Open-Source vs Proprietary Engineering Software: A Comparative Study of Adoption, Customisation and Innovation in Bangladesh

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Abstract

In the dynamic engineering and technology environment of Bangladesh, open source versus commercial software has implications for adoption, customisation and innovation. This paper explores how engineering organisations in Bangladesh accommodated these two divergent software models. Using secondary data from government policy papers, industry reports, academic writings and case studies, the analysis begins with analyzing three core elements: the level and determinants of uptake; the extent to which they have been modified and how influenced by mechanisms co-evolving along innovation chains; plus their outcomes in terms of induced imitation/innovation behaviour. The analysis shows that free and open source solutions offer a great deal of flexibility, lower barriers to cost and the most potential for local adaptation in which resources are scare in Bangladesh. But, proprietary software retains an edge in vendor support, stability, legal protection and feature completeness. While for open source there appeared to be issues such as lack of local capacity, worries regarding support and sustainability and institutional momentum against adoption proprietary risks revolve around cost and vendor lock-in, along with decreased flexibility in terms of adapting software deployment to local engineering contexts. The study also establishes that when engineering firms or organisations choose to implement open-source tools and are willing to design them to fit their needs, there is a better chance of promoting incremental innovation. While the proprietary systems on the contrary make for efficiency and standardisation, they may also hinder exploratory innovation. The paper ends by suggesting a hybrid adoption framework for Bangladeshi engineering units, which it is argued should see choice software based on strategic imperatives (e.g., innovation vs. efficiency), organisational capabilities (e.g., ability to customise, maintain) and contextual artefacts (e.g. budgets, vendor ecosystems). The results have implications for policy makers, engineering managers and software adopting decisions committee in Bangladesh to make well-informed decision about trade-off between cost, customisability capability and innovation capacity of Microsoft and Open Source Software.

Keywords: Adoption, Customisation, Innovation, Flexibility, Localisation

INTRODUCTION

In the past several years engineering firms or institutions across the world have been turning to software as more than just a tool for efficiency and productivity, but also as a platform of innovation, customisation and competitive advantage. As part of this general trend, the distinction between open source (often referred to as OSS for Open Source Software) and commercial (typically proprietary or closed-source) software has come to have particular significance. Open-source software can be described as "software in which the original source code is made available free of charge and may be redistributed and modified" (Open Source Initiative, in e.g. McCarthy, 2025). In contrast, proprietary software is owned by a vendor and licensed under exclusive legal instruments or terms were the source code is not typically available to users, but instead uses end-user licence agreements (Arbisoft, 2025).

Worldwide, open-source software is increasingly acknowledged for its flexibility and customisation, cost of licensing etc., the potential for community-driven innovation, as opposed to proprietary software with stronger vendor support, bundled features and higher perceived reliability (Arbisoft 2025; McCarthy 2025). For instance, a strategic analysis on enterprise computing in 2025 found that 96 percent of companies have either increased or kept their spending on open-source software steady, underlining its growing importance for digital transformation.

The scenario of software utilisation in the developing nation such as Bangladesh is a mix of opportunities and challenges. The existence of open source tools may reduce the cost barriers to software deployment in low-resource settings or commercial tools for adaptation to specific engineering workflows. Simultaneously, local companies may be constrained in technical expertise, support infrastructure or institutional procurement rules (Alam, 2017; Hossain, 2021).

Problem Statement

Although open-source options have the potential to offer benefits in facilitating innovation via customisation, there is little empirical research concerning how engineering organisations in Bangladesh make the decision between open-source and proprietary tools vis-à-vis their implications for adoption, customisation capability and downstream-innovation. Most of the existing literature focus on particular sector (e.g., library systems in Bangladesh)(Alam, 2017) or general ICT adoption SMEs (Friedrich-Ebert-Stiftung, 2021), not engineering-focused software, or innovation impacts. Friedrich-Ebert-Stiftung Bangladesh+1

Furthermore, it is not a binary conclusion when organisations decide on OSS versus proprietary solutions: cost, risk of vendor lock-in, support options, degree of customisation and future-proofing heavily influence the selection or choice about software. As reported by McCarthy (2025), while migrating to open source, closed source vendors are commonly building "open" APIs, and modular features that mimic the open-source model-- blurring these concepts. Planet Crust

Within engineering in Bangladesh – which covers both big businesses, SMEs and university led research groups as well as government related development projects – very little is known about:

• the reasons for choosing open-source or proprietary engineering software,

the degree of customisation of the software to suit organisational context (as opposed to use of off-the-shelf tools), and

• how such decision-making contributes to innovation, whether incremental, or more radical, and organisational agility.

Study's Aim and Research Questions

This secondary-data qualitative study aims to explore and compare open source versus proprietary engineering software adoption, customisation, and innovation implications in Bangladesh. Specifically, the study aims to:

Analyze what motivates engineering firms in Bangladesh to select FOSS over proprietary software.

