

What are the technical factors affecting the copyright protection of information resources in Libraries Information Systems? A Fuzzy Delphi Approach*

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ABSTRACT

Several factors, such as technical aspects, affect the copyright protection of information resources in information systems (ISs) used in libraries. By identifying the technical factors affecting the copyright protection of information resources in the systems, libraries can take the necessary measures to protect the rights of creators of works and make the resources legally accessible to users. The present study aimed to identify the technical factors affecting the copyright protection of information resources in the ISs of the National Library and Archives of Iran (NLAI).

The qualitative approach and documentary analysis, thematic analysis, and fuzzy Delphi methods were used in this study to collect and validate the data. The research population consisted of seven Iranian specialists and experts selected for interviews, 11 specialists selected for the Delphi panel, and seven ISs of the NLAI selected for examination and study. In this study, 16 indicators were identified as technical factors affecting copyright protection of the systems under study. These indicators were identified as effective technical factors in both bibliographic and digital systems. In general, the systems under study (i.e., digital and bibliographic) had no proper status regarding copyright protection of information resources. Therefore, the managers of such systems must take necessary measures to review the technical checklists to evaluate the systems in terms of protecting the copyright of information resources. Furthermore, they must try to improve the effective technical factors in these systems. Paying attention to the technical factors mentioned in the present research can reduce the risk of copyright infringement in information systems and digital libraries.

KEYWORDS

Copyright; Information resources management; Information systems (ISs); Technical factors; National Library and Archives of Iran (NLAI).

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1. Introduction

Intellectual property rights and copyrights pose various challenges for librarians in all stages of the information and source management cycle, from creating digitized resources and providing external resources to access and long-term digital collections management (Muir 2006). Various factors, including technical factors, affect the copyright protection of these resources in Information systems (ISs). Identifying the technical factors affecting the copyright protection of information resources in the information systems allows libraries to take necessary measures to protect the rights of the creators/producers of works and make the resources legally accessible to users. The rights of creators (i.e., copyright holders) of works can be protected in the digital space through technical requirements. However, some technical factors are not implemented in the systems for various reasons. As a result, it affects the protection of the rights of the producers/creators of information resources. The effective technical factors may be few, but libraries cannot neglect them. As we know, the information age has significantly affected all sectors of the society, including libraries. Libraries have experienced many quality improvements in their services, the nature of the information provided, and the beneficiaries, thereby turning into modern libraries. In these libraries, there has been much dependency on technologies in digitalizing information and data for effective access and greater efficiency in information storage and processing (Niqresh 2019). The reason is that technological developments have fundamentally changed many of the common, routine practices in libraries. Library resources are mostly used, delivered, and maintained digitally. Libraries provide collections of music, movies, etc., in digital formats thanks to features such as convenient search, retrieval, access, and transfer (Wahid 2017). They play a vital role in developing the information society by providing the users with information resources in various tools through the Web. Libraries and librarians encounter problems regarding digital information security management policy, data privacy, data backup, data protection against malware and viruses, and technical support. Hence, it is essential to protect library resources (Farid, Warraich, and Iftikhar 2023) from being misused. To prevent unauthorized access to library resources and copyright protection of resources, whether physical or digital, library managers and information experts should consider strategies to provide adequate security for digital information resources in libraries. The reason is that library resources contain valuable information that helps libraries meet users' information needs. In this respect, the development of digital collections, including audio-visual equipment, electronic sources, microforms, etc., will help libraries better meet the information needs of their users (Ferdinand, Ijiekhuamhen, and Nneka 2015).

Following the increased use of ISs, libraries have started their digitization programs to make library resources available to web users. To provide free access to information, libraries have been making their information resources available to users through ISs for years. To this end, they have used various information resources, including books, journal articles, research projects, manuscripts and lithographic books, maps, photos, theses, dissertations, etc. Libraries are usually less interested in providing the full content of resources through ISs as they tend to protect the copyright information resources and decrease the risk of unauthorized access. Although this solution cannot contribute to the survival of libraries in the long run, it may be used more for libraries that cover many diverse resources. National libraries in every country are responsible for providing, processing, maintaining, and disseminating information. In Iran, the National Library and Archives of Iran (NLAI) is

responsible for implementing ISs. Digital systems, including Iran's National Digital Library (Digital Library¹), Iran publications system², Iranian Scientific Publications System³, Iran Publications Database⁴, the National Document Center Network⁵ in Iran, the Catalog of Manuscripts⁶ available in Iran, and Iran Libraries Network⁷ are bibliographic systems that provide users with various resources. These information resources include books, manuscripts, lithographs, research projects, photos, maps, and journal articles. However, offering information resources in these systems has led to many issues related to resource digitization. As was mentioned, one of these issues is copyright protection of resources in the ISs, where the resources are stored and made accessible to users. Since the systems examined in this research were also common among other libraries, the suggestions and results of this research can be used by other libraries as well. Accordingly, considering the stated goal and problem, the current study will look for an answer to the following question to evaluate the systems under study by identifying the effective technical factors from the experts' point of view. The main question to respond to in this study is:

RQ. What technical factors affect the copyright protection of information resources in the systems under study?

2. Review of the related literature

Because of their importance, many studies have focused on security issues in ISs and digital libraries. For instance, Ismail and Zainab (2011) investigated the security of ISs of public libraries in Malaysia, considering network security to be one of the technical factors in the security of library ISs. Researchers proposed using the Library Information Security System Assessment Model (LISSAM) that libraries should also implement good backup policies and recovery procedures to ensure their data and services via information systems can be accessed and shared in a convenient way whenever it was needed and data can be restored quickly during downtime. Therefore, network security was considered an important technical factor.

