

Study of Open-source Software Adoption Strategy in E-government: Madinah Development Authority

Salma M. Elhag*

King Abdul-Aziz University/Information Systems Department, Jeddah, Saudi Arabia

E-mail: smomar@kau.edu.sa

ORCID iD: <https://orcid.org/0000-0002-1710-9286>

*Corresponding Author

Received: 25 October 2023; Revised: 11 September 2024; Accepted: 26 December 2024; Published: 08 February 2025

Abstract: Open Source Software (OSS) has gained significant traction in the government sector due to its potential to reduce costs, enhance security, and offer diverse benefits. This study focuses on the adoption of OSS within the Madinah Development Authority (MDA), a Saudi Arabian governmental agency. It aims to explore the OSS adoption process, identify challenges, and propose solutions to maximize its benefits. Employing a hybrid approach, data were collected through preliminary interviews with managers and a structured questionnaire survey among MDA employees. A SWOT analysis was conducted to evaluate the organization's IT environment and staff capabilities. The study's key contribution is the development of a phased strategy tailored for MDA to successfully adopt OSS, addressing identified challenges and optimizing the benefits of open-source solutions for government operations.

Index Terms: E.government, Madinah Development Authority (MDA), Open Source Software (OSS), Open Source Software Adoption, Open Source Software Strategy.

1. Introduction

Today, the public attitude towards Open Source Software (OSS) has shifted dramatically as it is getting more and more common [1]. Several organizations believe in OSS as a "quite viable alternative" to proprietary software. OSS is a software development approach that allows users to inspect, modify, edit, and redistribute the source code of any software system within the terms of free software licenses [2]. This notion of open-source software displays several advantages for organizations, including open innovation, competitive advantage, cooperation, and other strategic advantages, allowing businesses to customize software to their own needs. Recently, open-source software (OSS) has gained wide acceptance in the government sector, because of its potential benefits. In spite of this, implementing the transition to OSS in practical terms involves many questions and challenges. There has been little study conducted in this area, which might substantially assist governments in analyzing the adoption advantages of OSS and finally implementing it where it is appropriate [3]. In this context, Madinah Development Authority (MDA) considers the adoption of OSS as a strategic objective to achieve. MDA is a government agency that relies on commercial software on long-term contracts for its systems. To achieve its goal of switching to the use of OSS, the MDA needs a well-studied strategic plan to help it overcome the transition phase smoothly. In this research, we investigate the feasibility of using OSS in e-governments, and taking MDA as a model for this research. While Open Source Software (OSS) is increasingly recognized as a viable alternative to proprietary solutions, particularly in the government sector, there remains a significant gap in understanding how to effectively transition to OSS. Specifically, few studies provide actionable frameworks or detailed strategies tailored to address the unique challenges faced by governmental agencies, such as organizational resistance, IT capability gaps, and regulatory compliance. This lack of practical guidance hampers the ability of government entities to fully realize the potential benefits of OSS adoption, leaving many hesitant or unable to implement it effectively. The proposed approach addresses this gap by offering a phased strategy for OSS adoption in the government sector, with the following key benefits; Clear Roadmap for Transition. The strategy provides a step-by-step plan tailored to the specific needs and challenges of governmental organizations, reducing the complexity of transitioning to OSS. Organizational Readiness Assessment; By employing SWOT analysis, the approach ensures that the strengths, weaknesses, opportunities, and threats of the organization's IT environment and staff capabilities are identified and addressed. Cost Optimization; The approach helps optimize cost savings by

systematically evaluating where OSS can replace proprietary solutions without compromising performance or security. Enhanced Collaboration and Customization's adoption fosters collaboration across departments and allows for customization of software to align with the agency's unique operational requirements. Sustainable Implementation; The phased strategy minimizes risks by addressing challenges incrementally, enabling a sustainable and efficient transition to OSS. This structured and strategic approach not only maximizes the benefits of OSS but also provides a replicable model for other government entities aiming to adopt open-source solutions.

This research paper proceeds as follows: a literature review is presented in section two, the followed methodology is in section three, section four represents the methodology, section five represents the results, and a discussion is in section six before conclude the work.