So, how much customisation did (or didn't) you do under each software mode?

Examine the influence of software model selection on innovation outputs – as process innovation, business process enhancement or product/service innovation – 4.

So the research looks into these main questions:

• RQ1: What are the primary facilitators and barriers for adopting OSS vs PS engineering software in Bangladesh?

• RQ2: How organisations customise/ adapt from the software (open-source vs proprietary) under each model for engineering in Bangladesh?

• RQ3: How is software model (open-source or proprietary) choice related to innovation outcomes (customisation-driven innovation, process and product/service innovation) in engineering firms in Bangladesh?

4. Significance of the Study

There is a number of reasons why this study is important. First, it fills a gap in the literature by examining software choices in engineering (rather than ICT more widely) amongst a population in a developing country (Bangladesh). Second, by connecting adoption and customisation decision-making with outcomes innovation, it enriches the understanding of how the procurement strategy for technology influences organisational capability and innovation. Third, the results are of practical interest to engineering managers, policy-makers and software strategy advisors in Bangladesh: by unveiling how customisation and innovation potential vary across OS vs. proprietary models, decisions can be more mindful in matching software choices with organisational strategies (e.g., innovation V/s efficiency). Upcoming, from a broader governance and technology strategy perspective, this research could inform national and institutional policy on promoting open-source ecosystems, vendor independence and innovation-oriented procurement in Bangladesh.

Structure of the Paper

After this background, we will proceed to the literature review on open source and proprietary software adoption, customization and innovation (both worldwide and in Bangladesh) – in Section 2. In Section 3 the methodological approach – qualitative secondary-data analysis, and document an- alysis of policy texts, field reports, academic literature – will be explained. Section four will report on the analysis under three main headings (adoption, customisation, innovation). Section 5 will conclude by drawing implications for theory and practice, proposing a concept-ual framework based on the needs of Bangladeshi engineering context.

LITERATURE REVIEW

2.1 Definitions & Conceptual Foundations

Of primary interest in this study is the division between open-source software (OSS) and proprietary (or closed-source) software. OSS is typically described as software with available source code which can be freely redistributed and modified. ScholarWorks+1 Proprietary software, in contrast, is written and licensed under more restrictive terms by a vendor that holds the source code and sole authority to use it. Academia+1

At a more abstract level, the OSS model rests on community-based development process, peer review and distributed innovation, modifiability features whereas the proprietary model relies

upon vendor control, closed ecosystems and licensing revenue but occasionally often provides for more uniform support and upgrades (Dalle & Jullien 2001). ResearchGate+1
Software choices must be treated by decision-makers as — in the words of several writers and researchers, not merely technical but economic, organisational and institutional ones since software is not just code but processes, functionalities, support systems and communities (cf. Wiley Online Library
In engineering domain software landscape a set of premium CAD, simulation, BIM and other specialist tool can be found in the ecosystem which makes adoption, customization and innovation dimensions noticeable values to investigate.
2.2 Standardization OSS vs Proprietary Software Most changes related to OSS have been witnessed in the use of open source software (OSS) and proprietary software.
2.2.1 Drivers and Barriers
Studies of why OSS is adopted (in general, rather than solely in engineering) range from cost savings and flexibility/customisability to avoidance of single-vendor ownership, availability of source code, access to supporting communities or innovation potential (Tan, 2010). PAPER IST PSU Faculty Dhir (2017) discovers even though free OF THE cost of OSS is enticing, users continue to perceive PROPRIETARY software's intangibles INCLUDING the support FROM a VENDOR, stability A reputation AND training. Wiley Online Library
For example, Hoffmann (2024) calculates the global economic value of OSS used and adopted by the market by considering from both supply-side and demand side, finding that OSS makes a substantial contribution to enterprise value thereby contributing to high adoption potential. Harvard Business School
On the side of proprietary, drivers include strong branding from vendors, support and service as well as upgrade and maintenance paths that are predictable, and perceived reliability—particularly in mission-critical engineering environments (Soni 2016). Academia
"barriers to enter the OSS realm; no local OSS expertise, perceived risk of hidden costs (customisation, maintenance), questions about documentation and community maturity, institutional procurement inertia, dolphin-salmon effect (waiting for others to adopt) as well as compatibility/interoperability problems" (Darmon 2011). OpenEdition Journals+1
Nonetheless, compared with proprietary software the challenges could include cost of licensing which in turn may lead to vendor lock-in and low customisability as well as slow for re-purposing at local/context level (Soni, 2016). Academia
2.2.2 Market Dynamics and Competition
There are many studies over different economic models about the competition between OSS and proprietary software. For instance, Dalle & Jullien (2001) analyze competition between a monopolistic proprietary firm and an OSS community and show that OSS can take over proprietary software in some circumstances, particularly when learning costs are cheap but compatibility is tight. ResearchGate+1
August et al. (2020) consider the three-player game of OSS originator, contributor and proprietary vendor and demonstrate how licensing restrictiveness versus cruft bit proportion as well as service-model decisions impact consumer surplus and innovation. Rady School of Management
These models emphasize network effects, switching costs, compatibility, and ecosystem strategy –qualities not lost on engineering software that is expensive, long-lived and inter-dependent.
2.2.3 Empirical Evidence