Khan, Ibrahim, and Hussain (2021) also examined Pakistan university libraries' data and information security status. Their findings showed an unsatisfactory situation of such security measures. Lack of updated antivirus and library management software, firewalls, testing and debugging mechanisms, use of workstations, no backup data, and updated security patches for operating systems are some issues reported in the survey. Similarly, mandatory actions are usually taken by the IT section of any department. The measures such as allowing restricted user access to certain important databases, file sharing mechanism, and maintaining log of access (e.g., wireless connected devices) are some of the critical issues that need to be considered by libraries in this study. Other studies have dealt with the issue of the security of information resources in libraries. Farid,

¹ <https://dl.nlai.ir/ui/forms/index.aspx>

² <https://sana.nlai.ir>

³ <https://iranjournals.nlai.ir/>

⁴ <https://mags.nlai.ir/>

⁵ <https://docs.nlai.ir/>

⁶ <https://scripts.nlai.ir/>

⁷ <https://libs.nlai.ir/>

Warraich, and Iftikhar (2023) investigated the policy of digital information security management in academic libraries using a Systematic Review method. They concluded that digital information security policy and data are secure in some academic libraries, such as those in the United Kingdom, United States of America (USA), China, and the United Arab Emirates (UAE). However, other university libraries, such as those in India, Pakistan, Nigeria, Ghana, and Oman, have no such procedures. In Iran, Kokabi and Kohi Rostami (2015) found that access to information and processes of the organization should be controlled based on organizational and security needs. This rule should be considered in information dissemination and licensing procedure policymaking. The rights access rules of each user or group of users should be explicitly and accurately stated and recorded in the access right granting method document. According to Peykam and Salimifard (2016), organization's information security policy and the documentation of organizational processes are among the factors affecting the security of ISs. In addition, Eidi Ghaleshiri (2015) believes that the settings and management of firewalls and host-based intrusion detection systems (IDSs) at the level of applications and the configuration of firewalls and routers are among the challenges and technical factors in the design of digital libraries, especially the Digital Library of Astan-e Quds-e Razavi in Iran.

Rezvani (2018) considered two categories of solutions and factors to be effective in improving the security of Iranian digital library systems. This study was conducted using the correlation and path analysis. The author concluded that the security of ISs can be improved using encryption principles in the authentication or replication of services to increase the level of access. Also, using an enterprise service bus (ESB) to implement security controls in the architectural design and using security-WS were reported as effective measures for message-level security. In addition, the development of an information security policy, information architecture, organization of information security, development of ISs, security of human resources, and content protection affect information security in digital libraries. Doroudi and Jamshidi (2021) considered physical and environmental security; communication and operations management; access control; preparation, development and maintenance of ISs; human resource security; asset management; information organization; and security policy among the factors affecting information security in the digital libraries of the Qom province in Iran.

Other researchers have investigated the issue of licenses for information resources, technical requirements for protecting the copyright of resources in ISs, digital copyright, and copy detection systems. Fernández-Molina (2004) conducted an analytical study on licensing agreements for information resources and limitations and exceptions to copyright. He believes that the emergence and development of the digital environment have posed major changes in the conditions of access, distribution, and use of intellectual works, thereby affecting the rights holders and users. For online exploitation of intellectual works, contractual agreements and licenses can be used as the most common way of accessing projects. Therefore, there is a need for clear rules for license agreements and their relationship with limitations and exceptions to copyright. The activities performed by legal users without obtaining permission from the rights holders should be limited to not disrupt the adequate use of intellectual works and the proper functioning of the information society.

Gaber (2012) studied the users' rights in the Digital rights management (DRM) system, concluding that DRM prevents illegal access and copying, allowing users to have access only to digital content with permits based on license issuers. Griffin (2013) investigated the opportunities and threats of digital copyright exchange. The results showed that digital copyright can be implement-

ed as an alternative solution for traditional publishers, and the issuance of digital copyright helps present digital works more easily. In other words, it prevents the copyright infringement of works. Although this model may put traditional publishers at a weak point in the competition with digital licensing, it can change the way of creating new creative works and the way of using the copyright of the works. For instance, it can alter digital technology as a phenomenon that has facilitated sharing individuals' thoughts and works worldwide.

Papi et al. (2017) considered the copy detection system among the main infrastructure elements of the Iran's National System for Theses and Dissertation (INSTD). Applying copy detection systems, which use similarity-finding software, prevents unfair use and duplication of theses and dissertations. Thesis and dissertation integrated systems are of importance in setting up the infrastructure for the repository.

Papi (2021) investigated the copyright of printed and digital library resources in Iran using a qualitative approach and documentary analysis method. Fair use and exceptions, access to information resources, material and intellectual rights, license and agreement, for-profit use, type of resources, and supporting and violating the rights of creators are the most important issues to consider developing solutions for material and intellectual rights and the printed and digital source copyright policy in libraries; although there was no copyright policy in Iranian libraries. Finally, this author offered suggestions and operational solutions for the copyright bill of library resources and use in libraries according to the types of resources. Moreover, they suggested creating a field called "Copyright Status" or "Rights and Access" in the bibliographic record in library software, which can contribute considerably to protecting the rights of creators.

From studying various researches, it became clear that a category of studies addressed security components in library information systems. The research of Eidi Qaleh Shiri (2015) falls into this category. His research discussed firewalls in libraries and security issues. Other studies such as Ismail and Zainab (2011); Khan, Ibrahim, and Hussain (2021); Kokabi and Kohi Rostami (2015); Farid, Warraich, and Iftikhar (2023); Peykam and Salimifard (2016); Rezvani (2018); and Doroudi and Jamshidi (2021) also belong to this category.

For example, in the research by Kokabi and Kohi Rostami (2015) and Rezvani (2018), access control indicators in the systems of public libraries in Iran and the digital library systems of Iran were examined. In the first study, security indicators were rated at a moderate level, while in another study, the digital system of the National Library of Iran was rated at a good level. In addition to the above studies, the topic of licensing for information resources was explored in the research by Fernández-Molina (2004).

