

# Consolidated Information Resource of University Archives of Lviv Polytechnic as a Research Platform of Scientific Heritage, Historical and Cultural Memory: Project Implementation Methodology

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## Abstract

The creation of a digitized empirical base of research on the scientific heritage of the Lviv Polytechnic National University, accumulated during 1939-1941, will give impetus to the activation of multi-faceted scientific exploration, preservation, and popularization of educational, scientific, historical, and cultural traditions not only of the Lviv Polytechnic National University but also national and international. Solving this scientific problem requires the creation of a consolidated information resource of the archive of Lviv Polytechnic National University (CIRALP) to provide permanent online access to archival funds.

The article aims to present the methodology of the implementation of the scientific project on the creation of CIRALP as a research platform of scientific heritage and historical and cultural memory. To realize this goal, it is necessary to perform several tasks: to present the basic principles of the CIRALP project concept; to formulate the general methodological principles of digitization of archival documents for the period 1939-1941, stored in the archive of the Lviv Polytechnic National University; to determine the method of identification and selection of documents of the Lviv Polytechnic National University's archive for the period 1939-1941, intended for digitization; to develop a technical task for CIRALP design by creating information, functional models and a structural scheme of the archive's website.

The scientific novelty of the research is the presentation of the methodology of the implementation of the project on the digitization of the archival documents of the Lviv Polytechnic National University for 1939-41 and the provision of open access. Results. The CIRALP project implementation methodology ensures compliance with the principles of systematicity, dynamism, and effectiveness in solving the project's main problem, goal, and tasks. The concept of open data provides the possibility of using documentary and factual information about the activities of the Lviv Polytechnic National University during the beginning of World War II for the development of new innovative products and services, diversification of the areas and purposes of its application as a component of ensuring the sustainable development of society. Preservation of national memory and popularizing reliable documentary and factual information serves as a tool for meeting the informational needs of current generations, forming a robust informational foundation for protecting the interests of future generations.

## Keywords 1

Scientific heritage, historical and cultural memory, archival documents, World War II, university, consolidated information resource, documentary information, factual information

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## 1. Problem statement

Modern society, being in the conditions of information war and civilizational confrontation between various models of social development, needs stable foundations of public consciousness based on reliable and complete documentary and factual information. In the globalization of the information space, the principle of open access to documentary and factual information, which ensures the free circulation of information flows, is being updated. In the informatization of archival affairs, an important direction is the digitization of archival funds not only for their preservation but also for introduction into scientific circulation and popularization through the creation of a consolidated information resource of the archive.

The unique materials of the archive of the Lviv Polytechnic National University (LPNU) reproduce the events of 1939-1941 in the west of Ukraine, as they became a kind of historical watershed. Therefore, reliable knowledge about the events of World War II's first years is essential from such research aspects as geopolitical, socio-economic, and cultural.

The uniqueness of the historical period 1939-1941 also lies in the fact that without reliable knowledge of the political, socio-economic, and legal processes that took place in the western regions of Ukraine, it is impossible to clear the information space of stereotypes and manipulated interpretations of Soviet ideology, as well as to remove false facts from the mass consciousness of Ukrainian citizens. In the 30s of the XX century, LPNU was a center for the formation of personalities with a deep sense of the national idea. Stepan Bandera, Roman Shukhevich, Kateryna Zarytska, Oleksandr Hasyn, and many other national heroes studied here. Knowledge of documentary and factual information about students, scientific and pedagogical staff in LPNU of this period has not only retrospective significance but also forms a view of the future of Ukrainian society due to democratic governance and peacebuilding principles.

The **scientific problem** that needs to be solved is creating a digitized empirical base for scientific research on the scientific heritage of the LPNU, which was created during 1939-1941. This digitized empirical base will stimulate the multifaceted scientific research, preservation, and popularization of educational, scientific, historical, and cultural traditions not only of the LPNU but also national and international. Solving this scientific problem requires the creation of a consolidated information resource of the LPNU's archive (CIRALP) to provide permanent online access to archival funds.

The **purpose of the research** is to present the methodology of the implementation of a scientific project on the creation of a consolidated information resource of LPNU's archive as a research platform of scientific heritage, historical and cultural memory.

To realize this goal, it is necessary to perform **tasks**:

- to present the basic principles of the CIRALP project concept;
- to develop a tree of goals for the implementation of the CIRALP project;
- to formulate the general methodological principles of digitization of archival documents for the period 1939-1941, stored in the LPNU's archive;
- to determine the method of identification and selection of documents of the LPNU's archive for the period 1939-1941, intended for digitization;
- to determine the digitization algorithm of identified and selected documents;
- to develop a technical task for CIRALP design by creating information, functional models, and a structural scheme of the archive's website.

## 2. Analysis of recent research and publications

The analysis of the source base of scientific research in the field of exploration and the presentation of the National Archival Fund of Ukraine shows the relevance and social importance of the problem. It is due to the archival institutions' limited material, technical and financial support.

1939-1941 was marked by the beginning of the Second World War, the occupation of the territories of independent states by the military forces of Germany and the USSR. According to the Google Scholar search platform, political science, historiography, and culture studies of this period include 2,050 scientific papers in Ukrainian, 2,470 in Polish, 19,600 in English, and 36,300 in French (as of November

1, 2021). It testifies to the high relevance and demand for scientific research devoted to this historical period. Significantly, the number of publications in Ukrainian and Polish is much lower than the number of publications in English and French. It may indicate the absence, insufficiency, or inaccessibility of primary sources for scientific exploration, analysis, and generation of original scientific knowledge.

## **2.1. Informatization as a strategic direction for the development of archival institutions**

Peculiarities of information needs, the level of their satisfaction, and users' information behavior are permanent determinants of the adjustment of the development of archives. The quantitative methodology based on questionnaires was used to study the specifics of the information needs of users of the Historical Archive of the Complutense University of Madrid. The study's results proved that users search for personal information through the archive database. Search results meet the needs of users. A promising area of activity of the archive is the development of a strategy for its development as a consolidated resource for social and technological changes, adapted to the users' needs [1].

Systematicity and organization of records management are essential requirements for state bodies' proper and effective management. At Statistics South Africa (StatsSA), there are challenges in records management: record storage and disposal, stakeholder engagement, legal compliance, digitization, and records transformation. Improving the efficiency of records management processes involves digitizing the resource center through the implementation of Millennium and Sierra Integrated Library Systems software for records management, which will promote good governance, accountability, and transparency [2].

As a result of the analysis, the problems of finding large volumes of document and information arrays were revealed. One of the problems with the functioning of the archive of the Lviv Polytechnic National University is a large number of information requests (confirmation of completion of the educational institution, confirmation of auditions of discipline courses with recorded hours and grades, information on work experience or salary). Since the search for information is carried out through paper media, which significantly complicates and slows down the work of employees of the archive department, it is proposed to change the technology of manual search to electronic, that is, the introduction of electronic archive technology. The construction of an effective working electronic archive will allow employees of the archival department of the institution of higher education to increase the efficiency of fulfilling requests for verification of personal data of graduates and employees of the university [3].

In China, archival documents are the most reliable records about events and persons with significant historical, scientific, and cultural value. However, the number of state archives is minimal. They use traditional methods of archive management, and there is a risk of damaging archival documents. Archival institutions face urgent issues that need to be resolved: strengthening of archive management, use of digital technologies for organization and processing of archival information [4].

Digitization of ancient manuscripts is becoming standard in libraries and archives. The aging, destruction, and damage of the material basis of manuscripts make it necessary to perform various types of digital image processing to improve the text's legibility and ensure its analysis. Digital archives provide full access to information containing high-quality digital images of manuscripts. A metadata scheme for archive management helps to describe, store, access all available versions of manuscripts, and search them by content [5].

