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Open Source Software Adoption in the Financial Services Industry:
Exploratory Evidence From South Africa

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ABSTRACT

Although OSS has gained traction across industries worldwide, few studies have been reported on OSS adoption in the financial industry and even less in the context of developing countries. This paper presents an exploratory overview of the state of OSS adoption in the financial industry using the case of South Africa as a country with the largest and most developed financial sector in Africa. To achieve this, we conducted a qualitative study that leveraged the Technology-Organisation-Environme nt (TOE) framework, and the Diffusion of Innovation (DOI) theory as theoretical references and used thematic analysis to analyse the data collected from a focus group discussion (FGD) of eight experts from four financial services organisations based in South Africa. The study's findings reveal the state of practice of OSS and the technological, organisational, and environmental factors that affect OSS adoption, and diffusion in financial services organisations in South Africa. We also identified seven research themes that should gain the attention of researchers from now on.

KEYWORDS

Diffusion of Innovation (DOI) Theory, Financial Services Sector, Focus Group, Open Source Software, Technolog y-Organisation-Environment (TOE) Framework

INTRODUCTION

During the last 20 years, open source software (OSS) became mainstream across all sectors of the software industry (Blind et al., 2021). Many of the more recent breakthroughs (e.g., cloud computing, big data, machine learning, "internet of things," and streaming analytics) have their roots in open source. Companies renowned for building and selling proprietary software have seen the benefits of open source in the creation of their products as evidenced by IBM buying RedHat and Microsoft's purchase of GitHub, the world's largest host of open source software repositories (The Linux Foundation, 2020).

In general, the term OSS is applied to innovations that are jointly developed by different contributors and the output of OSS, like source code, can be included in products that are sold. In general, no royalty fees are paid to contributors and, again, in general there are no significant

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restrictions on how these outputs are used. Additions to the OSS may also need to be provided on an open source basis (Blind et al., 2021).

Open source has a significant impact on the economy. In 2018 the European Union (EU) invested approximately 1 billion euros, with an impact of between 65 and 95 billion euros. The cost-benefit ratio of using OSS is above 1:4, and it is expected that an increase of 10% in OSS contributions would generate an increase in EU gross domestic product of between 0.4 and 0.6% and create more than 600 additional start-ups. If the public sector procures OSS, the total cost of ownership will be reduced, vendor lock-in will be avoided, and digital autonomy within countries can be increased (Blind et al., 2021).

In much of the contemporary discussion on sustainable development, attention is given to climate change, ecological ecosystems, biodiversity, and reducing hunger and poverty. In contrast, it is also obvious that many of our activities are dependent and supported by an array of technologies, both hardware and software. If technologies are to support sustainable development goals, these technologies must be responsive to the needs of a majority of the world's population who live in developing countries. OSS can play an important role here as it is less restrictive and encourages broader public participation in decision making (United Nations, 2012).

A very nascent development that has its origin in open source development is open source theory. In this view open source is a stance, movement, process, perspective, and social phenomenon that has implications in sociocognitive theory. Open source theory has its focus more on the ways humans process, reconfigure, and use information in problem-solving activities, both individually and as a community. Open source theory emphasizes the importance of sharing information early and often and inviting contributors to be coowners in what they create. This has impacts on our being and operating in the world in general (Glassman, 2013).

OSS is important to economic growth, sustainability, and even the way we work. In the next section we present both a background on OSS in the financial services and banking globally and the motivation for our study.

OSS in Financial Services and Banking

Many industry surveys and studies note the increased prevalence, importance, and value of open source. The financial services industry has been a long-time consumer of open source software, but it has not been at the core of financial service industry business models or strategies (Ellison et al., 2021). The financial services industry has used open source for many years in infrastructure but less so in application development.

The largest quantitative survey on OSS in financial services was conducted by the Fintech Open Source Foundation (FINOS) and their research partners (Ellison et al., 2021). Subsequent sections show that, outside of FINOS, very little academic research has been done on open source and financial services with even less research on OSS and financial services in South Africa.

FINOS reports that 60% of financial respondents indicate that the economic motivation for open source is "efficiency" and "shared innovation"; 81% either agree or strongly agree that "innovation" is why their company participates in open source with "time to market" and "total cost of ownership" following closely with over 80% indicating this as a reason. These numbers show the major value that open source delivers in the competitive financial services domain (Ellison et al., 2021).

There are different ways of engaging with open source: consuming open source, contributing to open source, and publishing internal projects as open source software. Consuming open source is the most obvious way for organizations to get value from open source. Consumption in this sense means not only including open source components and libraries in bespoke applications but also using open source applications internally in infrastructure, like routers, servers, and personal computers, and deploying and migrating cloud native applications to public cloud infrastructure that are built on open source. If users can get the job done with open source software, the benefits are clear, as they can save on licensing costs and consulting fees.

Beyond the obvious benefits, Aitken et al. (2018) also noted several benefits in the financial services context:

- Reducing time to market: The effort and time invested in open source drastically reduces time to market. Modern software development is a complex enterprise that relies on many interdependent processes and tools. Front end development might use the AngularJS framework while user experience consistency is being provided by Bootstrap. All this links to back-end services provided by databases like MariaDB or MongoDB. Tooling is necessary for coding, testing, and deployment. All of these can be provided by a large array of open source software, which consists of thousands of hours of labor and time.
- Preserving high-value development resources: By freeing up developers from working on the coding infrastructure parts of projects, more time is available to work on products that provide differentiation in the market.
- Keeping developers happy and productive. Contributing to open source products keeps developer skills current and provides a pathway to mastering their craft and adding to their personal brand and reputation.
- Empowering, retaining, and attracting developers: Being part of an open source community drives developer satisfaction, appreciation, and recognition. It also drives relationships that arise from solving shared problems with peers.
- Supporting the health of a project relied on: A steady stream of contributions from a robust community keeps projects healthy. If a project relies on a critical open source component, there is a benefit to supporting and contributing to that open source project.

These benefits are noted in the financial services domain but extended into other domains. Despite the acknowledged importance and benefits of OSS globally, few studies have been reported on OSS adoption in the financial industry and even less in the context of developing countries.

On this background, the novelty of this study stems from the need for empirical studies on OSS adoption in the financial sector and the scarcity of similar studies in the context of developing countries. Theoretically, the study contributes to the understanding of the state of adoption of OSS, technology readiness for OSS adoption, and the drivers and challenges of OSS in the financial industry. The study findings should be helpful to business leaders and decision makers in the financial services sector and to OSS enthusiasts. The emergent research themes identified from the study provide a roadmap for future research on OSS adoption in the financial service sector.

In the remainder of this paper, Section 2 presents a review of relevant literature, while Section 3 describes the theoretical framework for the study. Section 4 presents the methodology for the study, including the data collection and analysis process. Section 5 presents the study's findings, while Section 6 provides a set of recommendations based on the findings. The study is concluded in Section 7 with a summary.

LITERATURE REVIEW

This section presents background on key aspects that pertain to this study. These aspects include an overview of the South African financial sector and its importance and a review of the literature on OSS in banking, OSS in South Africa, and OSS in financial services in South Africa.

The South African Financial Sector and the Importance of It

The South African financial sector is the largest and most developed in Africa. In the banking sector alone, South African banks make up 51% of all banking assets in Africa. In terms of insurance

Figure 1. Leading banks in Africa by assets (African business, 2022)

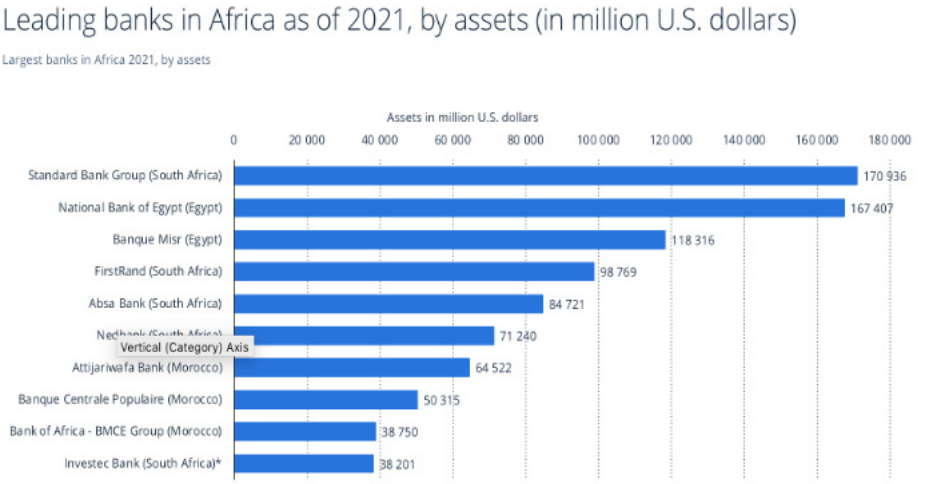
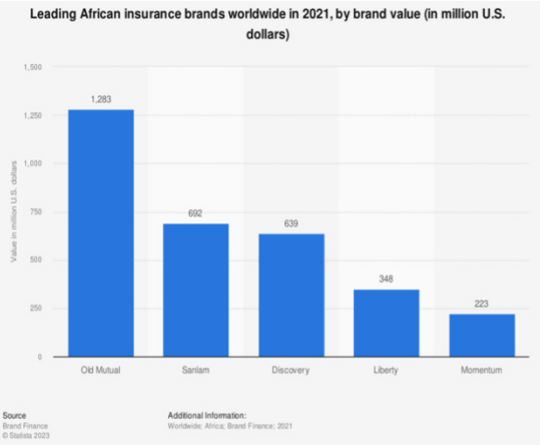


Figure 2. Leading African insurance brands worldwide in 2021, by brand value (Statista, 2021)



South Africa also dominates the African market. Figures 1 and 2 show the weight of the sector in the African context.

Overall, the South African financial sector plays a significant role in the African economy and is a major player in the global financial markets. It therefore is a good choice for this study. In addition, most of the organizations in the South African Financial Services Organizations (FINOSA) are multinational with operations across Africa.

Banking is important, especially in a developing country context. It is a vital driver of the South African economy as it facilitates the liquidity required by households and firms for consumption and future investment. The ability to lend and provide credit is important, on the one hand, as it means that credit and loans extended by financial institutions imply that households do not have to save up in order to make large purchases. Companies, on the other hand, can also start hiring and making capital expenditures immediately in anticipation of future demand and expansion (Banking Sector Education and Training Authority, 2019).