One of the technical factors for improving the virtual space and the interaction between users and creators is the use of DRM systems and attention to copyright in the digital environment. The application of DRM technology and digital copyright to prevent unauthorized duplication has been highlighted and emphasized in the research of Gaber (2012) and Griffin (2013).

Emphasis on the formulation of copyright policies and obtaining permission from publishers are two points related to the research by Papi (2021), which examined the copyright of printed and digital sources in Iran's library resources. The use of similarity detection can help identify violations of the rights of creators in information systems. In the research by Papi and et al. (2017), the copyright detection system was discussed as a technical factor. In the methodology section, the studies under consideration were conducted using various methods.

Some researchers, such as Ismail and Zainab (2011) and Khan, Ibrahim, and Hussain (2021), have explored data and information security in libraries and their ISs using survey methods and tools such as questionnaires and checklists. The digital information security management policy and copyright policy were analyzed by Peykam and Salimifard (2016), Papi (2021), and Farid, Warraich, and Iftikhar (2023). In the study by Peykam and Salimifard (2016), the researcher designed a questionnaire and used the Fuzzy Analytic Hierarchical Process (FAHP) technique to calculate the weights and ranks of factors. Papi (2021) studied resources using the Documentary analysis method. Farid, Warraich, and Iftikhar (2023) employed a systematic method for analysis.

Kokabi and Kohi Rostami (2015) and Doroudi and Jamshidi (2021) examined technical indicators using the survey research method. The research of Griffin (2013) and Fernández-Molina (2004), was conducted using the review and descriptive method. Also, Rezvani (2018) studied the information security by Correlational research and survey. In the study by Eidi Ghaleshiri (2016), Quantitative Evaluation Methods was used. Gaber (2004) used a qualitative systematic analysis to analyze technical indicators. Papi et al. (2017) research investigated the system by a checklist and the grounded theory approach.

Therefore, according to the examination and analysis of the studies conducted, it can be stated that such a research has not been done in Iran so far. Based on this, several features of the current research can be presented: in this research, the use of technical factors in support of copyright was examined. Additionally, various systems of the NLAI were reviewed in this study. From digital resource systems containing various informational resources (books, theses and dissertations, manuscripts, non-book resources, and the like) with different features and accessibility to other systems were analyzed in the current research. While in other studies, emphasis was placed on the security issues of libraries. Moreover, there were also differences in methodology compared to other studies. In this research, considering the objectives and research questions, methods and tools such as qualitative approaches, document analysis, thematic analysis, fuzzy Delphi methods, as well as tools like interviews and observations were utilized.

3. Methodology

In this applied study, a qualitative approach was employed for data collection. In the first step, different studies and resources were examined and analyzed using the documentary analysis method. For this purpose, Iranian and foreign databases, such as online public access catalog (OPAC) available in NLAI, the INSTED, and the Academic Center for Education, Culture, and Research (ACECR) in Iran, were searched using Persian keywords. Also, foreign databases such as Emerald, Google Scholar, Science Direct, Acalib, and Sage were searched using keywords and phrases such as “copyright in libraries”, “copyright and information resources”, “ISs”, “technical factors in systems”, and “security of ISs”. In the second step, the resources were studied, and the technical factors affecting the copyright protection of information resources were extracted. Until these factors are used alongside the factors extracted from the interviews for the checklist.

In the third step, semi-structured interviews were conducted with 7 Iranian and non-Iranian specialists and experts in person and via e-mail (Table 1). In selecting individuals for the interviews, purposive sampling was used, and then a snowball sampling method was employed.

Table 1. Characteristics of Experts in the Interview

<i>Interviewee Code</i>	<i>Level of Education</i>	<i>Area of Expertise</i>	<i>Work Experience (Year)</i>	<i>Name of Country</i>
1	Dr. at Law, Assistant Professor	Copyright and technology	10	India (Delhi)
2	PhD in Computer Science	Digital library strategist and metadata architect	25	United States (Pennsylvania)
3	Master of Library Science	Library Technology, Digital libraries, Intellectual property	40	United States (California)
4	Ph.D. in Knowledge and Information Science	Information technology	22	Iran (Tehran)
5	Ph.D. in Information Technology	Information systems	20	Iran (Tehran)
6	Ph.D. in Information Technology and Ph.D. in Knowledge and Information science	Information systems, Information technology	21	Iran (Tehran)
7	Master in Information Technology	Digital libraries	17	Iran (Tehran)

To clarify any ambiguities in the interview and to obtain more in-depth information, the interviews continued for three or four rounds. Before conducting the interview, a brief overview of the topic was provided to the interviewee. Numerical codes (1-7) were used to keep the interviewees' names confidential. The interviews continued until new data were obtained and until data saturation was reached. The interviews took place from March 2023 to May 2023.

After the interviews, the Thematic Analysis (TA) method was used to analyze them at two levels of concept and category.

TA is a method for systematically identifying, organizing, and offering insight into patterns of meaning (themes) across a data set. Through focusing on meaning across a data set, TA allows the researcher to see and make sense of collective or shared meanings and experience (Braun and Clarke 2012). An example of coding in the TA method is presented in Table 2.

