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ARMENIAN RESEARCH & ACADEMIC REPOSITORY IN ACTION: TOWARDS CHALLENGES OF THE 21ST CENTURY

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Abstract

The history of automation and computerization of Armenian libraries fulfilled its 30 years – a time with many achievements, also failures, and a time for opening new horizons for international cooperation. During this period, Armenia moved from the centralized economy management system to the market- based economy. Libraries are also in a renovation and cardinal reconstruction process. This article presents the current state in the field of library automation in Armenia, describes the evolution and challenges faced by the library community on its difficult way to the digitization. Activities of the Fundamental Scientific Library of the National Academy of Sciences of Armenia on implementing innovative ICT technologies and introducing R&D outputs to foster and improve digitization and long term preservation of fragile printed materials is provided.

Keywords and phrases

Digital libraries, cultural heritage, mass digitization, preservation.

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Համառոտագիր

Հայաստանի գրադարանների ավտոմատացման և համակարգչայնացման պատմու-թյունը բոլորեց իր 30 տարին, ժամանակաշրջան՝ լի բազում նվաճումներով, նաև ձախողումներով, ինչպես նաև ժամանակ՝ միջազգային համագործակցության նոր հորիզոններ բացահայտելու համար: Այս ժամանակահատվածում Հայաստանը տնտեսության կենտրոնացված կառավարման համակարգից անցում կատարեց շուկայական տնտեսության: Գրադարանները նույնպես գտնվում են վերականգնման և արմատական վերակառուցման գործընթացում: Հոդվածում ներկայացվում է գրադարանների ավտոմատացման ընթացում առկա իրավիճակը Հայաստանում, նկարագրվում են թվանշայնացման դժվարին ճանապարհին գրադարանային հա-մայնքի առջև ծառացած մարտահրավերները և թվանշայնացման զարգացումը: Բնութագրվում է ՀՀ ԳԱԱ հիմնարար գիտական գրադարանի գործունեությունը SՀS նորարարական տեխնոլոգիաների ներդրման և հետազոտական-փորձարարական արդյունքների ներկայացման ուղղությամբ՝ թվանշայնացումը խթանելու և վտանգված տպագիր նյութերի երկարաժամկետ պահպանությունը կազմակերպելու համար:

АРМЯНСКИЙ ИССЛЕДОВАТЕЛЬСКИЙ И АКАДЕМИЧЕСКИЙ РЕПОЗИТОРИЙ В ДЕЙСТВИИ: К ВЫЗОВАМ XXI ВЕКА

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Аннотация

Истории автоматизации и компьютеризации библиотек Армении исполнилось 30 лет - время многих достижений, а также неудач, время для открытия новых горизонтов для международного сотрудничества. За это время Армения перешла от централизованной системы управления экономикой к рыночной экономике. Библиотеки также находятся в процессе обновления и кардинальной реконструкции. Эта статья представляет текущее состояние в области автоматизации библиотек в Армении, описывает эволюцию и проблемы, с которыми сталкивается библиотечное сообщество на его трудном пути к оцифровке. Описывается деятельность Фундаментальной научной библиотеки Национальной академии наук Армении по внедрению инновационных ИКТ-технологий и внедрению результатов НИОКР для стимулирования и улучшения оцифровки и долгосрочного хранения хрупких печатных материалов.

Ключевые слова и фразы

Электронные библиотеки, культурное наследие, массовая оцифровка, сохранение.

Introduction

Each nation's political, cultural, and economic life is connected with the geographic place which carries the name of that nationality, with the place where during centuries the majority of that ethnic structure resides and flourishes transforming 2.into the next generations. 1. its unique cultural values.

As for the Armenians, the situation is a bit different. During its centuries-old history, even though they lacked statehood, Armenian merchants and intellectuals established communities, built churches, opened schools and printing houses

worldwide. They created and passed on to the future generations a vast number of treasures and masterpieces, including manuscripts, rare and early prints preserved in the different libraries, Armenological centers, museums, private and family collections in many countries.

