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Repository Landscape in Turkiye and GCRIS: The first National Research Information System

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Abstract

This paper describes the history and developments of research infrastructures and open science policies in Turkiye. Moreover, it focuses on the GCRIS (Grand Current Research Information Systems), Turkiye's first Research Information System by international standards, emphasizing the need for internationally interoperable research infrastructures in Turkiye. GCRIS Research Information System, implemented on the open-source software DSpace-CRIS 6.3, was developed with data analytics in mind and continues to be improved by Research Ecosystems Inc. As a strategic partner, Izmir Institute of Technology (IZTECH) is the first university to use GCRIS. Other Universities have used GCRIS since then. With the increase in the number of universities using GCRIS, Turkiye's Research Ecosystem will be trackable and measurable much better thanks to GCRIS intelligent reporting system. Most importantly, not only the research outputs of Turkiye will be more visible, but also research infrastructures' integration will facilitate with the European Open Science Cloud (EOSC) and other initiatives worldwide.

1. Introduction

Turkiye has one of the most significant higher education landscapes in Europe, with 208 universities. One hundred twenty-nine are financed publicly, four vocational colleges of higher education, and the rest are non-profit foundation universities. They can be seen via this link: https://www.yok.gov.tr/universiteler/universitelerimiz. It is essential for Turkiye's Higher education institutions (HEIs) to be aligned with Europe and beyond in the Open Science movement and research infrastructures [3].

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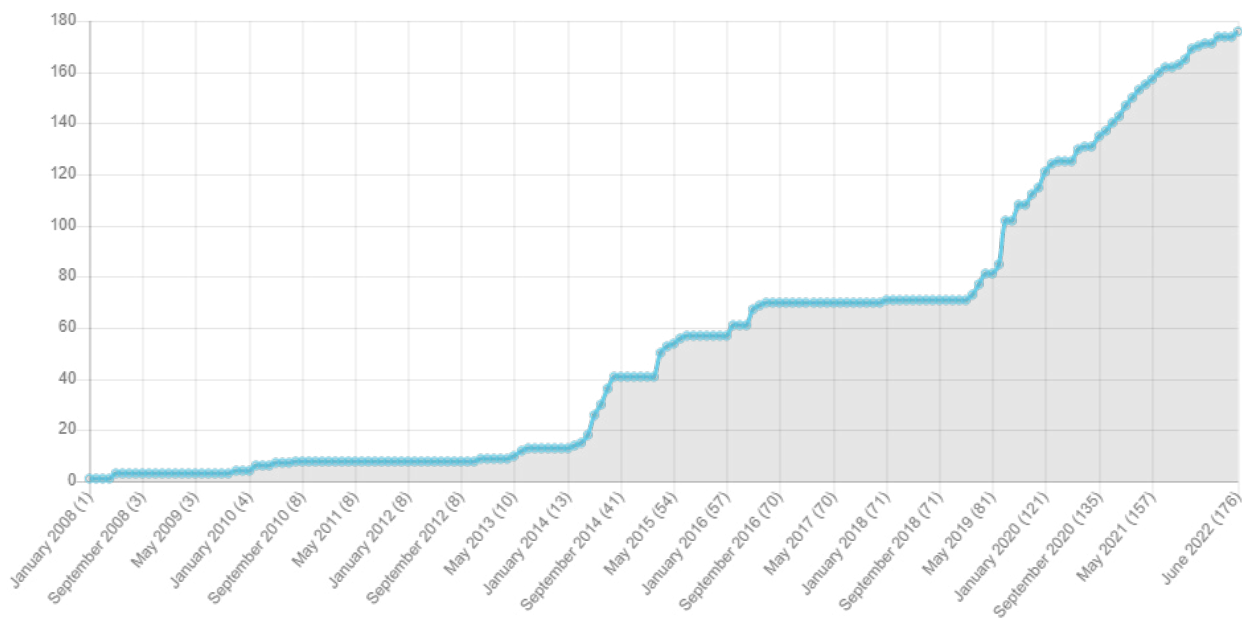 E-mail address: tugkantuglular@iyte.edu.tr

Fig. 1. The number of IR registered in OpenDOAR from Turkiye by years.