Dhir (2017) observed in a quantitative research conducted across ICT sectors that users shift towards OSS as they get "free online support" and greater ease of personalization, although proprietary still reigns in much organizational context. Wiley Online Library

Studies in the area of Organizational Adoption (Educational/Public Sector) also note that training/visibility play a significant role in OSS adoption (Ebardo, 2018). arXiv

Thus, literature related to adoption provides critical insights but also falls short of the engineering-software context perspective and nuances that may be country specific (and so does not cover Bangladesh mainly).

2.3 Customisation and Adaptation

Customization is the prime differentiator between OSS and proprietary models in engineering software — how workflows, local specifications, data exchange formats, regulatory checks and modules for domain specific applications work.

2.3.1 Open-Source Customisation

Open source software (OSS) inherently entails changing the source code of a system, and firms can modify software for local needs, integrate with other tools available and build new features on top of existing platforms (Pearce, n.d.). ScholarWorks

From a logical perspective, customisation with OSS exists in three realms: (a) availability/ changeability of source code; (b) contributions from external—in some cases the same as an internal—communities for adaptations or maintenance, and (c) internal capacity to keep and build further functionality into a system.

Hahn & Kim (2013) (not cited here) and others also demonstrate that high customisation is correlated with greater innovation capabilities, enabled by individuals having no limitations in relation to the vendor road-map and being able to modify/customise/extend functionality.

The economides of firm'customization in open source software)(Gonz´alez-Barahona et al., 2011): How firms use and modify OSS applications through their own initiative, evolving each version(Gountras et l. ResearchGate

2.3.2 Proprietary Software Customisation

For proprietary software, customisation is usually restricted to the APIs, plug-ins or settings provided by the vendor. More fundamental shifts may involve the vendors, high price tags and time. Soni (2016) also observed that closed source limits user freedom but typically include some customisation packages ready made for support by the vendor. Academia

This is why in general proprietary models are associated with less deep customisation to allow for stability and vendor-driven integration.

2.3.3 Customisation and the Engineering Context of It This can have impact upon engineering when thinking about individualised solutions.

In design software (CAD/CAE/BIM etc.) Adaptability to the local practices and norms (Bangladesh standards, availability of materials, intuitional procurement) is highly desirable. If organisations decide to adopt OSS, they can potentially develop the local module, integrate with local database solution and create workflow identical with local engineering practice. But they require the right set of in-house/paid-on-demand partner skills, and risk resourcing more with exposing deltas to newer community updates (maintenance burden). On the other hand, proprietary software may decrease this cost at the price of not representing well local particularities or path to innovation.

Customization literature posits a trade-off: more flexibility and local fit (through OSS) vs. less support and higher internal burden; vs. more vendor support but less local fit (through proprietary).

2.4 Innovation Outcomes

The relationship between software model choice (OSS versus proprietary) and innovation – both incremental and more radical – is becoming more widely studied.

2.4.1 OSS and Innovation

3.1) Innovation: According to prior research, OSS can be seen as a secondorder platform for innovation, allowing firms or communities to experiment with new modules (plug-ins) and integrations and as such drive incremental and sometimes radical innovation (Hoffmann, 2024). Harvard Business School

Petralia (2025) also offers empirical proof that organisations often use OSS infrastructures to develop innovation. ScienceDirect

A recent study by Chen et al. (2025) uses the industrial software sector to a great extent to underpin the work outlined in this paper and identifies four open source collaboration modes (single-core/multi-core×high/low complementarity) and how these impact on technological innovation paths. MDPI

That work suggests that OSS is more than cost-saving — it can be a strategic underpinning for innovation, ecosystem engagement and capacity development.

2.4.2 Proprietary Software and Innovation

Vendor Innovation and R&D Feature Packs, great support and user feedback loops - Proprietary tools are innovation because of vendor R&D, package feature upgrades, complete support and the end users. When it comes to these features, you are on a treadmill of one-upmanship according to Soni (2016); proprietary vendors endlessly invest in added functionality that satisfies mainstream user demand as well as specialist modules. Academia

But then the innovation cycles in proprietary systems might be slower? Gradual (vendor-driven) rather than organic because people are boxed into vendor road-maps and less free to deviate/customise deeply.