In terms of employment on a national scale, the South African finance sector employed a total of 2.51 million employees in 2019. This is the third largest sector in the South African economy, with a contribution of 15% to the total workforce. The largest is community and social services (22%) followed by trade (21%). The top five large banks, ABSA, Nedbank, First Rand, Standard and Capitec, collectively employ 96% of the labor force, which shows an over-concentration of employment in large corporations. These numbers show that the alternative banking sector and small and medium-sized companies are relatively small in terms of revenue generation and GDP contribution. The South African banking sector is highly regulated and, therefore, a substantial number of role players exist to ensure compliance with both local and international banking regulations (Banking Sector Education and Training Authority, 2019).

OSS in Banking

The only peer reviewed published article on OSS in banking relates to the adoption of OSS in Sri Lanka. The article notes that the adoption of free and open source software (FOSS) products in Sri-Lanka banks is poor (Perera & Weerawarna, 2013). The reason for this is the highly regulated and standardized nature of banking in Sri Lanka with very little room for innovation. FOSS is related to less important activities that do not fall into mainstream banking. This study reveals that core banking, intra-banking (checks), front office (ATMs, front office desktop software), back office and value adding (Web application, etc.), and Microsoft Office applications activities do not utilize a single FOSS product in any bank. As there is a requirement from banking that reliability operating ecosystems like Ubuntu are not to be used for front-line staff, Ubuntu does not provide onsite support compared to Microsoft, for example. Familiarity is also an adoption issue as users are more used to Windows. In the case of ATM machines, no hardware support is found for FOSS products. Accountability rates high in Sri Lankan banks, which can be considered as another reason for the low adoption, as many FOSS products have no commercial support. Another interesting phenomenon that contributes to the lower uptake of FOSS in this context is that senior business leaders get deployed to the information technology (IT) departments in late career and then they have less of an appreciation of OSS.

In contrast, infrastructure activities and programming tools show good FOSS adoption. Examples of this are Linux, Apache, Firefox, and PHP Software.

In summary, FOSS adoption by Sri Lankan banks is nonexistent for core banking, intra-banking, front office, back office, value adding, and office applications, while relatively high for infrastructure and programming tools.

Open Source in South Africa

The South African government initially supported OSS through strategy and policy. The South African Cabinet adopted policies from the Government IT Officer's Council regarding FOSS. The main argument for adopting these policies was the contribution to economic development in South Africa (Department of Public Service and Administration, 2006; Mutula & Kalaote, 2010). Government saw the use of open source as leading to lower administration costs, improvement in local ICT skills, less dependence on imported content, better access to ICT resources, better universal access, maturity of open source software, reduced vendor lock in, and less need to upgrade software when migrating to open source software (Mutula & Kalaote, 2010).

The literature shows that little of this initial promise played out in the public space. Shekgola (2021) found that, in a study limited to electronic records management in Gauteng municipalities, there is a low uptake of open source mainly because of a lack of top management support, ongoing contractual obligations, and lack of capability, organizational culture, and support. As an example, municipalities would rather rent electronic records management software and pay for installation, maintenance, and monthly license fees so that service providers would continue to supply them with electronic records management capabilities.

Hoy (2008) found the same trend in libraries. Libraries are unwilling to take up OSS, or in this case FOSS, because of constraints on technical skills, lack of consensus around open source, limited budgets, and constraints of bandwidth that all contribute to a more traditional non-open-source approach.

In another very limited study Chidoori and Van Belle (2018) focused on the uptake to OSS in small and medium sized companies (SMEs). These SMEs thought that OSS could have benefits for them because it is free to access, distribute, and customize, and it is peer-reviewed for reliability. Drawbacks from adopting open source are uncertain support, technical skills, and incomplete functionality. A key finding is that support of open source by external companies is a major factor that affects the attitude of SMEs toward the uptake of open source.

The largest study on OSS in South Africa, though limited to geospatial information technologies, by Henrico (2020), found that benefits attributed to open source software such as cost benefits, customizability, improved reliability, quality, and security do not primarily influence the use of open source. Habit is the most significant influence on intention to use followed by facilitating conditions, price values, and social influence. The theoretical lens of the study was the unified theory of acceptance and use of technology (UTAUT). The role of habit seems to be correlated to a finding by Johnston et al. (2009). Even though this study is unrelated to open source, they noted that South African outsourcing behavior is primarily driven by habit. This supports the finding of Henrico (2020), that habits play a role in South African technology or trend adoption.

OSS in Financial Services in South Africa

The review of the literature, on the adoption of open source in general and open source in the South African banking sector in particular, is based on searches in Google Scholar, Scopus, and Web of Science. Google Scholar was selected as it includes peer reviewed journals and books as well as unreviewed publications like policy documents and patents. Scopus and Web of Science, in contrast, include only peer reviewed journal articles, books, and conference proceedings.

When Google Scholar is searched with a combination of "open source" and "South Africa" in the title of an article, it yields 11 articles on Google Scholar of which eight refer to technology adoption.

If we expand the search to include "banking," Google Scholar does not yield any results. The search term used for Google Scholar is "allintitle: 'open source' and 'south africa' and 'banking'" and "'open source' and 'south africa' and 'insurance.'" The situation worldwide does not seem better. When we exclude South Africa and just focus on open source and banking, it yields seven articles of which only one (Perera & Weerawarna, 2013) refers to the adoption of open source software in banking and none on the adoption of open source in insurance.

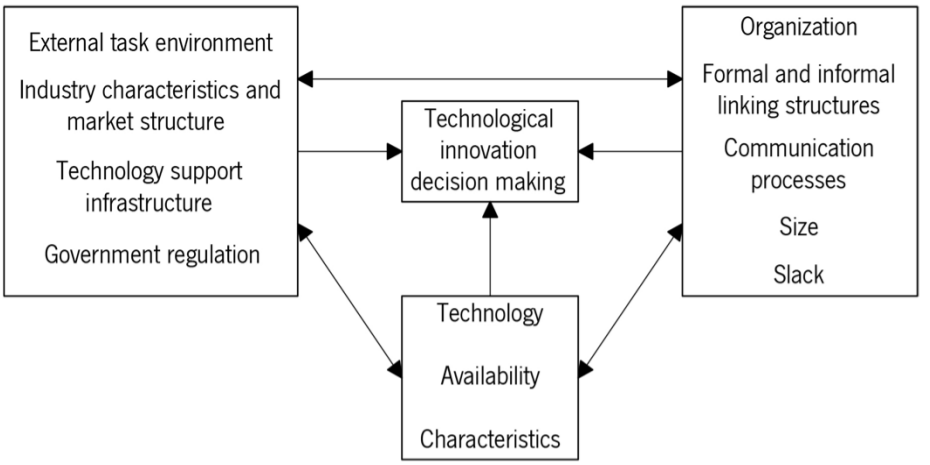
This situation using other research databases is not much better. Scopus yields no articles for "open source" and "banking" and also no articles for "open source " and "South Africa" in the title of articles. Web of Science yields seven results for "open source" and "South Africa" in the title and none for "open source "and "banking."

The conclusion from our literature review is that very little research has been done on open source technology adoption in South Africa and none on open source in banking or insurance.

THEORETICAL FRAMEWORK

There are numerous theories addressing technology adoption. The most used theories are the technology acceptance model, UTAUT, the theory of planned behavior, the diffusion of innovation (DOI) theory, and the technology organization environment (TOE) framework. Whereas the technology acceptance model, UTAUT, and the theory of planned behavior are used for studies on the individual's adoption of technology, DOI and TOE operate at the level of the organization (Oliveira & Martins, 2010). As this paper is answering the questions of open source adoption and of firms, and open

Figure 3. TOE adoption framework (Tornatzky et al., 1990)



source diffusion in the financial sector, we have chosen TOE and DOI as the theoretical references for our study.

TOE Framework

The TOE framework was developed by Tornatzky et al. (1990) to describe how an organization adopts and implements a technological innovation. The aspects of TOE are the technological, organizational, and the environmental contexts. The technological context describes the internal and external technologies that are relevant to the organization. The organizational context describes the descriptive measures of the organization such as scope, size, and managerial structure. The arena in which the organization operates (i.e., the industry, competitors, regulation, and government policies) is referred to as the environmental context, as shown in Figure 3.

The TOE framework is unique, as compared to DOI, in that it includes an environmental context that better explains intra-firm innovation adoption (Oliveira & Martins, 2010).

DOI Theory

The DOI theory enables understanding of the factors that determine the adoption and diffusion of new innovation (Rogers, 2003). An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption (Rogers, 2003). The DOI theory expouses the attributes that influence the adoption and diffusion of innovation, which are relative advantage, compatibility, complexity, trialability, and observability. Each of these attributes can be described.

1. Relative advantage describes the extent to which an innovation is perceived as better than the idea, program, or product it replaces.
2. Compatibility is the perception of the relevancy of the innovation relative to the values, experiences, and needs of the potential adopters.
3. Complexity is the perception of how difficult or easy is it to use the innovation.
4. Trialability is the measure of how well the innovation can be tested or experimented with before a commitment to adopt is made.
5. Observability is the extent to which the innovation provides tangible results that adopters can relate to.

Figure 4. DOI model (Rogers, 2003)

Rogers (2003) also identified five categories of adopters of innovation: innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%), and the laggards (16%), as shown in Figure 4.

METHODOLOGY

Focus Group Methodology

Our initial literature study showed that there is very limited adoption of OSS in the financial industry in South Africa. From this initial reading, we formulated four research questions:

RQ1: What is the state of OSS adoption in the South African financial sector?
RQ2: What are the factors that affect OSS adoption in the South African financial sector?
RQ3: What are the prospects of OSS diffusion in the South African financial sector?
RQ4: Which research opportunities exist regarding OSS adoption in the South African financial sector?

To answer these questions, we carried out an in-depth focus group that was based on the methodological guidelines of Kruegger and Cassey (2002). We chose a focus group approach to meet certain criteria.

- It is a well-suited approach for when one wants to obtain initial, qualitative feedback on specific topics and needs to clarify findings from other methods, in our case, the findings from the literature review (Calazans et al., 2017).
- It is cost-effective (Herrmann, 2013).
- We wanted to collect a concentrated set of observations in a short time space (Massey, 2011).
- Data are produced at three levels of analysis: individual, group, and interactive levels. Taken together, these three characteristics are not necessarily available in other methods (Cyr, 2019).

A focus group approach is an appropriate way to understand how people think about a concept, product, or service. The researcher provides the focus of the discussion, and the data are generated by the discussion in the group. Interaction is at the heart of the focus group method, and the data are generated by the group's interaction as experts react to each other's statements and points of view and bridges are built between the different shared perspectives. The researcher can also observe how a shared understanding is being built up during the discussion. The focus group can serve both exploratory and confirmatory purposes (Daneva, 2015; Daneva & Herrmann, 2019).