2. Literature Review

2.1. Open-source Software Strategy

This article [4] has stated why organizations require an open-source software strategy. According to them, working with open-source software is quickly becoming a demand for all software. Furthermore, the use of open-source software in business is rapidly increasing, including how open-source software will grow in popularity in the future. "Smart companies have begun to identify the best evolving open-source technology for each layer of the organization stack – such as Spark for analytics, PyTorch and Tensor Flow for AI, Kafka for messaging and streaming, and so on," they said. Before developing a strategy, they discussed the benefits and drawbacks of OSS. The benefits can sum up with "the larger the problem, the more developers are drawn like magnets to work on it." In terms of risks, "the biggest risk as open-source software's business use grows is that no entity will endure the liability for negative consequences." In the direction of an open-source software strategy: Specify the purposes for which employees may – and may not – use open-source software, establish governance, legal, and threat structures for open-source software use, build the skills necessary to manage the use of open-source software, and companies should determine whether employees can contribute to open-source initiatives as part of their jobs or on their own time. An analytical model was designed to explain when organizations adopt OSS applications and platforms [5]. Providing insights into a comprehensive open-source valuable strategy to managers and policymakers engaged in related decisions. The article demonstrated that open-source adoption is critically dependent on organizational IT abilities, network impacts, and the fit of OSS with the application needs of the organization. Moreover, the model predicts that firms will sometimes use a heterogeneous IT architecture comprised of open source and commercial software. Authors in [6] aimed to create a migration and integration plan for e-government which combines the old system with new one to get good service. They used The Open Group Architecture technique (TOGAF) framework and Architecture Development Method (ADM) approach to build, manage and implement the system. The migration model has 6 phases which are architecture vision, business architecture, IS architecture, technological architecture, opportunity and solutions, migration planning. The lack of clear guidelines for IT managers may impede the adoption of open-source software. It is critical to identify the factors that influence the adoption. [7] Seeks to provide the fundamental building blocks for developing an OSS adoption guide. A systematic review approach is used to examine existing literature in order to highlight the technological, economic, and organizational factors that must be considered during the adoption process. As a result, twenty-two different adoption factors are identified. The most important factors are Compatibility, Reliability, Support, Training and some economic factors like Total Cost of Ownership and Licensing Costs. Now comes the question, how can the organization turn to the use of open source software and manage it effectively. Due to the nature of OSS is incompatible with many large organizations' strict structures and processes, successfully managing OSS has proven to be extremely difficult. A single (qualitative) case study was conducted by [8] on a large Swedish IT company to gain a better understanding of this transition process. The corporate that acts as the empirical context's focal point will be referred to as 'Company I.' The research of the transformation process to OSS in the context of this company and its ecosystem have resulted in a six-stage process which are Awareness, Attitude Transition, Isolated Use, Accidental Use, Operational Transition, and Strategic Transition.

2.2. Open-source Software Adopted in E-government

Four open-source cloud storage solutions are considered a possible candidate for cloud adoption in creating e-government data centers [8,9]. They applied a fuzzy AHP approach focusing on response time, accuracy, stability, and security. Then, own Cloud is selected, and a new e-Government Cloud Data Center is implemented. Authors in [9] discussed how India developed policies for adopting Free and Open Source Software (FOSS) in the governance and academic arena. They mentioned that FOSS's IT products strongly drive one of India's most prestigious e-governance services. Also, other citizen-centric projects that utilized FOSS are DigiLocker, CCTNS of the Police department, and Air India. The Union government formalized its open-source policy by a set of policies the paper mentioned. These policies are mandatory for all government agencies, but it is optional for state governments. Estonia, Uganda, the United States, and India have implemented OSS into their e-governance systems and have confirmed benefits such as reduced costs and the ability to conduct code audits [10]. One of the policies of the U.S requires that all source code be shared among agencies. Uganda has been heavily reliant on proprietary software and has spent \$8 million US dollars on it.

When the Ugandan government adopted the open-source software, the cost was expected to decrease. In Estonia, OSS used to deliver 99% of government services online. Eventually, through the OpenForge (INDIA) platform, the government encourages the use of OSS and the sharing and reusability of e-governance source code.