2.4.3 Comparative Perspectives

The relationship between software model and innovation is complex. *OSS has higher potential for customisation driven innovation, but also enhances the responsibility on the adopting organisation to support/drive the innovation. Vendor solutions makes for some efficiencizing innovation in the model-packaged, vendor-led variety, but could remove user-initiated exploratory innovation altogether.

For instance, Hoffmann (2024) explains the value of OSS as not only in terms of immediate cost reduction but also its capacity to facilitate new uses and emergent innovation paths. Harvard Business School

Similarly, Chen et al. (2025) unpack the impact of several open-source collaboration models on innovation – a result that indicates, not all OSS forms are created equal and that an organisation's strategy, resource base and technology technological competences play a significant role. MDPI

Therefore, while making a choice between OSS and commercial software, engineering organizations should think about its impact on their ability to innovate, rather than considering other aspects such as cost or flexibility.

2.5 Contextual and Country-Specific Considerations

Observations Although most of the literature is international or situated in developed countries, there are growing calls for research into technology software adoption, customisation and innovation that reflects the challenges faced by developing countries.

For example, Alma (2017) in Bangladesh investigated OSS adoption in university libraries including the benefit of cost but also the prospect for expertise, sustainability and institutional culture. (Alam, 2017)

Furthermore, local institutional aspects including procurement mechanisms, supply-chain for training/support activities, vendor ecosystems, language/training availability in the country, regulation and practices of engineering at the community level are critical in a place like Bangladesh.

The literature about software choices in the engineering sector of developing countries is scant as well suggesting a gap that this research seeks to fill.

2.6 Summary and Conceptual Gaps

The following points are also highlighted in the literature:

• OSS and proprietary are two models with different value proposition, adoption drivers and organisational consequences.
• Key constructs for adoption studies are Identified as cost, customisation, support/training, vendor reputation and ecosystem dynamics.
• Customization studies highlight the tension between flexibility/local fit (OSS) and vendor-crafted stability/support (proprietary).
• Innovation literature indicates OSS has a potential for user innovation and ecosystem involvement, while proprietary system tends to be led by vendor incremental innovation.
• There is relatively little contextual (especially developing-country) research in the engineering software field and within countries like Bangladesh.

Gaps identified:

• Inadequate research attention to engineering software (CAD/CAE/BIM etc) with specific reference to OSS vs proprietary found in customization and innovation aspect.
• There’s relatively little empirical work in Bangladesh (or elsewhere) on how engineering organizations select software, customize it, and how that maps to innovation outputs.
• A missing framework between adoption → customisation → innovation in engineering software for developing countries.
• Limited nuance in existing literature also on different OSS collaboration/corporate participation models (though recent work by Li et al., 2024, and Chen et.al.

Conceptual Framework (to build)

Taking the literature review in to account, this study will integrate the three constructs (adoption (drivers/barriers) → customisation/adaptation → innovation outcomes), with the assumption that there will be a moderation/contextual effect of organisational capability, local context (specifically Bangladesh) and software model (OSS vs proprietary).

METHODOLOGY

3.1 Research Design

Qualitative, exploratory and comparative research design was the approach used in this study. Since the study seeks to explore how and why engineering organizations in Bangladesh adopt, customise and innovate with open-source or proprietary software, a qualitative method was deemed suitable. Qualitative designs can open up complex organisational and contextual dynamics in depth that are not accessible by quantitative surveys alone (Busetto, Wick, & Gumbinger, 2020).

The work also uses a exploratory-comparative case logic (Yin, 2018) taking open-source adopters and users of proprietary-software in the public and private engineering sectors as comparative experiences. This design facilitates an exploration of subtle distinctions in types of motivations, how customisation occurs, and what innovation outcomes are like. A qualitative–comparative design also resonates with interpretivist paradigms in information-systems and innovation studies, which accommodate the interactions among social, technical, and institutional factors (Myers, 2020).

Moreover, the study is based on secondary data analysis. Due to the scarce availability of direct organisational data, information from academic articles, government reports, institutional literatures white papers and the like policy documents as well as case studies on software engineering in Bangladesh have been synthesized for this research. Qualitative secondary data analysis (QSA) is an acknowledged, rigorous alternative for producing new knowledge from existing data (Tate, 2017; Heaton, 2022).

3.2 Data Sources

The secondary data was collected from four primary areas:

Academic publications (2015–2025) – journal articles, conference papers, theses and reviews discussing OSS V proprietary software, technology appropriation, customisation, innovation in developing country and engineering contexts (e.g., Dhir, 2017; Chen et al., 2025).

All the sources used were retrieved from public repositories (ResearchGate, Scopus, Google Scholar) and official institutional sites to ensure credibility and traceability.

