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### Information Access and Resource Sharing with Persistent Identifiers

Partha Sarathi Mandal\*, Sukumar Mandal

1-Ph.D Research Scholar, Dept. of Library and Information Science The University of Burdwan, Burdwan, 713104.

2-Assistant Professor, Department of Library and Information Science The University of Burdwan, Burdwan, 713104.

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#### ABSTRACT

Persistent identifiers (PIDs) are essential for information access and resource discovery in scientific journal management systems. It provides a unique and permanent reference identification number for digital objects, enabling researchers to locate access quickly and cite the data. The names of various persistent identifiers (PIDs) are Archival Resource Key (ARK), Digital Object Identifier (DOI), Handle System, and Persistent Uniform Resource Locator (PURL). This article deals with PIDs' characteristics and power, enabling data sharing, collaboration, and advancing research. The paper also discusses PIDs' benefits, applications, and future direction. Uses of persistent identifiers transform the impact of the research landscape.

#### Introduction

Data sharing is essential for research promotion and collaboration. The need for standardized digital object identifiers hinders information access and resource discovery. Implementation of persistent identifiers in the Scientific Journal Management System resolves these problems. They help identify and link data across various disciplines and repositories, ensuring long-term stability, completeness, and quality. PIDs also solve the problems created by the decentralized nature of the internet, which causes "link rot" as web access points disappear over time. The object's identity differs from its web location via a persistent identifier. It makes it uniquely identified. PIDs increase accessibility, accountability, reproducibility, interoperability, and transparency. Various persistent identifiers are discussed here.

#### Literature Review

The scholarly communication system provides a dependable interchange of information, and this constant is served by the DOI (Sompel et al., 2016). Digital object identifiers (DOIs) have garnered much acceptance as a type of persistent identifier that helps provide access to and identify scholarly outputs in the future (Hoy, 2019). Scholarly identifiers like DOIs are essential for reciprocity and easily identifiable within the scholarly community (Shim et al., 2016). It has a written format that allows scholars to cite and find content in their work, whereby the links are correctly archived to remain catchy in the future. This is particularly true for academic journal articles, where, within the context of referencing, DOIs are particularly relevant since they mark the definitive version of study results in most cases (Manual of the APA, 2020). The rising trend of DOIs has brought many positive returns in information retrieval and sharing of resources. Hoy

Corresponding author

Email:[mandalpsm@gmail.com](mailto:mandalpsm@gmail.com)

(2019) also stressed that DOIs can enable the user to find the full-text version of an article if the link is provided to another platform or limited by a paywall. Also, the fact that DOIs are permanent makes citing and referencing sources easier, making the work of researchers in tracking their contributions easier (Shim et al., 2016). However, the mentioned deposition of DOIs and their citation employment also have drawbacks. It was noted that the current citation practice indicates that at least half of the DOIs need to be served by a persistent URI but offer semantically less robust links (Sompel et al., 2016). According to Don Brower and Mikala Narlock, PIDs are essential for identifying and monitoring research data usage. For example, a standard persistent identifier such as DOI has become the norm concerning references on the web (Klein & Balakireva, 2020). They are a standard of ensuring the longevity or the life span of scholarly content, and they guarantee that it remains to 'hang out' in the digital space. It is crucial to identify the predatory journals to safeguard scholarly communication. The scientific findings need to be published in appropriately vetted journals in available format and continue to exist (Holcombe, 2019). A few PID initiatives offer a systematic and transparent method of attributions of scholarly contributions, such as CRediT taxonomy. Open-access electronic online journals are explored for their persistence (Lightfoot, 2016) and have been examined before. The corresponding author collected the metadata directly and from the DOAJ to analyze them. They have become pivotal because of their free hosting model as compiled using the Open Journal Systems software (Poltronieri et al., 2013). One of the articles covers the utilization of PIDs and how they support a trusted and reliable ecosystem involving the research data. They heavily rely on the technical aspects and the human infrastructures of the PID and their relations to the transportability of the PID. They shed light on the advantages of the scalable identifier systems that can record research activity and the technical connectivity of the research record. Later, they touch on the social and human challenges of increasing adoption. In the other article, the topic also involves the adoption and maturity of PIDs in citing and publishing surrounding datasets, software, and research facilities. It depends on various case studies directly involved in the referencing resources and relaxations of the use and evolution of the citations. They involve different case studies that provide indicative data on how to mature a practice, particularly referencing. Hence, they hint at the criterion of citing and reference and the role of the journal's editorial policy. Finally, PIDs provide better formal recognition for management, lowering costs and increasing trust in the unknown. In that case, it should become a common practice, and they think these behaviors are attainable only with more education. National-level efforts are relevant to enhancing the adoption of PIDs that enable physical aspects, such as the French national plan for open science.