Audiovisual archival documents function as primary sources for the historiography of musical art. Current multi-faceted analysis of archival musical art monument: a study of audiovisual documents in different media contexts at different times; creation of different methodologies of music historiography in the context of scientific research, education, and popularization of knowledge; functioning of archives of cultural memory from the standpoint of cultural studies; digitization of archival documents on musicology and its consequences for the organization of knowledge in the age of digital media [6].

## **2.2. Digitalization technologies of archival records and open access as a component of digital humanities**

Digitization and open access to historical records that preserve institutional memory are implemented in the Archive of Universitat Jaume I (Castellón, Spain). The Archive of Universitat Jaume I is formed from documents of the university itself and documents of former higher education institutions - Escuela de Magisterio and Colegio Universitario de Castellón. The archival fund is an information resource for researching the university's history, the evolution of teaching, the university's economy, and scientists' biographies. Digitization of historical records adds value to them. It is an innovative direction of the archive's work in line with the modern culture of "openness", based on European legislation on digitization and heritage, as well as the concept of digital humanities. Archive projects show that thanks to the expansion of traditional services, it can modernize its role and become a support for learning, teaching, and scientific research in the university [7].

Innovative technologies, software, and digital media can be used for the presentation, dissemination, promotion, and sustainable preservation of cultural heritage. New innovative technologies and tools for the preservation, access, and distribution of cultural heritage, are diverse: digital multimedia and interactive sites and platforms; digitization; collection and search of valuable cultural content in an interactive digital collection, digital library and archive, virtual digital content, and tours; applications of virtual and augmented virtual reality in the field of cultural heritage; virtual modeling and recreation, 3D models; technologies of interactive display on the desktop, storytelling with the help of robots and digital multimedia, smart educational games. Vast amounts of big data and archival databases can be collected, stored, analyzed, enriched, searched, and presented online [8].

In India, the archive of court cases is stored both in physical files and digital format, ensuring access to them and protecting the data's integrity. For archiving court cases, the most reliable is Blockchain technology. In the justice system, it can be used to ensure the confidentiality and integrity of archival court documents, as well as adequate verification and tracking for the storage of case files and evidence. At the same time, researchers propose a new method for Ethereum. The method is to use a distributed data warehouse for storing cases and evidence, in which court documents can be stored using text and image files [9].

The classification of archival documents as an element of university archives management is developing parallel with the computerization of archival files. However, the automatic classification of archival documents by computers requires specialized software. Liao X. investigates the issue of text classification of Chinese university archives in two aspects: classification using traditional manual technologies and automated classification technologies. Traditional and automatic classification provide for the distribution of texts according to such classification features as periodicity, the purpose of repetition, content, as well as document graphics [10].

The digitization of archival documents increases their potential as research objects by analogy with the potential of studying electronic documents, particularly blogs. So, with the help of the postulated extrapolation method, established the apparent dependence of the authors' professional affiliation and content of the blogosphere (by the features of blog content, blogger activity, the presence and intensity of feedback, and technical basis). Applying the postulated extrapolation method makes it possible to formulate assertions based on the dependence of certain outgoing statements and inferences from their derivative statements [11].

## **2.3. Projects on digitization of archival records**

The information solution of the Virtual archive reading room was developed in the context of the digitalization of the Slovenian state archive service. The Virtual archive reading room is a part of the project to create Slovenian public electronic archives e-ARH.si (2016-2020/2021). Special software was developed for the electronic archive, and a set of design, technical, and legal decisions were adopted [12].

The holdings of the Botany Archive of the University of Coimbra (BAUC) are of value in the fields of natural sciences, citizen science projects, and scientific communication for a broad audience. BAUC

includes textual, iconographic, photographic, and film information from the Botanic Garden, the Botanic Institute, the Botany Museum, and the University Herbarium. BAUC actively digitizes records to provide open access to unique documents. It implements projects that include: the creation of an online database "Digital Botanical Library and Archive"; preparation of the research project "The history of botany at the University of Coimbra and its expression in the Portuguese-speaking world"; development of the documentary series "Tracing Naturalists" and "Plant Letters"; launching a joint scientific initiative on the Zooniverse platform. BAUC provides the university community with documentary information for historical research and communication using traditional and innovative technologies [13].

The scientific community is systematically improving archival information systems. The pilot system developed at the Swiss Institute for Information Science at the Graubünden University of Applied Sciences solves actual practical tasks. As a database, it can be flexibly expanded to account for the peculiarities of archival records. For data protection, its materials can be managed in Linked Data-AIS [14].

The Deep Time heritage visualization project is implemented by the University of Newcastle's IT Services' Innovation Team (ITSIT) and the university library's Cultural Collections (UONCC), and the GLAMx Living Histories Digitization Lab. The joint project aims to create virtual versions of galleries, libraries, archives, museums (GLAM) using digital and information technologies. The result of the project is a 3D model of archaeological monuments and artifacts of the indigenous population for archival and historical interpretation in digital formats - in virtual reality. During the implementation of the project, the team: develops virtual reality software; explores digitization concepts, 3D modeling, and texturing technology; implements integrated learning through the use of new teaching technologies at the university. A broad professional and academic approach demonstrates the use of innovative technologies for the visualization and digitization of cultural heritage [15].

The GLAM project creates complete software packages for managing galleries, libraries, archives, and museums to make the world's cultural treasures accessible and exciting. Museum Space is a model-driven web platform for the digitization and preservation of the cultural heritage of museums [16].

## **2.4. Traditional approaches to the presentation and sustainable preservation of cultural heritage**

Digitization expands the boundaries of knowledge both in the field of scientific research and in practical activities. It involves changing the methods of saving, obtaining, selecting, and analyzing information. The historical narrative is changing, which is one of the challenges of the coming decades [17].

The personal archival collections contain a wealth of documented factual information about the life, personality, and work of prominent individuals, including Mehmet Seyfettin Özege, who is known for donating his collection of letters to the rectors of Atatürk University. The archive of Atatürk University obtains the original data. Personal research provides information about letters as a special category of documents, as well as about the personality and views of the collector. An essential component of the project is the study of information about the activities of Atatürk University for the operational organization and maintenance of the personal collection. The method of document scanning was used to obtain and evaluate data. The study of the peculiarities of the personal collection took place in the course of highlighting all the problems of the university regarding the donated publications [18].

Collections of films and motion pictures are traditionally the focus of scientific interest in film archives and cinema history. Screenplays as types of written documents usually are beyond the boundaries of film studies. Script collections are unique monuments of cultural heritage that have the potential to expand the boundaries of research sources, in particular, to substantiate the concept of new cinema history. The screenplay collection of the Czech Národní filmový archive, covering screenplays from 1940-1990, can be an interesting part of the worldwide screenwriting database [19].

Archive resources preserve a robust layer of national memory. Archival sources in the State District Archives of Znojmo refer to two Jewish political communities, Šafov and Miroslav, founded in 1867. Šafov community existed until 1919, and the Miroslav community until 1924. The archive contains documents about the historical development of Jewish settlements in both cities, funds of the political

communities themselves, and sources that illuminate the context of the life of the national Jewish community: funds of Christian communities, district branches, Jewish schools, and tax authorities. Archival sources have significant potential for researching the activities of national political communities [20].

A significant part of archival funds is epistolary heritage. In the Archiv of the Oberstkämmereramt there is a letter about the circumstances of finding the treasure from Haunoldstein and a description of 29 dinars. This archival document adds significantly to the hoard, which consists of a total of 900 denarii, a silver ring, and a silver brooch, and reveals aspects of the influence of the Marcommanic Wars in Noricum on European history [21].

