The Importance and Economic Advantages of Using National Open Source Software in Public Institutions

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Abstract

Open Source Software (OSS) stands out as a robust alternative in public institutions, offering significant advantages in terms of cost efficiency, independence, and security. This study examines the use of national open-source software in public institutions from economic, strategic, and operational perspectives, evaluating its contributions to digital transformation processes. Analyses of projects such as Pardus, Ahtapot, Engerek, and Liderahenk reveal that these solutions eliminate licensing costs, generate substantial budget savings, support the domestic software industry, and enhance technological independence. Moreover, these software solutions provide flexibility for customization based on user needs and strengthen data security. However, challenges such as infrastructure transformation costs, the need for technical expertise, and limited community support emerge as significant barriers to the implementation of open-source software. The study aims to contribute to informed decision-making in digitalization processes by offering strategic recommendations for the broader adoption of open-source software in public institutions.

Keywords: "Open-source software (OSS), public institution, economy."

1. Introduction

The rapid transformation in information and communication technologies has necessitated significant changes in the service delivery methods of public institutions. As part of the digitalization process, public institutions are expected to provide more efficient [1], transparent, and cost-effective solutions. In this context, Open Source Software (OSS) has emerged as a strong alternative to traditional proprietary software, offering innovative features and cost advantages.

The origins of the open-source software movement can be traced back to the 1960s. During this period, the "hacker" culture that emerged in the computer science laboratories of prominent American universities such as Stanford, Berkeley, Carnegie Mellon, and MIT, as well as in the research centers of private companies like Bell and Xerox, laid the foundation for the concept of open-source software. Within the framework of this culture, software source codes were openly accessible, and it was a fundamental principle that any improvements or modifications made to the software would be shared back with the developer community to ensure collective progress [2]. In addition to being freely accessible, modifiable, and redistributable, OSS provides strategic benefits such as technological independence, enhanced security, and flexibility. In addition, OSS contributes to the United Nations Sustainable Development Goals [3] by promoting digital public goods, increasing global access to technology, reducing inequalities through digital inclusion, and supporting innovation in a sustainable, transparent, and secure manner.

The adoption of national OSS in public institutions strengthens the state's information technology infrastructure and enhances the efficiency of digitalization processes. By promoting domestic software production, national software reduces dependency on foreign technologies and contributes to the national economy. These solutions offer public institutions cost-effective alternatives to commercial software. Moreover, the flexibility of open-source software allows users to modify and customize it according to institutional needs, enabling public institutions to undergo a more efficient, secure, and sustainable digital transformation process.

From an economic perspective, software costs can place a significant burden on public budgets. Today, open-source software is becoming increasingly popular due to its potential to eliminate licensing fees, reduce maintenance and update costs, and minimize external dependency. By lowering licensing and maintenance expenses, national OSS generates substantial savings for public budgets. Additionally, the widespread adoption of open-source solutions enhances competition in the software industry,

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increasing domestic software development capacity. This growth not only supports local software firms but also fosters job creation and drives innovation. Consequently, national OSS not only provides economic benefits for public institutions but also strengthens Turkey's technological independence and contributes to the development of a globally competitive software sector.

This study examines the economic advantages and strategic contributions of national OSS in public institutions. While evaluating the solutions offered by OSS, the study provides a balanced analysis of its potential advantages and disadvantages. The findings aim to contribute to the development of strategies that promote the broader and more effective use of OSS in the digital transformation processes of public institutions. In this context, the research offers a comprehensive discussion on the economic, national security, and strategic aspects of national OSS adoption.

2. Open Source Software

Open Source Software (OSS) and proprietary software are the two main categories on which information technologies are often built. Software programs whose source code is not publicly accessible are typically referred to as proprietary software. Source code refers to the entirety of code used to create the foundation of software. This code is generally hidden within the application. If developers choose not to share their code, such programs are classified as proprietary. OSS, on the other hand, allows individuals and organizations to install, use, modify, and redistribute the software without paying the original creators, regardless of whether any changes have been made [4].