This resulted in the creation of the trans-territorial network under the name "Spiritual Armenia": from Singapore to Constantinople and Smyrna (Izmir), from New Julfa to Saint-Petersburg and Theodosia, from Amsterdam to Tiflis and Baku, from Paris and Marseille to Lviv, Krakow and Transylvania, all the centers of "Spiritual Armenia" were interconnected and had one common goal – to protect the Armenian language and to re-establish statehood.

The Armenian National Council declared the independence of Armenia on 28 May 1918. One of the first decrees of the Government was about the National Library of Armenia (NLA), which was established on 5 June, 1919. The Fundamental Scientific Library (FSL) of the National Academy of Sciences (NAS) of the Republic of Armenia was founded in 1935. FSL is the second biggest Armenian library for the capacity of its collections and is the main and most extensive repository of scientific publications. It is a powerful information and bibliographical services centre for the whole National Academy of Sciences of Armenia with all of its 39 subordinate scientific research institutions, as well as scientists and specialists in all fields of physical, mathematical, natural sciences, and the humanities.

These two libraries, NLA and FSL, being the largest repositories of the Armenian language publications in the world, have become the central nodes of the "Spiritual Armenia" network, and as a significant cultural hub, are actively bridging Diasporas with each other and with Motherland. The Repository of Ancient Manuscripts – Matenadaran, Mother See of Holy Echmiadzin library, Mechitarist Congregation (Vienna, Venice), Ormanean Library of the Armenian Patriarchate of Constantinople, the Gulbenkian Library of the Armenian Patriarchate of Jerusalem, the Library of the Armenian Catholicosate of Cilicia, Holy Savior Cathedral library in New Julfa, Bibliothèque Nubar (Paris), The Association for the Research and the Archiving of Armenian Memory (Marseille), Armenian Library and Museum of America function as important centres of the "Spiritual Armenia" network.

Scholars must access the primary sources, including historical and legal documents, eyewitness accounts, statistical data, pieces of creative writing, audio and video recordings, speeches, and artefacts. It is the responsibility of librarians and archivists to find and catalog all such treasures, prepare bibliographies, and make these collections accessible worldwide. Understanding weaknesses of the printed bibliographies, being aware of the fact that information technologies and the Internet are key supporters of the knowledge bridging process combining it/ besides providing a good theoretical basis for developing digital repositories, when implementing "Open Access" publishing models and "Creative Commons" licensing schemas as well as having well-prepared library staff to apply to maintain and use Free/Open Source Software products, the librarians of FSL have initiated the development of the Digital Library modules since 2008.

When *Information Development* was launched in 1984, library automation was considered very much in its infancy from today's perspective. The largest libraries in the world, such as the Library of Congress and the British Library, had sizeable databases of catalogue records. University library catalogues were available online within their institutional four walls, and library circulation was also automated. Still, data was generally confined to the institution that held it since there was no network resembling the Internet (Hopkinson, 2009, p. 304).

In the 21ˢᵗ century, Information Technologies and the Internet are acting as key supporters in the bridging process. Development of digital libraries, "Open Access" publishing models, Free/Open Source Software solutions for building online heritage institutions, Artificial Intelligence, "Creative Commons" licensing schemas are new challenges for the librarians. They are opening new horizons for cultural exchange.

According to these challenges in 2008, FSL developed its digital agenda, stating:

OUR MOTTO is: Digitization of Armenian Cultural Heritage is a key solution for the cross-cultural interactions, for the long term preservation of printed heritage, and Knowledge Mobilization and Public Dissemination in large.

OUR MISSION is: To develop bibliographic databases, subject-oriented datasets, and statistical datasheets, to support research and education. Where applicable to link the bibliographic records with full-text materials.

OUR VISION is: All solutions should be based (if possible) on **Free/Open Source Software** products. All content should be stored in **Open Access Domain**. The Copyright model should be based on the **"Creative Commons"** licensing scheme.