## **2.5. Interaction of archives and social media**

The modern archive widely implements its functions through interaction with social media. A questionnaire methodology was used to study the archival centers' social media toolkit and analyze their role in increasing archival literacy. Primary data were collected using a structured questionnaire distributed to Japan's prefectural, municipal, city, and university archive centers. The National Archives of Japan (NAJ) has a significant following on Twitter, Facebook, YouTube, and RSS subscribers. Prefectural and municipal archives mainly use social media and web tools to provide only basic information about their activities. They are not taken into account user feedback to improve their service. An interactive model of archival literacy is proposed that integrates users, archival centers, and social media tools [22].

Successful activity of university archives is closely related to strategic planning of their development and coverage in social media. The study of planning methods and objectives was conducted in 58 archives of private and public institutions of higher education in Ecuador, accredited by the High Council of Ecuador. It demonstrated a lack of strategic planning knowledge and an urgent need for archive management and planning training. Only a few archives have up-to-date strategic plans that meet institutional goals and publish them on their websites [23].

Following European and national legislation, Spanish public institutions must publish on their websites and periodically update any information that guarantees government transparency. University archival departments also publish their information, which enhances their visibility, credibility, and image. The transparency of archival departments was evaluated based on the presence of a number of indicators on their websites. Along with the information on the best practice of archives, a lack of information on perspectives and analysis of activities was found [24].

Cultural organizations use websites to promote activities and spread their services on the Internet. However, research suggests difficulties in managing strategies to increase the visibility and accessibility of library, archive, and museum (LAM) websites. It is proposed to solve the problem of evaluating the effectiveness of websites by implementing a project to optimize search engines based on three factors: content management, speed, and security. The website optimization algorithm is a step-by-step technological process that focuses on meeting the needs of users, increases the organizational structures and culture of the visibility of LAM services [25].

Traditionally, research has examined the value of documentaries in archival, historical, and audiovisual aspects. Thanks to digitization, memorial newsreels are distributed on websites and social networks. New online documentary contexts have new forms of presenting and evaluating these images in public and commercial archives. The analysis of the Gaumont Pathé Archives, British Pathé, Archivo Histórico NO-DO, and Archivio Luce websites was performed according to the following indicators: access to information, interactivity, use of social networks, and contextualization of content. The newsreel gave way to a new genre - an audiovisual information and entertainment program in the information space. Thanks to the strategy of digitalization and distribution on websites and social networks, archive newsreels are updated as a resource of documentary memory and media literacy [26].

## **2.6. Educational innovations and archives**

Educational programs in information sciences have become widespread in Swiss universities of applied sciences. Universities offer continuing education master's degrees and regular computer science

master's programs in their computer science departments. The University of Zurich offers a master's program in library science, and the University of Bern offers a master's program in archival science. However, the problem is the possibility of employment for graduates of master's degree [27].

Digitized archives are an essential component of the implementation of didactic tasks. Increasing teachers' digital competences in social sciences and history, using digitalization and information and communication technologies is an opportunity for professional improvement of teachers and the introduction of educational innovations in educational work. At the Public University of Navarre, an innovative didactic project TPACK was implemented. It involves the use of a knowledge model of technological pedagogical content for digitized primary sources in three resources: PARES (Spanish Archive Portal), EUROPEANA, and BNE (National Library of Spain). The project's main goal is to develop teachers' digital competence while teaching social studies by integrating technological, pedagogical, and industry knowledge. During the implementation of the project, the following tasks were completed: the basic digital knowledge of students regarding the use of ICT during the study of history was analyzed; didactic material was introduced into history and social science courses using Spanish and European digitized primary historical sources; the impact of the didactic project on the development of types of knowledge was evaluated [28].

Thus, modern research on the digitization of archival documents is manifested at the theoretical and practical level and covers complex directions of scientific research:

- informatization of archival institutions as a strategic direction for the development of archival institutions;
- technologies of digitization of archival records, open access to them as a direction of digital humanities;
- digitization projects of archival records;
- traditional approaches to the presentation and sustainable preservation of cultural heritage;
- interaction of archives and social media;
- educational innovations and archives.

The driving force behind the intensive deployment of archival document digitization processes is the synergy of humanitarian and technological aspects of information interaction. The implementation of a set of social communication conditions - free circulation of information, accessibility to primary and secondary sources of information in all their diversity, overcoming language, territorial, and departmental information barriers - allow us to affirm the formation of the information behavior of users, the definition of information needs and their satisfaction at the current level.

The basis of the technological convergence of archival institutions is the process of digitization, i.e., the conversion of content into a digital form, which:

- allows digital media to deliver archival information to the user;
- provides a single technological platform for saving and distributing archival content;
- makes it possible to distribute digital format content in various forms;
- makes it possible to activate the digital content format in a verbal and visual form, creating interactivity during presentation events in the archives.

### **3. Methods**

Research methodology involves general scientific methods of analysis, synthesis, grouping, generalization, formalization, visualization, descriptive method, decomposition, and modeling. Using the analysis, synthesis, and descriptive methods, we formulate the goal, tasks, principles, and expected results of the CIRALP scientific project.

We widely use the modeling method in the study to design CIRALP at various stages. The tree of goals was used for visual graphical reproduction of the dependence and interrelationships of goals, which distributes the main goal and tasks of the project. By using the decomposition method, the general goal was connected with ways to achieve it and reveal the structure of the implementation of the CIRALP project. In order to develop the technical task for the design of CIRALP, an informational, functional model and a structural scheme of the archive website from the positions of the administrator and the user were built.

By using methods of grouping, generalization, and formalization, a system of archival documents indexing was created, as well as templates for forms of document's and person's metadata, and technological cards of cases were developed.

## **4. Results**

### **4.1. CIRALP project's concept**

The CIRALP project as a research platform of scientific heritage, historical and cultural memory is relevant in the context of social and communication processes. It will provide open access to primary archival information and ensure further scientific research of historical and cultural heritage. The project is an interdisciplinary study of historical, political, educational, socio-communication, and informational directions. Implementing such a project will contribute to developing scientific and technical, socio-political, educational, and scientific potential, preserving and multiplying national memory and culture, and sustainable development in global, regional, and national challenges.

CIRALP scientific project aims to preserve and popularize the scientific heritage, historical and cultural memory, and intercultural and international relations formed at the beginning of World War II (1939-1941) through the creation of a consolidated information resource of open documentary and factual information about scientific and pedagogical staff, students of higher education, as well as about the organization of educational and scientific activity of the LPNU.

The realization of the goal of the CIRALP scientific project involves the following tasks:

- development of a methodology for the digitization of personal, organizational-administrative, reference information, educational and methodological documents of the LPNU from 1939-1941, which are of apparent and potential scientific and practical value for domestic and international research;
- identification and selection of personal, organizational-administrative, reference-informational, educational-methodical documents of the LPNU from 1939-1941, intended for digitization;
- digitization of selected documents;
- development of a prototype of a consolidated information resource of the LPNU's archive;
- practical implementation of the consolidated information resource of the LPNU's archive;
- approbation of the consolidated information resource of the LPNU's archive.

The main expected results of the project should be considered on different planes at different levels. At the mental and worldview level, the project opens up perspectives for:

- dissemination of scientific knowledge about the scientific heritage of the LPNU formed at the beginning of World War II (1939-1941);
- preservation and popularization of the historical and cultural memory of the Ukrainian educational community;
- development of intercultural and international relations, scientific collaboration, and academic mobility of university communities of Ukraine, Poland, Lithuania and other countries.