OSS refers to software whose code is freely shared and can be modified and redistributed by developers. Cost factors such as hardware expenses, direct and indirect software costs, and personnel expenses make OSS an attractive option. Additionally, OSS offers advantages such as low-cost adaptability across various domains, innovative and customizable features tailored to specific needs, enhanced information security, high performance, and extended service life. These attributes have contributed to the growing popularity of OSS among public institutions and private organizations today [5].

OSS provides users with freedom and flexibility, granting open access to its source code. Key features of OSS include:

- Easy Access to Source Code: The publicly available source code can be reviewed, redistributed, and modified by anyone.

- Low Cost: OSS is predominantly free or significantly cheaper compared to commercial software.

- Freedom and Flexibility: Users can freely distribute and customize the source code, contributing to the software's development.

- Transparency and Security: Since the code is open, its functionality is transparent, enabling rapid identification and correction of malicious code or security vulnerabilities.

- Innovation: The accessibility of the source code facilitates the continuous addition of new features and improvements by programmers, fostering ongoing innovation.

## 3. National Open Source Software Used in Public Institutions

National open-source software (OSS) is an essential tool designed to strengthen the state's technological independence and promote domestic software production. These software solutions offer strategic advantages such as low cost, flexibility, and security, playing a significant role in the digital transformation processes of public institutions.

Pardus, initiated theoretically by TÜBİTAK in 2003, is a Linux-based national operating system developed to meet the demands of SMEs and public institutions since 2004. ULAKBİM (National Academic Network and Information Center) continues to develop Pardus as Turkey's largest and most comprehensive open-source software project, aiming to make it competitive with commercial products and sustainable [5]. Pardus is currently used by various government ministries such as the Ministry of National Defense, Ministry of Interior, Ministry of Justice, and several local municipalities. The main areas where open-source software can be used within public institutions under the Pardus project are as follows:

3.1. Pardus

The Pardus is a Linux-based domestic operating system developed by TÜBİTAK (The Scientific and Technological Research Council of Turkey). The first version was released in 2003, and it continued development under the PİSİ infrastructure until 2011. In 2013, it was restructured based on Debian. Pardus is one of the largest open-source software projects in Turkey,

encouraging the development of open-source solutions for public institutions and SMEs [6]. Used for both desktop and server solutions, Pardus is particularly popular in public institutions and educational sectors. Today, the sustainability and competitiveness of Pardus contribute to the development of Turkey's software ecosystem. The basic features of Pardus software are given in Figure 1.
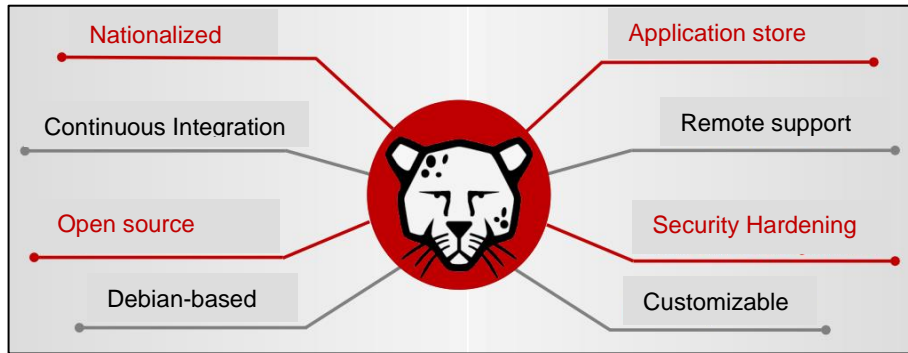
Fig. 1. Key Features of Pardus Software.

The primary features of Pardus are as follows:

- Open Source: Pardus is an open-source software, allowing users to freely use, distribute, and modify the software.

- Linux-Based: Built on the Linux kernel, Pardus benefits from the robust security features of Linux.

- User-Friendly Interface: Pardus provides a simple and intuitive desktop environment for easy user adaptation, compatible with desktop environments such as GNOME and Xfce.

- Domestic Software Support: Pardus is designed with Turkish language support and software solutions tailored to Turkey's specific needs.