I.   **The beginnings .** After a difficult period in the 1990s (the collapse of the Soviet Union, economic and social problems, due to transition to a market economy), Armenia faced the challenges posed by independence. Deterioration of the social and economic situation of the country has considerably affected the entire academic and educational systems. State budget allocations were curtailed; the renovation and maintenance of the NAS institutions were drawn to a minimum; the academic publishing system was in financial straits. Although scientific work in the institutions is active nowadays and there are collaborative partners in different EU and US-funded projects, researchers are not satisfied with the existing scholarly communication system which is mainly based on the approaches and managerial mechanisms dating back to the 1970s. The main reasons for such a situation could be ascribed to: (i) miserable state allocations to the Sciences, (ii) academic institutions are not well prepared for the challenges of the Knowledge Society; (iii) scientists and publishers are not familiar with modern trends in using ICT tools for scholarly communication; (iv) paper-based publication mechanisms are becoming obsolete and must be replaced by electronic ones (Zargaryan & Hopkinson, 2009, pp. 43-44). During 2008-2015due to the grants from the international organizations introduced and implemented

scholarly communication mechanisms, digital library services, and library management tools to the Armenian academic and library communities[32,33,34,35,36,37,38].

All these projects intend:

- to help Armenian stakeholders to construct and implement digital library modules;
- to support NAS institutions on connecting to the European scientific research area which is increasingly driven by digital technologies; and
- to introduce modern scientific communication mechanisms to the Armenian scholars and academic publishers.

II. From paper based publishing models to hybrid solutions. Starting from the 2000s, the academic publishing system in Armenia was searching for new publishing mechanisms and information dissemination tools. Due to the financial problems, journals were being published with significant delays; dissemination took a long time; library users were surprised that these journals are not available as an electronic version. Besides these factors, the present system of scholarly communication (commercial peer-reviewed academic journals) was far from ideal; modern technology offers enormous possibilities for improvement. In 2008 FSL was awarded a grant from the Open Society Institute Assistance Foundation to introduce the open access (OA) publishing model to the Armenian academic community. Two OA journals, namely 'Armenian Journal of Mathematics[39]' and 'Armenian Journal of Physics[40]' are already online, both were registered in the Directory of Open Access Journals, Google, and other Internet search engines index repositories. NAS institutions expressed interest in producing their own OA journals and have asked FSL for technical support and advice. Thanks to these activities, the OA movement found more and more supporters in Armenia, and FSL continues advocating the OA philosophy amongst the academics.

One of the largest collections of rare Armenian books (printed during 1512-1800) and 18th and early 20th centuries Armenian periodicals are held in FSL which is a unique source for scholars from multiple disciplines. All collections are fragile, and actually, the intensive usage of the FSL rare books is accelerating the paper destruction

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[32] ISOC Community Grants Programme 'Establishing a Content Creation Centre in the Fundamental Scientific Library of the National Academy of Sciences of Armenia'.

[33] NATO ESC(SPS)(2011)0265 ICS EAP.NIG 984285 projects 'Building Networked Content Creation Centre for Distance Learning Programmes'.

[34] European Union Tempus Programme JEP-14502 l-TEMPUS-2008-UK-JPCR 'NEW MASTERS PROGRAMME ON LIBRARY AND INFORMATION SCIENCE'.

[35] 'Introducing Free/Open Source Software Library Automation Tools to the Armenian Library Community'. 2010. Grant # 16518 from OSI Assistance Foundation.

[36] 'Introduction of the new scholarly communication mechanism to the Armenian academic community' 2008. Grant 15591 from OSI Assistance Foundation.

[37] NATO PDD(CP)(EAP.NIG 983118) project 'Harmonization of the Academy of Sciences Network Infrastructure for Connecting to GÉANT'.

[38] The British Library Endangered Archives Programme EAP180 'Preservation through digitisation of endangered Armenian rare books and making them accessible on the Web'.

[39] http://www.flib.sci.am/eng/journal/Math (accessed 20 August 2020).