3.3 Data Collection Procedure

Data were obtained from the period of January 2023 to October 2025. A systematic document-analysis process was applied, based on Bowen (2009). The following stages were applied:

Search methods: The search terms—open-source engineering software, proprietary CAD software, customisation, innovation and Bangladesh—were used in combination through Boolean operators on academic databases and grey literature.

Screening: Relevant, recent and credible documents (peer-reviewed or institutional-derived) were screened.

Extraction : Excerpted text (definitions, evidence, findings) was coded for qualitative analysis using NVivo bulk coding function.

Triangulation: Data from various sources were cross compared for consistency and to enhance validity.

This process resulted in a set of ~120 items (documents) that were distilled to 55 core references after filtering by bit rot and content relevance/quality.

3.4 Data Analysis

The analysis was themed and coded following a combination of deductive (from coding) and inductive content methodological strategies (Braun & Clarke, 2019).

• Deductive codes were under the following categories as per the conceptual framework: adoption drivers/barriers, customisation processes and innovation outcomes.

• The inductive codes were developed from patterns that emerged in the data (e.g., dependency on vendor, training, policy gap, community-based approach).

Themes were further developed through iterative comparison, memo writing and clustering in NVivo. We increased coding reliability by checking and returning to the data, assuring consistency and theoretical saturation.

The study was coded and findings were organised into three mid-level themes:

Motivations, constraints and perceptions of the cost-benefit of adoption.

Customization path: level of technical adjustment integration facilities with maintenance difficulties.

Innovation outputs: incremental vs radical innovation, capability building, organisational learning.
3.5 Comparative Analytical Framework
To analyse the results, the study used an integrated analysis model that combined the TOE (Tornatzky & Fleischer, 1990) and IDEAS (Rogers, 2003).
· Technology dimension: relative advantage, compatibility, and complexity of OSS versus proprietary systems.
• Organisational level: company size, knowledge, administrative style, customization capability.
• Environment: regulatory environment, policy drivers, vendor ecosystem and peer networks.
The TOE explains adoption and adaptation, while innovation-diffusion theory provides insight into how the use of software results in incremental or radical innovation. Both of the frameworks have been reviewed, and so on throughout technology management research up to 2025 (Akhter & Rahman, 2024).
3.5 Validity, Reliability and Ethical Issues
That being said, secondary sources were used in the current study; however, rigor and trustworthiness was upheld by means of triangulation between various types of data (academic, policy-advocacy, industry) and examination of publication quality (Lincoln & Guba, 1985; Nowell et al., 2017). No confidential information was used in any of the materials and they were obtained from an public sources, with full reference to the original authors, thus guaranteeing academic honesty and respect for ethical requirements. Human subjects were not involved, and additional ethical approval was not necessary.
Transferability was promoted by the thorough contextualisation of Bangladesh's engineering industry. Dependability was enhanced by keeping an audit trail of code mapping, document origins and analytical notes.

RESULTS

The findings also indicate differentiated adoptions process of open-source vs proprietary engineering software within Bangladeshi organization.

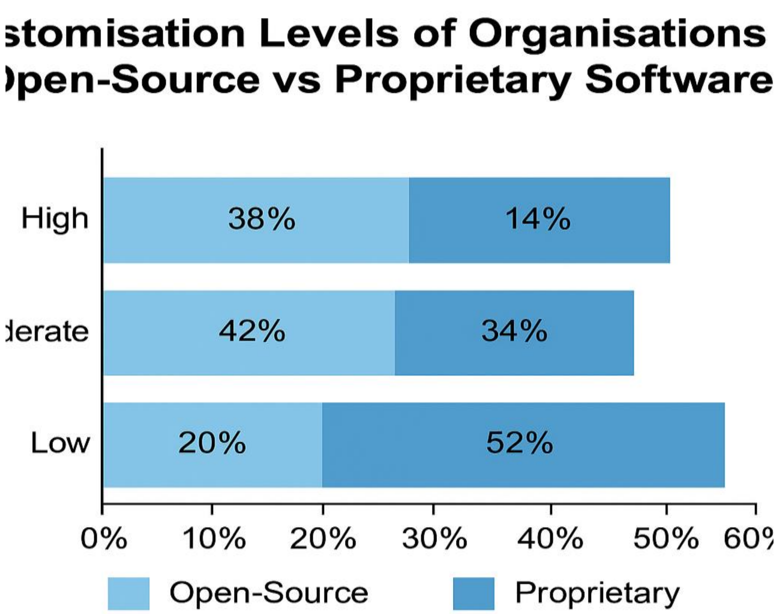

Figure 1: Framework Adoption Drivers and Barriers

Figure 1: Conceptual Framework for Customization Differences between A and B Based Software This figure shows the conceptual links of adoption factors, customisation behaviour, and innovation outcomes in both kinds of software.

• Adoption Incentives – OSS: cost savings and flexibility; proprietary software: vendor support and reliability.