The Council of Higher Education (CoHE), which plans, coordinates, and governs of higher education system in Turkiye, The Scientific and Technological Research Council of Turkiye (TUBITAK) which is the biggest funder, Anatolian University Libraries Consortium (ANKOS), and IZTECH have taken a leading role in open science and open access studies. As a result of strong collaboration between these significant stakeholders institutional repositories (IRs), and open science practices in Turkiye have gained tremendous momentum in time [1, 4].

As can be seen in Fig. 1 and Fig. 2, the number of institutional repositories (IRs) registered in OpenDOAR from Turkiye was only ten in 2013, but according to OpenDOAR Statistics dated June 2022, this number increased to 176, and %84 of them use DSpace software. On the other hand, an increase in the number of IRs was insufficient because Turkiye has a significant need for a Research Information System that meets international standards for visibility, research support, performance monitoring, and integration with Europe and beyond.

IZTECH is a pioneer and leader in open access, open science, open data, and IR studies in Turkiye. Like most institutions in Turkiye, IZTECH had also used the DSpace platform from 2013 to 2021. Since April 2021, GCRIS (https://gcris.iyte.edu.tr/) has been used in IZTECH. GCRIS was developed by Research Ecosytems Inc. in Technopark Izmir, the IZTECH's technopark, to offer Institute's all research components and outputs, such as awards, projects, equipment, and data sets, publicly available. Four universities have been using GCRIS so far, and it is aimed to increase the number of universities using it in Turkiye and other countries in the future.

The rest of the paper is structured as follows: The second section presents the history and development of IRs in Turkiye since 2000. TUBITAK's open science services and infrastructures, such as DergiPark, Harman, and Aperta, are introduced in section three. Section four provides information about Turkiye's open science policy development. The need for Research Information Systems at international standards, as well as features of GCRIS, Turkiye's first international-standards information system are explained in section five. Finally, we conclude the paper in section six.

2. History and Development of Institutional Repositories (IRs) in Turkiye

With the establishment of the Anatolian University Libraries Consortium (ANKOS) in the early 2000s, the concepts of Open Access (OA) and IRs began to be discussed in Turkiye. The Ankara University Open Archive was the first institutional archive set up and registered at OpenDOAR [1, 5].
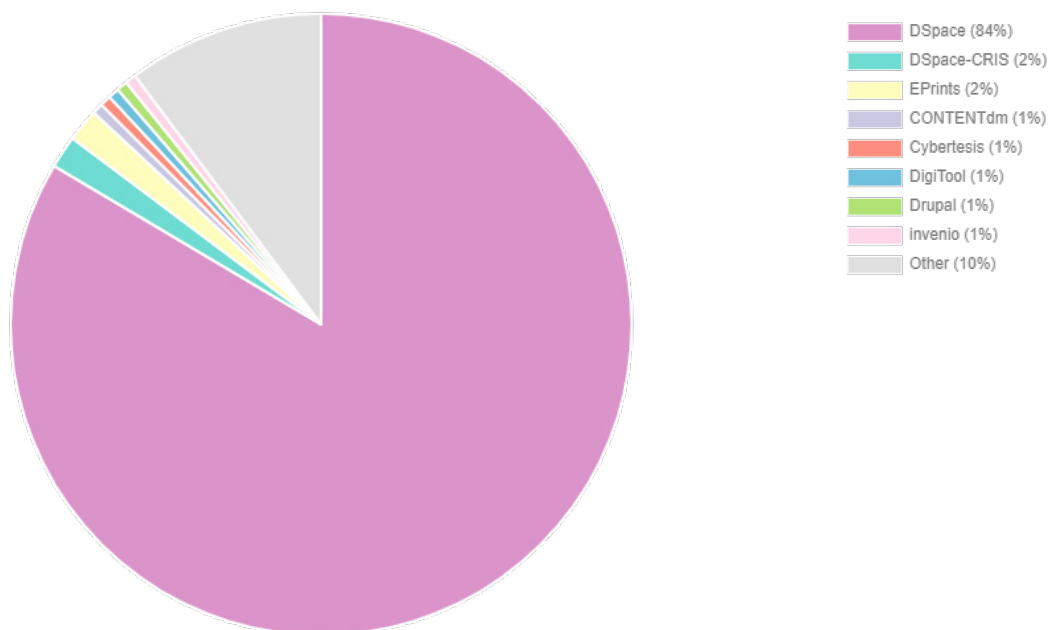
Fig. 2. Software platforms at registered in OpenDOAR from Turkiye.

