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Exploring Determinants of Open Data Repository Adoption among Malaysian Academic Researchers: Towards a contextualized conceptual framework

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Abstract

This paper integrates the Technology Acceptance Model (TAM) and Technology-Organization-Environment (TOE) framework to explore the determinants of open data repository use among Malaysian academic researchers. The proposed model explores the influence of technical attributes, institutional context, and community on perceived ease of use, perceived usefulness, and actual use. Findings aim to identify key drivers and barriers to open data practices, offering practical insights to improve repository engagement, foster research collaboration, and support data-driven initiatives in Malaysia's academic landscape.

Keywords: Open Data Repositories; Technology Acceptance Model (TAM); Technology-Organization-Environment (TOE) Framework; Academic Research

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1.0 Introduction

Adopting open data repositories and science practices has become increasingly essential in academic research, promoting transparency, collaboration, and innovation. These practices enhance the visibility and impact of research outputs, foster a culture of sharing, and advance sustainable development goals. In Malaysia, as in other countries, the integration of open science is influenced by various factors, including technology, culture, and institutional frameworks. Therefore, understanding these influences is critical for driving open science initiatives that address societal challenges and advance knowledge.

2.0 Study Background

In Malaysia, the adoption of open data repositories among academic researchers is shaped by technological, cultural, and institutional factors. Technologically, limited infrastructure and a lack of dedicated data repository services remain key barriers (Amanullah & Abrizah, 2023). Culturally, concerns about data misuse and academic credit discourage sharing (Oladokun & Gaitanou, 2023). Institutionally,

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strong leadership, clear policies, and researcher support are critical for encouraging data practices (Nie et al., 2021). While awareness of open science is increasing, targeted efforts are needed to address these challenges and foster a more open research culture.

This study aims to explore the key technological, cultural, and institutional factors influencing researchers' attitudes and behaviours toward open data practices in Malaysia. While it seeks to identify determinants that support the active use of open data repositories, the study is limited to selected research universities. It may not reflect all academic settings nationwide.

3.0 Literature Review

3.1 Adoption of Open Data Repositories in Academic Research: Global and Malaysian Perspectives

The adoption of open data repositories in academic research has gained significant traction globally, including in Malaysia, where Institutional Repositories (IRs) are increasingly recognized for their potential to enhance research visibility and accessibility. While many academic libraries have established IR services in Malaysia, a notable gap remains with the absence of dedicated data repository services, as highlighted by Amanullah and Abrizah (2023). Their study revealed that although 85% of libraries maintain IRs, none are registered as open data repositories on major platforms, indicating a need for stronger data management practices in Malaysian academic institutions. Globally, metadata is emphasised for improving the discoverability of open data, as demonstrated in Canadian health data repositories, where explicit metadata mechanisms significantly enhance data accessibility (Thornton & Shiri, 2021). The adoption of the Findable, Accessible, Interoperable, and Reusable (FAIR) principles is also crucial in advancing open science, with Coelho et al. (2022) highlighting both the challenges and opportunities involved in harmonizing health data across repositories. Similar challenges are observed in the Malaysian context, echoing issues faced by other regions, such as South Asia, where a lack of defined content management policies in IRs restricts effective data sharing (Baro & Nwabueze-Echedom, 2022). Overall, integrating open data repositories within academic research increases the visibility of research outputs and fosters a culture of transparency and collaboration within the scientific community, reflecting the growing support for open practices worldwide.

3.2 Technology Acceptance Model (TAM) and Its Application in Research Data Management

The Technology Acceptance Model (TAM) has emerged as a pivotal framework for understanding user acceptance and utilization of technology, particularly in the context of Research Data Management (RDM). TAM, introduced by Davis, suggests that perceived usefulness and ease of use significantly influence users' intentions to adopt technology (Kamal et al., 2020). TAM has been widely validated across various domains, with recent studies confirming its relevance and integration with other frameworks like TOE to enhance its predictive power (Sharma et al., 2020). Furthermore, the integrating TAM with other theoretical frameworks, such as the Innovation Diffusion Theory, has been demonstrated to enhance its explanatory power regarding users' behavioral intentions toward e-learning systems. In the realm of healthcare, emphasized that cultural and social contexts significantly shape technology acceptance, indicating that TAM can be adapted to address specific user demographics (Kim & Park, 2012).