Table 1. Features of the focus group

Date	21 November 2022
Location	University of Johannesburg, South Africa
Number of participants	8 (excludes scribes, facilitators and observers)
Industry coverage	1 x Multinational Universal Bank 2 x Multinational Insurers 1 x Medium size financial data brokerage firm
Roles	4 x Enterprise Architects 1 x Head: Software Engineering 1 x Technical Platform Lead 1 x Technical Lead 1 x Board Member
Selection Criteria	Panelists were selected from those who knew what the technology toolset the organization was (in this case, Enterprise Architects) and those who set the guidelines for technology use (in this case, Heads of Software Engineering, Platform leads and Technical Leads). A board member was invited as they have a sense of the commercial implications and organization strategy as it could pertain to open source. The experience of each practitioner was verified prior to the study. We approached the practitioners individually and secured their participation.
Facilitation	A professional facilitator was used, and the two authors kept notes. The Focus group was recorded.
Process	Questionnaire-based was developed and discussed at the focus group. The Miro tool and physical stickie notes were used to capture and theme the different responses to the questions. Intergroup discussion was used to clarify and discuss the answers.

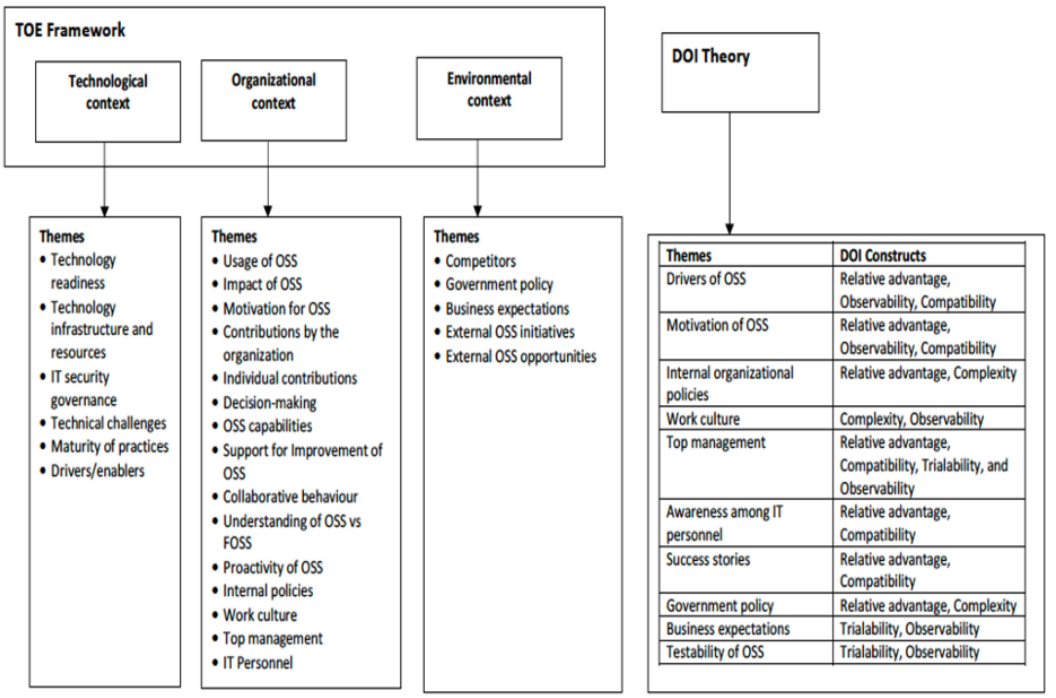
Based on the four research questions, we generated a questionnaire for use at the focus group session. We aimed to invite one management person and one or more technical persons from four different companies (a large multinational bank, two multinational life insurers, and a small financial data brokerage firm). The roles represented were board member, enterprise architect, technical leads, and head of software engineering. A professional facilitator was used to facilitate the session, which ran for about 6 hr. The Miro tool and sticky notes were used to group the answers of the different participants into themes. Two notetakers were also used to capture some of the discussions, and the meeting was recorded. Table 1 shows the focus group features.

Data Analysis

The data collected from the focus group discussion (FGD) include individual responses to questions by each participant written on sticky notes, transcripts of participants' discussions, and notes taken by the researchers during the FGD. The research questions of the study and the guiding questions used for FGD were jointly formulated by the two authors of this paper. After collecting data, the authors individually reviewed and listened to the FGD transcripts.

The focus group data were analyzed using thematic analysis to identify the themes and subthemes that relate to the TOE framework, comprising the technological context, organizational context, and environmental context, and the DOI. We initially used deductive thematic analysis by looking for codes that are associated with the constructs of the TOE framework (RQ1 & RQ2), and DOI (RQ3). Deductive (viz., top-down) thematic analysis involves applying predetermined codes (a priori codes) from a concept or theory in the process of qualitative data analysis (Boyatzis, 1998). We conducted the deductive analysis by following the six steps proposed by Braun and Clarke (2006): (a) familiarization with the data, (b) generating the set of initial codes, (c) searching for themes, (d) reviewing themes, (e) defining and naming themes, and (f) producing a final report. We subsequently conducted inductive analysis to search for other themes relating to OSS adoption and OSS diffusion and to generate more

Figure 5. Identified themes from deductive-inductive thematic analysis



elaborate description of the data. This yielded additional themes and subthemes. The Atlas.ti software tool was used to extract themes after coding. Atlas.ti enables the application of the thematic analysis, which quickens the process of analysis as well as permits deeper analysis of the data.The first author generated initial codes and a set of themes and subthemes. The second author then reviewed the initial themes and subthemes to ensure investigator triangulation and quality assurance. Finally, the new themes identified by the second author and adjusted themes were discussed during three joint review sessions by the authors. The process led to refining the themes and consensus on the final set of themes and subthemes from the analysis of FGD data. The list of themes is presented in Figure 5, while the set of themes and subthemes are shown in Table 2.

Table 2 shows the consolidated themes and subthemes generated from the analysis of FGD data.

RESULTS

The findings of this study, which stem from the data analysis, are presented in sequel sections according to the identified themes that pertain to the three aspects of the TOE framework and the five factors that influence technology diffusion according to the DOI theory. We start with analysis of findings based on the TOE framework and, subsequently, the DOI theory.

Technological Context: TOE Framework

Technology Readiness for OSS

All participants agree that the level of technology readiness of FINOSA is currently very low at the organizational level. However, there is an openness to embrace OSS adoption.

Table 2. Consolidated themes and subthemes of FGD data

Theoretical Construct	Themes	Subthemes
TOE: Technology	Technology readiness (TR)	• Organizational level TR • Individual level TR • Challenges of TR • Enablers of TR
TOE: Technology	Technology infrastructure and resources	• Team collaboration • cloud computing strategy
	IT security governance	• Simplification of IT governance • Shortage of expertise in IT security; • Trust in OSS
TOE: Technology	Technical challenges	• Human factors (HF) • Policy and procedures (POP) • technical and operational issues (TOI) • Organization factors (OF)
TOE: Technology	Maturity of practices	• Guideline/framework for OSS adoption • Metrics for OSS maturity
TOE: Technology DOI: Relative advantage, observability, compatibility	Drivers/enablers	• Externally induced drivers (ED) • Process-based drivers (PB) • Benefits and rewards (BR)
TOE: Organization	Usage of OSS	• Open source tools • Contribution to OSS
TOE: Organization	Impact of OSS	• OSS for front-end operations • OSS for internal operations • Exploration of OSS
TOE: Organization DOI: Relative advantage, Observability, Compatibility	Motivation for OSS	• Quality attributes of OSS • Benefits of OSS
TOE: Organization	Contribution by the organization	
TOE: Organization	Individual contributions	• Personal development • Advancement of software development practice
TOE: Organization	Decision-making	• OSS decisions by senior management • OSS decisions by middle management
TOE: Organization	OSS capabilities	• Investment in Additional OSS capabilities
TOE: Organization	Support for improvement of OSS	• Additional support for OSS • Policy and guidelines for OSS adoption
TOE: Organization	Collaborative behaviour	• Collaboration amongst individuals on OSS
TOE: Organization	Understanding of OSS vs FOSS	• Difference between FOSS and OSS
TOE: Organization	Proactivity of OSS	• Process improvement of OSS • resource commitment to OSS
TOE: Organization DOI: Relative advantage, Complexity	Internal policies	• Organizational policies and regulations on OSS
TOE: Organization DOI: Observability	Work culture	• Improvement of work culture

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Table 2. Continued

Theoretical Construct	Themes	Subthemes
TOE: Organization DOI: Relative advantage, Compatibility, Trialability and Observability	Top management	• Management support for OSS
TOE: Organization DOI: Relative advantage, Compatibility	Awareness of IT Personnel	• Awareness and readiness among IT Personnel for OSS
TOE: Environment	Competitors	• Competitors' disposition
DOI: Relative advantage	Success stories	• Success stories of OSS adoption
TOE: Environment DOI: Relative advantage, Complexity	Government policy	• Government regulations on OSS
TOE: Environment DOI: Trialability, Observability	Business expectations	• Security and availability • Customer expectations • Business goals
TOE: Environment	External OSS initiatives	• Contributions to OSS initiatives
TOE: Environment	External OSS opportunities	• Exploration of OSS opportunities
DOI: Relative advantage, Observability, Trialability	Testability of OSS	• Product acceptance • Testing of OSS solutions

"Low: Business unit open to adoption, but we prefer EOT [Enterprise Operation Transformation] solutions."; "The organization is low to moderately ready. There are projects currently heading towards adopting OSS."; "Groupwide - very low CIB [Corporate Investment Banking] - Open to adoption, but with challenges. As an enterprise: very low; As pockets/individuals: Medium."

"People Challenges: Capacity is always strained, add to that always being asked to do more with less, constant change... If not integrated into what is considered "work" Open Source has no chance of survival. Limited awareness and thus usage"

There is more technology readiness at the level of individuals because there are instances where specific individuals champion OSS. However, in such cases, the drive diminishes when those individuals leave the organization.

"It was typically a pet project for strong individuals, and it died after they left. The organizational skills and structures were never built to make it sustainable."