- Comprehensive Software Support: Pardus supports widely-used Linux applications and provides most of the software users may need (office suites, graphic tools, internet browsers, etc.).

- High Security: Being Linux-based, Pardus has high security levels, offering protection from viruses and malware.

- Customizability: Users can make modifications to the system and create a personalized working environment.

- Corporate Usage: Pardus offers special support and installation tools for institutions, facilitating its use in both public and private sectors.

The general view of the Pardus desktop is given in Figure 2 above.

Pardus Use Cases:

- Public Institutions: Pardus is widely used in government institutions and public services, especially for reasons related to software independence and security.

- Educational Institutions: Schools and universities may use Pardus to promote open-source software usage in education.

- Home Users: Pardus is also suitable for non-technical users and can meet home users' basic needs such as internet browsing, media consumption, and office work.
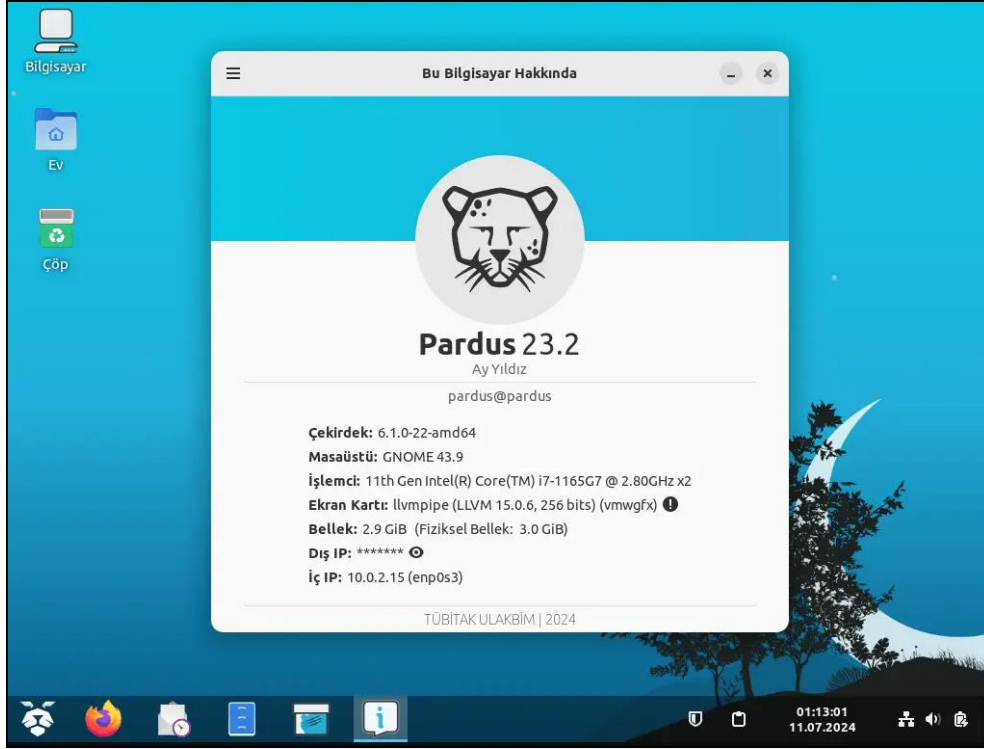
Fig. 2. General View of the Pardus Desktop.