## Objectives of the Study

The goals of this study are the following:

- To explore the overview of Identifiers (PIDs);
- To Identify the Challenges in Information Access and Resource Sharing;
- To Explore the Implementation of Persistent Identifiers (PIDs);
- To discuss how PIDs help in data sharing and research collaboration.

### 1. Methodology

This section briefly provides insight into persistent identifier's main concepts and characteristics. There are two of them: Persistent Identifiers are long-term permanent addresses of digital objects. The characteristic feature of PIDs is that they are independent of a location and may simultaneously identify one object in numerous locations. Another feature is their long-lasting function – the PID must function long after the object it identifies. The most commonly used PIDs are free ones: ARK and PURL.

### 2. Understanding Persistent Identifiers

A persistent identifier refers to a stable handle that will remain valid for the resource's foreseeable future. While with URLs, one can always encounter a situation where it becomes invalid or changes, with the PIDs, this should not ever be a problem because it simply provides permanent access to the given resource no matter the location of the resource or the System under which it is situated. This stability is necessary to guarantee that access to information will be constant. Information searching and retrieval in today's world of Internet means and globalization is tedious because of the vast amount of information available on the World Wide Web. PIDs are fundamental to forming stable and durable references to digital objects, which is highly significant concerning harmonizing this process. Fig 1 shows how different Entities are connected with PIDs.

(Source: "<https://blog.lib.uiowa.edu/news/2023/03/07/the-power-of-persistent-identifiers-in-data-sharing/>")

#### I. Digital Object Identifiers (DOIs)

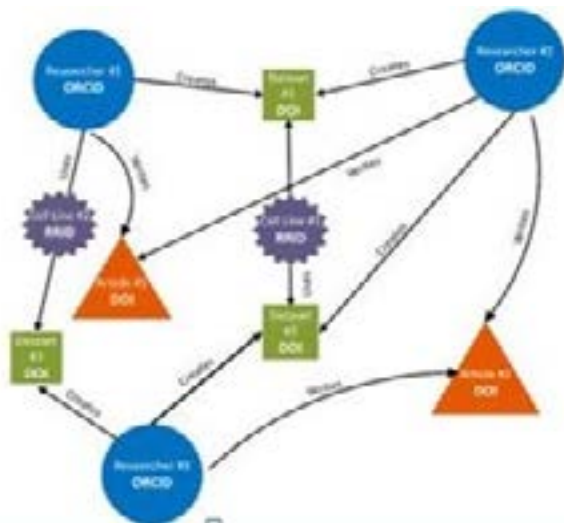


Fig 1: Entities' Connection with PIDs

DOIs are unique alphanumeric strings assigned to digital objects, such as journal articles, to permanently link to their online location. While obtaining DOI involves fees (e.g., through CrossRef), there are also free alternatives for smaller or open-access journals. Free DOI Providers are Zenodo and Figshare. This picture shows how DOI for a dataset resolves to the specific URL in IRO.



Fig 2: DOI resolves URL in IRO

(Source: Nosé, M. (2019). "Practice of research data management in solar-terrestrial physics [PowerPoint Slides]. Institute for Space-Earth Environment Research, Nagoya University. <https://slideplayer.com/slide/17406586/>)

Integration Example -

Open Journal Systems (OJS): Zenodo and Figshare can be integrated with OJS through plugins or manual metadata synchronization, enabling automatic DOI assignment and linking for articles published in the journal.

II. ORCID IDs

An ORCID ID, a unique identifier for researchers, improves the overall value of books and journals to the community for helping and ensuring more excellent retention of the authors and readers. It works with many PID organizations to construct trusted connections, among other identifiers. The future of ORCID iD looks promising as it ensures the effective management and dissemination of scholarly knowledge.