ANKOS Open Access and Institutional Repositories (OAIR) Working Group was established in 2006 to raise awareness of Open Access and Institutional Repositories among information professionals in Turkiye and cooperate with domestic and international organizations operating in the relevant areas. OAIR Working Group developed new channels for creating awareness about open access to the academic society. ANKOS OAIR also initiated an inter-university project under the name "National University Open Access Project" in 2009. This project was constructed with MITOS software developed using local resources [6]. However, the project failed because the software was not adequately developed and necessary technical support was not provided.

On the suggestion by the ANKOS OAIR Working Group, CoHE established "CoHE Institutional Repositories and Open Access Working Group". The goal of this group was to gather the academic outputs that Turkish Universities are producing and archive them into the open repositories compliant with international standards, presenting them to the service of the scientific community. This Working Group held its first meeting in January 2014 with the attendance of the Higher Education Council Chairman and created an action plan which would form the framework of the "National Open Archive Project". These two groups, ANKOS and CoHE Working Groups, carried out very successful studies on IRs. Some of these achievements [1]:

- Prepared a website: http://acikerisim.yok.gov.tr for sharing the necessary documents of the "National Open Archive Project" and the results of the studies.
- Made recommendations to institutions for using DSpace software. Translated the DSpace Software into Turkish and prepared the Turkish guides about installing the program on the Linux operating systems.
- Held several well-attended pieces of training, workshops, and seminars on the creation of institutional repositories, DSpace, data input, etc.
- Announced the Driver Guide 2.0, which is arranging the infrastructure and data input standards for the institutional repositories.

As a result of the "National Open Archive Project" studies, the number of IRs increased significantly from 10 in 2013 to 70 in 2016, as seen in Fig. 1. Due to changes in the management of CoHE, studies on IR slowed down until the end of 2018. Turkish Open Science Summit, organized by Sabanci University, TUBITAK, IZTECH, Hacettepe University, and ANKOS, was an essential milestone for long-standing works on Open Access and Open Science in
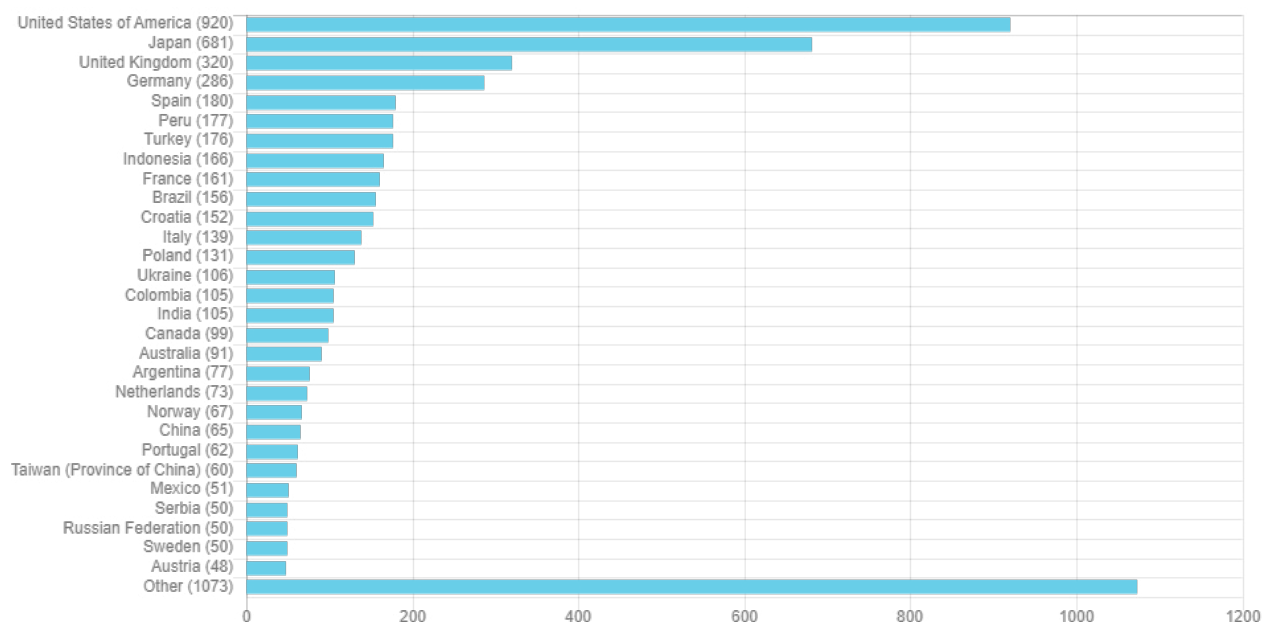
Fig. 3. Repositories registered in OpenDOAR by countries.