At the functional level, the project implements a complex of information products designed to perform society's essential social and communication functions. Will be created:

- the methodology of processing documentary and factual information from the LPNU's archive;
- consolidated information resource of open access to full-text digitized original documents of the LPNU's archive;
- representative forms of popularizing retrospective personal and official information as a branding tool of the domestic scientific community.

### **4.2. Methodology of the CIRALP project**

The synergy of general scientific and special methods used in various spheres of scientific knowledge will increase the effect of disseminating new knowledge about educational and scientific activities of Ukrainian universities and, in particular, LPNU. The research methodology of CIRALP involves conducting a set of activities designed to create a consolidated information resource of the



LPNU's archive as a source of primary documentary and factual information about the historical and cultural heritage of the Ukrainian scientific community. The project methodology covers the following principles:

- the unity of theory and practice, which are mutually determined and reveal the dialectic of the movement;
- systematicity, based on which each researched object is considered as a single entity, and each phenomenon or event is evaluated with others;
- development, which consists in the formation of new scientific knowledge with a reflection of the contradictions of a specific era, quantitative and qualitative changes of the object of research;
- objectivity, which requires taking into account all the factors of the existence of realities for the characterization of the objects, phenomena and processes under study without prejudice;
- decomposition, which will help the fragmentation of researched objects, phenomena, and processes for their effective analysis and design;
- abstraction, which consists in highlighting significant and omitting non-essential properties of the studied phenomena and processes;
- generalization, which will contribute to the identification of typical features and regularities of the object of research, a logical transition from individual to general knowledge.

The successful organization of project implementation, monitoring of effectiveness, the dynamism of search works, and compliance with the logical sequence will be facilitated by accounting for the volumes of completed works, reporting, and presenting the received scientific results of the implementation of the current stage. At the 2-6 stages of project implementation, we use the statistical method to record the amount of work performed and report.

The CIRALP project is an interdisciplinary study of historical-political, educational, socio-communication, and informational directions. Its methodology covers a whole complex of methods, each updated depending on the tasks of each research stage. The implementation of the CIRALP project covers six stages.

### 4.3. The main stages of the CIRALP project

Implementation of the CIRALP project involves the development of a goal tree, which allows for determining the main goal and establishing intermediate stages for its achievement. The tree of goals defines the movement vector and the search for CIRALP project implementation options. The main goal is to develop a consolidated information resource, and sub-goals correspond to the stages of project implementation (Fig. 1).

At the **first stage of project** implementation, the development of a methodology for the digitization of personal, organizational-administrative, reference-informational, educational-methodical documents for the period 1939-1941, which are stored in the LPNU's archive, and also constitute an apparent or potential scientific and practical value for domestic and international research.

The development of a methodological base for the implementation of the project involves the adoption of organizational, methodical, and management decisions regarding:

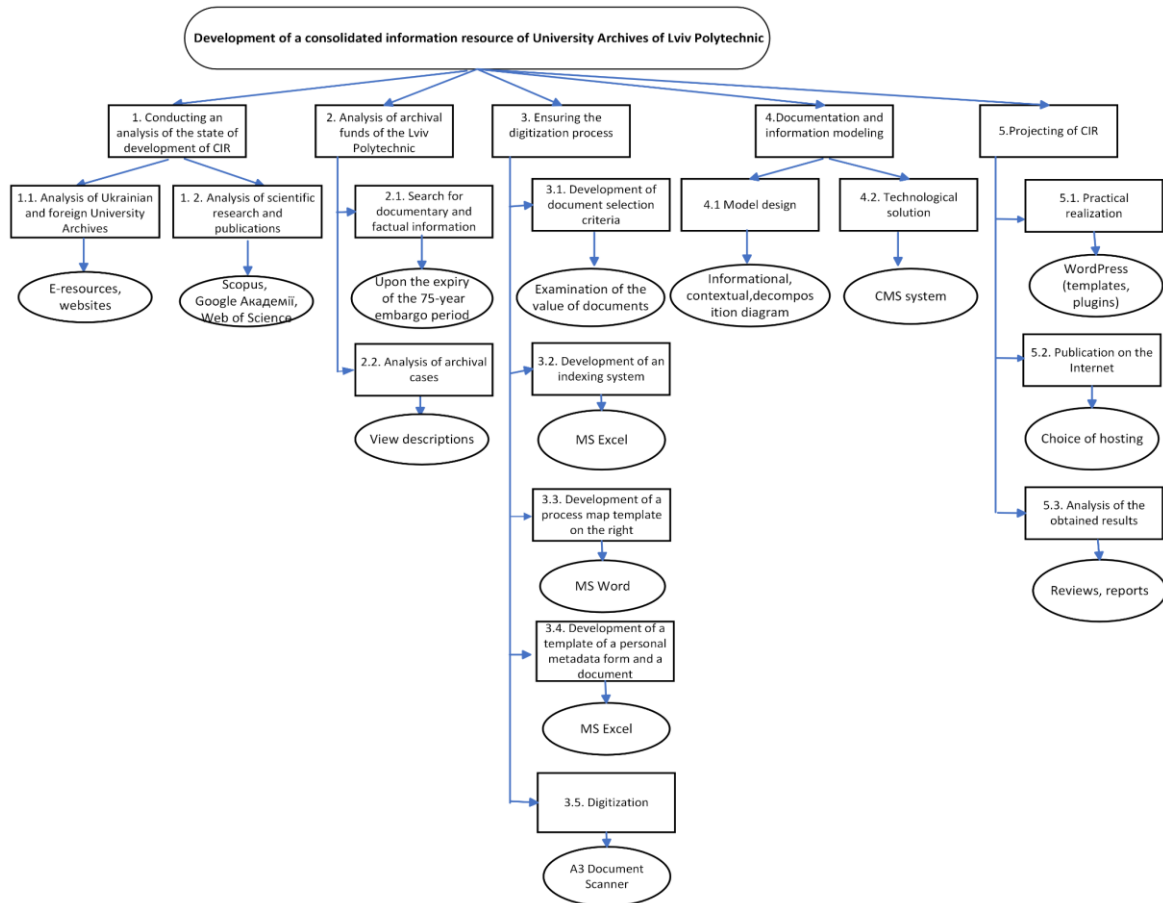
- to determine the principles of exploration of archival documents;
  - to establish the criteria for selecting cases and names of documents for digitization that are of apparent or potential scientific and practical value;
  - to develop the indexes of names of documents for accounting and systematization;
  - to develop the template of a technological card of the case with the task of digitizing and indexing each selected document;
  - to develop the templates of forms for person's and document's metadata;
- to develop the template of a card for keeping records of the volume of performed work.

The primary defined principles of exploring archival documents are completeness of coverage, historicism, systematicity, and integrity of documents.

Criteria for selecting cases and titles of documents for digitization:

- by chronology, the documents must have been created during the years 1939-41;
- by value, the documents must be of apparent or potential scientific and practical value;

- by type, the documents must belong to organizational-administrative, reference-informational, personal (general), personal, accounting-financial, economic-contractual, and educational-methodical documents;
- by physical wholeness, documents of any physical condition, and wholeness.



**Figure 1:** The tree of the goals of the CIRALP project implementation

Information about the typological structure of the archive cases will allow studying and drawing conclusions about the directions of archive users' educational, scientific, and business activity and their information needs. The typological structure can be established by De Vizu continuously reviewing the documents, establishing their typological features, and assigning them a classification index (Tab. 1).

**Table 1**

Indexing of archival documents

Index of document type	Type of document	Names of documents
OAD	Organizational and administrative documents	Order, decree, statute
RID	Reference informational documents	Reference, list
PDg	Personal documents (general)	Order, decree, personnel list
PD	Personal documents	Applications, autobiographies
AFD	Accounting and financial documents	Act, receipt
ECD	Economic and contractual documents	Contract, agreement
EMD	Educational and methodical documents	Work program, list of disciplines

The purpose of preparatory content analysis of cases is to obtain primary source information to ensure the digitization and classification of received records. For this, a technological card is drawn up for each case with the task of digitizing and indexing each selected document (Fig. 2).

