НААН,
кандидатка історичних наук
(Київ, Україна)
e-mail: tlm2017@ukr.net
ORCID: 0000-0003-4714-6958

Тетяна Підгайна,

вчена секретарка
Національної наукової сільськогосподарської
бібліотеки НААН,
кандидатка історичних наук
(Київ, Україна)
e-mail: pidgayna2012@ukr.net
ORCID: 0000-0002-8896-8336

ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ В ДІЯЛЬНОСТІ ПРОВІДНИХ БІБЛІОТЕК СВІТУ ТА ЇХ ВИКОРИСТАННЯ ЗА УМОВ СУЧАСНИХ КОМУНІКАЦІЙ

Мета статті – висвітлити основні тенденції розвитку та впровадження інформаційно-комунікаційних технологій у системі бібліотечного обслуговування провідних країн світу.

Методологія дослідження ґрунтується на комплексному використанні загальнонаукових та структурно-функціональних методів. Для з'ясування еволюції інформаційно-комунікаційних стратегій у бібліотечній практиці використано соціально-комунікаційний підхід, спеціальні історичні методи.

Наукова новизна дослідження полягає в комплексному узагальненні сучасних інформаційно-бібліотечних послуг, що застосовуються в різних країнах світу.

Висновки. Серед пріоритетних завдань зарубіжних бібліотек – створення власних електронних продуктів, розробка пошукових інформаційних стратегій, вирішення проблем оцифрування документів, впровадження інноваційних засобів інформування. Лідерство в розробці комунікаційних технологій належить бібліотекам США, які в 70-х роках минулого століття реалізували перші проєкти з інформатизації бібліотечних процесів, оцифрування фондів та створення електронних бібліотек. Серед європейських країн інформаційно-комунікаційні технології інтенсивно впроваджуються в бібліотеках Німеччини, Швеції та Данії. Концепція технологізації інформаційних потоків отримала стрімкий розвиток у країнах Сходу, насамперед у бібліотеках Китаю, Японії та Кореї. Україна на шляху розроблення власної стратегії інформатизації бібліотечної справи активно використовує міжнародні електронні бази даних. На цьому етапі стоїть завдання створення інтегрованих глобальних інформаційних ресурсів на основі корпоративної діяльності бібліотек із накопичення, зберігання та поширення інформаційних потоків, розробки ефективних пошукових систем та інформаційних сервісів для користувачів.

Ключові слова: комунікаційні технології, інформаційні послуги, документальні ресурси, оцифрування бібліотечних фондів

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