3.2. Ahtapot Integrated Cybersecurity System

Ahtapot Integrated Cybersecurity System is an open-source security solution developed by TÜBİTAK ULAKBİM. Its main purpose is to ensure cybersecurity in public institutions and reduce dependency on foreign software. It is an open-source cybersecurity system project designed to be used by both private sector businesses and public institutions, running on the Pardus operating system. Below in Figure 3 are the basic features of the Octopus software.
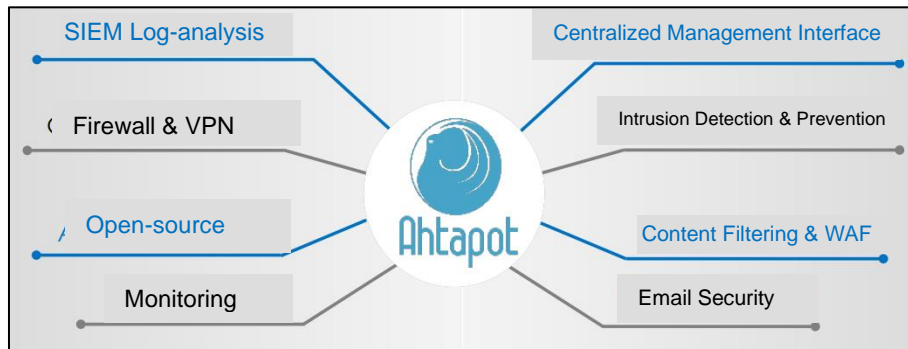

Fig. 3. Key features of the Ahtapot software.

The Ahtapot monitors, analyzes, and secures internal network traffic. Since the system continuously monitors the network, abnormal activities, security vulnerabilities, and open doors can be detected easily and automatically. Components of Ahtapot include email security systems, network traffic monitoring, content filtering, intrusion detection and prevention systems, firewalls, and network device-server-client monitoring. Additionally, the provision of Turkish documentation makes it easier for system users to install and use the system [7].

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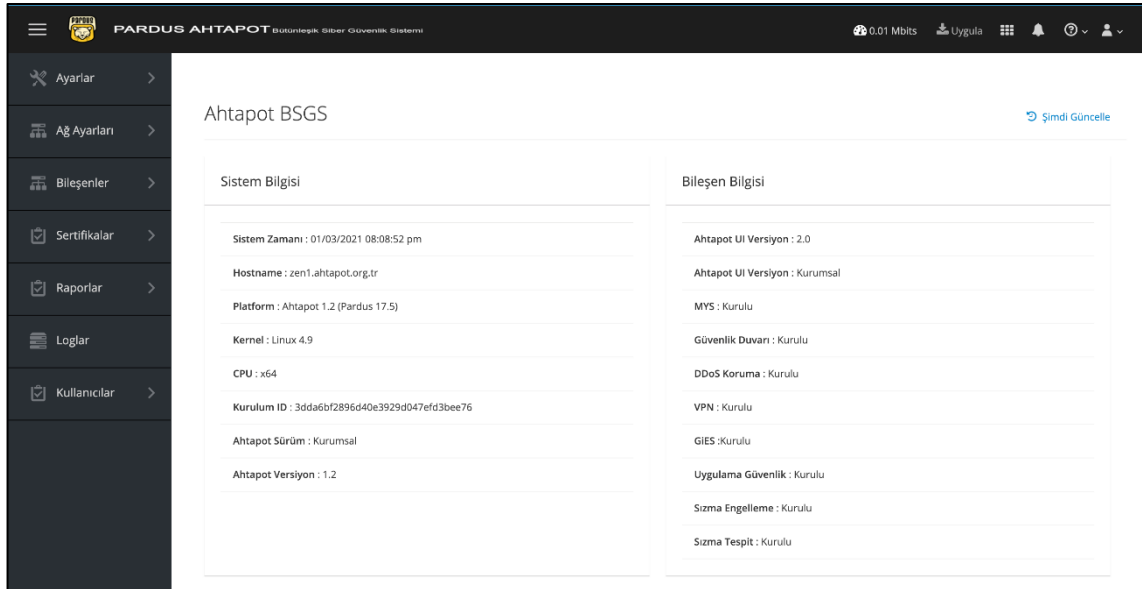
**Fig. 4. User Interface of Ahtapot Integrated Cybersecurity System.**

Figure 4 above shows the User Interface of the Octopus Integrated Cyber Security System.

Key features of Ahtapot Integrated Cybersecurity System include:

- Open Source: Allows users to inspect the software, eliminating risks associated with hidden backdoors.

- Centralized Management: Enables easy installation, configuration, and updates of systems.

- Localized Support: Provides Turkish documentation and user-friendly guides.