The participants go further to identify the following as challenges that account for the low level of technology readiness for OSS in FINOSA: preference for EOT solutions, more loyalty to vendors than loyalty to the organization, history of poor track record of OSS in some organizations, lack of continuity of OSS adoption initiatives, lack of organizations skills and structures to make OSS sustainable, governance and compliance restrictions in a highly regulated environment, lack of promotion/motivation of OSS as a strategic enabler of organizational operations, inconsistency of agile ways of working, limitations around human capacity, limited awareness of OSS that affects usage, and trust issues and concerns regarding OSS.

"Vendors drive organizations and loyalty to vendors sometimes higher than organizational loyalty."; "There is an openness, but history and the track record in organizations for open source are not good."

"Low, as we natively don't make use of open source software."; "Currently Low as especially from a GRC [Governance, Risk management, and Compliance] perspective we face a lot of questions around open source in the financial industry."

The participants also identify some existing attributes within the South Africa financial industry, such as innovative culture, readiness of individuals within work units to collaborate, and a generally positive disposition to OSS by many individuals, as capable of promoting the readiness for OSS in the South African financial industry.

"When space and platforms are created, teams and people bring themselves to solve any problem. We already have a culture that creates space for innovation, and block out two weeks every PI towards quiet time."

Technology Infrastructure and Resources for OSS

The rating of the technology infrastructure and IT resources to support OSS in FINOSA varies among the participants. One participant rates it as very high in certain environments due to the adoption of a cloud-first strategy, while other participants give a low rating (5-10%), mild (33%), and average (50%). The participants agree that factors such as the choice of collaboration tools used by software development teams and cloud strategy can affect the effectiveness and benefits of OSS adoption.

"I would give it a 5 out of 10. We are using bitbucket, which I think brings about a lot of friction when it comes to collaboration among developers. There are just too many technologies used across the organization and no central place to tie in everything together."
"It's about 33%."; "Very high due to cloud first strategy. AWS (and not so much Azure yet) open the doors from an IaaS perspective."; "In particular areas: very High on average I believe the resources / Skill required is available."; "Neutral, not sure."; "It is 5%."; "10% some cloud-based solutions are used for data handling."

IT Security Governance for OSS

The participants agree that OSS adoption affects IT security governance in FINOSA. On the one hand, it increases the complexity of IT security governance.

"It will lead to a lot more governance."; "It would add a layer of complexity to our IT Security governance."; "It would potentially simplify it, but this is where the largest barrier to acceptance is."; "It would lead to a lot of security controls one would need to put in place."; "They'll need to exercise their processes and enable simplified means to do their security checks on OSS."

In addition, the participants also opine that OSS adoption poses a challenge to IT security governance.

"There is a big skills shortage in deep-level IT security. Most organizations are vendor driven in their security approach."; "Not sure, honestly, especially with all the data breaches we currently hear about, a lot of change will have to happen in the company."

Technical Challenges of OSS

The participants identified several technical challenges that could affect OSS adoption from the discussion. These are issues around security change management, business compliance and regulations, tools for team collaboration, complexity within the organization, challenges of supply chain management and security, lack of community contribution compliance, lack of internal adoption management, issues of skills and trust, lack of technical documentation (which can affect implementation and troubleshooting), resilience to change on the part of the staff, high availability capability, and policies and procedures of the organization.

Maturity of OSS Practices

All participants mention that there is no defined template for OSS adoption. Also, there needs to be a metric/framework/standard for assessing the quality of OSS practices.

"There is no model that I know off. I have been asking middle management and executives, but it sounds like it is not even a conversation."; "No (not yet), but yes for inner source, WIP."; "No, none that I know of."

However, one participant observes that his organization has metrics for assessment of the quality of inner source. Another organization has started a platform engineering initiative by creating API enablement teams and DC platforms based on their shared appreciation for open source.

"We have created our API Enablement Teams and DC Platforms based on our shared appreciation for open source - Document Everything - Measure of Maturity is linked to the degree of self-service for feature teams to build, deploy and operate their features on your platform - Automate your standards into your pipelines (code quality, testing, build, deploy etc.) (DORA, not opensource specific, but great) - Get to know your community. Here we make various spaces available for showcasing; this helps in developing understanding."

Drivers/Enablers of OSS Adoption

The participants identified the following as technology drivers for OSS adoption: market usage, use of good team collaboration tools, code and tools reuse, enabling supply-chain management for OSS, curating vetted OSS in bank repositories, managing the gnome garden, driving maturity through platform engineering, cost reduction, ease of use, reliability, and shared knowledge of a big community.

"The driver are 1. Enabling supply-chain management for OSS 2. Curating vetted OSS in bank repositories 3. Managing the gnome garden 4. Driving maturity though platform engineering"
"Drivers include cost, ease of use, reliability"; "cost, shared knowledge of a big community."

Organizational Context: TOE Framework

Usage of OSS

According to the participants, OSS is used in various units and sections of most financial organizations to perform various tasks. However, instances where a financial organization has put out OSS for open consumption and amendment are rare.

"I know it is being consumed in my space in the form of Java frameworks and servers, but I don't know of any part of the organization that is putting software solutions out there for open consumption

and amendment."; "It is being used in CI/CD 2. Infrastructure Automation 3. Unix Estate Replacement 4. Platform Engineering 5. Cloud adoption. To drive innovation, e.g. in PoC's or PoT's, open source frameworks have been used to accelerate CI/CD and Continuous Testing initiatives."

Impact of OSS

Most participants (n=6) think that OSS could have a high impact in areas that focus on internal operations and, to a lesser extent, front-end operations.

"I think internally across all business units and in our business-to-business solutions. Businesses care about their bottom line and therefore would be willing to pay for resources to contribute to OSS."

"1. Unix Replacement 2. Platform Engineering and DevOps"; "Backend system (accounting, Core PAS, Core Banking) where there are no business benefits to have unique systems. And front end like chromium, android, etc. that reduce the number of interfaces to develop customer experiences."; "Anything that would lie in the areas of not core, not a differentiator. Another area would be where we try to unlock the same ease of use for all customers"; "Software, DevOps, quality engineering."

Fewer participants (n=2) believe that the applicability of OSS needs to be explored more to determine where it can have its biggest impact.

"It's debatable at this stage. We're yet to explore the option and build out use cases."; "We will need to explore the applicability."

Motivation for OSS

The participants opine that the potential of OSS to faster adaptation to change, foster a culture of innovation and good engineering practices through skills development, simplify operations and reduce cost, reduce vendor lock-in, and increase the speed to market are the motivations for OSS adoption.

"Allow the organization to adapt to change faster and foster a culture of innovation and solid engineering practices through skills development."; "1. Simplification 2. Cost reduction 3. Agility 4. Reducing vendor lock-in (I'm looking at you, AWS)"; "Lower cost basis with the same risk profile."; "Speed to market - solving challenges faster"; "Quicker to market capability, customisable to fit the purpose. Budget-friendly."

Also, one participant posits that issues about OSS's security, reliability, and maintainability affect motivations for OSS adoption.

"Is it secure? Is it reliable? And is it easy to maintain".

Contribution by the Organization

The participants state that the organizations in FINOSA have not been contributing to OSS. However, they identify the likely drivers of contributions to OSS. These are the desire of an organization to attain leadership in the industry, expression of DevOps-based culture, facilitation of skills development, recognition for people and the organization, the desire to solve common industry challenges or problems, linkage to some business metric that contributes back to society, and desire to promote new trends and innovation.

"1. Industry leadership 2. Expression of DevOps-based culture 3. "Tide lifts all boats equally."; "Increased security, skills development and innovation"; "Innovation Increased security larger knowledge base."; "Skills development, recognition for people and the organization";

"Solving Common Industry Challenges/ Problems (things that give us all a joint headache) - Linkage to some sort of business metric that contributes back to society (e.g. Environment Scores, Transformation Scores) -Skills and Culture, EVP."

"Solving issues, implementing clean code, performance and security flaws."; "Not contributing at this stage, but I would say for the benefit of group knowledge, adopting and promoting new trends and innovation."

Individual Contributions to OSS

The participants identify likely reasons for individuals or employees within FINOSA to contribute to OSS: skills development, the desire to express personal creativity, an affinity with a solution or system, to gain industry credibility, desire for career growth and recognition, satisfaction derived from problem solving, collaboration with like-minded people, and working for the common goal of enablement and growth of the software development practice.

"Skills development and better quality assurance are my reasons. The freedom to express my creativity."; "1. An expression of personal values 2. An affinity with a solution/system 3. Industry credibility 4. Experience"; "Skills Development and Recognition. Solving your own blockers, problem-solving satisfaction recognition"; "Career growth and recognition. Developer satisfaction for individuals."

Decision Making on OSS

In most financial organizations in South Africa, the key decisions on OSS are made mainly by people in roles such as chief information officers, architects, tech leads, software asset managers, and risk and compliance managers.

"Decisions are made by senior and middle management only."; "CIO, Architect, tech lead."; "The wrong ones 1. Software Asset Management 2. The Compliance Cabal."; "Tech Leads and Architects Heads of Area Security / Risk and Compliance."

OSS Capabilities

All participants observe that their organization do not invest in additional OSS capabilities.

"No."; "Not that I know of. Unless you consider Hackathons as open sourcing innovation."; "No. Happens incidental."; "No, we consume but don't invest."; "Not that I am aware of."

Support for Improvement of OSS

The participants are unsure whether financial organizations in South Africa are making any direct efforts to improve OSS practices.

"Unsure"; "Indirectly."

However, they identify different areas where additional investments can be made to improve the use of OSS in FINOSA. These include platform solutions, starting with inner source and the use of learning to drive OSS; establishing a formal mechanism for open source consumption and contribution; training and upskilling in OSS capabilities; more conversation around OSS, consumption, and contribution; an operating model that enforces business outcome and technology outcomes; and development of OSS policy and guidelines in FINOSA because currently such do not exist.

"Within our platform solutions where most developers build their solution on, so basically starting with inner source and then use the learnings to drive OSS"; "having an Operating model that drives and enforce business outcome and total technology outcomes."; "Establishing a formal mechanism for open source consumption and contribution."; "Create processes to adopt open source and make it clear about the do's and don'ts for OSS.; "Training and upskilling which will allow companies to assess capabilities to possibly implement."; "Training I would say as well as enablement to have the conversation around OSS, consumption and contribution."

Collaborative Behavior

Half of the participants attest to the promotion of collaborative behavior in OSS-related activities like inner sourcing, hackathons, and boot camps within their organizations.

"There is verbal collaboration and not really implementation collaboration. Consulting is what is championed. Guilds."; "Inner sourcing - Platform Engineering - Collaborative Delivery enablement."; "Knowledge Sharing Hackathons Showcases building a Platform"; "Engineering Bootcamps, demos, hackathon."