In terms of e-government transformation authors in [11] studies two aspects of it. First, they trace the prediction of how the e-government transformation will be according to two combined models, the Open Government Maturity Model and Tim Berners-Lee's five-star model of open data development. However, this model is subject to a number of limitations such as lack of theoretical foundation, most models suit just an individual organization, a little consideration of overall change strategies and lack of clear guidance in growth models. After that, they assess the actual transformation based on a survey on 1560 cultural heritage institutions in different 11 countries. Consequently, they start to describe the different stages of innovation adoption that e-government should go through to develop and adopt open source systems, which are awareness, interest, evaluation, trial and adoption stages. The result of this research was the development of a new model for e-government maturity and growth that contains nine independent characteristics such as, type of institution, the most characteristic of heritage objects, geographical locations, number of employees and volunteers, revenue sources, the ratio of volunteers in its workforce, and the legal structure of the organization. Another study conducted in Dubai was aimed at verifying the benefits of adopting open source software in e-government [12]. The objectives of this study are to: (1) analyze the major factors that impact the adoption of OSS by government entities in Dubai; and (2) propose a Soft System Approach for OSS adoption in Dubai government agencies. The results showed that there are 3 main categories of influencing factors, which are social, economic, and technical. From each category there are 3 sub-factors. Fig. 1. Illustrates these factors and their subdivisions.

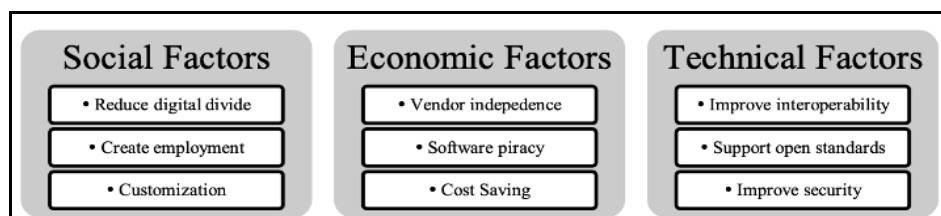


Fig.1. Factors that impact the adoption of OSS by government

To shed more light on the issues that may stand in the way of adopting the use of open-source software, [13] conducted a survey-based study on the Philippines with the main purpose of aide IT managers and workers in using strategic IT planning and policy-making for using, managing, and deploying OSS to support organizational processes. The study focused on the 3 main factors to determine the status of organizations in terms of the shifting to OSS using which are awareness, proficiency and the issues and challenges. Table 1 illustrates the results of the survey-based study. The study's findings revealed that the obstacles and challenges in the use of OSS are the most challenging for IT employees in the government sectors.

Table 1. The Results of the Survey-based Study

OSS Learning and Awareness Sources	Proficiency in the Use of OSS	Issues and Challenges in the Use of OSS
• Video Tutorials • Online Articles • Online For a • OSS Online Communities	• Industry Sector and Education Sector: Very Good • 2- Government sector: Good	Selection of OSS Industry and Education: High Government: very high
		Procurement Industry and Education: Moderate Government: Very High
		Human Factors Industry and Education: High Government: very high
		Local Development and Language Support Industry, Education and Government: Low
		Legal/License Issues Industry and Education: High Government: very high
		Usability. the difficulty of the challenges brought about by OSS usability Industry and Education: High Government: very high
		Software Development Service and Support Industry, Education and Government: very high
		Interoperability and Integration. Industry, Education and Government: Low
		Security Industry, Education and Government: Moderate

2.3. Influnce of Adoption of Open-source Software

Other authors [12] used a Chandra et.al model from a previous study in 2010 used to analyze mobile payment systems and use this model to study adoption of open source software (OSS). The researcher proposed some hypotheses and apply it to that model to get OSS trust and adoption research model. The result illustrates that all hypotheses are included except H1, where the reputation will not affect the user trust directly. Furthermore, the results show that the trust and usefulness are strongly related and they conclude that the user trust is often based on pre-existing opinion

about OSS and the produced company regardless of who the individual developers are. Authors in [13,14], where it reviewed and synthesized 44 articles related to barriers and challenges that affect Free/Liber Open Source Software (FLOSS). First, they identify the challenges that were mentioned in these articles explicitly and implicitly. Then, the analysis outcomes include 50 barriers and challenges so, they assess them either to high-level or low-level barriers. They finally created the TOEI framework of FLOSS Adoption which includes four dimensions (Technological, Organizational, Environmental and Individual) which contain 19. According to South Africa cabinet recommendations from the Government to adopt Free and Open-Source Software (FOSS). Authors in [14] searches for the factors that may influence the adoption FOSS. They use a qualitative research approach where they collect data from 10 municipalities in Gauteng province in South Africa. The results show that all of these municipalities did not use FOSS in their record management system and the last two municipalities did not use any technology at all, where they still use traditional paper-based techniques. After interview and investigation, the factors could summarize into lack of support a commitment on senior management, contractual issues with software providers and resistance to changes. In the case of the last two municipalities, the problem was that they were unaware of the existence of FOSS.