Technological card of the case No \_\_\_\_\_

Case No	Document type index	Document number in order	Unique document index	Pages to scan

**Figure 2:** Template of the technological card of the case

The unique index of the document consists of the case number, the index of the document type, and the document number in order, separated by hyphens. For example, 0005-OAD-3.

The document's metadata characterizes information about the document for inclusion in the CIRALPA database (Fig. 3).

No	Metadata of the document	Data about the document
1	Unique document index	
2	Surname and first name of the personality	
3	Abstract of the document	
4	Document creation date	
5	The language of the document	
6	Unique features of the document (presence of photos, vultures, seals, signatures, resolutions)	
7	Method of document creation (printed, handwritten)	
8	Scope of the document	

**Figure 3:** Template of document's metadata form in Excel

Person's metadata characterizes information about staff of LPNU for inclusion in the CIRALPA database (Fig. 4).

No	Metadata of the person	Data about the person
1	Last name	
2	First name	
3	Date of birth	
4	Place of birth	
5	Sex	
6	Position	
7	Degree	
8	Academic status	
9	Department	

**Figure 4:** Template of person's metadata form in Excel

The indicator of achieving a positive result at this stage will be the development of "Methodological recommendations for the digitization of archival documents of the LPNU from 1939-1941, which are of apparent or potential scientific and practical value for domestic and international research.

The **project's second stage** is dedicated to identifying and selecting documents from the LPNU's archive for the period 1939-1941, intended for digitization. The intermediate goal of the stage is to prepare archival documents of the LPNU for digitization. This time-consuming stage requires attention, logic, experience, and scientific intuition for unique, rare documents. With the full right, it can be considered a stage of source science heuristics, which is related to searching and discovering documentary information outside the boundaries of scientific discourse. It is worth noting that the

collection of personal archival documents of the LPNU for the years 1939-1941 was not the object of scientific research. They may contain interesting, unique information that will become the missing links in the set of connections in critical social processes at the beginning of World War II: the time of occupation by German troops of the western territories of Poland and the Soviet occupation of the eastern territories.

Preparatory work includes the following tasks:

- to conduct an examination of the scientific value of archival documents of the LPNU for the years 1939-1941 and conduct their content analysis following the methodology;
- to fill out technological cards of the cases with the task of digitizing and indexing each selected document.

During the selection and preparation of documents for digitization, it is necessary to pay attention to their physical condition and wholeness. To ensure the preservation of the originals of archival documents, it is necessary to select documents with a high degree of destruction of the physical basis, with the threat of information loss (fading of the text), and submit them for restoration.

The indicator of achieving a positive result at this stage will be creating an array of cases with technological cards for digitizing selected documents.

The **third stage of the project** covers the digitization of selected documents to form an array of digitized archival documents of the LPNU, as well as the aggregation of metadata of persons and documents. The detailed list of tasks of this stage includes:

- to digitize the selected documents following the technological cards of the cases;
- to fill out persons' metadata forms;
- to fill out documents' metadata forms;
- to fill out the card of the volume of performed work.

The selected documents are digitized according to the algorithm (Fig. 5).



**Figure 5:** Algorithm of the digitization process of archival documents

The indicator of achieving a positive result at this stage will be creating an array of digitized archival documents for publication on the consolidated information resource of the LPNU's archive.

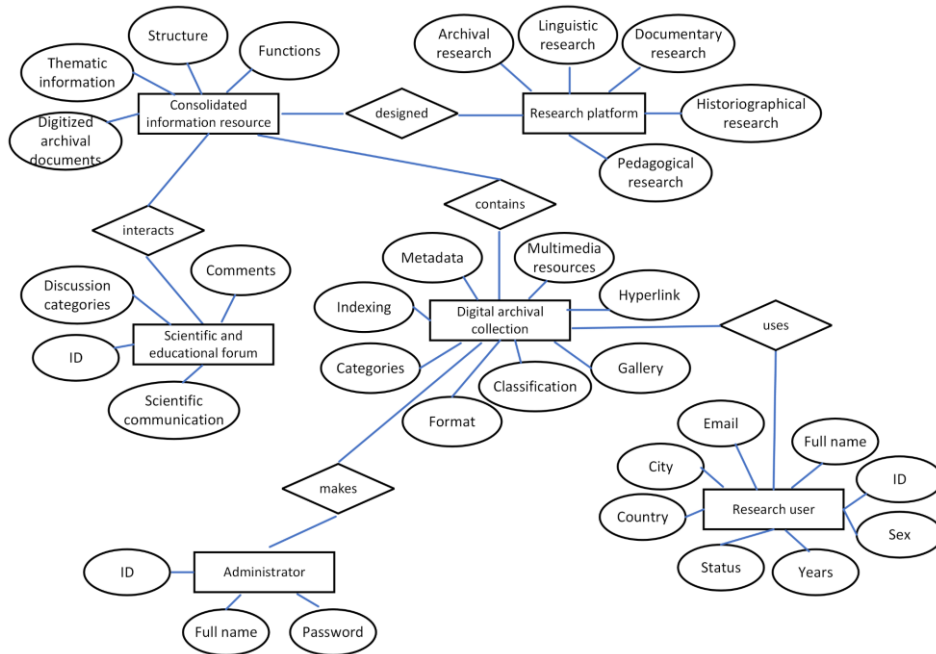
At the **fourth stage of the project** implementation, a prototype of the consolidated information resource of the LPNU's archive will be developed. It will cover the implementation of tasks using information technologies:

- to develop a technical task for the design of the CIRALP structure;
- to choose software development methods, programming languages, content management platforms (CMS), and database design;
- to create a database of the CIRALP and its web interface.

The development of the technical task for the design of CIRALP involves creating information, functional models, and a structural scheme of the archive website.

ER model of CIRALP in Chen notation represents conceptual interdependencies using generalized blocks. The main entities are defined as "User-researcher", "Administrator", "Scientific and educational forum", "Research platform", "Digital archive collection" and "Consolidated information resource".

According to the developed ER model, the consolidated information resource contains a digital archive collection, which is entered by the administrator and used by the research user. The consolidated information resource is intended for use as a research platform and interaction with a scientific and educational forum (Fig. 6).



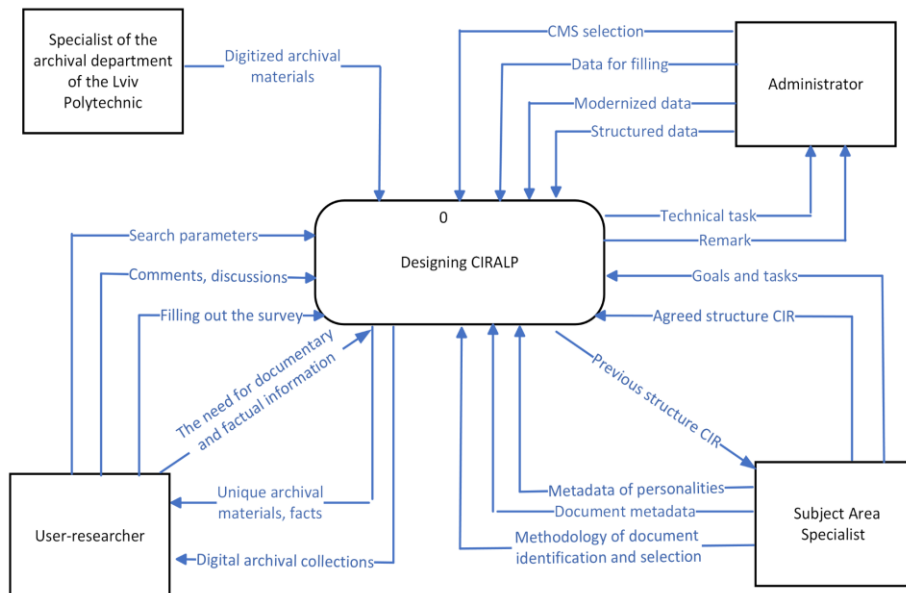
**Figure 6:** ER-model of CIRALP

CIRALP's primary means of modeling functional requirements is its functional model. With the help of a context diagram (DFD), functional requirements are divided into components and presented as a network connected by data flows.