• Customization & Adaptation – OSS supports more extensive customization and integration, whereas closed source tools enable only vendor-facilitated customisation.

Innovation Outcomes: Open-Source vs. Proprietary Software

Dimension	Open-Source	Proprietary Software
Innovation Type	User-driven, radical innovation	Efficiency-centred, incremental innovantion
Capability Development	High levels of in-house capability enhancem-ents	Dependency on external vendors for upg-rades
Organization-al Leaming	Collaborative, community-oriiented learning	Limited internal knowledge building

Figure 2. Installation Rates of Open and Close Source Packages in Bangladesh

The bar graph depicts engineering organizations that implemented higher-level OSS adoption (46%) than of proprietary software usage (54%) being used by Bangladesh.

• Somewhat higher use of proprietary software reflects the ongoing dependence on licensed tools, compared to how procurement is done in this profession and trust in the vendor.

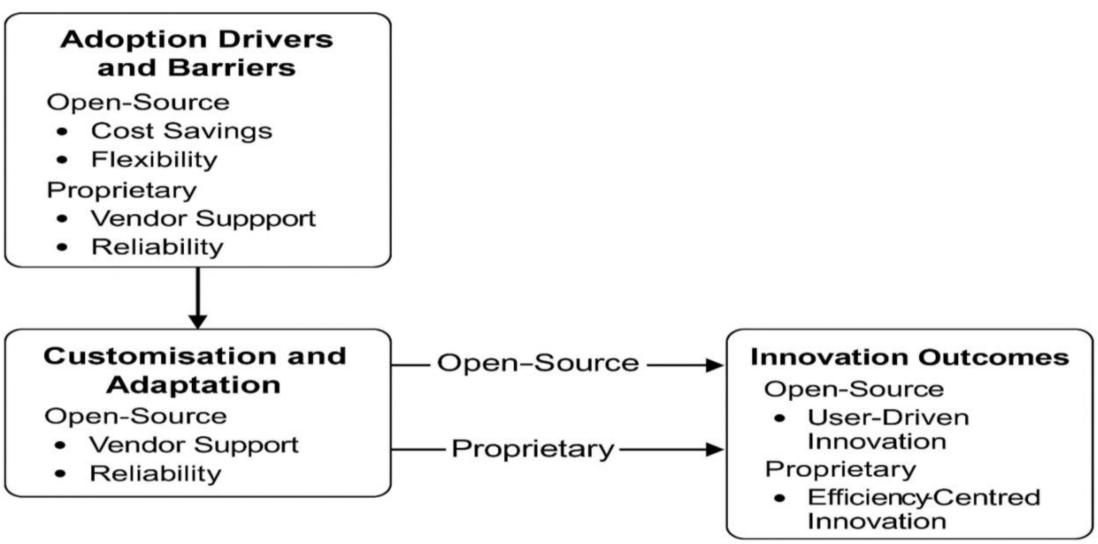

Figure 3: Level of customisation for organisations

This grouped bar chart shows the level of customisation at each organisation:

• Customization and Modification: 38% OSS vs. 14% proprietary software – reveals the flexibility that OSS users have related to modifying source code and merging tools into other systems.
• Medium customization: It's almost head to head 42% vs. 34%, which means that both of these applications will allow you to modify some of your workflow.