- Flexible and Scalable: Customizable and expandable to meet the needs of different institutions.

3.3. EnGerek Identity Management System

EnGerek Identity Management System, developed by TÜBİTAK ULAKBİM, is an open-source identity management solution. The system simplifies centralized authentication and authorization processes for institutions, securely storing user credentials and facilitating faster authentication. It also supports Single Sign-On (SSO), allowing users to access various applications with a single login. The basic features of EnGerek software are given in Figure 5.
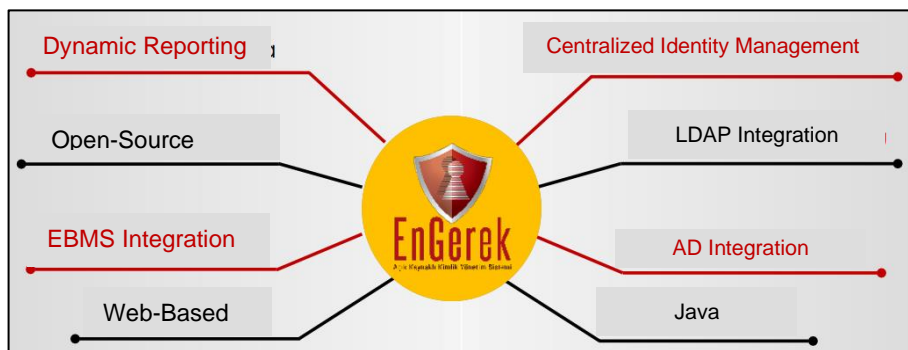
Fig. 5. Key features of the EnGerek software.

Developed using the Java programming language, EnGerek is an open-source, web-based identity management system. Its primary goal is to automatically and centrally manage corporate users' accounts across IT applications and systems. EnGerek includes features such as authorization review, request approval workflows, user account and password management, and ready-to-integrate connectors with other systems. Through defining role relationships and reducing the complexity of relationships, EnGerek increases efficiency in managing tasks such as account creation, modification, and authorization changes [8].

3.4. Liderahenk Centralized Management System

Liderahenk Centralized Management System is an open-source solution developed by TÜBİTAK ULAKBİM for managing users and devices in corporate networks from a central location. The system consists of two components: Lider (on the server side) and Ahenk (on the client side). The basic features of Liderahenk software are given in Figure 6 below.
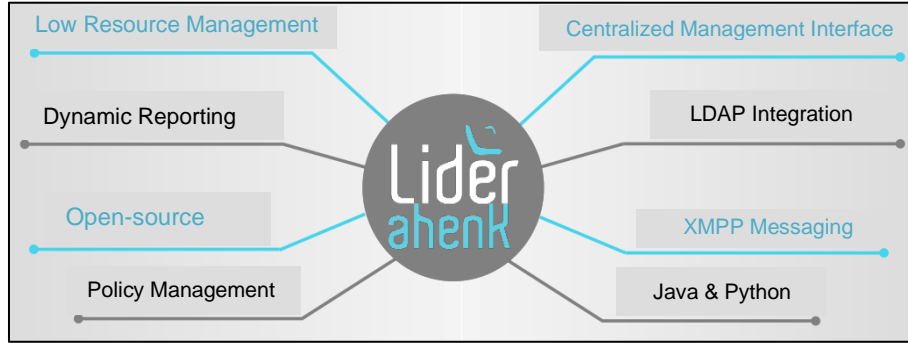

Fig. 6. Key features of the Liderahenk software.

Components of the Liderahenk Centralized Management System:

- Lider: The core component responsible for storing data gathered from clients, distributing defined policies, and assigning tasks to clients.

- Ahenk: A service software responsible for executing tasks sent by Lider, applying policies, and reporting results back to Lider. It operates as a super user on managed systems.

- Lider Interface: The interface where client and user management tasks are performed, including defining policies, adjusting server settings, and reporting.