The other half says that their organizations do not have any form of collaboration on OSS-related activities.

"Do not know of any"; "None."' "None."

Understanding of OSS Versus FOSS

Generally, there is no distinction between free open source and OSS in FINOSA.

"Not that I know of. FOSS seems to be inferred from OSS."; "We do not necessarily distinguish between the two; the old guards do nothing without a support agreement, so there is an unintentional tendency to OSS."

Proactivity of OSS

The participants observe that their organizations do not relook at their business model to improve OSS initiatives.

Internal Policies

The participants claim that, currently, there are policies that can hamper OSS adoption. For example, some organizations have internal policies that promote vendor loyalty at the expense of organizational loyalty, which makes widescale OSS adoption within the organization difficult.

"[There is] vendor lock-in, broader support neded especially in development, and budget";
"Vendors drive organizations and loyalty to vendors sometimes higher that organizational loyalty."

Work Culture

The participants agree that the work culture within an organization can affect OSS adoption. For example, they observe that the culture of vendor loyalty in many organizations can impede OSS adoption. However, the culture of wanting to share can help OSS adoption. Also, the value that OSS can bring influences the organizational culture.

"There is verbal collaboration and not really implementation collaboration."; "There is the adoption of software that encourages collaboration and enforces visibility of inner workings of software solutions across the organization."

However, the culture of vendor loyalty that exists in many organizations limits OSS adoption.

"Most organizations are vendor driven in their security approach."

Top Management

The participants observe that management support varies depending on a management executive's background and professional experience.

"Buy-in from the CEO level is important for successful adoption of OSS."

IT Personnel

The participants observe that the level of awareness of OSS in FINOSA is varied depending on individuals' academic background and professional experience. Those who have worked in environments where OSS initiatives have been encouraged are more disposed to it than those who have not.

"There is an openness [to OSS], but past history and the track record in organizations for open source is not good. Organizational memory is not good. It was typical a pet project for strong individuals, and it dies after they left."

Environmental Context: TOE Framework

Competitors

According to the participants, adopting OSS is not entirely dependent on the activities of competitors. However, the business success stories of other competitors and wider industry usage spur OSS adoption.

"As a large organization, there has been a growing trend in which we look like followers of trends due to our slow implementation of new solutions. We tend to increase the pace at which we adopt new solutions once we have seen the benefits from other competitors."

"Our organization would adopt irrespective of the adoption in the industry but would expect to see wider adoption as a result."

"Being Risk-averse, the activity of competitors would provide credibility and structure. In addition, it would spurn interest and buy-in. Knowing how this translates in value or how to establish a link between the use of OSS and measuring the business value it creates.";

Government Policy

The participants observe that government significantly influences what financial organizations do, particularly in terms of regulation and policies. However, most participants agree that government policies and regulations do not negatively affect organizations because they are free to do whatever is deemed suitable to increase their efficiency and productivity. Thus, if OSS can offer a competitive advantage, government regulations should not limit them.

"Governments will not bring out rules that will limit listed companies. If the government develop abundant skills in open source platforms, it will become a good alternative for organizations."

"Medium. While organizations will always comply to regulations and policies when the competitive advantage to be gained is seen to be substantial, then organizations plot their own path; we saw it in many industries, even our own, when it came to adopting cloud."

However, few participants think government regulations influence processes and procedures, particularly from an OSS data risk and exposure perspective.

"Governance and regulations have a lot of effect on our processes and procedures especially from a data risk and exposure perspective so again risk and the perspective of risk via OSS."

Business Expectations

The participants observe that security and availability underpin customers' trust. Thus the organizations in FINOSA are expected to provide these. OSS may not be the way to go because of its associated exposure risks, but it can be an option if it can ensure security and availability. FINOSA organizations are profit-driven and ready to adopt anything that can lead to better customer retention and higher profit, although that may be poorly implemented.

"Customers lean on us with their most valuable resource and therefore expect us to take security and availability seriously, and from hindsight, OSS may not look like the way to go as we are exposing ourselves."

"Organizations are profit driven. Anything that they perceive will lead to better customer retention and higher profit will be adopted. Most times, these will be badly implemented."

"'Always on and Always secure' underpins customers/stakeholders trust in the organization's threat of attacks. In addition, requires a solid adoption model needs to be applied. Whether internal or external, this is still the foundation; once benefit and risk can be shown, this can be met."

External OSS Initiatives

The participants state that, so far, FINOSA organizations are involved in the consumption of OSS projects and have not contributed to external OSS initiatives. However, organizations' open coding and sharing practices occur in inner source projects.

"No contribution at all, only consumption and forking."; "I contribute to/lead an inner source project. I have submitted a number of merge requests in my personal and professional capacity, with mixed results."; "Yes, inside. provide frameworks, tools and solutions."; "Currently consumption of OSS projects only."

"Inside the Organization – Yes, we have adopted a philosophy of Pioneer and Share); in some cases, this means that teams can take our scripts/frameworks, and in other cases, they can expose their features via APIs, allowing for updates and contribution back. Outside, no, we tried once but then were stopped by legal and compliance."

External OSS Opportunities

The participants agree that FINOSA organizations do not scan the external environment for OSS opportunities at the organizational level. One of the factors responsible for this is when an organization is vendor-driven and has big-vendor loyalty.

"No (Groupwide), plan to (CIB)"; "No. [due to] vendor-driven and big vendor loyalty." "Not that I know off." "No, but I think that given the time and effort to execute a planned used case would definitely work."

At the individual level, some team members have explored open platforms such as Engineers Gone Wild and IP Sprint to showcase their work, get feedback, and give support.

"Team Members do, and platforms like Engineers Gone Wild, Programme Sync or IP Sprint are great platforms to showcase, get feedback and support."

OSS Diffusion

In this section, we analyze the findings of our study using DOI as a lens from the perspective of five attributes that influence the diffusion of innovation: relative advantage, compatibility, complexity, trialability, and observability.

Relative Advantage

The participants identify several areas where adoption of OSS offers relative advantage that culminates in the spread of OSS diffusion as an established and prevalent practice within FINOSA. The themes for which there are responses (Figure 5) that convey a perception of relative advantage of OSS are expressed and outlined.

1. Existence of positive drivers of OSS.

"There is a business value that comes out when adopting OSS. The fact that we can solve issues, implement solutions with a fractions of the costs if we used OSS. Broaden the community support with official platforms."

"The adoption of software that encourages collaboration and enforces visibility of inner workings of software solutions across the organization".

2. Existence of positive motivation for OSS. The participants opine that positive motivation to adopt OSS exists because of its advantages compared to the use of proprietary tools.

"1. Simplification 2. Cost reduction 3. Agility 4. Reducing vendor lock-in (I'm looking at you, AWS)"

"Lower cost basis with the same risk profile."; "Speed to market —solving challenges faster"; "Quicker to market capability, customisable to fit purpose. Budget friendly"

3. Internal policies. The participants note that friendly internal policies aid OSS adoption and diffusion, while proliferation of harmful internal policies hamper it.

"Most organizations are vendor driven in their security approach."
"[There is] vendor lock-in, broader support needed especially in development, and budget";

4. Top management. Participants agree that an understanding of the capabilities and relative advantage of OSS among personnel at senior to middle top levels can aid OSS diffusion.

"Decisions are made by senior and middle management only."; "Buy-in from the CEO level is important for successful adoption of OSS."

5. Awareness of IT personnel. In some organizations there are employees with high awareness and readiness for OSS, which can aid OSS diffusion in terms of understanding its relevant advantage and compatibility.

"When space and platforms are created teams and people bring themselves to the solve any kind of problem. We already have a culture that creates space for innovation, and block out 2 weeks every PI towards quiet time".

6. Success stories. Participants observe that success stories of OSS can aid diffusion because it fosters understanding of relative advantage and compatibility of OSS.

"Businesspeople follow business success stories, not technology success stories. If the adoption of a new OSS makes one of their competitors 10 times me profitable, there will be interest."
"Success stories and the value that OSS will spark interest and investment to it."; "Similar industry usage and success stories will allow the conversation to be taken further."

7. Government policies. The participants opine that favorable government policies can aid OSS diffusion, while unfavorable government policies hamper it, because bad policies hinder relative advantage and increase the complexity of OSS.

"The influence is very big as we are handling people's finances, and our work impacts almost every living organism in the country, so I perceive it to be a highly regulated environment."
"Governments will not bring out rules that will limit listed companies. If the government develop abundant skills in opensource platforms, it will become a good alternative for organizations."
"[Government regulations] It hinders and is sometimes purposefully misconstrued as a risk or challenge to compliance."

Compatibility

Compatibility as an influential factor of technology innovation refers to the perception of the relevancy of an innovation concerning the values, experiences, and needs of the potential adopters.

The responses of participants indicate that the existence of positive drivers of OSS, motivation for OSS, positive disposition of management personnel, high awareness of OSS among IT personnel, and availability of success stories enhances the perception of compatibility of OSS, which aids OSS diffusion in FINOSA.

Complexity

From the perspective of the DOI theory, complexity is a measure of the difficulty associated with how easy or difficult it is to adopt a new innovation. The themes that relate to complexity of OSS (Figure 5) are work culture, internal policies, and government policy. The participants observe that the culture of knowledge sharing and collaboration among workers can enhance skills development and minimize the complexity of OSS. However, unfriendly internal policies of an organization and government policy increase complexity of OSS and hamper OSS diffusion.

Work culture:

"There is verbal collaboration and not really implementation collaboration."; "There is the adoption of software that encourages collaboration and enforces visibility of inner workings of software solutions across the organization."

Internal policies:

"Most organizations are vendor driven in their security approach." "Vendors drive organizations and loyalty to vendors sometimes higher that organizational loyalty"
"Most organizations are vendor driven in their security approach."

Government policy:

"[Government regulations] It hinders and is sometimes purposefully misconstrued as a risk or challenge to compliance."

Trialability and Observability

Based on participants' responses, we find two themes, business expectations and testability of OSS, as most relevant to trialability and observability.

1. Business expectations: The participants observe that financial organizations in South Africa are ready to adopt solutions that enable them to meet customers' expectations and business goals. Hence, the trialability and observability characteristics of OSS can enable its diffusion in FINOSA.

"Organizations are profit driven. Anything that they perceive will lead to better customer retention and higher profit will be adopted. Most times these will be badly implemented."

At the same time, financial organizations are cautious of adopting OSS because they need assurance that their business objectives and the desire to satisfy customers' expectations are not jeopardized.