There is no doubt that security is one of the most important issues related to the use of open-source software in e-government. Authors in [15], a case study is conducted to demonstrate the viability of using SAST in an open-source e-government project as part of a human-driven security evaluation process. Static Application Security Testing (SAST) in software engineering, is a widely used quality assurance technique. An expert interview was undertaken a preliminary review of the prototype. Based on both previous literature and expert opinions, the researchers selected 7 of SAST tools which are SonarQube, Infer, IntelliJ IDEA, VCG, Huntbug, PMD, and Spotbug. Each SAST tool has reported with the following metrics: Recall, Precision, and F1 Score. The result revealed that with a precision score of 0.6, Sonarqube is the most accurate. With a score of 0.69, IntelliJ has the best F1 score. PMD for the error handling class has the highest F1 score for a single CWE class.

3. Methodology

This research is designed to study and analyze the current strategic plan for MDA in order to suggest and propose some solutions to help the authority improve. We followed the methodology phases as depicted in Fig.2 below. Initially, two interviews with IT management were conducted. The first interview is to assess the current situation and discuss potential improvements with IT management. The second interview is to obtain the necessary information for MDA's adoption of open-source software. Before implementing the OSS, it is critical to assess and understand the current level of employees' skills, awareness, and capabilities. Also, we must see if the MDA can adopt o Fig.2 Methodology Phases.

Open source software with its current situation. The required data was gathered through a Google Form questionnaire and distributed to MDA's IT employees. SWOT analysis was then performed to identify strengths, weaknesses, opportunities, and threats regarding the MDA environment .Analysis was done and then the proposed strategy is given with extra recommendations.

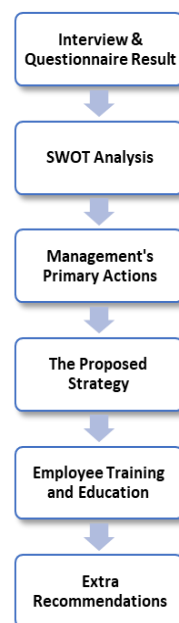


Fig.2. Methodology phases

4. Result

This section describes our findings regarding the extent to which the MDA can transition to open-source software. As evidenced by our results, there is an opportunity and possibility to adopt open source programs while taking our suggestions into account. The results have many different aspects as demonstrated below.

4.1. Interview & Questionnaire Result

We started with an initial meeting with the IT department to get a better understanding of the Authority's vision, mission, and goals. We asked the IT manager at this meeting, "What are the issues or trends that the authority wants to develop but is unable to do so due to a lack of a planned strategy? Or what are the authority's strategies to implement that are still being researched?" The response stated that, "The authority is now focusing on the fields of cloud computing and digital transformation, and one of the things that the authority hopes to achieve is the adoption of OSS, which is within the second field, where this trend receives government support, but it lacks clear strategies and criteria to begin with". Following this meeting, the adoption of OSS was approved as a topic for this paper's research. Following the completion of the literature reviews and knowledge of the aspects, factors, challenges, and barriers that may arise during the adoption process. We conducted another interview with the authority, with the goal of learning more about it in depth and from various perspectives, such as the authority's size based on the number of IT employees, the number of departments served by the IT department, and their relationship, as well as the authority's relationship with other city authorities. We relied on several aspects, such as the operating systems used, the ability to train staff in the event of certain changes, the type of software and contracts currently in use, and what areas their IT department focuses on, to understand the nature of their work and their environment. We also performed a survey to determine the amount of IT staff's knowledge and skill in areas linked to OSS adoption. This was accomplished by assessing their years of experience, awareness of the impact of OSS on profitability and security issues, and prior familiarity with similar software. Employees' desire to learn new skills and commitment to mastery, excitement for switching to OSS, and willingness to train their colleagues were all measured using a 5-point Likert scale.

4.2. SWOT Analysis

We have illustrated (SWOT) Analysis of OSS Adoption. This analysis is based on the previous interviews and questionnaires of MDA's IT manager and staff.

Strengths:

The following are the MDA's strengths that enable the adoption of OSS:

- OSS does not appear to be unusual, since the MDA utilizes Linux, an open source operating system, as one of its operating systems.
- Adopting OSS needs a clear understanding of the criteria as well as the capacity to meet them, which the MDA is committed to and defined by.
- The huge number of staff helps with the rapidity of response and the power of assistance.
- The IT department is well-connected and interacts with other departments and management levels.
- The MDA accepts the responsibility of training and preparing its staff to work with the new systems and open source software.
- Employees have a high level of commitment and desire to learn new skills.