Additionally, Ritchie et al. (2011) argued that while TAM has been widely applied, there remains a gap in its application to knowledge management systems, suggesting a need to explore its implications in RDM further. The model's adaptability is further evidenced by its extension to include factors such as data quality and user experience, which are critical in the context of RDM systems. Overall, the continued evolution of TAM underscores its relevance in guiding the design and implementation of technology solutions in research environments, ensuring that user acceptance is prioritized in developing effective RDM strategies.

3.3 Technology-Organization-Environment (TOE) Framework: Understanding Institutional Factors

The Technology-Organization-Environment (TOE) framework offers a comprehensive approach to understanding the institutional factors influencing technology adoption across various sectors. Initially proposed by Tornatzky and Fleischer (1990), the framework highlights the dynamic interaction between technological, organizational, and environmental contexts and continues to be widely used in contemporary innovation adoption research (Bag et al., 2022). Its applicability spans multiple fields; for example, Ramdani et al. (2020) applied the TOE framework to study mobile health adoption in Chinese hospitals, finding that organizational readiness and external pressures play significant roles in technology uptake. Additionally, integration with models such as the Technology Acceptance Model (TAM) enhances the framework's flexibility, which deepens the understanding of adoption behaviors across different settings (Sun et al., 2024). Overall, the TOE framework remains essential for researchers and practitioners seeking to navigate the complexities of technology adoption within institutional environments, enabling informed decision-making and strategic planning.

3.4 Barriers and Drivers of Open Science Practices in Malaysia

The barriers and drivers of open science practices in Malaysia reflect a complex interplay of institutional, cultural, and technological factors. Establishing the Malaysia Open Science Platform (MOSP) in 2019 marked a significant step towards promoting open science, aiming to facilitate data sharing and enhance research accessibility among Malaysian researchers. However, despite these advancements, several barriers persist, including institutional inertia and a lack of incentives for researchers to adopt open science practices. A national survey revealed that awareness and attitudes towards open data among Malaysian researchers are still developing, indicating a need for targeted educational initiatives to foster a culture of openness (Hodonu-Wusu et al., 2020). On the other hand, drivers of open science in Malaysia include the increasing recognition of the importance of research integrity and transparency, as noted by Irawan et al. (2022), who emphasize that open science practices can enhance the quality and reproducibility of research. Additionally, as Ahmed (2021) explored, promoting institutional repositories is vital in enhancing the openness of research outputs in Malaysian

universities, encouraging researchers to share their findings more freely. Addressing the barriers while leveraging the existing drivers will be essential for advancing open science practices in Malaysia and fostering a more collaborative and transparent research environment.

4.0 Methodology

This conceptual paper adopts a theory-driven approach to develop a framework explaining factors influencing data deposition among Malaysian researchers in open data repositories (ODRs). The methodology involves an integrative review of existing literature on open data practices and applying the Technology Acceptance Model (TAM) and Technology-Organization-Environment (TOE) framework. These models were selected for their established relevance in explaining individual and organizational technology adoption behaviors. The procedure entailed systematically identifying, analyzing, and synthesizing peer-reviewed articles and policy documents related to open data, repository usage, and digital research infrastructure, focusing on studies conducted in comparable socio-technical contexts. This theoretical integration guided the construction of the proposed conceptual framework. Justification for this approach lies in its capacity to map key variables and their interrelationships prior to empirical testing, ensuring conceptual clarity and theoretical grounding for future research. This design aligns with established norms in conceptual model development.

5.0 Conceptual Model Development

5.1 Theoretical Overview: TAM-TOE Model

Adopting open data repositories is increasingly being informed by theoretical frameworks such as the TAM and TOE models. Integrating these models provides a comprehensive understanding of the factors influencing the acceptance and utilization of open data repositories, particularly in the context of biological and biomedical research. The TAM emphasizes user perceptions of ease of use and usefulness, which are critical for motivating researchers to deposit their datasets in repositories like Metabolomics Workbench or MetaboLights (Thompson & Moseley, 2023). Meanwhile, the TOE framework expands this perspective by incorporating organizational and environmental factors, such as institutional support and funding agency policies that mandate data sharing (Gangwar et al., 2015). Accordingly, this dual approach allows for a nuanced analysis of how internal motivations and external pressures converge to facilitate the adoption of open data practices.