The stage of development of the decision's functional model consists of specifying the participants (external entities) in interaction with the primary process - the development of CIRALP. The development of consolidated information resource of the LPNU's archive is represented by a data flow diagram in the Heine-Sarson notation. The context diagram contains one primary process - "Designing CIRALP". It is connected with the help of data flows to four external entities that influence this process: "Specialist of the archive department of Lviv Polytechnic", "Administrator", "User-researcher", and "Subject Area Specialists". Consider the relationship of each external entity with the primary process. The external entity "Specialist of the archival department of the Lviv Polytechnic" is a person with the level of access and the ability to work with archival funds. This specialist selects cases for the period 1939-1941 and carries out digitization for open access.

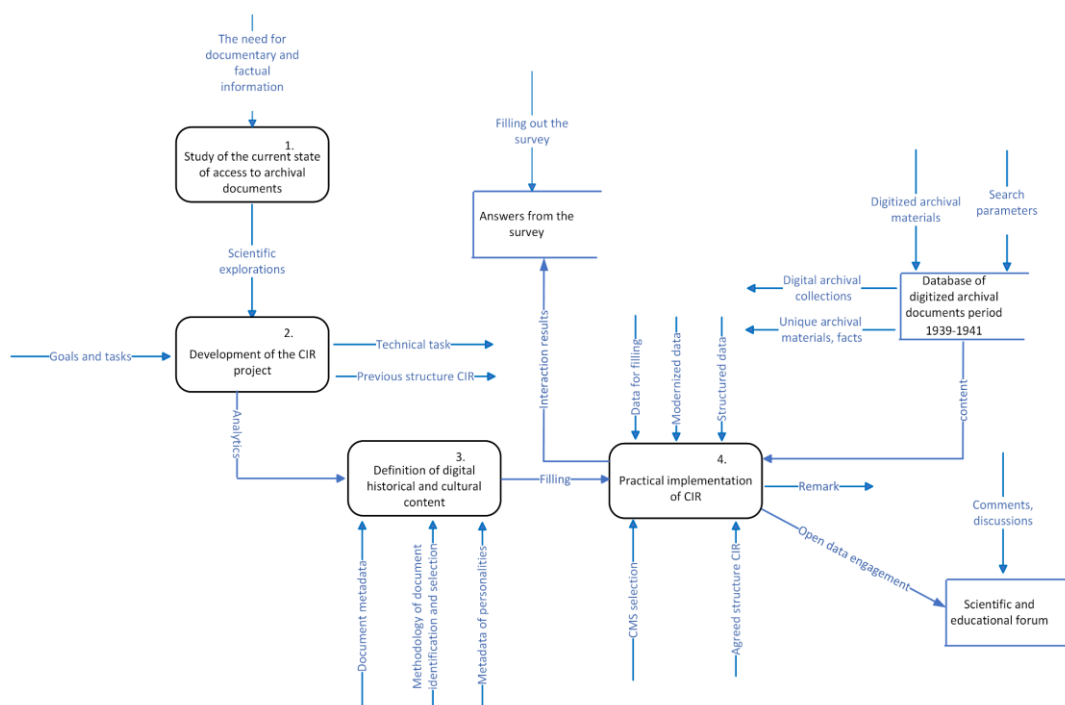
"Administrator" is the person responsible for developing and maintaining the CIRALP. The functions of this participant are: development and organization of CIRALP according to the technical task; administration on maintenance of updating and editing information of digital archival collections for the period 1939-1941. "User-researcher" are Ukrainian and foreign documentary and factual information researchers from 1939-1941 who conduct scientific exploration in historical, archival, documentary, pedagogical, and linguistic research. In order to develop multi-faceted scientific research, the user-researcher performs search queries, conducts discussions, leaves comments on the CIRALP's forum, and as a result of the interaction, takes a survey on the research platform. As a result of the request, the user receives unique archival materials, facts, and digital archival collections. "Subject Area Specialists" is an interdisciplinary collective of researchers whose task is to preserve and popularize the scientific heritage and historical and cultural memory of the unique historical period of 1939-1941 with

the help of CIRALP. They develop a methodological basis for the identification and selection of documents. In particular, the metadata of documents and persons are input data streams to the primary process. Accordingly, the preliminary structure of the CIRALP comes from the primary process (Fig. 7).



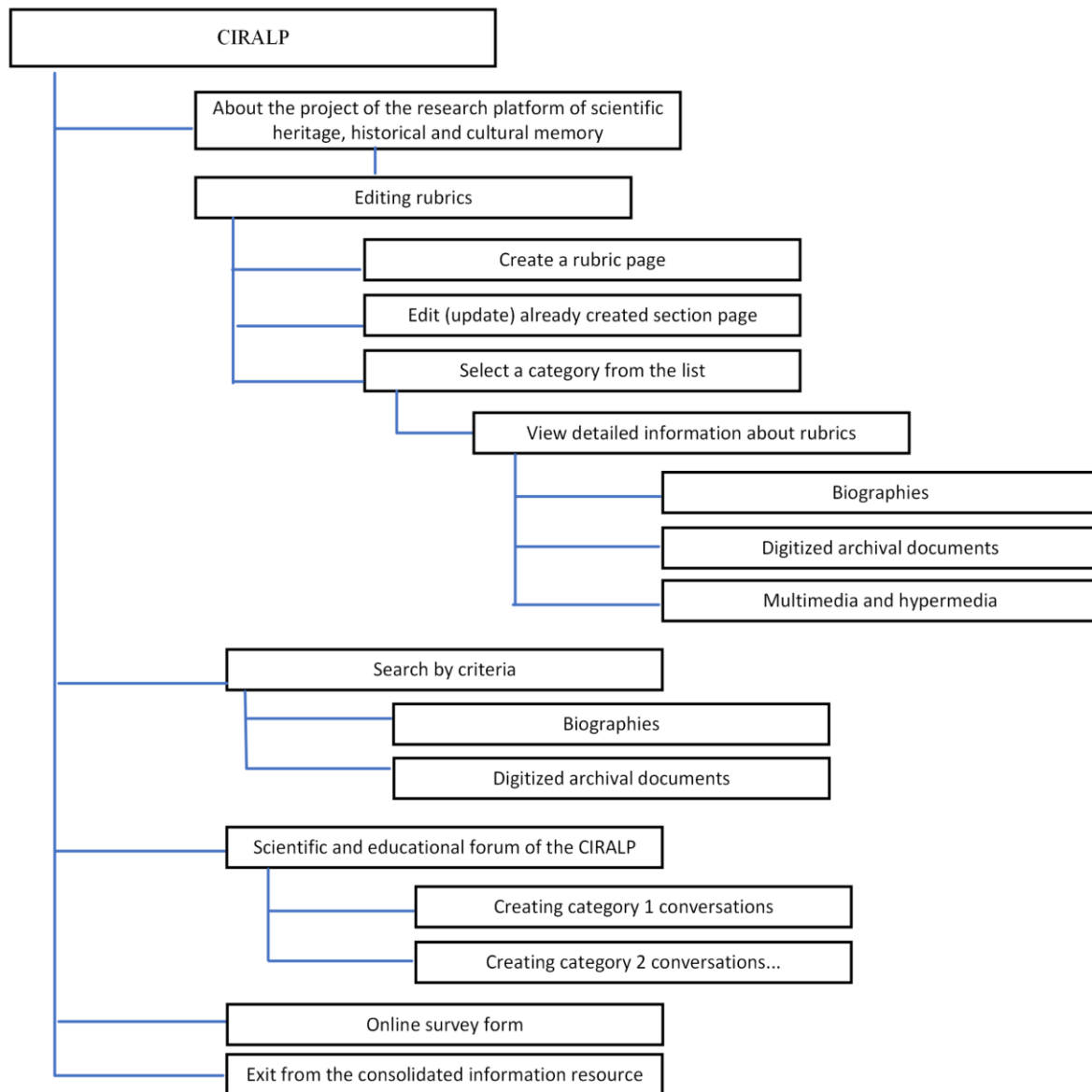
**Figure 7:** Context diagram of the CIRALP development process