"Customers lean on us with their most valuable resource and therefore expect us to take security and availability seriously and from hindsight OSS may not look like the way to go as we are exposing ourselves."

2. Testability of OSS: The participants observe that OSS encourages testing and experimenting with different versions of a solution before final deployment, which can ensure security and availability. The testability of OSS enhances trialability and observability, which can aid OSS diffusion.

"To drive innovation e.g. in Proof of Concepts (PoC) or Proof of Technology (PoT), open source frameworks have been used to accelerate CI/CD and Continuous Testing initiatives."

DISCUSSION

In this section, we discuss the findings of this study in relation to the four research questions (R1-R4) posed.

State of OSS Adoption

Our study shows no distinction between free open source and OSS. The senior to middle management roles make decisions on OSS in FINOSA. There is also a widespread perception that adopting OSS can shape the work culture within FINOSA. We also find that the level of awareness of OSS in FINOSA varies depending on individuals' academic backgrounds and professional experiences. In all financial organizations, support for OSS adoption from the top management (chief executive officer level) is crucial for OSS adoption.

OSS adoption is motivated by several positive factors, including the capacity to enable faster adaptation to change, foster a culture of innovation and good engineering practices through skills development, simplify operations and reduce cost, reduce vendor lock-in, and increase the speed to market. Also, motivation for OSS is influenced by perceived security, reliability, and maintainability.

So far, OSS tools and resources are being used at various levels for various tasks within FINOSA. Examples include using Java frameworks and servers, infrastructure automation, Unix estate replacement, platform engineering, continuous testing, and DevOps engineering initiatives. Specific open source tools being used include Chromium, Android, PostgreSQL, AWS Cloud, and Code Quality software. There is increasing consumption of OSS tools and resources in the financial sector of South Africa, which confirms the findings of the FINOS 2021 report, which states that OSS consumption in the financial sector is increasing globally.

The adoption of OSS is expected to have a high impact in areas that focus on internal operations (such as business-to-business solutions, Unix replacement, platform engineering, DevOps, quality engineering, and backend systems where there are no business benefits to having unique systems) and to a lesser extent on front-end operations. Furthermore, the impact of OSS is bound to grow with more exploration of the applicability of OSS by FINOSA.

Factors That Affect OSS Adoption

We discuss this from the technological, organizational, and environmental perspectives regarding OSS adoption by financial organizations.

Technological Factors of OSS Adoption

The perception of the rating of technology infrastructure and resources for OSS in FINOSA varies. While it is rated high in certain environments due to the adoption of a cloud-first strategy, the ratings can be described as low (5-10%), mild (33%), and average (50%) in some other organizations.

There are positive technological factors that can aid OSS adoption in the financial industry. There is openness to embrace OSS in most organizations. Also, technology readiness at the level of individuals is appreciable. Although Petrov and Obwegeser (2018) observed that individual factors, such as employees' resistance to change and noncompetitive technology leadership behavior, might negatively influence the adoption process, which is not a problem yet in FINOSA.

Several enablers that can aid OSS adoption exist. These include market usage, good team collaboration tools, enabling supply-chain management for OSS, curating vetted OSS in bank repositories, managing the gnome garden, driving maturity through platform engineering, cost reduction, ease of use, reliability, and shared knowledge of a big community.

Negative technological factors can impede OSS adoption:

Low Technology Readiness at the Organizational Level. So far, technology readiness at the organizational level is low. Although technology readiness at the level of individuals is appreciable, it is not being driven sustainably. Thus far, the readiness for OSS adoption at the organizational level has been hampered by challenges that include issues such as the history of a poor track record of OSS, vendor loyalty, over-reliance on vendors, preference for EOT solutions, inconsistency in the use of agile ways of working, lack of trust in OSS, insufficient promotion of OSS within organizations, lack of awareness of OSS, over-regulation and restrictions, lack of continuity of OSS initiatives, lack of structures that ensure the sustainable pursuit of OSS initiatives, and limitation in terms of human capacity. Also, there is no process maturity model (PMM) to assess the quality of OSS practices in the financial industry of South Africa. These findings are supported by Petrov and Obwegeser (2018), who observed that issues of vendor lock-in, free/libre, FOSS maturity, and lack of external support are the technological barriers to FOSS adoption.

IT Security Governance. OSS increases the complexity of IT security governance. Thus, there is a need to (a) put more security controls in place and (b) derive simplified means to perform security checks on OSS. However, adopting OSS can also simplify IT security governance in the financial industry. This observation is supported by Carter et al. (2022), who stated that increased focus on OSS improved security in the state of open source in financial services reports for 2022.

However, considering the current state of things in FINOSA, OSS adoption poses a challenge to IT security governance because (a) there is a skills shortage in deep-level IT security, (b) many organizations are vendor-driven in their IT security approach, and (c) there are concerns about trust in OSS due to occurrences of data breaches. This observation confirms the findings of Ellison et al. (2021) and Carter et al. (2022), as reported in the state of open source in financial services reports for 2021 and 2022, that financial institutions must continue developing open source governance, policies, processes, tools, and training.

Existence of Technical Challenges. Several technical challenges that can hamper OSS adoption exist. These challenges can be classified into four categories: human factors, external policy factors, technical and operational issues, and organizational factors. Specific challenges pertain to each of these categories:

- Human factors: lack of community contribution compliance by employees, shortage of skills and lack of trust in OSS by some employees, and resilience to change on the part of employees.
- External Policy factors: business compliance and regulations challenges.
- Technical and operational issues: issues around security change management, tools for team collaboration, challenges of supply chain management and security, lack of technical documentation (which can affect implementation and troubleshooting), and high availability capability.

- Organization factors: complexity within the organization, lack of internal adoption management, and policies and procedures of the organization.

Lack of PMM. Currently, in FINOSA there is no maturity model to assess the quality of OSS practices. Also, only a few have considered developing quality assessment metrics for activities such as inner source and platform engineering.

Organizational Factors of OSS Adoption

Our findings show that the existing culture of wanting to share among employees in many organizations can help OSS adoption. Also, adopting OSS can positively shape the work culture within FINOSA. There are individuals within FINOSA who are driven by personal goals and motivated to contribute to OSS initiatives. Some of the personal goals include the quest for skills development, a desire to express personal creativity, an affinity with a solution or system, to gain industry credibility, a desire for career growth and recognition, satisfaction derived from problem solving, collaboration with like-minded people, and working for the common goal of enablement and growth of the software development practice. Also, some organizations have a culture of promoting collaborative work activities such as inner sourcing, platform engineering, collaborative delivery enablement, hackathons, and bootcamps, which can aid OSS adoption.

There are areas where improvements are required to ensure OSS adoption. FINOSA organizations have not paid attention to initiating OSS projects for open participation by other organizations and the public. Financial organizations in South Africa must start promoting public OSS initiatives relevant to the financial industry to stimulate collaboration for excellence within the financial industry instead of competition. Also, FINOSA organizaations have not been contributing to OSS. It has been more about consumption than contributing to the advancement of OSS (Carter et al., 2022). However, several drivers can facilitate more contributions to OSS. These include the desire of an organization to provide leadership, earn recognition and reputation, and collaborate with peers in the industry.

FINOSA organizations have yet to consciously invest in additional OSS capabilities that can advance OSS practices. In addition, so far, no direct efforts have been made by FINOSA to improve OSS practices. However, additional investments can be made in many areas to improve OSS practises by FINOSA. These include establishing a structure for the OSS governance (policy and regulations, guidelines for consumption and contribution to OSS), training and capacity improvement on OSS, promotion of platform solutions and inner source, and a model that enforces both business outcome and technology outcome.

Some financial organizations are not doing enough to encourage collaborative behavior that can aid OSS-related activities. Many organizations are not proactive in their approach to OSS because they do not relook at their business model to improve OSS initiatives. Certain organizations have internal policies that can hamper OSS adoption while some organizations have a work culture of vendor loyalty that can impede OSS adoption. For example, large banks are quite conservative and, in general, do not have the decision-making agility of smaller companies. As noted in the earlier section on banking in South Africa, much of the workforce in the financial sector is concentrated in the large banks (96%). This may be one of the reasons for a lower uptake of OSS.

Environmental Factors of OSS Adoption

Our study reveals that, although the adoption of OSS by a financial organization is not dependent on the activities of competitors, the business success stories of competitors can aid the adoption of OSS. Generally, government policies and regulations in South Africa are not considered inimical to OSS adoption. However, government regulations are believed to influence processes and procedures, particularly regarding risks associated with OSS data. However, for OSS to gain wider adoption in FINOSA, it must meet customer and business expectations regarding security and availability issues.

FINOSA organizations have not been making contributions to external OSS initiatives. However, open coding and sharing practices within the organizations occur in inner source projects. This situation supports the position of Carter et al. (2022) that financial organizations have focused more on the consumption of OSS resources than their contribution to OSS. Also, FINOSA needs to do more in sourcing for external OSS opportunities. Generally, they do not scan the external environment for OSS opportunities at the organizational level. The fact that many financial organizations are still vendor-driven and have big-vendor loyalty may be responsible for this. The vendor loyalty problem may be because proprietary products are perceived to have superior quality, particularly in developing countries. This notion has hampered OSS adoption in some cases (Spinellis & Giannikas, 2012; Tome et al., 2014; Petrov & Obwegeser, 2018).

Prospects of OSS Diffusion

Our study reveals several factors that can influence the spread of OSS as prevalent practice in FINOSA. Curently there is a signicant perception that OSS possesses the attributes of relative advantage, compatibility, trialability, and observability, which can lead to diffusion of OSS in FINOSA. There are also concerns that can increase the complexity of OSS, which can hinder its diffusion in FINOSA.

Relative Advantage and Compatibility of OSS

First, there is a sense that OSS can yield relative advantage in terms of promoting the ability to adapt faster to change, fostering a culture of innovation and good engineering practices through skills development, simplified operations and reduced cost, reduction in vendor lock-in, increased speed to market, code and tool reuse, and security, reliability, and maintainability of OSS. All of these provide good motivation for OSS adoption and diffusion. Second, there are existing conditions within FINOSA that can enable OSS diffusion. These include externally induced drivers (e.g., market usage), process-based drivers (e.g., use of good team collaboration tools, supply-chain management for OSS, curating vetted OSS in bank repositories, managing the gnome garden, platform engineering practices), and benefits and rewards (e.g., cost reduction, ease of use, reliability, shared knowledge of a big community). Third, an increased understanding of the relative advantage of OSS among top management aids OSS diffusion.