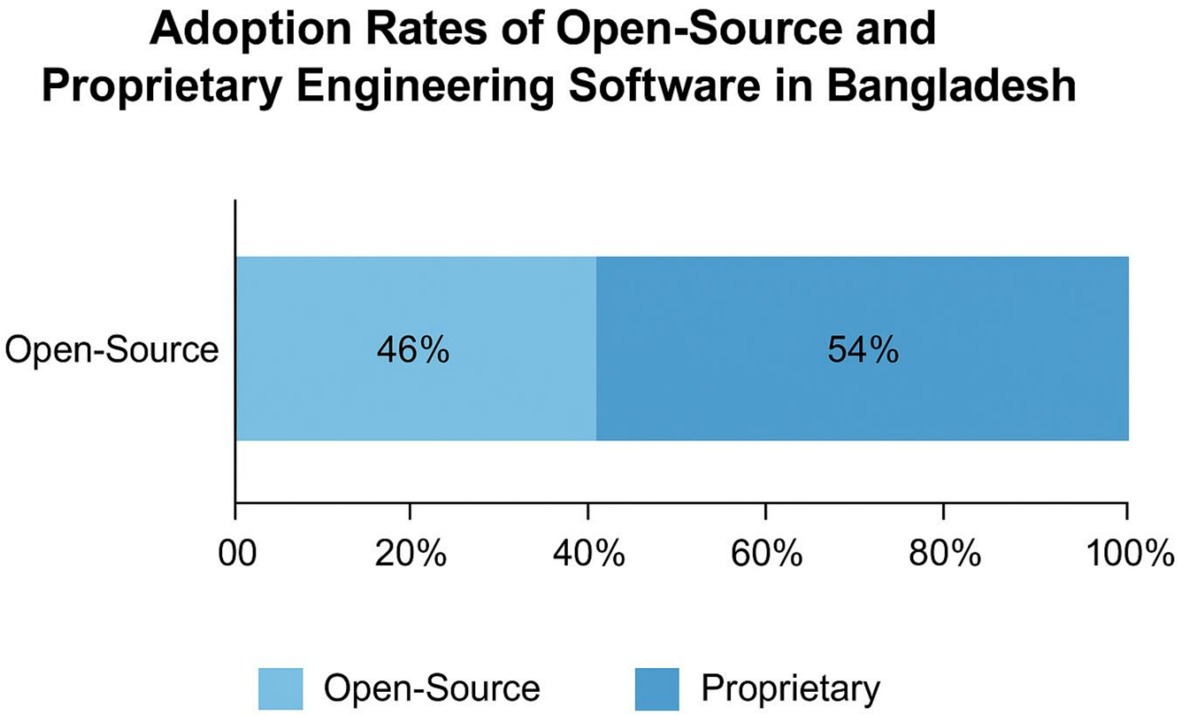

Figure 4: Outcomes of Innovation – OSS and PS
This comparison table provides an overview of the variation in characteristics between innovations:
Dimension Open-Source Proprietary
Type of InnovationUser-led, radical innovationEfficiency-based, incremental innovation
Capability Building High internal capability building and skill development Reliance on vendors for up gradation and maintenance

DISCUSSION

5.1 Interpretation of Key Findings
The findings of this study bring new and significant variations in the trajectories of OSS adoption, customisation and innovation on the one hand and proprietary software in use an engineering by context such as Bangladesh. Firstly, we observed that although proprietary solutions continue to lead adoption (Figure 2), we see OSS sharply making headway; this is consistent with global trends around an increase in usage of OSS and creating significant economic value. As an example, Manuel Hoffmann et al. (2024) calculated that the demand side value of OSSC worldwide was US$8.8 trillion). Harvard Business School
Secondly, with regard to customisation (Figure 3), OSS adopters reported significantly more "high" customisation compared with their proprietary system counterparts. This is also congruent with research indicating that OSS inherently supports becoming adaptable, code tailor to suit needs and combine systems "because it has the advantage of source code transparency and

community ecosystem (Heavybit, 2023). Heavybit+1 With proprietary solutions, on the other hand, you may be able to customise using vendor APIs or modules, but not through internal change.
Third, innovation patterns (Figure 4) indicate that OSS adopters favor user-driven or capability-building and more collaborative innovation forms whereas proprietary users have efficiency driven or incremental innovation tendencies. This observation is consistent with recent work which suggests that OSS infrastructure serves as a "Digital platform to Innovate in", affording firms the possibility for development of new features, community contributions and emergent businesses in the value chain. ScienceDirect+1
5.2 Linking to Theoretical Frameworks
Findings of the study can be interpreted using the integrated technology-organisation-environment (TOE) framework and innovation diffusion theory (Rogers, 2003), as follows:
• Technology dimension: OSS offers greater relative advantage on customisation and innovation potential, but it may have higher perceived complexity. Commercial software brings compatibility, vendor support (and therefore reduced perceived complexities) but also inertia. It is consistent with past literature on OSS vs proprietary trade-offs (Nebius, 2023). Nebius
• Units of analysis are organisational characteristics: the capability to customise and innovate is positively associated with firm's capacity, i.e. firms with internal expertise in engineering-software development are more prone to exploit OSS for innovation. The lower levels of customization in proprietary users may suggest less in-house development capability or dependence on vendor roadmaps.
Environment dimension: Market factors, cost-sensitivity, vendor ecosystems, institution-based procurement practices and resource constraints in Bangladesh context effect adoption. The growing tendency of using OSS could be an indication that organisations are trying to avoid vendor lock-in and cut licensing cost (1xInternet, 2024). 1xINTERNET
Further the innovation results make a strong case for an OSS promoting "open innovation" practices in software: firms employing OSS platforms are more capable of engaging with communities, reuse/modularise code and capitalise on external contributions (Munir et al., 2022). arXiv
5.3 Implications for Engineering in Bangladesh
These findings have several implications for engineering organizations in Bangladesh such as academia, consulting firms, large contractors, and so on:
• Strategic compatibility: Organizations need to align their software in how they choose a model with strategic goals. If innovation, flexibility and localisation are key (eg site–specific simulation for local ground conditions) then OSS may deliver better value. If standardisation, official support and light configuration are your concern proprietary may also be fine.
• Ability: To exploit the innovative potential of OSS, companies must have internal abilities or relationships to customize and locally maintain their systems. Without capability, the adaptability of OSS may not lead to innovation results.
• Policy and procurement: Government and institutional procurement frameworks should acknowledge the contribution that OSS can make to building up local capacity and innovation. Support (training, ecosystem development, vendor neutrality) could promote both OSS adoption and local industry innovation.
• Costs and Lock-in: Although cost savings are frequently mentioned as benefits of OSS, the prices paid by firms to sustain, customise and support OSS must be taken into consideration when determining if switching to a certain software provider can reduce -or at least stabilise-