Moreover, the effective implementation of open data repositories hinges on establishing robust metadata practices that ensure the discoverability and interoperability of datasets. By identifying essential metadata elements, researchers can enhance the usability of these repositories, thereby increasing their adoption rates. The integration of TAM and TOE addresses the technological aspects and highlights the organizational readiness and environmental conditions necessary for successful implementation (Stamenkov & Zhaku-Hani, 2021). Notably, this holistic view is particularly relevant as the scientific community increasingly embraces the FAIR principles to promote open science (Thompson & Moseley, 2023). Consequently, understanding the interplay of these factors through the TAM-TOE lens is vital for fostering a culture of open data sharing and enhancing the overall impact of research outputs. Figure 1 displays the integrated TAM-TOE model adapted for this study.

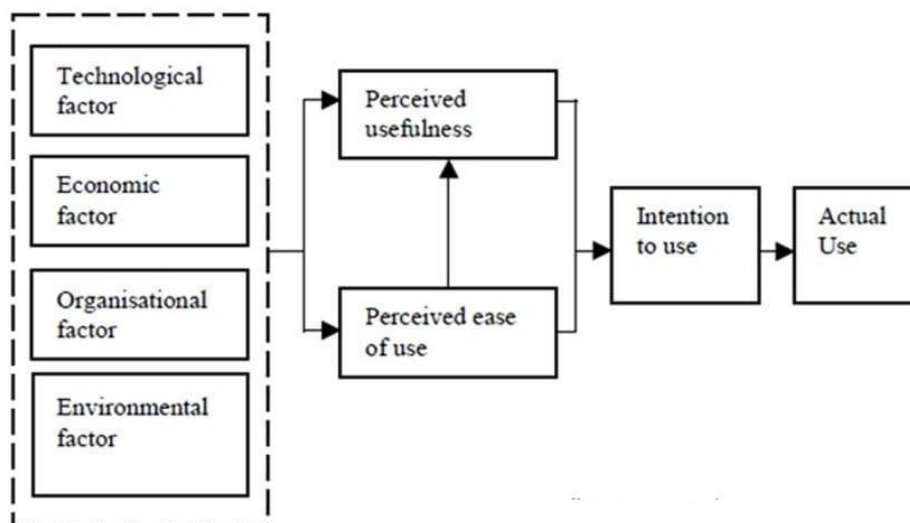


Fig. 1: Integrated TAM-TOE Model
(Source: Qin, X., Shi, Y., Lyu, K., & Mo, Y. (2020))

5.2 Discussion of The Concepts Involved and Proposed Framework

The integration of the Technology Acceptance Model (TAM) with the Technological, Organizational, and Environmental (TOE) framework

offers a comprehensive lens for understanding the adoption of open data repository (ODR) among Malaysian academic researchers. TAM emphasizes perceived usefulness (PU) and perceived ease of use (PEU) as key determinants of technology acceptance. However, TAM lacks the contextual depth to address broader institutional, infrastructural, and social factors. The TOE framework complements TAM by introducing external determinants—technological, organizational, and environmental—that influence individual perceptions and behaviors (Nuryyev et al., 2021). This integrated TAM-TOE framework provides a multidimensional view of ODR usage and contributes theoretically by extending TAM's explanatory scope beyond individual cognitive factors to include institutional and environmental enablers.

Technological attributes like system usability and infrastructure quality are critical for researchers' engagement with ODRs. In Malaysia, inadequate internet connectivity and ICT infrastructure have been shown to hinder repository usage (Singeh et al., 2013). Conversely, improvements in digital infrastructure enhance system trust, functionality, and the academic value of depositing data (Wacha & Wisner, 2011), directly influencing both PU and PEU. By incorporating such technological realities into the adoption model, this study addresses the need for a more grounded understanding of digital infrastructure's role in shaping technology acceptance.

Institutional context also plays a vital role. Supportive governance, training initiatives, and performance-based incentives aligned with open science principles significantly impact researchers' willingness to deposit data (Abrizah et al., 2019). Policies must not only mandate data sharing but also facilitate it through resource provision and recognition mechanisms (Gani et al., 2020). Integration of repository practices into institutional goals fosters sustainability and broader adoption. These findings reinforce the theoretical assertion that technology acceptance in academic settings cannot be fully understood without considering the structural and normative forces exerted by institutions.