In addition, there is high awareness of OSS among IT personnel in some financial organizations in South Africa, unharmful government policies, and ample success stories from some organizations that have adopted OSS practices. All of these increase the understanding of the relative advantage and compatibility of OSS, which increase the prospect of OSS diffusion in FINOSA. This finding agrees with observations from previous studies on DOI that have explored the relationship between relative advantage and compatibility on the perceived usefulness and perceived ease of use of mobile payment as an innovation in the banking sector (Manrai & Gupta, 2022), and in the diffusion and adoption of an open source learning platform (Huang et al., 2020). These studies show a strong positive correlation between user behavioral intention toward the diffusion and adoption of new technology and the perception of relative advantage and compatibility.

Complexity of OSS

The prospect of OSS diffusion is enhanced by the culture of knowledge sharing and collaboration that exists among employees in some financial organizations. A culture of knowledge sharing engenders skills development, which minizes the complexity of OSS operations. However, the existence of internal policies that promote vendor loyalty at the expense of organizational loyalty in some financial organizations in South Africa increases the complexity of OSS. Also, the advent of harmful government policies that can lead to inadequate regulatory support increase the complexity of OSS, which hampers OSS diffusion. Our observation on the influence of complexity on OSS diffusion in FINOSA agrees with the findings of the study by Matsepe and Van der Lingen (2022)

that focused on the determinants of emerging technologies adoption in the financial sector of South Africa. The authors found that complexity and user insecurity inhibits technology adoption at the individual level while, at the firm level, competitive pressure, regulatory support, customer demands, decision-maker risk orientation, opinion leadership, effective communication mechanisms, and top management supports adoption.

Trialability and Observability of OSS

In this study, we find that trialability and observability characteristics of OSS aid technology diffusion. This observation agrees with the findings by Huang et al. (2020) regarding the factors influencing the diffusion and adoption of an open source learning platform. The authors found that trialability, observability, ease of use, and relative advantage are the factors most related to the diffusion and acceptance of the open source learning platform innovations. Our study also suggests that triabillty and observability are similarly critical for adoption and diffusion of OSS in FINOSA.

Comparative Analysis of OSS Adoption in FINOSA and Other Sectors

Sequel to our findings on OSS adoption in FINOSA, in this section, we present a comparative analysis of findings relative to other sectors in South Africa.

FINOSA and Other South African Governmental Agencies

The factors driving the adoption of FINOSA as compared to public enterprises are very different. In general, FINOSA organizations are more open to OSS as compared to municipalities. In research done by Shekgola et al. (2021), there seemed to be minimal appetite for OSS in municipalities. The adoption of OSS for the management of electronic records is mainly absent in the Gauteng (a province in South Africa) municipalities. Several factors contribute to the low OSS, that is, a lack of support from senior management, contractual obligations, and resistance to change (Shekgola et al., 2021). These are not primary factors for FINOSA.

FINOSA and South African Geospatial Software

Henrico (2020) did a study on the adoption of open source geospatial software in South Africa. Even though this was at an organizational level and not at an individual level, some interesting differences between FINOSA and the adoption of OSS geospatial software adoption are noted. The findings of their study show that the adoption of open source geospatial software in South Africa is not primarily influenced by the benefits attributed to open source software. Habit and facilitating conditions (support) have a stronger influence than, for example, cost benefits and customizability. The implication is that geospatial software users do not perceive OSS to be worth the effort of breaking their current habits.

None of these factors idemtified by Herinco (2020) play a role in FINOSA adoption of OSS. Factors important to FINOSA are security, technical challenges, process maturity, or personal growth.

FINOSA and Other Global Financial Services: OSS Studies

In 2021 FINOS published its report on the state of open source in financial services (Ellison et al., 2021). Our study's and FINOS's findings show a remarkable difference in terms of organizational and personal contribution to OSS. In this study, we raise the issue that the financial industry in South Africa does not contribute to open source projects and that it does not contribute to the improvement of OSS. This is in contrast to Ellison et al. (2021), who reported that globally, 40% of their survey respondents spend at least a few hours a month working on OSS projects officially, but 65% spend a few hours of personal time on OSS.

An area of agreement between FINOSA and the global trends is the lack of organizational policies. Ellison et al. (2021) reported that only 8% of their study's respondents have policies that always encourage upstream contribution, that 15% of employees are unclear of OSS contribution policies,

Table 3. Sample research questions on OSS adoption and diffusion

S/n	Research question	Methodology
1	What are the barriers and drivers of OSS adoption and diffusion in a specific type of financial services organization (e.g. insurance / banking / brokering / fintech)?	Qualitative study — using case study/ multiple case study/ grounded theory
2	What are the determinants of OSS adoption and diffusion in a specific type of financial services organization (e.g. insurance / banking / brokering / fintech)?	Quantitative study — using survey/ Structural equation modelling
3	How does OSS adoption and diffusion in the banking sector compare with the insurance sector?	Qualitative study/mixed-methods — using case study/ multiple case study/ grounded theory/survey
4	What is the impact of OSS adoption in financial services organizations in South Africa (or elsewhere)?	Qualitative study/mixed-methods — using multiple case study/ survey

and that 56% of respondents have difficulty making good decisions around OSS. This correlates well with this paper's findings that the lack of internal adoption management, policies, and procedures of the organization limits OSS adoption.

Research Opportunities in OSS Adoption in the Financial Services Industry

The exploratory overview in the next four sections presents some research opportunities for researchers. The research themes that we have identified are presented next.

Studies on Barriers to and Drivers of OSS

More studies on the drivers of and barriers to OSS adoption in the financial services industry are needed. So far, few studies have been reported in the literature. Studies on this topic that adopt a multiple case-study approach create a more robust basis for generalization. So far, only a few studies have looked at this.

Tome et al. (2014) investigated the barriers to open source enterprise resource planning adoption in South Africa, but the study context is separate from the financial sector. The authors used an online survey and FGD, characterizing the study as mixed-methods research. Van Belle and Mark Reed (2012) investigated OSS adoption in South Africa by applying the TOE framework to a case study. The study focused on a single case of a small financial services organization (one of the largest medical aid administrators in South Africa) but not in the financial sector. Furthermore, these two studies were conducted 10 years ago, so the findings are outside the current realities in the financial sector. The other published studies on OSS adoption in South Africa are: Shekgola et al. (2021), "Factors Influencing the Adoption of FOSS for Electronic Records Management by Municipalities"; Mutula and Kalaote (2010), "Open Source Software Deployment in the Public Sector"; Chidoori and Van Belle (2018), "Attitudes Towards the Uptake of Open Source Software by Small and Medium Enterprises"; and Theunissen et al. (2004), "A Preliminary Investigation of the Impact of Open Source Software on Telecommunication Software Development." These do not focus on the financial sector of South Africa. Thus, this research theme is necessary and viable. Example of research questions and methods that can be explored for further research regarding barriers to and drivers of OSS adoption are shown in Table 3.

Technology Readiness for OSS Adoption

Findings from this study reveal the need for a deeper understanding of the level of technology readiness of the financial services industry for OSS adoption.

According to Etim and Daramola (2023), technology readiness focuses on the disposition to use innovation or new technologies, while technology adoption and acceptance focus on the experience

Table 4. Sample research questions on technology readiness for OSS

S/n	Research question	Methodology
1	What are the factors that influence readiness for OSS adoption in a specific type of financial services organization (e.g. insurance / banking / brokering / fintech)?	Qualitative study — using case study/ multiple case study/ grounded theory
2	What are the determinants of readiness for OSS adoption in a specific type of financial services organization (e.g. insurance / banking / brokering / fintech)?	Quantitative study — using survey/ Structural equation modelling
3	What is the relationship between OSS readiness and organizational culture in a a specific type of financial services organization?	Quantitative study/mixed-methods —Survey
4	What are the challenges to OSS readiness in a financial services organizations in South Africa (or elsewhere)?	Qualitative study— using case study/ multiple case study

Table 5. Sample research questions on OSS-related practices

S/n	Research question	Methodology
1	What does platform engineering entail in the context of a financial services organization (e.g. insurance / banking / brokering / fintech) in South Africa (or elswhere)?	Qualitative study — using case study/ multiple case study/ grounded theory
2	What are the characteristics of inner source initiatives within the financial services sector (e.g. insurance / banking / brokering / fintech)?	Qualitative study — using case study/ multiple case study/ grounded theory
3	What are the success factors for platform engineering/innersource in financial services organization (in South Africa or elsewhere)?	Quantitative study —Survey
4	What is the level of process maturity of platform engineering in financial services organizations in South Africa (or elsewhere)?	Mixed methods study— using case study/ multiple case study, survey

after technology use. Hence, a thorough understanding of technology readiness for OSS should precede OSS adoption. Thus, there is a need for empirical studies based on applying quantitative, qualitative, and mixed-methods approaches to investigate the level of technology readiness of financial services industry for OSS at the individual and organizational levels. Such studies will lay a solid foundation for the understanding of issues of OSS adoption in the financial services industry. Potential research questions and research methods that are worthy of exploration are shown in Table 4.

Assessment of OSS-Related Practices

Our findings reveal that some organizations in the financial services sector currently engage in OSS-related practices such as inner source and platform engineering. These activities are a necessary precursor to more elaborate OSS adoption. However, studies that assess the characteristics and quality of these practices in the financial sector still need to be included in the literature. Understanding the state of these practices in the financial industry is necessary to foster the prospects of OSS adoption in financial industry. Some viable research research questions that cann be pursued to explore this theme further are shown in Table 5.