Weaknesses:

The weaknesses highlighted below are current issues that must be considered before implementing OSS:

- IT personnel have typically been trained (and practiced) in the use of Closed Source Software (CSS) applications; nevertheless, the introduction of new programs / software may require staff retraining to enable them to utilize OSS. It's a common misconception that OSS requires specialized expertise, not necessarily programmers, but often a system administrator to configure the application.
- Despite the fact that the majority of the desired customers speak Arabic, the training program will be offered in English rather than Arabic.
- Too many employees might lead to a reliance on one another and a lack of loyalty to their jobs.
- Most IT staff have no prior experience with OSS and have never worked with it, which might slow down the adoption process.
- There is no clear strategy or duty for the government to shift to open source software, so each authority is responsible for planning and selecting the path and software that best suit its needs.
- Some OSS may have a negative impact on legacy systems, as most authorities rely on old infrastructure and knowledge.
- In government procurements for an OSS digital solution, major ICT vendors are favored above SME (Small and Medium Enterprises).

- High Integration and Migration Costs: Because most existing proprietary systems do not work well with other software, migrating from one CSS to another OSS becomes prohibitively expensive.
- The OSS is more exposed to attacks because now source code is available. This may be minimized by utilizing the recommended stable version of OSS, which comes with all of the necessary support and updates.
- Support and maintenance charges might sometimes surpass the costs of the proprietary program, and they may involve 'hidden' commitments. It is possible that enough assistance may not be accessible at all times, and this will become the OSS's largest weakness.

Opportunities:

The opportunities of adopting OSS and the possible advantages that emerge from those opportunities are described below:

- Vital to support cross-industry cooperation since MDA already uses Linux as one of its operating systems and OSS allows cross-industry collaboration through consortia such as the Linux Foundation, Open MAMA, and others.
- MDA is prepared to offer high-quality training programs. This is seen as a great opportunity to improve the abilities of IT Department staff and qualify them to work with OSS efficiently and effectively.
- The remaining period on the CSS contracts can be used to prepare for the transition and prepare the OSS infrastructure.
- The large number of IT staff makes the training process easier, and by employing the peer training technique, MDA was able to save money on training and spend it more effectively in OSS.
- The Authority's lack of association with other city authorities gives it greater freedom to develop and choose appropriate software for its work.
- The digital government authority, which was backed by the government, provided a set of OSS suggestions. In general, there are many competing support service providers on the OSS solution, as opposed to limited choices with CSS; thus, multiple choices are available with an OSS solution to choose an appropriate service agency; this leads to a simpler and cost-effective strategy when switching the support service agency.
- Offering support services on OSS, capacity building on OSS, innovation of new products (including OS, Cloud, VM, and so on) using OSS libraries, development of integrated solutions on desktop, server, incorporated, cellular phones, set top boxes, network, open hardware (like 3D printers, robots), and so on are all new business opportunities for local economy.

Threats:

The following are some of the threats and obstacles to consider while implementing OSS:

- In the lack of an OSS implementation agency, the changeover process may take longer than the remaining CSS contracts, causing a major issue that will cost a lot of money and effort.
- When OSS is employed, there may be a lack of in-house specialists in OSS, forcing the hiring of more experienced staff. The switch to OSS systems comes with less incentives.
- Decision makers' attitudes of OSS solutions are slowly changing. The terms "licensing model," "intellectual property infringement," and "legal compliance" are all frequently misinterpreted. It will be easier to make better judgments if awareness initiatives are conducted and suitable reports are provided.
- The established authorities' current system is endangered by OSS's new arrival, which may lead to resistance to change.
- It's tough to get help because there are so many different OSS solutions for each domain.
- Another threat to address is the absence of continuing development of the OSS solution.
- Due to a diversity of departments and MDA needs, there may be a mismatch between multiple libraries of the integrated OSS solution, resulting in a bad integrated system.

4.3. Management's Primary Actions, along with an Explanation of Their Impact. Derived from the European Commission's Open-source Software Strategy

- Setup the Open-Source Program Office: establishing centralized open-source programs offices (OSPOs) to foster, guide, and align open-source best practices with business strategy. It will speed up all of the activities in the action plan.
- Improve skills and hire experts: Contribute to the recruitment and retention of employees
- Use open-source labs to enable and create innovation: Encourage co-creation and drive innovation
- Expand community outreach: Improve services by encouraging innovation.
- Incorporate open source into internal IT governance: Improve organizational efficiency; encourage innovation
- Ensure security: Increase the organization's and society's value of open source.