Environmental factors, particularly community influence, further shape repository engagement. Peer support, disciplinary norms, and academic collaboration encourage positive data-sharing behavior (Wacha & Wisner, 2011). Researchers are more inclined to deposit data when it aligns with collaborative expectations and is facilitated by librarians and institutional advocates (Amanullah & Abrizah, 2023). A culture of openness supported by peer networks is essential to sustaining repository usage. The inclusion of environmental constructs, often overlooked in TAM-based studies, underscores the need for models that account for collective behavioral dynamics and social influence, especially in research communities.

Within the Technology Acceptance Model (TAM), Perceived Ease of Use (PEU) continues to be a fundamental factor influencing users' acceptance of technology. This concept is particularly shaped by individuals' confidence in their computer skills (computer self-efficacy), the degree of trust they place in the system's reliability, and the overall design and usability of the user interface (Putri, 2024). Effectively addressing challenges related to usability through enhanced user training programs and improvements in interface design can significantly boost user engagement by reducing cognitive and psychological barriers that often discourage repository use. These observations highlight the importance of considering internal cognitive perceptions, such as ease of use, alongside the availability of external resources and support mechanisms. Adopting this perspective underscores the interconnectedness and mutual influence between individual user factors and organizational or technological supports, reinforcing the combined TAM-TOE framework's more holistic approach to understanding technology acceptance.

Perceived Usefulness (PU) is equally significant. Researchers value ODRs for enhancing the visibility, accessibility, and citation impact of their work (Baro & Nwabueze-Echedom, 2022). Features like FAIR-compliant design and impact metrics increase the perceived academic benefits of data sharing (Coelho et al., 2023). High-quality metadata and streamlined processes are essential to maintaining repository credibility and encouraging widespread use. These findings refine the PU construct by emphasizing utility in task completion, scholarly value, and institutional recognition, thereby deepening the theoretical understanding of what constitutes "usefulness" in academic contexts.

This study focuses on actual use rather than behavioral intention. In Malaysian public universities, institutional mandates and compliance with open science initiatives often necessitate actual data deposition, making behavioral intention a less relevant construct. Researchers are typically aware of ODRs, and their practices are more influenced by existing policies and institutional environments than initial intentions (Thompson & Moseley, 2023). This theoretical adaptation suggests that TAM's traditional focus on intention may not suit all policy-driven or compliance-based environments, highlighting the need for flexible theoretical models that reflect varying degrees of voluntariness in technology adoption.

Similarly, the economic factor from the TOE framework is excluded. Financial barriers are minimal in Malaysian public universities due to institutional and governmental support for data repositories. Thus, non-monetary barriers such as institutional capacity, researcher readiness, and policy alignment are more pertinent determinants of ODR usage. This omission further supports the argument for context-sensitive model adaptation, enhancing the theoretical applicability of TOE to settings where financial cost is not a primary concern.

This study contributes to the theory by demonstrating how the TAM-TOE framework can be refined and adapted to reflect the real-world complexities of academic technology adoption. It advances existing models by embedding individual perceptions within broader technological, institutional, and environmental contexts. This integrated perspective offers a nuanced, policy-relevant foundation for future research on open science practices and digital infrastructure in higher education, particularly in emerging economies.

5.3 Proposed Framework

Based on the review above, the propositions for the research framework as shown in Figure 2, are combinations of two different models and manifest into hypotheses H1 through H9 as follows:

Proposition 1: There is a significant relationship between Technical Attribute and Perceived Ease of Use (PEOU).

Proposition 2: There is a significant relationship between Institutional Context and Perceived Ease of Use (PEOU).

Proposition 3: There is a significant relationship between Community Influence and Perceived Ease of Use (PEOU).

- Proposition 4: There is a significant relationship between Technical Attribute and Perceived Usefulness (PU).
 Proposition 5: There is a significant relationship between Institutional Context and Perceived Usefulness (PU).
 Proposition 6: There is a significant relationship between Community Influence and Perceived Usefulness (PU).
 Proposition 7: There is a significant relationship between Perceived Ease of Use (PEOU) and Perceived Usefulness (PU).
 Proposition 8: There is a significant relationship between Perceived Ease of Use (PEOU) and Actual Use of Open Data Repositories (ODRs).
 Proposition 9: There is a significant relationship between Perceived Usefulness (PU) and Actual Use of Open Data Repositories (ODRs).