Contextualized Maturity Model for OSS

Currently, no PMM can be used as a standard to rate the quality of OSS practices and processes in the financial industry of South Africa. Cater et al. (2022) advocated for a PMM that can be used as an industry standard for OSS in the financial industry. However, if this were to be created, it would still need to be customized for relevance to the South African context. Thus, there is a need

Table 6. Sample research questions on OSS maturity model

S/n	Research question	Methodology
1	How can a OSS process maturity model be developed for a specific type of financial services organization (e.g. insurance / banking / brokering / fintech) in South Africa be developed?	Mixed methods study — using case study/ multiple case study/ Design Science Research
2	What are the metrics for OSS process maturity in the context of a specific type of financial services organization (e.g. insurance / banking / brokering / fintech) in South Africa (or elsewhere)?	Qualitative study/ Quantitative study/ mixed methods — using case study/ multiple case study/ survey
3	What is the level of OSS process maturity in a speicific financial services organization(e.g. insurance / banking / brokering / fintech) in South Africa (or elsewhere)?	Quantitative study — Survey, Experiment
4	How does the OSS process maturity in the banking sector of South Africa (or elsewhere) compare with the insurance industry?	Mixed methods study— using case study/ multiple case study, survey

Table 7. Sample research questions on OSS governance practices

S/n	Research question	Methodology
1	What factors influence OSS governance in a specific type of financial services organization (e.g. insurance / banking / brokering / fintech) in South Africa (or elsewhere)?	Qualitative study — using case study/ multiple case study/grounded theory
2	What are the challenges of OSS governance in a specific type of financial services organization (e.g. insurance / banking / brokering / fintech) in South Africa (or elsewhere)?	Qualitative study — using case study/ multiple case study
3	How can a OSS governance framework be developed for a specific type of financial services organization (e.g. insurance / banking / brokering / fintech) in South Africa (or elsewhere)?	Mixed methods study — using case study, survey, Design Science Research
4	What are the characteristics of OSS governance in financial services organization in South Africa (or elsewhere)?	Quantitative study— using a survey

for investigations that can identify the standard and contextual metrics for the assessment of OSS practices in FINOSA. Typical research questions that can be explored are shown in Table 6.

Understanding of OSS Governance Practices

Open source governance enables identifying and mitigating security and legal, organizational, and community risks associated with OSS adoption. It can boost the confidence of OSS actors, make them more productive and compliant with licensing terms, and stimulate their ability and willingness to contribute to community OSS projects and initiatives (McAffer, 2019). So far, little is known about the OSS governance practices of most organizations because few empirical studies have been reported in the literature. The findings from South Africa also support this viewpoint. Thus, there is a need for empirical investigation of OSS governance practices in different financial services organizations in South Africa and other countries. Such studies may facilitate the development of a robust OSS governance framework that can reasonably cater to the peculiarities of the financial services sector. It may also help to define appropriate guidelines for OSS practices in the financial sector. Examples of research questions that can be explored regarding this theme are shown in Table 7.

Organizational Culture and OSS Adoption and Diffusion

Empirical case studies on the relationship between organizational culture and OSS adoption in financial services organizations in different subsectors of the financial industry, such as banking, insurance, brokering, and financial technology, would be valuable to foster an understanding of the role of culture in issues of technology adoption at the organizational and individual levels. Theories

Table 8. Sample research questions on organizational culture and OSS adoption and diffusion

S/n	Research question	Methodology
1	What is the relationship between organizational culture (e.g. work culture, communication etc.) and OSS adoption and difussion in a specific type of financial services organization (e.g. insurance / banking / brokering / fintech) in South Africa (or elsewhere)?	Quantitative study — using survey Qualitative study — case study/multiple case study
2	How does organizational culture affect OSS governance in a specific type of financial services organization (insurance/ banking / brokering/fintech) in South Africa (or elsewhere)?	Qualitative study — using case study/ multiple case study
3	How does organizational culture influence OSS process maturity in a specific type of financial services organization (Insurance/ Banks / Fintech) in South Africa (or elsewhere)?	Qualitatve study/ Mixed methods study — using case study, survey

that focus the study of firm-level phenomena, such as dynamic capabilities theory (Teece et al., 1997), resource-based view of the firm (Barney, 1991b), absorptive capacity theory (Cohen & Levinthal, 1990), knowledge-based theory of the firm (Grant, 1996), technology adoption theories at the firm-level, for example, institutional theory (Scott, 2004), DOI (Rogers, 1995), and TOE framework (DePietro et al., 1990), would be ideal candidates to use as the theoretical reference for these types of investigation. Table 8 contains smaple research questions that can be explored under this theme.

Application of Different Methodologies and Theoretical Frameworks for OSS Adoption in the Financial Services Sector

It is helpful to conduct a series of studies that employ different methodological approaches, theoretical frameworks, and conceptual frameworks to investigate each of the six research themes (1-6) we identified. The deliberate use of methodological triangulation (the use of different research methods to study a particular phenomenon) and theoretical triangulation (the use of different theories and their combinations to study the same phenomenon) facilitates the development of a vast and robust body of knowledge on OSS adoption in the financial sector over time. In information systems research, theories, models, and frameworks are used as theoretical lenses to guide data collection, data analysis, and interpretation of findings. Hence, each of the sample research questions that is posed in Tables 1-7 can be explored using different theories and combinations of theories, with each study yielding relevant but varied perspectives on each research theme. This inevitably leads to development of a robust body of knowledge around OSS adoption and diffusion in the financial services sector in South Africa and other developing countries. Hence, we recommend other researchers to join in this.

Limitations of the Study

We recognize a limitation of this study because of our choice of focus group as the method of data collection. A lack of generalizability is one of the main features of a focus group, as it is just a sample and not the total population size (Barbour & Barbour, 2018). We mitigated this concern by ensuring that the participant selection includes those who make the OSS usage decisions (software engineering managers and team leads) and those (enterprise architects) who have a view of what gets used across the organization.

Participation dynamics is another feature of focus groups that is not necessarily as evident as in quantitative research (Barbour & Barbour, 2018). Focus groups should be avoided where social stigmatization due to disclosure in a group setting might arise or where participants are uneasy with one another. The risk is that participants may not freely discuss their feelings and opinions. To mitigate this limitation, to a certain extent, we made use of trained facilitators and the use group dynamic techniques like ice-breakers to ensure free participation and expression by all participants. However, we also recognize that the strength of focus groups is the depth of insight, which generally comes at

the expense of statistical rigor (Barbour & Barbour, 2018). The purpose of this paper is exploratory, as reflected in the title, and not statistical, hence our choice to use a focus group approach.

RECOMMENDATIONS TO ORGANIZATIONS FOR THE ADOPTION AND DIFFUSION OF OSS

In this section, we highlight some of the major recommendations from the study. We do not introduce new findings but provide a summary of the more important aspects.

Increase the Usage of OSS Especially for Back-Office Functions

The usage of OSS in banking is growing. The adoption of OSS is expected to have a high impact in areas that focus on internal operations (such as business-to-business solutions, Unix replacement, platform engineering, DevOps, quality engineering, and backend systems where there are no business benefits to having unique systems) and to a lesser extent on front-end operations.

Organizations Should Establish Some Enablers of Open Source

Having more OSS application choices in vetted bank software repositories and enabling supply chain management of procuring the software should ease the use of OSS. Showing the cost-effectiveness, ease of use, reliability, and access to a large community of developers should ease the change management of getting organizations to accept open source. Large-scale initiatives like platform engineering can act as a springboard for more OSS if these projects use OSS from the start.

Get Organization Support and Governance Functions on Board

While individuals are keen to look at OSS, our research shows that organizations are not. One of the main obstacles to a greater adoption of OSS is security concerns. These concerns stem from a lack of skill and concerns around trust. The readiness of an organization's vendor management function is also a concern, as the research shows that vendor lock-in is an obstacle to moving to open source. OSS practitioners must work with all the support functions to ensure that open source governance, policies, processes, tools, and training are in place.

Implement an OSS Maturity Model

Currently, in FINOSA there is no maturity model to assess the quality of OSS practices. Also, only a few have considered developing quality assessment metrics for activities such as inner source and platform engineering. By having a standard not only internally but also across the industry, common pitfalls can be avoided, and the skills around OSS can be built and increased.

Contribute to OSS Projects Internally and Externally

FINOSA organizations have not paid attention to initiating OSS projects for open participation by other organizations and the public. Financial organizations in South Africa must start promoting public OSS initiatives relevant to the financial industry to stimulate collaboration for excellence within the financial industry instead of competition. An excellent example of this is the open banking initiative in the United Kingdom (Omarini, 2018; Open Banking Implementation Entity, 2022). Collaboration is also an excellent way to build engineering skills, which are in short supply in South Africa.

CONCLUSION

In this paper, we have presented an exploratory overview of OSS adoption in the financial services sector of South Africa. The study's findings stem from the thematic analysis of data collected from an FGD of eight experts that lasted for 6 hr. The study participants were from four financial services

organizations based in South Africa. The study's findings reveal the state of practice of OSS and the technological, organizational, and environmental factors that affect OSS adoption, along with the influential factors for OSS diffusion in FINOSA.

The technological factors that can aid OSS adoption are openness by many organizations to embrace OSS, an appreciable level of technology readiness by individuals working in FINOSA, and several enablers for OSS adoption such as masters of specific OSS tools and resources and willingness to collaborate, which already exists in FINOSA. The technological factors that can impede OSS adoption are low technology readiness, the complexity of IT security governance, the existence of several technical challenges, and the lack of a PMM.

Organizational factors crucial for OSS adoption are a knowledge-sharing culture among employees in many organizations, individuals who are motivated to contribute to OSS, and some organizations that promote collaborative work activities. Conversely, organizational factors that can impede OSS adoption are a lack of (a) readiness to initiate OSS projects for open participation by other organizations and the public, (b) contribution to OSS initiatives, (c) investment in additional OSS capabilities that can advance OSS practices, (d) direct efforts to improve OSS practices, (e) collaborative behavior that can aid OSS related activities, and (f) a proactive approach to OSS. OSS adoption can also be impeded by internal policies that can hamper OSS adoption and a work culture that promotes vendor loyalty.

Environmental factors, such as the actions of competitors, may not necessarily influence OSS adoption, but the business success stories of competitors can influence OSS adoption. In addition, unharmful government policy aids OSS adoption, and the customer and business expectations of the organization regarding security and availability influence OSS adoption.

We also find that positive perception of relative advantage, compatibility, trialability, and observability characteristics of OSS aids its diffusion, making it a more prevelant practice in FINOSA. At the same time there are issues around complexity of OSS that stem from work culture, internal polices, and government regulations that could increase the complexity of OSS, which could hamper its diffusion.

Based on the study's findings, we also identify seven research themes that should get the attention of researchers going forward on issues of OSS adoption in financial services industry. These are the need for further research on (a) barriers and drivers of OSS, (b) technology readiness to lay a solid foundation for OSS adoption and diffusion, (c) assessment of OSS-related practices, (d) development of a contextualized PMM for OSS, (e) OSS governance practices, (f) the relationship between organizational culture and OSS adoption and diffusion, and (g) application of different research methodologies and theoretical frameworks on the identified research themes (1-6).

The study makes a significant contribution to scholarship on OSS adoption because it is, to the best of our knowledge, a pioneering effort that spotlights OSS adoption in the South Africa financial industry. Globally, it also ranks among the few studies on OSS adoption in the financial sector. Subsequently, we intend to actively conduct further studies on several aspects of the research themes identified through this exploratory study.

CONFLICTS OF INTEREST

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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