Table 2. A sample of the Thematic Analysis (TA) method (coding of interviews)

<i>Codes</i>	<i>Sentence examples</i>	<i>Concept</i>	<i>Category</i>
Code 1	"By the type of such works (audio, video, audiobook, and e-book), they would mostly be licensed and so by way of contract ..." (Code 1).	Existence of a license and contract	license and contract
Code 2	"Clear information on copyrights and licenses and/or permissions, maintained alongside digital library content to which they apply ..." (Code 2).	Getting licenses/ permissions for the content	license agreement
Code 6	"Laws and statutes should actually be made to protect digital resources. We need to have information security management policies to prevent internal and external attacks".	information security management policies	Formulating information security management policies

In the fourth step, the technical factors were initially extracted. The new categories extracted from the interviews, which were related to the technical factors of the systems, were added to the checklist. For the sake of reliability, the list of indicators were presented to two experts in digital libraries and ISs, who confirmed all the indicators. Then, Cronbach's alpha was used to measure the reliability of the indicators. The obtained score was 0.99, indicating the checklist's high reliability. SPSS 24 was used for Cronbach's alpha. In the fifth step, after confirming the indicators, the fuzzy Delphi method was used for their validation and group consensus. A 5-point Likert scale was used in the above checklist to examine the effectiveness of technical factors, with 1 indicating very low and 5 indicating very high effectiveness. The fuzzy Delphi method was conducted in two rounds. A panel of 11 experts and specialists with good work experience in ISs and digital libraries and accessibility were selected (Table 3).

Table 3. Characteristics of experts selected as members of the Delphi panel

Row	Level of Education	Area of Expertise	Work Experience (Year)	First Round	Second Round
1	Ph.D. in Communication	Digital libraries	25	✓	✓
2	Ph.D. in Information Technology	Information systems	21	✓	✓
3	Ph.D. in Knowledge and Information Science	Digital libraries	20	✓	✓
4	Ph.D. in Knowledge and Information Science	Digital libraries	20	✓	✓
5	BS in Hardware Engineering	Information systems	30	✓	✓
6	MS in Information Science and Epistemology	Information systems	10	✓	✓
7	Ph.D. in Knowledge and Information Science	Digital libraries	15	✓	✓
8	Ph.D. in Knowledge and Information Science	Digital libraries	10	✓	✓
9	MS in Information Technology	Digital libraries	17	✓	✓
10	MS in Computer and Networks	Information systems	17	✓	✓
11	MS in Knowledge and Information Science	Information systems	17	✓	✓
Total				11	11

The checklist was presented to the experts to receive their opinions. The members of the Delphi panel expressed their opinions through verbal variables (Table 4). The numbers were fuzzified by converting the triangular fuzzy numbers equivalent to the 5-point Likert scale into fuzzy numbers.

Table 4. Triangular fuzzy numbers equivalent to the 5-point Likert scale

<i>Triangular Fuzzy Numbers</i>	<i>Linguistic Terms</i>
(0, 0, 0.25)	Very Low
(0, 0.25, 0.5)	Low
(0.25, 0.5, 0.75)	Average
(0.5, 0.75, 1)	High
(0.75, 1, 1)	Very High

Then, the fuzzy average was calculated from the scores using the equation and converted into a definite number using the andequations. The results of all fuzzification calculations are given in Tables 5 and 6. The threshold value was considered 0.5 in this study.

In the fuzzy Delphi method, which has a screening mode, variables with a minimum agreement of 50% are confirmed (Habibi, Firouzi Jahantigh, and Sarafrazic 2015).

Fuzzy Delphi analysis was performed for all accepted indicators in two rounds, where 16 indicators were confirmed based on the opinions of 11 experts (Tables 5, 6 and 7). If the difference between the mean scores of the first and second-round questions is less than 0.2, the survey process will be stopped (Habibi and Afaridi 2022). None of the indicators scored less than 0.2, suggesting that all 16 indicators were confirmed. The above indicators were placed in 5 components.

In the first round, the indicator “Using different firewalls and remote access to protect (secure) the server” with an average of 0.841 related to network security ranked first among experts. Then, the indicator “Formulating information security management policies to protect digital resources” with an average of 0.795 in the standards and frameworks component ranked next. Additionally, the indicator “Using proxy servers to receive resources and apply access restrictions” with an average of 0.765 related to network security ranked third among experts.

In the second round of the Delphi panel, the indicator “Using different firewalls and remote access to protect (secure) the server” again ranked first with an average of 0.826, and the indicator “Undocumented (unlogged) access” with an average of 0.811 related to standards and frameworks ranked second. Furthermore, the indicator “Formulating information security management policies to protect digital resources” also again ranked third among experts in this round with an average of 0.841 (Table 5, 6 and 7).

Table 5. Results for the first round of fuzzy Delphi

<i>Dimensions</i>	<i>Components</i>	<i>Indicators</i>	<i>Triangular fuzzy average</i>			<i>De-fuzzified average</i>	<i>Status</i>
			<i>l</i>	<i>m</i>	<i>u</i>		
Technical factors	Network Security (4)	Not using a firewall (failure to use a firewall)	0.455	0.705	0.864	0.674	Confirmed
		Using different firewalls and remote access to protect (secure) the server	0.636	0.886	1.000	0.841	Confirmed
		Blocking access to data transfer from the server for system employees	0.409	0.659	0.864	0.644	Confirmed
		Using proxy servers to receive resources and apply access restrictions	0.545	0.795	0.955	0.765	Confirmed
	Technical Infrastructure (3)	Outdated Digital Rights Management (DRM) software	0.409	0.659	0.864	0.644	Confirmed
		Limited computational space (servers, software, etc.) provided by the systems	0.455	0.705	0.909	0.689	Confirmed
		Limited temporary storage space	0.455	0.705	0.932	0.697	Confirmed
	Copy control (4)	Costly audio/video transcription algorithms	0.318	0.568	0.795	0.561	Confirmed
		Not using “look inside” to access pages and different parts of digital content	0.409	0.659	0.864	0.644	Confirmed
		Using “look inside” for text, audio, and video formats	0.455	0.705	0.886	0.682	Confirmed
		Copy (plagiarism) detection systems	0.477	0.705	0.864	0.682	Confirmed
	Frameworks and standards (3)	Undocumented (unlogged) access	0.500	0.750	0.932	0.727	Confirmed
		Formulating information security management policies to protect digital resources	0.591	0.841	0.955	0.795	Confirmed
		Applying Metadata Encoding and Transmission Standard (METS)	0.455	0.705	0.886	0.682	Confirmed
	License (2)	Lacking publisher’s license agreement to publish audio-books on the systems	0.545	0.795	0.932	0.758	Confirmed
		Smart contracts	0.523	0.750	0.886	0.720	Confirmed