[40] http://www.flib.sci.am/eng/journal/Phys/index.html (accessed 20 August 2020).

process. Through the British Library 'Endangered Archives Programme'–the library started digitizing fragile collections, which opened new horizons for better preservation conditions for the originals to make these collections accessible to the world academic community via their surrogates. Later the digitization of NAS academic journal publications was initiated, including the first issues as well.

Electronic publishing models are already successfully introduced to the Armenian academic community. This is a continuous process, and ~~shortly,~~ more and more publishers will be able to produce research papers in an electronic format.

The main results for this phase apply to

- establishing a digitization centre in the Fundamental Scientific Library;
- implementing a modern scanning and conservation centre for the care of vulnerable resources.
- creating high-quality digital copies from the original materials for preservation purposes;
- making the metadata and images of digitized materials freely available via the Web to researchers, students and educators all over the world.

III. **Changes in thinking: from the isolated solutions to the collaborative survival models.** In the year 2010, the Open Society Institute Assistance Foundation decided to support the FSL initiative and grant the project 'Introducing Free/Open Source Software (FOSS) Library Automation Tools to the Armenian Library Community'. The purpose of the project was to:

- Introduce alternative software solutions versus the commercial products for the libraries.
- Assist Armenian libraries to become leading digital resource centres.
- Improve Armenian and international users' access to the information resources, via an Integrated Library Systems and Digital Libraries solutions.
- Support the production of local content and share Armenia's cultural heritage with the world.
- Promote the use of international standards and best practices in library and information science.

An undeniable trend in library automation involves a movement toward the vendor-supplied systems and away from the locally developed ones. Libraries large and small admit that they do not have the resources to develop and maintain library automation systems. Our experience of automation demonstrates that Armenia will also begin to use turnkey systems. Different commercial vendors suggested a wide variety of solutions with good support and maintenance mechanisms. This contrasts with "in house" library products, which require an extended period for their development and are far from internationally approved standards, besides the maintenance fees are too low for keeping the system alive during its expected lifespan. Our vision for Armenia is that FOSS can be used in parallel with commercial products, as an alternative solution. The FOSS library products market is growing fast, and for the next few years, we plan to implement systems from the FOSS family (Breeding, 2002). At present, there are several FOSS products with reliable support mechanisms

and large open source communities in the software market. Different libraries actively use such products. Areas covered by the FOSS products, which we are planning to explore for Armenian library needs are (but not limited to) the following: **Integrated Library Systems; Collections - Repositories management systems; Open Source Electronic Course Reserve systems; Federated Searching Tools; Link Resolvers.**

The change from the commercial systems to the FOSS products is going to be complex. It will require the libraries adopted new skills, new working styles and thinking, the ability to operate in a new technological environment. For the next few years, the most vulnerable element for the digitization projects in Armenia will be the human component. Library and information work change rapidly, and librarians should always be attuned to the events and developments in their subject areas (Zargaryan, 2009, pp. 8-11).

IV. **Innovation and International Cooperation: key elements for success.** As a leading organisation in Armenia on creating digital library modules FSL, for the sake **'connecting Diasporas and bridging the Knowledge'**, suggests carrying activities in 4 main directions.

1. To develop strategic partnerships across the libraries sphere and build stronger relationships with Armenological centers.

2. To provide end-users with high-value collections and services flexibly and effectively as well as supporting librarians with the necessary systems based on advancements in Information Science and Librarianship.

3. To establish a scientific-educational portal "ARAR @" (Armenian Research and Academic Repository) and embed the library services within international research and learning communities.

4. To implement a first-class infrastructure that continues to innovate based on broadband data transfer network between libraries, Big Data technologies and cloud computing capabilities.

PILLAR 1. DEVELOPING STRATEGIC PARTNERSHIPS ACROSS THE LIBRARY SPHERES. We are trying to establish cooperation schemes with Armenian research centres all over the world. In our joint digitisation activities, we have partners from Armenia and abroad (Zargaryan & Ghazaryan, 2017, pp. 289-300).