4.4. The Proposed Strategy for Moving Toward Open-source Software for MDA

Phase I: Setting a goal: Full or partial transformation: Since one of the most effective strategies for implementing open source software is to transform gradually, we propose that the first conversion be partial for the remaining time of contracts and current staff skills. So, our proposition focuses just on the infrastructure program in the current situation.

Phase II: Set a timeline for implementation: choose a suitable time that coincides with their previous plans and the remaining time of existing software contracts. We estimate that the adoption of OS infrastructure software will take a maximum of two years.

Phase III: Select the OSS: Selection of appropriate open-source software for the MDA. Keep in mind that security should be a top priority when evaluating and selecting open-source software. For the MDA, all the proposed software provides adequate security and stability. Regardless, Management must determine the appropriate period. With the presence of support companies: They can be relied on to support those systems and benefit from their experience with other clients. Table 2 displays the proposed OS infrastructure software for the MDA.

Phase IV: Training employees and end users: At each step, must train the staff and the end-users. The following section delivers some of the proposed training programs to help with staff training.

Table 1. The proposed OSS for the MDA based infrastructure

Infrastructure Programs	
Subcategories	Proposed Software
Desktop OS	Ubuntu
Server OS	CentOS
Virtualization Technology	oVirt
Cloud Infrastructure	Openstack + Ceph
Infrastructure Monitoring	Nagios
Email Server	Zimbra Email Server
Email Client	Zimbra Email
Database	MySQL
Backup and Restore	Bacula
Analytics / Log Analysis	Elastic Stack
In-Memory Caching Server	memcached

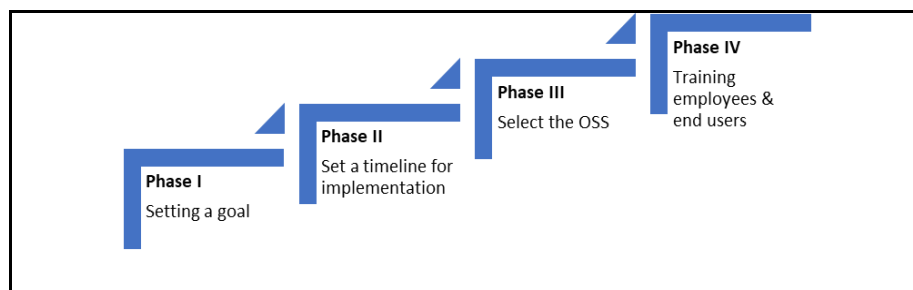


Fig.3. Main phases of the adoption strategy

4.5. Employee Training and Education

To enhance available skills through training and education, MDA management must commit to and select a team of highly skilled employees with software skills, collaboration, a willingness to train and support colleagues, and experience working with open-source programs. After that, it is the responsibility of this team to transfer knowledge, train, and educate the rest of the IT staff. So, the recommended educational resources for the selected team are mentioned below, with a schedule determined by management.

4.6. The Recommended Open-source Educational Resources

- Considerable courses on specific OSS applications on edX, Skillshare, Coursera, and Udemy
- FLOSSbok: aims to provide comprehensive information about OSS, allowing users to find a wide range of materials applied to many aspects of open-source development and use.
- Opensource.com (IBM&RedHat)
- TODO Group (Linux Foundation): Most useful open-source practices for companies (todogroup.org/guides/)
- OS Project Office 101
- Open-Source Summit: the top-ranked event for open-source technologists, developers, and community leaders to cooperate, share information, solve problems, and acquire knowledge, advancing open-source innovation

4.7. Extra Recommendations for Adoption of OSS

- Training should be provided to the project teams involved.
- Technical documentation should be prepared and distributed to the project team.
- Backup and recovery mechanisms should be clearly stated.
- Application data should be backed up on a regular basis. The open-source solution should be kept in the repository.
- Once implemented in one project, the OSS solution should be reused in other similar projects with some customizations based on the project requirements.
- Mechanism of Collaboration Enhanced For the adoption of OSS, a collaborative mechanism (such as a knowledge portal, help desk, issue tracking system, e-mail support, discussion forums, and telephone) should be formed.
- Developing open-source applications with Arabic language interfaces should be encouraged.
- GUI, Meta-Language, and Templates should be provided to make software development more straightforward.
- Providing application development and deployment environments for open-source stack reuse with support services.