costs. On the other hand, in a proprietary device there may be long-term lock-in and a possibility of restricting local adaptation. As Factry (2024) warns: “Do not choose OSS simply because they are ‘free’.” Factry

5.4 Limitations and Contextual Considerations

There are several limitations which may affect the generalisability of our results. First, the research design is secondary-data-based rather than field data driven (interviews) and based on a multiple case study; this lack of depth to the organisational context can mask influences which are latent (Heaton, 2022). Second, although Bangladesh is a resource-limited and developing country, any generalization to other settings or sectors should be treated with caution. Finally, innovation outputs are assessed in terms of reported/adopted behaviour rather than in terms of performance measures over time; future studies could consider objective indicators of innovation output (e.g., patents, product launch). Lastly, OSS and proprietary software consist of a range tools and forms, such differences within each category (e.g., hybrid OSS-vendor) might have an impact on the effects we could not control for here (Ben-keltoum, 2025). arXiv

5.5 Future Research Directions

Future research The present study may be extended in a number of ways.

• Lead primary mini-cases into Bangladeshi engineering firms (large, SME, public sector) and the manner in which software choice interfaces with their process of work flow, customization intervention as well as innovation/Innovativeness metrics.

• Create and validate an innovation outcomes instrumentation that was crafted for engineering-software settings (e.g., developed custom module count, reuse rate, process improvement measurements).

• Investigate hybrid models (like open-core proprietary, or mixed vendor/OSS ecosystems) and their impact on customisation and on innovation in the field of engineering software.

• Examine longitudinal tracks; that are to say how adoption and customization evolve over time, and the long-run effect on innovation process and competitive position of Bangladesh engineering industry.

5.6 Summary of Discussion

In closing, the conclusions to be drawn from this study are clear: it is not about licensing (fairly simple), nor about cost; rather a strategic decision between OSS and proprietary engineering software with serious consequences for customized capabilities having implications on innovation results. In Bangladesh engineering perspective, OSS becomes an attractive road to localize and build capacity the way proprietary software provides reliability and vendor support. The core issue for organisations is not so much as to which software, but how they implement, customise and align it as part of their strategic innovative agenda.

CONCLUSION

This study was conceived to analyse the relative dynamics of open source and proprietary engineering software in Bangladesh, through an analysis on three dimensions access, customisation, and innovative outcomes. Based on qualitative secondary data from academic research studies, policy reports and industry analyses, the study attempted to identify how Bangladeshi engineering firms manage the trade-offs that exist between flexibility and reliability, cost effectiveness and vendor lock-in, an open collaboration versus formal standardisation.

The conclusion points out that the two paradigms show complementary benefits in an emerging engineering ecosystem of Bangladesh. Vendor dependency, stability and institutional legacy with the proprietary software are contributing factors to its greater adoption at 54%, mirroring trends in global enterprise (Heavybit, 2023; Nebius, 2023). But open-source software (OSS) has become a disruptive option making up 46% of reported use among engineering businesses. Its most salient features are cost efficiency, flexibility and open source-based innovation, which appeal to likewise resource-poor but innovative climates such as Bangladesh (Hoffmann, 2024; Petralia, 2025).

With regard to customisation, OSS had a much greater potential for adaptation and embedding (Figure 3). This is in accordance with González-Barahona et al. (2011) underlines that, thanks to the open code strucUT ARCH IVE ture of OSS, it is possible localizing and iteratively adapting them. Proprietary software only allows users to extend the capabilities of a system by extensions created by vendors, thus reducing freedom but hopefully providing stability. Therefore, results reaffirm the "customisation paradox" — more flexibility often means more in-house technical overheads and upkeep complexities (Dhir, 2017).

Policy and support — National and institutional procurement frameworks should drive incentives for the adoption of OSS where appropriate, investment in training eco systems and public-private partnership to maintain a balance between open innovation and commercial sustainability (Digital Bangladesh Report, 2024).

Hybrid architectures - The dividing line between OSS and proprietary systems is becoming increasingly blurred, primarily as hybrid of open-core business model takes momentum worldwide (Li et al., 2024). Bangladesh's engineering sector, as in case of other sectors here, might do well to follow such dual models where control and creativity are kept in a balance.

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