Participants from Armenia: National Library of Armenia, Fundamental Scientific Library, Repository of Ancient Manuscripts, the library of Mother See of Holy Etchmiadzin, municipal libraries.

Participants from Abroad: Catholicosate of Cilicia (Antelias) Library, the Holy ~~Savior~~ Monastery of New Julfa Library (Isfahan), The Armenian Patriarchate of Constantinople – Ormanean library.

We do also have invisible contributors, such as "the Europeana" project, "Hathi Trust" initiative of US Universities, Book Archive program of UNESCO, "Google Books" online service, Association for Research of Armenian Memory - "ARAM" portal. You can find digitized Armenian prints in these digital libraries, with "Full View" future embedded. For such books or periodicals, we are just creating direct links to the full-text materials.

Such cooperation could be ascribed as **"A STEP TOWARD TOMORROW'S LIBRARY."**

PILLAR 2. PROVIDE END-USERS WITH COLLECTIONS AND SERVICES OF HIGH VALUE FLEXIBLY AND EFFECTIVELY BY ALSO PROVIDING LIBRARIANS WITH THE NECESSARY SYSTEMS BASED ON ADVANCEMENTS IN INFORMATION SCIENCE, ARTIFICIAL INTELLIGENCE AND LIBRARIANSHIP. "Armenian Research and Academic Repository" is more than a digital library. It is also a:

- **laboratory** for testing Open Access publishing models;
- **a community** of Free/Open Source Software developers and contributors, who are piloting and suggesting solutions for the library community;
- **learning classroom** for the Master Degree students from the School of Library and Information Science;
- **research centre** to explore the Semantic Web, Cloud Computing, Artificial Intelligence, Mobile APPs futures for the libraries.

Products developed or piloted in the Fundamental Scientific Library are in use in the National Library of Armenia, Mother See of Holy Echmiadzin library, in the State Linguistic University library, in the Armenian National Agrarian Academy, in the National Academy institutions libraries, in Armenian regional libraries.

PILLAR 3: ESTABLISH SCIENTIFIC-EDUCATIONAL PORTAL "ARAR@" AND EMBED THE LIBRARY SERVICES WITHIN INTERNATIONAL RESEARCH AND LEARNING COMMUNITIES. Starting from 2008, FSL using FOSS solutions has developed different subject-oriented databases[41], such as: "Armenian Book" in 4 sequences – "The Armenian Book in 1512-1800", "The Armenian Book in 1801-1850", "The Armenian Book in 1851-1900", "The Armenian Book in 1900-1920" (the "Greenstone[42]" FOSS product is in use); "Online portal of academic series publications" and "Continuous publications of NAS" (the "Internet Archive BookReader[43]" FOSS product is in use); an online portal for NAS journals articles ("Eprints[44]" FOSS product is in use), and more. Having in mind the great success of several brand digital library initiatives, such as "the Europeana[45]", "World Digital Library[46]", "Hathi Trust[47]", in 2016 FSL started preparation activities for its new digital library project - development of the "Armenian Research and Academic Repository". The main idea was to merge all the databases mentioned above into one, to develop multilingual "Subject Headings" and "Authority Records" datasets, to offer end users many powerful possibilities such as searching the content of the collected resources, searching bibliographic descriptions using multilingual synonyms dictionary, grouping digital publications and navigating their structure or precise and extensive ability to define rules for access to resources. The end users also

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[41] http://www.flib.sci.am/eng/node/2   (accessed 20 August 2020).
[42] http://www.greenstone.org/   (accessed 20 August 2020).
[43] https://openlibrary.org/dev/docs/bookreader   (accessed 20 August 2020).
[44] https://www.eprints.org/   (accessed 20 August 2020).
[45] https://www.europeana.eu/   (accessed 20 August 2020).
[46] https://www.wdl.org/   (accessed 20 August 2020).
[47] https://www.hathitrust.org/   (accessed 20 August 2020).

can navigate through the content using Eastern Armenian or Western Armenian interfaces.