5. Discussion

Governments have begun to accept and encourage OSS adoption because of its benefits in a variety of areas, including material, developmental, and other factors. Therefore, moving away from legacy software and systems will require a deliberate strategy. As a result, we looked for potential barriers and challenges to this transition from previous literature research compared to the challenges currently in the MDA. Consequently, it became obvious to us that there are a number of common obstacles and challenges, as well as a set of challenges that the MDA did not specify and expect, but that may arise in the future during the adoption process, as indicated in Table 3. For these challenges and obstacles, the research included a number of recommendations and solutions, both during SWOT analysis and after the proposed strategy.

Table 2. OSS adoption challenges

Expected and Common Challenges	Unexpected and Uncommon Challenges
Contractual issues with CSS	A poorly integrated system may arise due to the difference and diversity of technical requirements between departments.
Misunderstanding information about OSS adoption	Lack of trust in some developers of OSS
Unaware and untrusted information about regulation, rules and security issues related to OSS	Management's preference for plans that are clearly profitable rather than risky
Resistance to change, whether at the level of management or the entire organization	Management commitment
Due to a lack of benchmarks and suitable ready OSS infrastructure, the selection process for OSS is difficult.	Cultural issues
-	No patient for long-term results

The proposed strategy is a compilation and digest of earlier literature research, where their offered strategies were adapted and harmonized to meet the MDA's environment and culture. In terms of government support for OSS, literature studies show that a number of governments have encouraged their government institutions to use OSS in their work. The Saudi government also provided support, but it went above and above by creating a website with a variety of recommendations for applications and systems that can be employed, which easing the adoption and transition process. We used that website to offer infrastructure programs for MDA to use as a starting point for the transition.

The findings underscore the following benefits:

- **Alignment with Strategic Goals:** OSS adoption aligns with the Authority's focus on cloud computing and digital transformation, reinforcing its commitment to modernization and innovation.
- **Enhanced Cost Efficiency:** Transitioning to OSS offers opportunities to reduce software licensing costs and allocate resources to other strategic initiatives.
- **Empowered Workforce:** By assessing staff readiness and willingness to embrace change, the research identified a strong foundation for capacity-building initiatives that can enhance technical skills and foster innovation.
- **Improved Operational Flexibility:** OSS enables greater customization of software solutions, allowing the Authority to tailor tools and platforms to meet specific organizational needs.
- **Strengthened Interdepartmental Collaboration:** The insights into departmental relationships and IT operations highlight opportunities for OSS to improve cross-functional communication and efficiency.
- These benefits collectively pave the way for the MDA to achieve a sustainable and impactful transition to OSS, enhancing its operational capabilities and supporting its strategic objectives in digital transformation.

6. Conclusions

Many governmental and non-governmental organizations have begun to adopt and use open software in their environments as a result of global interest and then government interest in OSS. Despite this, there is no obvious strategy that can be implemented and followed in this situation. There are a variety of challenges and barriers that this procedure may face. Therefore, in this study, we looked at a variety of studies on OSS adoption and the strategies that have been used to make that shift and adoption. The MDA was assigned to recommending an appropriate OSS transition strategy. Before suggesting the strategy, we conducted a series of interviews to have a better understanding of the authority's current situation. Then we performed a survey among IT employees to determine their awareness of OSS and desire to implement it. Following a series of analyses, a four-phase strategy was proposed, with a number of software serving as the foundation and infrastructure for the OSS adoption process. Hence, we've put up a list of suggestions that we hope will be considered in order to reduce or remove potential obstacles during the transition process. The results of this study highlight the significant potential benefits of adopting Open Source Software (OSS) within the Madinah Development Authority (MDA). Through a combination of interviews, surveys and SWOT analysis; key insights were gathered about the Authority's vision, operational landscape, and staff readiness, which informed the development of a practical, phased strategy for OSS adoption. In the future, we hope to present an integrated system made up of open source software that the MDA can use. Furthermore, research and studies are required because this field needs studies and case studies that provide strategies and methods that may be used as a benchmark in OSS adoption.