Table 6. Results for the second round of fuzzy Delphi

<i>Dimensions</i>	<i>Components</i>	<i>Indicators</i>	<i>Triangular fuzzy average</i>			<i>De-fuzzified average</i>	<i>Status</i>
			<i>l</i>	<i>m</i>	<i>u</i>		
Technical factors (5)	Network Security (4)	Not using a firewall (failure to use a firewall)	0.500	0.750	0.955	0.735	Confirmed
		Using different firewalls and remote access to protect (secure) the server	0.614	0.864	1.000	0.826	Confirmed
		Blocking access to data transfer from the server for system employees	0.455	0.705	0.932	0.697	Confirmed
		Using proxy servers to receive resources and apply access restrictions	0.477	0.727	0.909	0.705	Confirmed
	Technical Infrastructure (3)	Outdated Digital Rights Management (DRM) software	0.477	0.727	0.909	0.705	Confirmed
		Limited computational space (servers, software, etc.) provided by the systems	0.500	0.750	0.955	0.735	Confirmed
		Limited temporary storage space	0.477	0.727	0.932	0.712	Confirmed
	Copy control (4)	Costly audio/video transcription algorithms	0.364	0.614	0.818	0.598	Confirmed
		Not using “look inside” to access pages and different parts of digital content	0.432	0.682	0.909	0.674	Confirmed
		Using “look inside” for text, audio, and video formats	0.432	0.682	0.909	0.674	Confirmed
		Copy (plagiarism) detection systems	0.568	0.818	1.000	0.795	Confirmed
	Frameworks and standards (3)	Undocumented (unlogged) access	0.591	0.841	1.000	0.811	Confirmed
		Formulating information security management policies to protect digital resources	0.636	0.886	1.000	0.841	Confirmed
		Applying Metadata Encoding and Transmission Standard (METS)	0.364	0.614	0.818	0.598	Confirmed
	License (2)	Lacking publisher’s license agreement to publish audiobooks on the systems	0.568	0.818	0.955	0.780	Confirmed
		Smart contracts	0.455	0.705	0.932	0.697	Confirmed

Table 7. Comparison of the first and second rounds

<i>Indicators</i>	<i>De-fuzzified average (first round)</i>	<i>De-fuzzified average (second round)</i>	<i>Difference</i>	<i>Status</i>
Not using a firewall (Failure to use a firewall)	0.674	0.735	0.061	Confirmed
Using different firewalls and remote access to protect (secure) the server	0.841	0.826	-0.015	Confirmed
Blocking access to data transfer from the server for system employees	0.644	0.697	0.053	Confirmed
Using proxy servers to receive resources and apply access restrictions	0.765	0.705	-0.061	Confirmed
Outdated Digital Rights Management (DRM) software	0.644	0.705	0.061	Confirmed
Limited computational space (servers, software, etc.) provided by the systems	0.689	0.735	0.045	Confirmed
Limited temporary storage space	0.697	0.712	0.015	Confirmed
Costly audio/video transcription algorithms	0.561	0.598	0.038	Confirmed
Not using “look inside” to access pages and different parts of digital content	0.644	0.674	0.030	Confirmed
Using “look inside” for text, audio, and video formats	0.682	0.674	-0.008	Confirmed
Copy (plagiarism) detection systems	0.682	0.795	0.114	Confirmed
Undocumented (unlogged) access	0.727	0.811	0.083	Confirmed
Applying Metadata Encoding and Transmission Standard (METS)	0.682	0.598	-0.083	Confirmed
Lacking publisher’s license agreement to publish audiobooks on the systems	0.758	0.780	0.023	Confirmed
Smart contracts	0.720	0.697	-0.023	Confirmed
Formulating information security management policies to protect digital resources	0.795	0.841	0.045	Confirmed

After validating and confirming the indicators, the seven information systems were evaluated by the researcher and the managers of the systems. Two options “Yes” and “No” were used in the checklist. The research population comprised the National Digital (Digital Library), Iran publications systems, Iranian Scientific Publications System, Iran Publications Database, National Document Center Network, Catalog of Manuscripts, and Iran Libraries Network. The first three are considered digital systems, while the rest are placed in the bibliographic category because they provide information on information resources and are of the type of database. The authority and credibility of the Iranian National Library among other libraries, its legal duty to collect all library resources including digital materials, and the diversity of its ISs were among the reasons for selecting it and the NLAI as the research population.

In analysis, all fuzzy Delphi calculations were performed in Excel 2016. Moreover, the methodological triangulation method was used to validate the qualitative findings. This method was employed because using different methods and tools for data collection, such as documentary analysis, thematic analysis, fuzzy Delphi and interview, observation, and checklist, gives further validity to qualitative research.

The most common way of triangulating with method is using both qualitative and quantitative data collection instruments and procedures and data analysis in a single study. Another way of triangulating with the method is to use in-method triangulation. As the name suggests, multiple approaches within the same research approach (qualitative or quantitative) were employed in a study. For example, in one study, the researcher collected data from documentary analysis, observation, and focus group interviews (Donkoh and Mensah 2023).

Before answering the main research question and presenting the results, we need to explain the studied systems briefly.

3.1. What are ISs of NLAI?

The existing systems in the NLAI provide users with information in the form of bibliographic and full-text ISs. Accordingly, of the 7 ISs, only the digital resources system (National Digital) provides the full text of some resources in addition to bibliographic and metadata information. Other systems currently provide only bibliographic and metadata information on the resources. One of the most practical ISs in libraries is the digital library, which most Iranian libraries have designed and implemented.