The "Armenian Research and Academic Repository (ARAR)" digital library has been created with support from the Academic Scientific Research Computer Network of Armenia (ASNET-AM) and the EU-funded EaPConnect project[48], in collaboration with the Polish NREN, Poznan Supercomputing & Networking Center (PSNC), Institute for Informatics and Automation Problems (IIAP) of NAS and FSL in a range of the EU funded by "Enlighten Your Research" program 'Digitisation of Cultural Heritage' project, awarded to the Fundamental Scientific Library in 2017[49]. Thanks to the collaboration, ARAR was built using the dLibra Digital Library Framework[50] (Mazurek, 2013). dLibra is a tool for creating professional repositories of digital documents for the purpose of sharing them with other people and systems over the Internet. It's the most widely used software of this kind in Polish institutions, and it starts to expand to other countries. It has been developed by PSNC since 1999 and in 2002 it became a part of the DInGO software suite that supports many more aspects of managing a digital library, from mass digitization of physical objects and further processing to long term preservation. Apart from the aforementioned features targeted at end-users, dLibra offers rich features for the content creators. Digital objects can be grouped into distinct multi-level groups (e.g., years, months and issues of periodicals) and at the same time organized into hierarchical collections (for example, by content theme or by organizational units). The metadata scheme (such as titles, authors, keywords) is flexible with either open or controlled attribute dictionaries and can be mapped to various standards like Dublin Core, RIS, Bibtex. Object data can be imported into and exported out of dLibra based on generally accepted standards and protocols such as RSS, RDF, MARC, Z39.50 or OAI-PMH. The access rights to the resources can be controlled precisely per each object and user or by whole groups. The system is operating using the cloud facilities provided by ASNET-AM (Astsatryan et al. 2015). The specialists from PSNC and IIAP provide technical support and maintenance of the system. The web address of the portal is https://arar.sci.am.

PILLAR 4: IMPLEMENT A FIRST-CLASS INFRASTRUCTURE THAT CONTINUES TO INNOVATE, BASED ON BROADBAND DATA TRANSFER NETWORK BETWEEN LIBRARIES, BIG DATA TECHNOLOGIES AND CLOUD COMPUTING CAPABILITIES. FSL and IIAP carry out joint activities.

▪ These organizations are sharing computational resources, digitising equipment and human resources.

▪ e-Content is being mounted in the 'ARAR @' public domain for free reading and downloads.

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[48] https://www.eapconnect.eu/ (accessed 20 August 2020).
[49] https://www.eapconnect.eu/?s=Zargaryan+T (accessed 20 August 2020).
[50] https://dingo.psnc.pl/ (accessed 20 August 2020).

For the success of such an endeavour, it is important to have qualified IT staff, broadband data transfer network, complex computation and data facilities, like the federated Cloud platform, which requires not only high-performance computing and large volumes of data storage resources-but also skills in data analytics, cloud computing and service provisioning. The FSL alone can't solve such a complicated task.

Only in close cooperation with ASNET-AM – providing with broadband data transfer network and high skilled techies; IIAP – providing industrial-grade server solutions, HPC and distributed computing infrastructures; PSNC - sharing knowledge and technological solutions flowing from and with European partners on the development and use of digital libraries, can FSL succeed in developing a modern digital library system in Armenia.