Integration Example - Open Journal Systems (OJS): OJS supports ORCID iD integration through the ORCID Profile Plugin. Authors can link their ORCID iDs during submission, ensuring consistent author identification and attribution across articles.

III. Handle System

The Handle System provides a general-purpose identifier infrastructure that ensures long-term access to digital resources. Handles can be used for journal articles, datasets, and other digital objects. Digital Public Library of America (DPLA) offers a free Handle service for cultural and academic institutions. The National Library of Australia's Trove also handles Australian digital content.

Integration Example - Repository Software: Many repository systems, such as DSpace, have built-in support for the Handle System, allowing seamless Integration and assignment of handles to journal articles and other content.

IV. Archival Resource Keys (ARKs)

ARKs are URLs designed to be stable even when the resources they point to move or change. They are widely used for identifying digital objects in libraries, archives, and museums. California Digital Library (CDL): Offers free ARK services through its EZID tool, enabling institutions to create and manage ARKs for their digital content. Fig 3 shows the architectural structure of ARK.

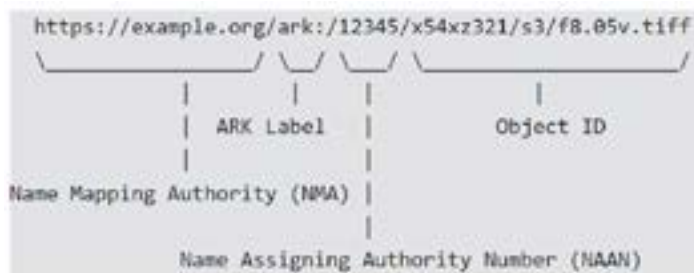


Fig 3: Structure of ARK

(Source: <https://arks.org/about/>)

Integration Example - Digital Repositories: ARKs can be integrated into journal management systems via repositories like DSpace or institutional repositories that support ARKs, ensuring stable and persistent access to journal articles.

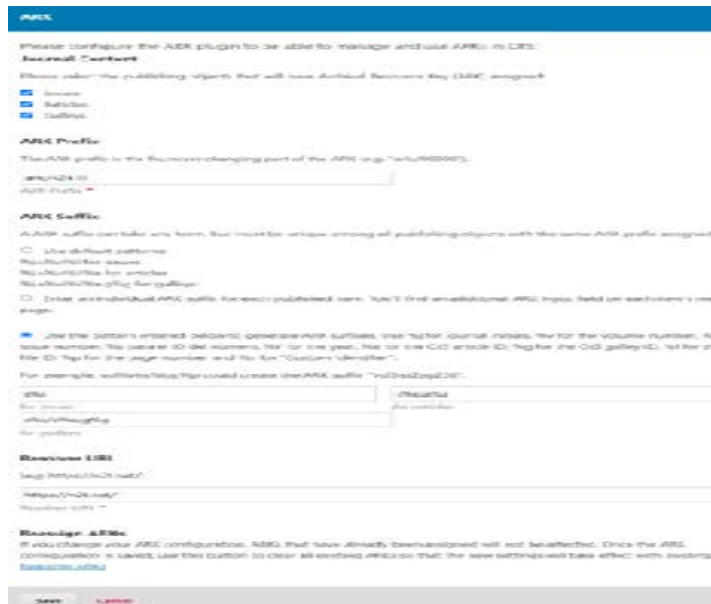


Fig 4: ARK Plugin in OJS

(Source: <https://n2t.net>)

## V. Persistent Uniform Resource Locator (PURL)

Configuring the PURL PID plugin is similar to the ARK plugin. The URLs of the PURL identifier must be registered in the Internet Archive's PURL service. The resolver provides services using the URL <https://purl.org>. A PURL is a Uniform Resource Locator (URL) often used to reference a specific resource that changes address over time from the same address. PURLs redirect to web clients and handle the URL resolution process. The PURL concept enables widespread Internet preservation of the Uniform Resource Identifier (URI). PURLs allow third-party control over URLs (Overton, J. et al., 2020).