In general, the web-based ISs of the NLAI are the National Digital (Digital Library), Iran Publications systems, Iranian Scientific Publications System, Iran Publications Database, the National Document Center Network, the Catalog of Manuscripts, and Iran Libraries Network.

Iran Libraries Network, the National Document Center Network, Catalog of Manuscripts, and the Iran Publications Database are provided through the National Iranian Memory (NIM). These resources were set up to facilitate fair access to all library resources, manuscripts, documents, and journal articles in Iran. This platform makes it possible to search in each of the systems separately, e.g., searching book resources through the Iran Libraries Network, searching documents through the National Document Center Network, searching manuscripts through the Catalog of Manuscripts, and searching journal articles through the Iran Publications Database (Search guide in the National Document Center Network n.d.). So far, as many as 3,000 active academics, public, and specialized libraries in the Library Network and 64,000 articles in the Iran Publications Database are available on this platform. Also, it includes the list of documents available in 7 archival centers in the National Document Center Network, a list of 1 million Persian and non-Persian manuscripts in Iran, and the manuscripts of Iraq and the Persian manuscripts of countries in 1868 centers in the Catalog of Manuscripts. In fact, the NIM guides the researchers and the audience to documentary and library collections, enabling them easier access to information resources (National Iranian Memory n.d.).

The Digital Resources System (National Digital Library) has millions of documents, manuscripts, lithographic and lead-printed books, periodicals, theses and dissertations, reports, research plans, photos, maps, etc. Therefore, it enables users to access these resources through the library and digital documents. Users are provided with services after the on-site and online collection, selection, conversion, and processing of the resources in the library and digital documents. Users can browse and search for the resources, see the in-line delivery of the resources, and print their content. The NLAI has adopted this measure for the long-term protection and greater accessibility of the written heritage of Iranians.

Iran publications systems includes publications relate to the historical periods of Qajar, Pahlavi, and the Islamic Revolution. The periods of these publications are: 1) publications of the Qajar period (1193-1304 Lunar Calendar / 1779-1926 Gregorian Calendar); 2) publications of the first Pahlavi period (1304-1320 SH/ 1925-1941 Gregorian Calendar); 3) publications of the second Pahlavi period (1320-1357 SH/ 1941-1978 Gregorian Calendar); 4) publications after the Islamic Revolution (1357 SH/ 1957 Gregorian Calendar); and 5 Latin publications (Iran publications systems 2023). In the first stage, member users have access to the full text of some publications, and to receive the full text, they must send their request to the website administrator. There is no difference in terms of access type (including viewing or downloading) on this system. The publications of the Qajar period are related to the last 100 years. Considering the copyright protection period (up to 50 years after the author's death)⁸, some publications can be made available to the public, and the download and viewing rights can also be given to member users.

Iran Publications Database as many as 61,064 articles are available on this website (Iran Publications Database 2023). It gives no information about the variables, such as articles and historical periods; instead, it merely gives a search guide. It lists the Iranian newspapers and magazines from the beginning until now. It also makes it possible to comment, complete, and participate in data correction (National Iranian Memory n.d.).

As mentioned above, the NIM consists of 4 bibliographic databases. It uses the Oracle database and its indexing with Lucene. Its profile is similar to the Rasa software of the National Library of Iran⁹. Oracle is a relational database that uses the Structured Query Language (SQL).

Iranian Scientific Publications System like those of other systems, have been compiled based on the main approach of the organization. Its publications include those written in English, Russian, Arabic, Persian, and French. The information of a publication is provided, and the system is searched based on the publication's date, author's name, title, and the subject of the publication (Iranian Scientific Publications System 2023). Accessing the full text and viewing the articles is possible through a link given to the publication in the system. Therefore, in terms of the type of access, it is possible to view and download some resources only in the Digital Library (including manuscripts and lithographs, theses and research projects), Iranian Scientific Publications System, and Iran publications systems.

4. Results

What are the technical factors affecting the copyright protection of information resources in the systems under study?

With the explanations given about the systems under study, the main question of the research, i.e., the technical factors affecting the copyright protection of information resources in the systems under study, is answered as follows:

⁸ To get more information about the protection period of the works in the Law on the Protection of the Rights of Authors, Writers, and Artists, see the following two links: <https://rc.majlis.ir/fa/law/show/788903> and <https://rc.majlis.ir/fa/law/show/96427>.

⁹ Messages from Hassan Bagheri (system administrator) to author, 31 August 2022.

As shown in Tables 5, 6 and 7. and based on the fuzzy Delphi method, 16 indicators were identified as the technical factors affecting the systems. Here, the greater the de-fuzzified mean, the more agreement there is on the indicator.

The obtained indicators were identified as effective technical factors in both bibliographic and digital systems. Not using a proper firewall (failure to use a firewall), using different firewalls and remote access to protect (secure) the server, blocking access to data transfer from the server for system employees, using proxy servers to receive resources and apply access restrictions, outdated DRM system, limited computational space (servers, software, etc.) provided by the systems, limited temporary storage space, costly audio/video transcription algorithms, not using “look inside” to access pages and different parts of digital content, using “look inside” for text, audio, and video formats, copy (plagiarism) detection systems, undocumented (unlogged) access, applying the METS Metadata, lacking publisher’s license agreement to publish audiobooks on the systems, and smart contracts related to the license component are important for the ISs of libraries. Evaluating the studied systems also showed that only the two technical factors of “not using a firewall” and “using different firewalls and remote access to protect (secure) the server” were used in the bibliographic systems to prevent intrusion into the systems and maintain network security.

In the digital systems, the indicators “Blocking access to data transfer from the server for system employees” and “using different firewalls and remote access to protect (secure) the server” were used. Besides, according to the manager of digital systems, the METS Metadata was largely used. Other technical indicators, effective as technical factors in protecting the copyright of information resources, were not used in the studied systems. Therefore, based on the fuzzy Delphi outputs, the de-fuzzified average of the indicators shows a consensus among the experts over all the indicators. However, the two indicators of “using different firewalls and remote access to protect (secure) the server” and “formulating information security management policies to protect digital resources” were more effective than the other technical factors considering their de-fuzzified average. Fig. 1 depicts the technical factors affecting copyright protection in the studied ISs. As mentioned above, the indicators were: network security, licensing, frameworks and standards, technical infrastructure, and copy control.