Turkiye. All stakeholders came together for the first time at the Turkish Open Science Summit held in 2018 at the Seed located in the Sakip Sabanci Museum in Istanbul [2]. With the Impact of the Turkish Open Science Summit, CoHE took action to speed up open science and IRs studies again.

CoHE formed a new Commission on Open Access and Open Science comprised of the rectors, related faculty members, TUBITAK representatives, CoHE representatives, and library experts; and the Research Data and Open Data Sub-Working Group consisting of librarians from different universities in 2019. CoHE highlighted the importance of establishing the "Open Academic Archive System" in the international standards in all universities. In addition, CoHE sent an official letter to all universities to periodically report the work carried out by universities and the number of publications in open academic archives in a method and format specified by CoHE [1].

In summary, CoHE has been the driving force behind the increasing number of institutional repositories in Turkiye. According to OpenDOAR statistics dated June 2022, Turkiye is ranked 7th in the world by the number of repositories, as seen in Fig. 3. As of June 2022, the number of repositories is registered in OpenAIRE 137, ROAR (Registry of Open Access Repositories) 166, and DRIS (The Directory of Research Information Systems) 4.

3. Services and Infrastructures to Open Science Developed by TUBITAK

The Scientific and Technological Research Council of Turkiye (TUBITAK) is the leading agency for management, funding and conduct of research in Turkiye. In 1996 Turkish Academic Network and Information Centre (ULAKBIM) was founded as an institute of TUBITAK. TUBITAK ULAKBIM set up "The National Open Science Committee", which consists of academicians, Information and Library services experts of the institutions, and TUBITAK experts in open access studies, to decide on national open access and open science strategies in 2015[2]. The Committee has taken decisive actions toward Open Access and Open Science in cooperation with CoHE.

TUBITAK ULAKBIM created crucial infrastructures listed below:

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[1] Source: CoHE
[2] Source: TUBITAK ULAKBIM

- TUBITAK ULAKBIM established "DergiPark" (https://dergipark.org.tr/en/) in 2014 to provide free hosting services to open access to academic peer-reviewed journals published in Turkiye and support national academic journals to gain presence according to international standards and increase their visibility. DergiPark journal hosting platform is one of the biggest OpenAIRE data providers, with 2.498 journals as of June 2022.
- The "Harman" (https://harman.ulakbim.gov.tr/) is the first OAI harvester in Turkiye, established by TUBITAK ULAKBIM in 2016. It is built to enable widespread access from a single center to scientific content that is limited and suitable for open access and provides easy and safe access to the national and international scope. There are 163 institutions and 2.669.044 records in the archive as of June 2022. Harman requires using DSpace, GNU EPrints, or any open archive software supporting the OAI-PMH protocol and the OAI-DC format.
- Established in 2018, "Aperta" (https://aperta.ulakbim.gov.tr/) is the leading research data management platform nationwide and containing research outputs from all fields of science. Any researcher who would like to share their peer-reviewed publication or data from their publication would be able to use this platform. The ultimate goal is to publish all publicly funded research articles on an open-access basis.
- TUBITAK ULAKBIM has also prepared the "Research Data Training Portal" (https://acikveri.ulakbim.gov.tr/), where sample data management plans are shared to assist the researchers in data management and sharing.