The next step is decomposing a developed context diagram detailing the primary process. At the heart of the decomposed context diagram are the sequential stages of development of the CIRALP from the study of the current state of access to archival documents, the development of the project, and the definition of digital historical and cultural content to practical implementation (Fig. 8).



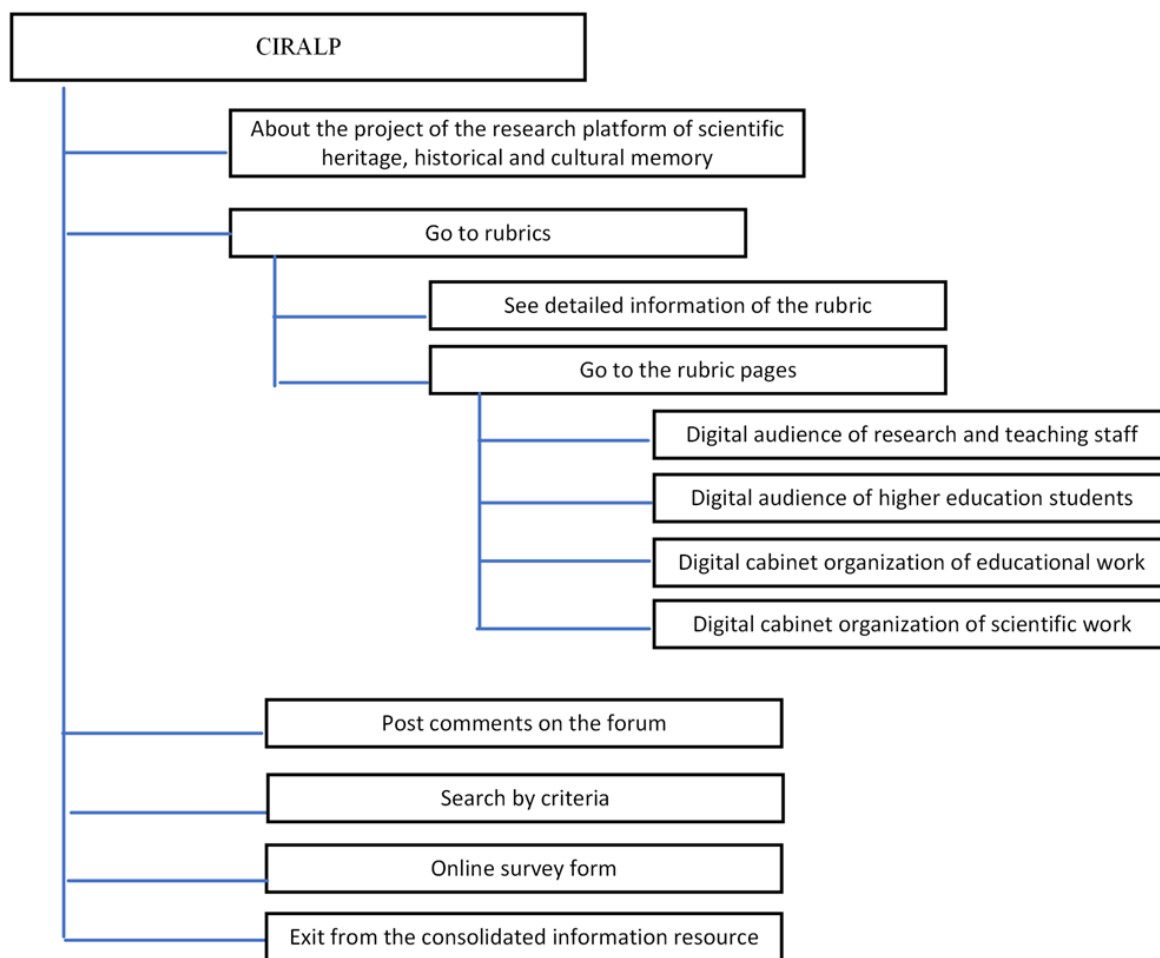
**Figure 8:** The first level of detailing the primary process

The CIRALP's structural scheme is a hierarchical structure of the website rubrics of the archive. Two structural schemes of CIRALP have been developed: for the administrator and the user-researcher. The main task of the administrator will be the creation of rubrics for digitized archival materials, their updating, and complement (Fig. 9).



**Figure 9:** Structural scheme of CIRALP for the administrator

The user-researcher can enter the archive's website and explore digitized archival documents from 1939-1941. The home page will contain the rubrics: "About the project", "Digital audience of research and teaching staff", "Digital audience of higher education students", "Digital cabinet organization of education work", "Digital cabinet organization of scientific work", "Scientific and educational forum", and "Online survey form". On the "About the project" page, a detailed description of the project will be presented, which will increase the motivation for scientific research and the development of interest in the issues of the historical heritage of the LPNU. The pages "Digital audience of research and teaching staff", "Digital audience of higher education students", "Digital cabinet organization of education work", and "Digital cabinet organization of scientific work" will contain biographies, digitized archival documents, as well as multimedia and hypermedia. The structure of CIRALP provides for the functioning of the "Scientific and educational forum" page, which will allow feedback between project developers and users and scientific collaboration between users (Fig. 10).



**Figure 10:** Structural scheme of CIRALP for the user-researcher

The indicator of achieving a positive result at this stage will be the creation of a prototype of the CIRALP.

In the **fifth stage of the project**, the CIRALP will be practically implemented by entering digitized information and metadata of persons and documents into the database of CIRALP. The indicator of achieving a positive result at this stage will be the CIRALP, filled with digitized documents and metadata of persons and documents.

The sixth stage of the project will be devoted to the approval of the CIRALP to verify its completeness and functionality. Organizational and technical processes, and acts of communication interaction, which will testify to the achievement of project goals, will embody the following tasks:

- to provide open access to the CIRALP;
- to analyze feedback (number of views, comments, distribution in social media);
- to develop online questionnaire forms for surveying users of the resource;
- to update the content of CIRALP following the comments and suggestions of information users.

The indicator of achieving a positive result at this stage will be an upbeat assessment of the completeness and functionality of the CIRALP as a source of primary documentary and factual information about the historical and cultural heritage of the Ukrainian scientific community.