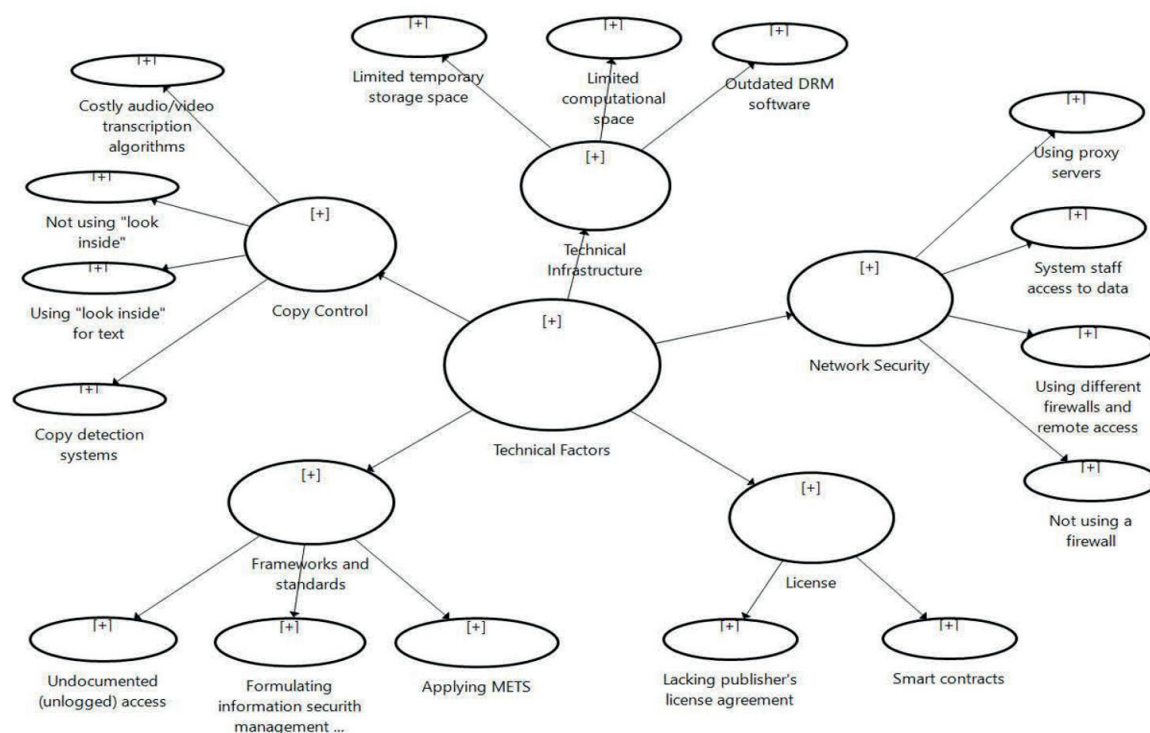


Fig. 1. Technical factors affecting copyright protection in the studied systems (bibliographic and digital)

5. Discussion

The current study aimed to identify the technical factors affecting the copyright protection of information resources in the ISs of the NLAI. Documentary and thematic analysis methods were used to review and analyze the resources and studies. In addition, the fuzzy Delphi method was used to validate the indicators and thus evaluate the studied systems. According to experts and specialists, some indicators are effective as technical factors in the studied systems. Overall, 16 indicators were identified as technical factors affecting the copyright protection of information resources in the studied ISs.

The results analysis revealed that the indicators “not using a firewall”, “using different firewalls and remote access to protect (secure) the server”, “Blocking access to data transfer from the server for system employees”, and “using proxy servers to receive resources and apply access restrictions” were effective in maintaining the security of the network and protection of copyright in the studied systems. This issue was emphasized in an interview with experts:

“What factors can be effective in the copyright protection of the systems? We should see where the servers are located; they must be located in the protected zone of the organization. Also, they must have firewalls. There are different types of firewalls. There must be different remote access” (Code 6).

“Penetration testing must be done for the system to identify the security holes that may exist. We checked many systems, and they were not really safe. I think the system itself must be secure, and we must have an

ISMS in the organization. Developing ISMS in the departments with content electronic services should be a security investment” (Code 6).

The use of indicators such as “network security” and “the use of firewalls and routers” was already emphasized by Ismail and Zainab (2011), Khan, Ibrahim, and Hussain (2021), and Eidi Ghaleshiri (2016). In the current research, network security was also discussed as an important technical factor in information systems. This factor can play a role in preventing attacks from hackers and malware.

Obtaining a license and an agreement with the publishers can considerably help overcome the challenges related to the copyright protection of the resources. In the current study, the lack of license was identified as a technical factor affecting the performance of the systems under study. Considering the nature of the resources, the need for a license is a requirement obtained from the owner of the material and intellectual rights of the work based on the contract. Obtaining license must occur by the libraries before the digitization of resources and uploading of resources to information systems. In such a way that the type of license and access is clearly specified in the information systems. License and access can be provided in the form of an information content package for each of the systems.

Another non-Iranian expert mentioned the licenses of Creative Commons and other licenses:

“If a Creative Commons or other license has been declared for particular material on the Archive, to the extent you trust the declaration and declarer (which is rarely the Internet Archive), you may use the content according to the terms and conditions of the applicable license” (Code 3).