TUBITAK has also been a member of the EOSC European Open Science Cloud and continues to study the development of open science and open data infrastructures.

4. Open Access and Open Science Policies in Turkiye

Open Access and Open Science practices have gained tremendous momentum in the country since 2011 due to participation in EC projects. Hacettepe University participated in MedOANet (2011-2013) and PASTEUR4OA (2014-2016) projects. These projects helped develop national open access strategies and policies and facilitated the coordination among European countries to establish aligned open access policies. From December 2011 to February 2021, IZTECH participated in various phases of the OpenAIRE project. OpenAIRE has strengthened the Turkish community in achieving its open access and open science goals through its recommendations, knowledge sharing, good practices, and training activities within a well-connected network [1, 4].

As a result of these studies, the Parliament enacted compulsory open access to theses and dissertations in 2018. That has been a significant improvement for open access and much more theses and dissertations from Turkiye have been available to the scientific world. OA Theses and Dissertations increased from 56.3 percent in 2017 to 97 percent in 2019. Also, the number of theses downloaded from the CoHE National Thesis has exceeded 16 million also[3].

Another crucial policy at the country level is that the TUBITAK Board of Directors accepted Open Science Policy based on OpenAIRE model Policy on Open Science for Research Funding Organisations (RFOs), on March 14, 2019. This Policy covers publications and research data which is produced with TUBITAK support, completely or partially, and the publications and research data of TUBITAK researchers[4].

At the institutional level, IZTECH has played a pioneering role in Open Access and Open Science Policies in Turkiye. IZTECH Senate approved the Mandatory Open Access Policy on 08 October 2013, and Open Science Policy includes details on both publications and research data, on 26 March 2019 [5]. Both policies were the first in Turkiye and sent to other Turkish universities as a model policy by CoHE. As of June 2022, there are 114 repositories registered in ROARMAP (The Registry of Open Access Repositories Mandatory Archiving Policies) from Turkiye.

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[3] Source: CoHE
[4] Source: TUBITAK Open Science Policy
[5] Source: IZTEH Open Access Policy and IZTEH Open Science Policy

5. From IR to CRIS

5.1. The First Research Information System by International Standards in Turkiye: GCRIS

The IZTECH Open Access System was established in 2013, where academic studies at IZTECH are archived and made accessible worldwide. As in many institutions in Turkiye, IZTECH was using the DSpace as a software platform. However, IT support was inadequate for the implementation and development of IR. CoHE has frequently requested various reports on publications and the IRs could not provide these reports. Consequently, as valuable as these repositories have been, they have become unable to effectively meet the needs and expectations over time, such as new institutional demands, research performance monitoring requirements, and more integration with Europe and beyond.

DSpace-CRIS 6.3, which is open source, was far from meeting these expectations; on the other hand, the prices of commercial products were prohibitively expensive for Turkish universities. The existing research information systems in Turkiye didn't meet international standards neither. Briefly, university administrations and the universities in Turkiye needed a new national platform in international standards to store and manage their research assets.

Due to the need to develop an international standards research information system, Research Ecosystems Inc. was established with an experienced team to ensure the sustainability of the studies and create financial resources in Technopark Izmir, the IZTECH's technopark. After signing a strategic cooperation agreement between Research Ecosystems Inc. and IZTECH, GCRIS was developed with respect to the COAR Next Generation Academic Archives Report, which includes recommendations for adopting new technologies, standards, and protocols. Besides the GCRIS, the first Research Information System in international standards in Turkiye, Research Ecosytems Inc. is working on innovative software projects that include analytics and artificial intelligence applications in line with the data analytics company's vision. These projects are software projects that include federated software and blockchain architectures in health, information, and energy technology. It became a member of EuroCRIS and YASAD (Software Developer Industrialists' Association) in May 2022.

As a strategic partner, IZTECH started to use GCRIS as the first university in April 2021, later TOBB ETU (University of Economics and Technology) (https://gcris.etu.edu.tr/), Eskisehir Technical University (https://gcris.eskisehir.edu.tr/), and Konya Technical University (https://gcris.ktun.edu.tr/) began to use it. Only these four universities from Turkiye are registered in DRIS.