Liderahenk works on Linux-based operating systems and aims to manage and monitor each client in the corporate network from a single location. It is suitable for distributed organizations with a central structure. Liderahenk consists of three main sections: the central Lider server, clients with Ahenk components connected to the Lider server, and a management panel called the Lider Panel for performing administrative tasks. Liderahenk is a modular system that can be enhanced with plugins, updated to meet business needs, and integrated with other systems [9].
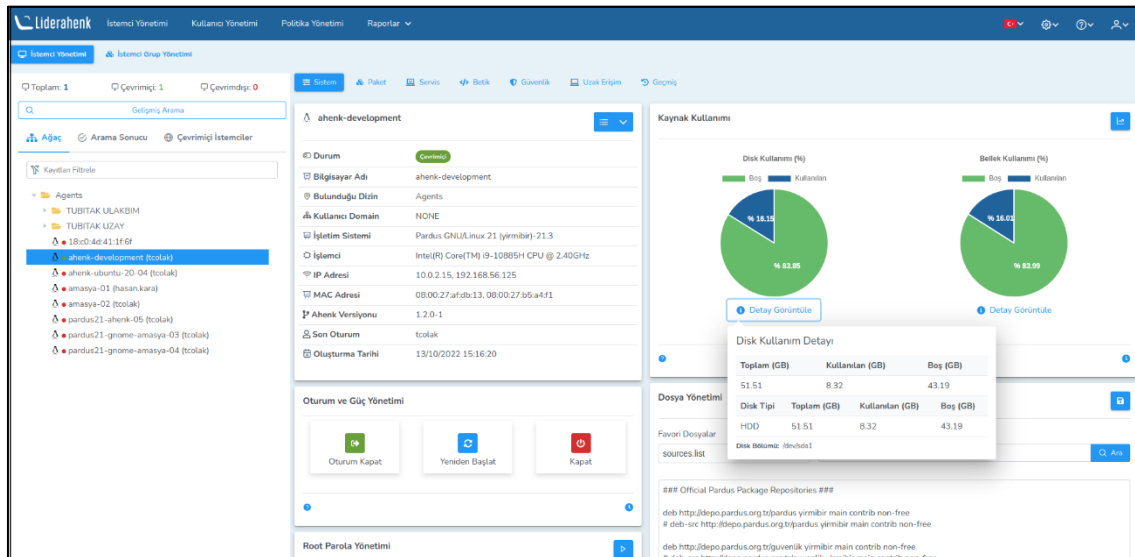

Fig. 7. User interface of the Liderahenk Centralized Management System.

Figure 7 above shows the user interface of Liderahenk Central Management System.

Key features of Liderahenk Centralized Management System:

- Client and User Management: Bulk task deployment, user addition, deletion, and migration can be performed.

- Policy Management: Policies for internet browsers, session management, USB access, etc., can be defined and enforced.

- Scripting Support: Custom tasks can be defined using Python, Bash, Perl, and Ruby scripts.

- Session and System Monitoring: Session durations and login times can be tracked, and system information can be displayed on the user's desktop.

- Additionally, it offers enterprise integration features such as Active Directory integration and remote desktop access.

3.5. Interactive Whiteboard Interface Project (ETAP)

The Interactive Whiteboard Interface Project (ETAP) is an interface specifically designed for interactive whiteboards used in educational institutions in Turkey. Developed by TÜBİTAK BİLGEM and ULAKBİM, ETAP is based on the Pardus GNU/Linux operating system and is open source. The project aims to enhance the use of touch screen devices, and it has been developed entirely with local resources. Figure 8 shows the basic features of the ETAP software.

Fig. 8. Key features of the ETAP software.

ETAP, which is used on interactive whiteboards and touch devices within the FATİH Project in schools under the Ministry of National Education, is based on the open-source Pardus operating system [10]. This interface aims to provide an effective, user-friendly, and functional educational experience on interactive whiteboards. It facilitates access to and interaction with digital materials for both students and teachers and is widely used in schools across Turkey.

Key features of ETAP software:

- User-Friendly Interface: A special design aimed at easy use for teachers and students.

- Domestic Development: Completely developed by TÜBİTAK with local resources.