## 3. Enhancing Information Access with Persistent Identifiers

The proper mechanism for overcoming barriers to accessing digital content will be location-technology strategies. An example is persistent identifiers (PIDs) supporting digital resources' long-term availability and trustworthiness. PIDs provide reliable references to digital objects and play crucial roles in academic publishing, libraries, and archives. Providing PIDs aims to construct an information environment that allows users to quickly discover the most relevant and authoritative resources (Mandal and Mandal, 2024), irrespective of where or in what System. PIDs improve access on several levels:

**Sound System of Reference** – While other forms of identifiers require rebidding to access the resource easily, PIDs present a library with a reliable access point that it can use in later years to access its copy wherever, in reality, it may be stored. This is especially important now that established academic and research material may be cited several years after publication.

**Improved Resource Findings** - This is done by assigning PID to each digital object. This ensures that since researchers and librarians are always compelled to search for resources using PIDs, they are always sure to find correct versions that are accessible.

This is crucial when sharing data between different information systems: Cooperate by offering a standard means for referencing the digital object into these Information Systems. This is crucial in integrating information from different platforms and sources and improving data sharing. Persistent identifiers are used for these attributes in various applications within and outside library and information services.

**Academic Publishing** – DOIs create a permanent link among articles, datasets, and other research outputs in academic publishing. It will enable researchers to cite sources with confidence and ensure the long-term availability of this information, promoting credibility and reproducibility among open-access publications.

**Libraries and Archives** - libraries and archives use PIDs to manage digital assets for access. PIDs help users maintain user access to resources, library systems, and technologies evolve.

**Data Management**- PIDs are used in various stages of research data management, such as unique dataset identification (for easy tracking and citation). Another possibility is especially relevant to massive research projects with corresponding copious data.

## 4. Challenges to Implementation of PIDs

Though there are many benefits of using persistent identifiers (PIDs) for digital resource management, there are some limitations also. Some of these challenges and considerations are listed here:

1. **Infrastructure Implementation Costs:** Installing, operating, and sustaining PID systems can be costly. Organizations must support the necessary technology stack, such as servers and databases - hosting core PID registration and resolution services.
2. **Maintenance:** Maintenance is needed for intervention at the system level, but it requires long-term financial and human resources, which may be nearly impossible to sustain over a more extended period.

It involves running the server, responding to abnormal situations, and updating their information.

3. **Lack of Standards:** This lack of similarity practice among diverse sectors may slow the acceptance and use of PIDs. Interoperation and Integration between various organizations may face challenges. PIDs can only be effective with authoritative and complete metadata. If an item contains terrible or missing metadata, it will ultimately suffer in discovering information sense and be underused.
4. **Future Adoption:** Academic publishing has adopted PIDs well, but other areas still need to catch up. It necessitates the need for large-scale adaption in various domains. While PIDs should be long-lived in principle, they require constant pursuance by the host organizations.
5. **Technical Challenges:** An additional requirement of PID references is resolved to some concrete URL or location of the resource referenced. Failed or downtime can break the availability of digital resources. Integrating the PID systems with other existing electronic structures can be a technically challenging affair, as there should be clear-cut planning and execution to enable multiple platform access.
6. **Data Privacy & Security Concerns:** PIDs often reference metadata about resources, which can reveal sensitive data's privacy. Organizations need to protect the user information. Cyber attacks can be conducted by an unauthorized person who manages to gain access to the PID systems of some facilities.
7. **Ethical and Legal Considerations:** PIDs may simplify/enable access and sharing with digital resources, which can impact intellectual property management. Organizations must navigate these legal minefields to ensure they are within copyright law. Using PIDs in different fields poses a further problem from the ethical side, mainly when dealing with sensitive topics or areas such as health scientific domains, such as help-freely sharing personal data.

## Conclusion

From this study, it is clear that the full potential of PIDs underpins research, communication, and innovation. Organizations should plan how those responsibilities can be transferred or continued access otherwise realized. Organizations should have quality control processes to ensure good metadata is associated with PIDs. Implementations of PIDs increase the citation rates and journal visibility. It also enhances community engagement, encouraging widespread adoption and community input through workshops or webinars to spread understanding of best practices. Engaging with the donor community and policy-makers to promote free PIDs facilitates their uptake and embedment in research infrastructure. Embedding accessible persistent identifiers in journal management systems streamlines scholarly information's identification, availability, and credit. Persistent identifiers are potent tools for enhancing information access and resource sharing, but their successful implementation requires careful consideration of various challenges and considerations. Despite the challenges associated with their implementation, the benefits of persistent identifiers will be an essential component in the future.

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