Next-generation research repository GCRIS collects, manages, preserves, showcases, and analyzes a university's research output and data types and tracks its world impact. As can be seen in Fig. 4, it has an excellent user-friendly interface and draws attention with its page appearance and color harmony.

Different research metrics are available to measure researcher performance from the field weighted citation impact to h-index, publications by subject area and by the year, journals information and Q distribution, competency cloud, etc. Organizational unit reports are available. Besides, the number of open access publications, h index, q distribution, competency cloud and similar innovative metrics and badges are provided. It is possible to make advanced reporting with different metrics, such as department-based comparisons, comparing research performance among researchers.

Some benefits of GCRIS for research institutions are as follows:

- To increase visibility for researchers and organizational units of universities, including the universities themselves,
- To increase the visibility of publications, patents, and projects,
- To help researchers concentrate on their research rather than their visibility and eliminate tasks like submitting performance data and performance report compilation,
- To help universities with fulfilling their reporting obligations with one click,
- To provide universities with business intelligence to derive their strategies with advanced reporting tools.

5.2. GCRIS Infrastructure

GCRIS contains DSpace-CRIS 6.3 in its core. It is wrapped with new web client technologies, such as TypeScript, React 16.3, React Bootstrap, and React Range. Some web pages that come with DSpace-CRIS 6.3 are replaced by

Fig. 4. The IZTECH GCRIS interface.

the pages developed with these new technologies. For instance, the home page coupled with headers and footers is designed to be configurable to match the university theme. Headers and footers of all the pages are configured to follow the university theme. The new researcher page and organizational unit pages reflect various statistics and listings from different sources. All pages follow the color palette that is part of the university theme. Wrapping DSpace-CRIS 6.3 with all these new features is unique in the world to the authors' knowledge.

A completely new reporting and dashboard software is coded and integrated. This software is developed using Restful API on Spring Boot running on JVM. The repository layer of the three-layer architecture is created following the repository-service pattern and developed by SOLID principles to work with JDBC. This layer connects to the database created by DSpace-CRIS software and generates reports with custom SQL queries. HikariPool has been added to the system to make SQL queries run faster. Using Plotly.js technology at the presentation layer, users can choose both chart types and parameters and produce charts that allow comparison. A cache system has been added for the reporting and dashboard software to work faster and more efficiently. Redis is preferred as the third-party cache software. Swagger is used as API documentation. The reporting and dashboard software has been developed following 12factor.net methodology and prepared as a docker container to integrate the wrapped DSpace-CRIS software.

Docker-compose is used to install the GCRIS on servers more efficiently. Containerizing the software and installing it on different servers is automated with shell scripts. In addition, GCRIS is accelerated with the use of the Redis cache.

In short, GCRIS is a composition of wrapped DSpace-CRIS software and the newly developed reporting and dashboard software. This GCRIS architecture is designed so new software, such as research performance evaluation or research project monitoring, can seamlessly integrate. These two new software is currently under development by

Research Ecosystems Inc., which continuously researches adding value through data analytics to CRIS systems. For instance, Research Ecosystems Inc. incorporated new metrics into its researcher pages, such as field-weighted citation impact and lecturing score.

6. Conclusion

There has been a growing need for research infrastructures that are internationally interoperable for institutions and countries. These systems are essential for integration into European Open Science Cloud (EOSC), implementation of Open Science, and following the FAIR principles. They can also be used as a scholarly publishing platform.

In Turkiye, the first research information system in international standards called GCRIS meets the evolving requirements of institutional repositories at the national and international levels. Although it was developed in Turkiye, it is capable of responding to the needs of other countries' research information systems. It is compliant with Common European Research Information Format (CERIF), which the European Union accepts and recommends as a standard format. It is also intended to be used as a publishing platform in the future.

Research Ecosystems Inc. and IZTECH will continue to work with essential players in open scholarly communication such as COAR, OpenAIRE, EuroCRIS, and RDA and closely follow developments worldwide.

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