- Hardware Compatibility: Compatible with HID-supported touch hardware and has low system requirements (2 GB RAM, 25 GB disk space).

- Free Software: Offered as free software under the GNU GPL v3 license.

4. Advantages and Disadvantages of National Open Source Software

The use of national open-source software (OSS) holds significant importance from various perspectives. First, these software solutions ensure that the country's software infrastructure is based on domestic production, thereby reducing external dependency. This independence is particularly critical in strategic areas, as full control can be maintained over national software. Furthermore, national software contributes to the development of the domestic software sector, thereby fostering economic growth and increasing employment opportunities.

Open-source software stands out for its cost advantages for public institutions. One of its most notable features is the absence of licensing fees compared to commercial software. This allows public institutions to manage their allocated budgets more

efficiently, without the burden of paying for licenses. This results in substantial budget savings, particularly for public institutions with large software infrastructures. Additionally, since OSS code is open to everyone, it can be modified to meet the specific needs of institutions [11].

Another economic advantage of open-source software is its ability to eliminate dependency on commercial software, thereby reducing the reliance of institutions on external IT infrastructure. This is strategically important for national security-related projects. Moreover, public institutions can save on maintenance costs by benefiting from the free support and development opportunities provided by the global developer community, which continuously updates and improves open-source software [12]. Since open-source software does not require license renewals, it is a more cost-effective and sustainable option compared to proprietary software.

Another important advantage is security. Open-source software allows for the rapid identification and resolution of security vulnerabilities due to the transparency of the code. This provides a significant advantage in protecting critical national infrastructure. Domestic software can defend against external threats more quickly and effectively. Furthermore, national software provides high levels of data security by preventing foreign software from monitoring national data.

However, the implementation of open-source software also comes with certain disadvantages. Initially, migrating from proprietary software to open-source software may incur higher upfront costs. Consulting services, infrastructure changes, and training may temporarily strain budgets during this transition. Moreover, effective use of these software solutions requires hiring personnel with technical expertise or training existing staff. This may lead to additional costs, particularly in public institutions with insufficient technical infrastructure.

Domestic software is often less mature compared to its international counterparts. This can lead to limited features and functionality of the software. Another disadvantage concerns maintenance and support services. While community support is generally the foundation of open-source software, paid support services may be required for urgent system issues. Compared to commercial software, national software may have limited support and update services. Additionally, users may struggle to find solutions for software errors or security vulnerabilities.

Public institutions are in search of solutions that can be compatible with proprietary software and existing infrastructures during the transition phase. National open-source software may cause integration difficulties if it does not ensure compatibility with existing systems. Finally, community support is essential for the survival of open-source projects; if a software's developer community decreases or updates cease, this may lead to future problems and may necessitate the software's modification [13].

5.   Conclusion

This study has focused on the importance and economic advantages of open-source software (OSS) in public institutions. The findings reveal that OSS provides critical advantages over proprietary software, including cost savings, security, flexibility, and independence. The elimination of licensing fees offers significant savings in public budget management, while the flexibility in maintenance and development processes allows institutions to create solutions tailored to their needs. However, short-term challenges, such as infrastructure transformation costs, technical knowledge requirements, and staff training, need to be addressed during the implementation process. In some cases, the inadequacy of community-based support systems may increase the need for paid support services. It is clear that OSS should be considered a strategic tool in the digital transformation processes of public institutions. These software solutions, in addition to cost advantages, provide greater security and flexibility, ensuring more effective and sustainable delivery of public services. For example, the Pardus operating system strengthens Turkey's technological independence, while projects like Ahtapot and Engerek play critical roles in ensuring national security. The Liderahenk and ETAP projects also enhance efficiency in education and management, supporting the accessibility of public services. Economically, national OSS not only reduces licensing and maintenance costs but also boosts the production capacity of the domestic software industry, creating opportunities for innovation and employment. The widespread adoption of national software contributes not only to public institutions' cost savings but also strengthens Turkey's technological independence and enhances global competitiveness. This process is of great importance in the creation of a sustainable technology ecosystem.

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