As closing remarks, we want to emphasize the fact of creating synergies by combining knowledge and experience provided by these three organizations. A considerable amount of dataflow was organized from subject-oriented databases into the "ARAR" repository. Systems librarians from FSL, "ARAR " digital library administrators from IIAP, Data&AI specialists from PSNC during two months were involved in the data migration process. See figure 1 for details. Intensive 3-day F2F training sessions were organized for "ARAR" digital library administrators and Armenian systems librarians by PSNC staff. FSL librarians did testing of "ARAR" digital library stability, consistency of indexes, Search & Retrieval functionality for the Armenian language.
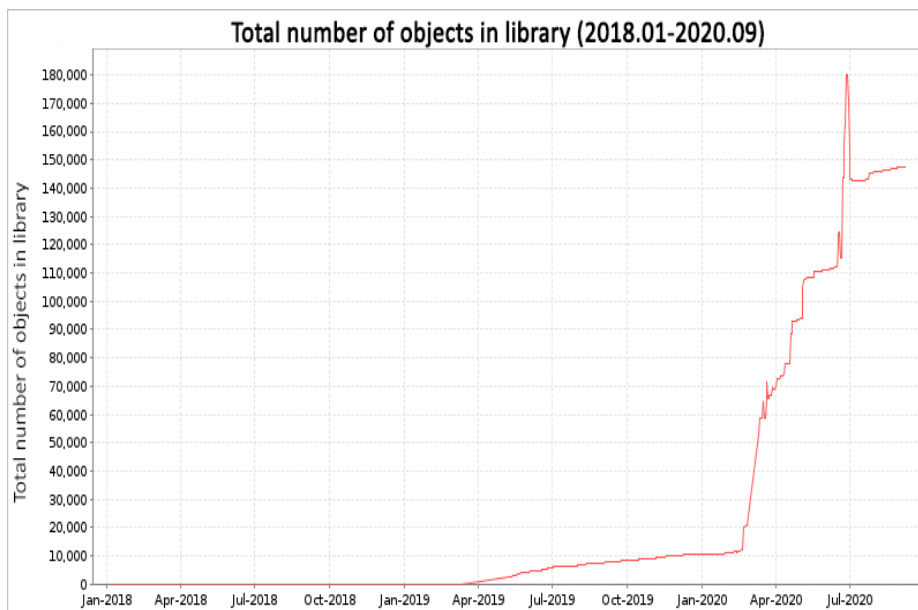

Figure 1. Total number of uploaded objects

Statistical picture (see figure 2) demonstrates that the newly constructed digital library is having a high demand amongst the end-users, and we are confident that these numbers will grow.
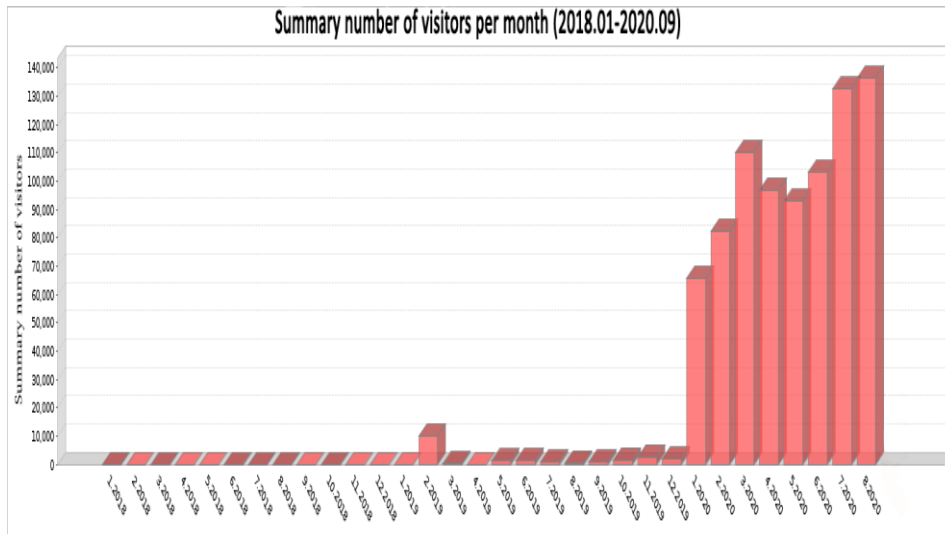

Figure 2. Number of visitors per month

After fine-tuning, the "Armenian Research and Academic Repository" will become one of the constant elements of the national computing infrastructure, and this will open research articles produced in Armenia to the world by increasing the visibility of Armenian scientists worldwide.

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