References

- [1] V. Lagergren and A. Norelius, *Managing the Transition Towards Open Source Software Adoption: Considerations for Large IT Companies*. 2019. Accessed: Apr. 24, 2022. [Online]. Available: <http://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-264204>
- [2] F. Canlas, "Issues and Challenges of Free and Open Source Software Adoption in the Philippines: A Baseline Survey for Information Technology Strategy Formulation," Nov. 2019.
- [3] N. H. AlMheiri, A. Rajan, and V. Akre, "Framework for Open Source Software implementation in the Government Sector of Dubai," in *2018 Fifth HCT Information Technology Trends (ITT)*, Dubai, United Arab Emirates, Nov. 2018, pp. 71–76. doi: 10.1109/CTIT.2018.8649506.
- [4] "Why You Need an Open Source Software Strategy," BCG Global, Apr. 16, 2021. <https://www.bcg.com/publications/2021/open-source-software-strategy-benefits> (accessed Apr. 24, 2022).
- [5] E. Katsamakos and M. Xin, "Open source adoption strategy," *Electron. Commer. Res. Appl.*, vol. 36, p. 100872, Jul. 2019, doi: 10.1016/j.elerap.2019.100872.
- [6] L. Fitriani, "Migration planning for e-Government," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 434, p. 012051, Dec. 2018, doi: 10.1088/1757-899X/434/1/012051.
- [7] V. R. Sanchez, P. N. Ayuso, J. A. Galindo, and D. Benavides, "Open Source Adoption Factors—A Systematic Literature Review," *IEEE Access*, vol. 8, pp. 94594–94609, 2020, doi: 10.1109/ACCESS.2020.2993248.
- [8] I. Syamsuddin, R. Nur, D. Nur, Irmawati, and D. Al-Dabass, "LOW COST e-GOVERNMENT CLOUD DATA CENTER: A CASE STUDY OF OPEN SOURCE ADOPTION," *Far East J. Electron. Commun.*, vol. 18, no. 2, pp. 237–250, Mar. 2018, doi: 10.17654/EC018020237.
- [9] R. Kumar, S. Kumar, and S. K. Tiwari, "Adoption of Free and Open Source Software in India," vol. 13, no. 16, p. 7, 2018.
- [10] A. Z. Sikka Dr Sunil, "Free and Open Source Software in e-Governance," *Free Open Source Softw. E-Gov.*, 2020, Accessed: Apr. 24, 2022. [Online]. Available: <http://www.internationaljournalssrg.org/IJEMS/paper-details?Id=618>
- [11] B. Estermann, "Development paths towards open government – an empirical analysis among heritage institutions," *Gov. Inf. Q.*, vol. 35, no. 4, pp. 599–612, Oct. 2018, doi: 10.1016/j.giq.2018.10.005.
- [12] University of St Gallen, M. Silic, J. Barlow, California State University, Fullerton, A. Back, and University of St Gallen, "Evaluating the Role of Trust in Adoption: A Conceptual Replication in the Context of Open Source Systems," *AIS Trans. Replication Res.*, vol. 4, pp. 1–17, Mar. 2018, doi: 10.17705/1atrr.00021.
- [13] N. Obwegeser, "Barriers to Open-Source Software Adoption: Review and Synthesis", Accessed: Apr. 24, 2022. [Online]. Available: <https://core.ac.uk/reader/301376330>
- [14] M. Shekgola, J. Maluleka, and A. Rodrigues, "Factors influencing the adoption of free and open-source software for electronic records management by municipalities in Gauteng Province, South Africa," *J. South Afr. Soc. Arch.*, vol. 54, pp. 43–54, Nov. 2021, doi: 10.4314/jsasa.v54i1.4.
- [15] A. Nguyen-Duc, M. V. Do, Q. Luong Hong, K. Nguyen Khac, and A. Nguyen Quang, "On the adoption of static analysis for software security assessment—A case study of an open-source e-government project," *Comput. Secur.*, vol. 111, p. 102470, Dec. 2021, doi: 10.1016/j.cose.2021.102470.

Authors' Profiles



Salma M.Elhag received her Ph.D. degrees in computer science from the University of Khartoum, Sudan. Since 2014, since 2011, she worked as a Lecturer with the Faculty of Computing and Information Technology, King Abdul-Aziz University, as an Assistant Professor, since 2014, and as an Associate Professor, since 2019. Her research interests include artificial intelligence, computation intelligence, network security, data mining, artificial neural networks, fuzzy logic, and evolutionary algorithms.

How to cite this paper: Salma M. Elhag, "Study of Open-source Software Adoption Strategy in E-government: Madinah Development Authority", International Journal of Information Technology and Computer Science(IJITCS), Vol.17, No.1, pp.16-25, 2025. DOI:10.5815/ijitcs.2025.01.02