Using Creative Commons licenses and access to articles have become common among scientific journals in Iran for several years. Issuance of digital licenses, giving licenses, and licensed agreements mentioned in this study are consistent with the views raised in the studies of Kokabi and Kohi Rostami (2015), Fernández-Molina (2004), and Griffin (2013) since obtaining permission from publishers reduces the risk of copyright infringement of information resources. While considering the need to get written licenses, Gaber (2012) criticizes that the DRM system has not been used in the systems investigated in the current study. Another technical factor affecting the copyright protection of information resources in the studied systems is the use of “look inside”, which has been ignored in the mentioned systems. This important point was expressed in an interview with one of the experts in this field:

“For some theses, we said, for example, the readers can view pages 4 to 14, which becomes ten pages. Our “Look Inside” required that only the first ten pages or the second ten pages be displayed, which was one of the technical factors that had to be developed. In the “Look Inside” that the item is part of the development plan, we said that we would specify the item access level, i.e., the access level of the item itself, which again required a higher development level processing, for example, to say that all the items can be accessed separately. Thus, we can create some restrictions for all items” (Code 7).

The use of “Look Inside” and the segmentation of images related to digital content in the mentioned digital systems can prevent illegal downloads and uses to a large extent. Not using “Look Inside” for accessing different pages and sections of digital content that were controlled by copy-

right. The use of “Look Inside” in digital libraries were employed for previewing book content. It also enables searching within the content of books.

Other technical factors such as smart contracts, METS metadata, and access documentation are among other technical factors affecting the copyright protection of information resources. The use of smart contracts and METS Metadata was mentioned in an interview with digital library specialists:

“We wanted to assign a part of a content to its copyright notice. We considered composite content for our implementation. But let us mention this in the more developed world. The issue of METS should be considered as well. Yet, it’s much more developed form is the smart contract, which enters the digital asset world. Although it is a digital asset for which there should be a smart contract, we did not use it in our analysis. These are the technical factors of it” (Code 7).

“A part that makes a great contribution is the documentation issue; every file or database should have access to a document. Such documents should be transferred, and we need to have knowledge management to transfer them. In this way, the security issue may not be challenged. Usually, files that are stored for a long time and are forgotten by a technician like me, and there is no writing anywhere. Consequently, we do not know how to access it, which becomes a problem” (Code 5).

Another technical factor mentioned in this study is the copy detection system, an instance of which is a concordance system. This point was outlined in an interview with a specialist in Iran’s ISs:

“I think one of the most effective factors is the next steps. For example, in scientific works, they say that we should use a concordancer to see how much plagiarism has occurred in a work. They use applications and have huge databases to check a work for plagiarism. In my opinion, these are technical requirements that must exist and be observed” (Code 4).

Papi et al. (2017) also emphasized the need for copy-detection systems, which is consistent with the current study’s findings.

Another indicator and effective technical factor mentioned in the current study is “formulating information security management policies to protect digital resources of information”, which is neglected in many digital libraries and ISs. According to Farid, Warraich, and Iftikhar (2023), Peykam and Salimifard (2016), and Rezvani (2018), there is no digital information security management policy or security policy in some university libraries. In Iran, like the current study, and it is in line with the findings of Papi’s study (2021), confirming the lack of a copyright policy in Iranian libraries. Khan, Ibrahim, and Hussain (2021) evaluated the university library system in Pakistan regarding data and information security. These researchers indicated an unfavorable status, which is consistent with the current study’s findings. In the above studies, issues such as the lack of copyright policy have been highlighted.

The subject of content protection and the role of human resources in it has been highlighted in various studies, such as Rezvani (2018) and Doroudi and Jamshidi (2021), since protecting content and human resources are among the technical factors that affect the copyright in the digital libraries.

6. Conclusion

In general, technical factors are effective in developing and protecting authors' copyright affairs in information systems in libraries. The studied systems (digital and bibliographic) are not favorable regarding copyright protection of information resources. Therefore, the managers of such systems must take necessary measures to review the technical checklists to evaluate the systems in terms of respecting and protecting the copyright of information resources. In addition, they are required to improve the effective technical factors in these systems, thereby increasing the trust of the creators of the works in the libraries.

The technical factors that were discussed in the present study were: "not using a firewall", "using different firewalls and remote access to protect (secure) the server", "Blocking access to data transfer from the server for system employees", "using proxy servers to receive resources and apply access restrictions", "Obtaining a license and an agreement", "look inside", "smart contracts", "METS metadata", "access documentation", "copy detection system" and so on.

It seems that focusing on network security measures and developing standards and technical frameworks for better content protection can have a greater impact on copyright protection in systems compared to other indicators. Because the absence of any of these indicators can affect the violation of the rights of the creator of the work. Therefore, the attention to the technical factors mentioned in the present research can reduce the risk of copyright infringement in information systems and digital libraries. Undoubtedly, it is not possible to support the authors' copyright in the information systems of libraries without using technical measures.

6.1 Practical implications

According to the discussion regarding the findings of this study, the following are some of the practical implications that this study may have for libraries, information centers, and policymakers to ensure that libraries have the capacity to help maintain copyright of information resources while securing ISs. Therefore, it was essential for libraries to utilize technical standards to ensure the security of systems before implementing ISs and digitization processes. Some suggestions were made in this study for this purpose. Libraries should strive to enhance the relationship between copyright laws and technical issues to better implement technical infrastructures in ISs. The current research can offer a new approach for interaction between legal and technical discussions in libraries.

6.2 recommendations

After answering the research question, some suggestions for respecting copyright in ISs, both in current digital systems and for the future and development of bibliographic systems, were proposed. The some of following suggestions were the result of data analysis and can be utilized by libraries and information centers.

- Use of "look inside" for digital, audio, and video resources;
- Development of a copyright policy for all digital resources/use of legal metadata for digital resources;

- Documenting all accesses; documenting the type of access based on the type of resource and its publication date;
- Use of web services;
- Use of firewalls and various remote access methods for server protection;
- Use of proxy servers to obtain resources and impose access restrictions.

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