## 5. Discussion

### 5.1. Analysis of the problem in university archives

The consolidated information resource of the LPNU's archive has several advantages compared to existing analogs. Existing e-resources popularize local history materials. "Interactive Lviv" and "Electronic Encyclopedia of the Lviv Polytechnic" contain biographies and illustrations about figures



of science, culture, and education in Lviv [28; 29]. They are secondary sources that are not a reliable empirical basis for scientific research. The website of the Archive of Lviv National University (LNU) presents individual digitized documents of the personal cases of LNU scientists [31]. The CIRALP project is envisaged as a source of full-text archival documents of the LPNU from 1939-1941. The resource will provide multi-faceted scientific studies of the role of the LPNU in the development of scientific, educational, cultural, and political processes during the beginning of World War II.

## **5.2. Scientific novelty of the project**

The project's novelty is to highlight the scientific and educational activities of the LPNU during the Soviet occupation to ensure interdisciplinary research in historical, socio-communication, and information fields. The array of archival cases of the LPNU, as one of the oldest academic technical schools in Europe, is essential for clarifying and tracing trends in the development of Ukrainian science and education during the beginning of World War II and analyzing the data obtained. For the first time, it was offered:

- to develop a methodology for the creation of a consolidated information resource following the generalized criteria for the distribution of documentary and factual information about the scientific and pedagogical staff of the LPNU during the beginning of World War II;
- to develop a consolidated information resource of the LPNU's archive as an online research platform of open data with full-text digitized originals of personal cases of all scientists of the LPNU who worked in the period 1939-1941;
- to outline methods of retrospective representation of personal information of scientific and pedagogical staff of the LPNU, which will form the tools for branding the domestic scientific community.

The results obtained during the project implementation reveal new prospects for finding relevant information, complementing and deepening modern scientific research on scientific and educational activities during the World War II. The research results can be used in historical, archival, documentary research, and pedagogical and linguistic research.

## **5.3. Practical significance of the obtained results**

The primary practical significance of the obtained results is the creation of a consolidated information resource of open documentary and factual information about scientific and pedagogical staff, as well as about the organization of educational and scientific activity of the LPNU, which is of scientific and practical value for domestic and international research.

The project's expected results describe the obtained scientific and technical products with an indication of the expected qualitative and quantitative (technical) characteristics. Scientific and technical products include:

- consolidated information resource of the LPNU's archive;
- methodological recommendations, study guide on the methodology of implementation of the consolidated information resource of the LPNU's archive;
- a series of webinars for archival workers of higher education institutions regarding the popularization of funds.

Digitized archival materials on the personalities of the Ukrainian scientific figures, scientific and pedagogical staff of the LPNU, obtained during the project implementation, will be widely used in scientific investigations from the whole complex of subject areas of the humanitarian sphere.

Historiographic research will supplement or eliminate gaps in the descriptions of the course of historical events of 1939-1941 in the west of Ukraine. For Ukrainian and foreign researchers, these original materials are highly relevant historical primary sources, especially considering the artificial suppression of interest in the events after September 17, 1939

Archival research will provide an optimal organization of user access to socially important retrospective documentary information for all segments of the population and its comprehensive use

through the electronic archive. Creating CIRALP will allow the systematization of archival information, facilitating social and scientific communication at the regional, national, and international levels.

Pedagogical research will allow following the evolution of the educational process of a specific specialty based on digitized working programs, according to which the students of the departments of the LPNU were trained.

Linguistic research will make it possible to study cross-linguistic contacts, the interaction of the Ukrainian language with Polish and German, the peculiarities of the language of official-administrative documents, and documents of personnel administration in the years 1939-1941.

Documentary studies will provide an opportunity to trace the step-by-step historical development of the system of documents of scientific and educational activity and personnel records in an educational institution.

The scientific results obtained during the implementation of the project will be used in the educational process for students of the specialty 029 "Information, library and archival affairs" in the study of individual topics within the disciplines of organization of exhibition activities, innovative activities of libraries and archives, technologies of archiving and information storage, analytics information needs, management of library and archive institutions, information analytics in the activities of libraries and archives, office management: methodology and practice.

An essential aspect of the practical value of project implementation is the preservation and dissemination of documentary and factual information, which is recorded on material media older than 75 years and is subject to disposal. Physical use (exposure) of paper media is problematic due to the natural destruction of the material basis of documents.

#### 5.4. Prospects for further research

The practical implementation of the project requires a thorough understanding and visualization of the progress of each stage of the project. Thus, at the fourth stage of the project, there will be a need to draw up a detailed scheme of the process of developing a prototype of the CIRALP. The fifth stage, during which the CIRALP will be created with digitized documents and metadata of persons and documents, will require the development of a detailed scheme of the process of its practical implementation. The task of the sixth stage is to confirm an upbeat assessment of the completeness and functionality of the CIRALP, and therefore it will require the development of a detailed scheme of the process of its approval.

A promising direction of the project's development is the organization of international research on the creation of digitized content for the Wrocław University of Science and Technology (Poland). In the post-war years, at this university, the emigrated professor of the Lviv Polytechnic continued their work.

#### 5.5. Risks of implementing the CIRALP project

During the implementation of the CIRALP project, technical and organizational risks may arise, which may affect the timing and quality of project tasks. Therefore, it is crucial to predict possible risks and ways to prevent or solve them at the initial stages (Tab. 2).

**Table 2**

Project implementation risks

Risk	Ways of prevention
1. Exceeding the expected volume of processing of archival funds: compliance with the principle of the integrity of the archival case as a complete and reliable empirical base of research on all scientists who worked during 1939-1941 requires identifying and processing documents about their activities before 1939 and after 1941 p.	Involvement of employees of the LPNU's in processing archival documents within the limits of compliance with the labor legislation of Ukraine. Adjustment of criteria for selection of materials for processing (restriction of personnel by positions, scientific degree, scientific title)

Risk	Ways of prevention
2. Low quality of digitization of handwritten texts and worn paper media: personal files contain documents that differ in the way they were created and the quality of the material basis.	Digitization of archival documents involves the use of modern technical means with high technical and operational characteristics
3. Untimely purchase of special equipment (equipment): missing equipment for digitizing archival documents will lead to a violation of the calendar plan for project implementation	Use of LPNU's resources
4. Exceeding the expected volume of digital information: the technical characteristics of the server may not be sufficient to save digital information	Use of LPNU's resources

Achieving the goal and fulfilling the complete set of project tasks requires additional funding to purchase modern special equipment. However, a powerful reserve for the successful implementation of the project is the material and technical base, equipment, and facilities of the Department of Social Communications and Information Activities and the LPNU's archive.

## 6. Conclusions

Ukrainian researchers need a high-quality, accessible scientific empirical base that would allow them to overcome territorial, communication, information, and organizational barriers. In times of globalization, the issue of the scientific and cultural heritage created at the LPNU at the initial stage of World War II goes far beyond the borders of domestic issues. Documentary and factual information related to this period is of significant scientific interest to researchers from different countries. The particular value of documentary and factual information for scientific research is because the LPNU was formed under the conditions of three states: Austria-Hungary, Poland, and the Soviet Union. The formation of a consolidated open access information resource about polytechnic scientists of the specified period and its integration into a single information space will ensure the possibility of automated information processing, free access, and the use of unique documents. It will also contribute to the establishment of international scientific collaboration and the implementation of international scientific projects.

The CIRALP project implementation methodology ensures compliance with the principles of systematicity, dynamism, and effectiveness in solving the project's main problem, goal, and tasks. The concept of open data provides the possibility of using documentary and factual information about the activities of the LPNU during the beginning of World War II for the development of new innovative products and services, diversification of the areas and purposes of its application as a component of ensuring the sustainable development of society. In this aspect, the preservation of national memory and the popularization of reliable documentary and factual information serve not only as a tool for meeting the informational needs of current generations but also for forming a robust informational foundation for protecting the interests of future generations.

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