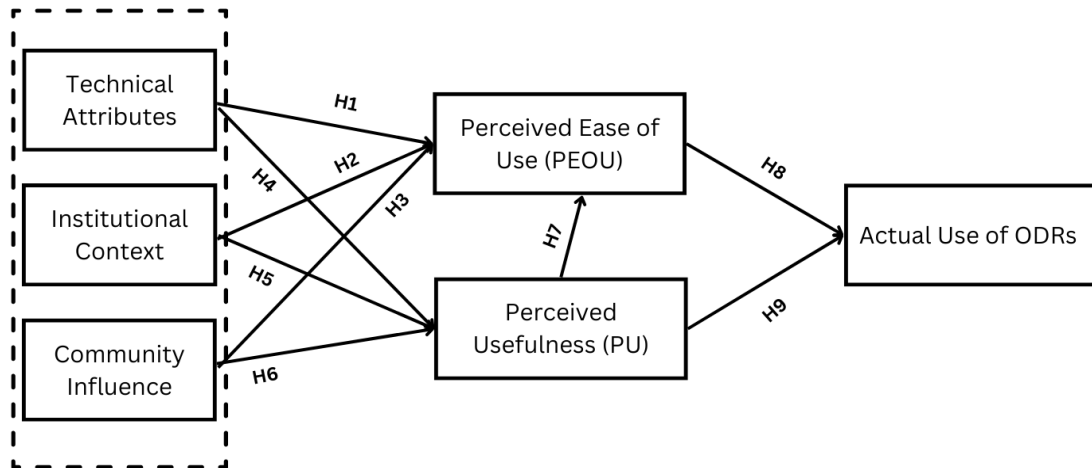


Fig. 2: Proposed conceptual framework for Open Data Repository adoption in Malaysia

This study advances the theoretical understanding of technology adoption by integrating the Technology Acceptance Model (TAM) with the Technological, Organizational, and Environmental (TOE) framework to examine open data repository (ODR) usage among Malaysian academic researchers. While TAM focuses on individual perceptions such as perceived usefulness and ease of use, the TOE framework adds contextual depth by incorporating institutional, technological, and social dimensions. This integration enhances TAM's explanatory power, especially in structured environments like public universities where open data practices are policy-driven. The model reflects real-world practices and policy compliance by emphasizing actual deposition behaviour over the behavioural intention. Moreover, excluding the economic factor acknowledges the limited financial barriers in such contexts, reinforcing the need to adapt theoretical models to specific institutional realities. This study thus offers a context-sensitive extension of TAM-TOE, contributing to a more comprehensive framework for understanding open data adoption in developing academic settings.

6.0 Conclusion

This conceptual study highlights the potential of open data repositories (ODRs) to enhance research transparency and collaboration within Malaysian academia. By applying the Technology Acceptance Model (TAM) and Technology-Organization-Environment (TOE) framework, the study offers a theoretical foundation for understanding the key factors influencing researchers' data deposition behavior. While the proposed framework provides valuable conceptual insights, it remains limited by the absence of empirical validation. Future research should employ quantitative or mixed-method approaches and broaden the sample to include institutional support staff and policymakers. Incorporating variables such as trust, perceived data sensitivity, and institutional incentives may further refine the model.

Beyond academia, this research offers practical implications for government agencies, non-governmental organizations (NGOs), and industry stakeholders seeking to leverage open data for policy formulation, innovation, and public accountability. The framework can inform national strategies that promote data democratization, enabling inclusive access to scientific outputs and greater transparency in governance. For instance, policymakers can develop regulations that incentivize data sharing, while industries—especially in healthcare, agriculture, and technology—can harness academic datasets for product development and data-driven decision-making. NGOs and civil society organizations may also utilize open data to monitor service delivery and advocate for reform.

To operationalize these insights, institutions should mandate data management training, embed data-sharing policies into grant protocols, and enhance the usability of repository platforms. Government bodies could offer incentives such as recognition schemes or funding benefits for data deposition. Inter-sectoral workshops and national guidelines for data governance should be established to foster a robust culture of open science. These collaborative efforts will strengthen Malaysia's open data ecosystem, ensuring its long-term sustainability, fostering innovation, and contributing to democratic engagement across sectors.

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Paper Contribution to Related Field of Study

This study contributes to the field of RDM by proposing a conceptual framework that integrates TAM and TOE. It comprehensively explains the factors influencing open data repository adoption among Malaysian academic researchers. By addressing technological, organizational, and environmental determinants, the study provides insights to guide policymakers and institutions in promoting effective open data practices, ultimately fostering greater transparency, collaboration, and innovation within Malaysia's academic research landscape.

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