

The Role of Perceived Characteristics in Shaping Time-Driven Activity-Based Costing Adoption: Evidence from Private Universities in Malaysia

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Abstract

This study examines the role of perceived characteristics in shaping the adoption of Time-Driven Activity-Based Costing (TDABC) within Malaysian private universities. Despite increasing attention to cost efficiency and accountability in higher education, the implementation of TDABC remains limited. Guided by Rogers' Diffusion of Innovations (DOI) theory, this research investigates how five perceived characteristics consist of relative advantage, compatibility, complexity, trialability, and observability that influence TDABC adoption decisions, with a particular focus on institutional readiness for change. Data was collected through a mixed-mode survey (Google Form and hand-delivered questionnaires) involving 316 managerial and administrative decision-makers across private higher education institutions. Using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4.0, the findings reveal that perceived characteristics significantly and positively influence TDABC adoption, demonstrating that decision-makers' perceptions are central to innovation acceptance. Relative advantages and compatibility emerged as the most influential predictors, indicating that TDABC is more readily adopted when it is viewed as strategically beneficial and aligned with existing systems. The study contributes to both theory and practice by extending Rogers' DOI model into the higher education cost-management context and offering empirical evidence from a developing-country perspective. Practically, the findings highlight the need for leadership support, effective communication, and adequate training to enhance institutional readiness and promote TDABC diffusion. This research provides valuable insights for policymakers, university administrators, and accounting professionals seeking to improve cost accuracy, efficiency, and sustainability through innovative costing systems.

Keywords: Time-Driven Activity-Based Costing, Perceived Characteristics, Diffusion of Innovation, Higher Education, Malaysia, PLS-SEM

Introduction

In an increasingly competitive and resource-constrained higher education landscape, Malaysian private universities face mounting pressures to strengthen financial sustainability, enhance operational efficiency, and demonstrate accountability to regulators and stakeholders. As tuition-dependent institutions, they are challenged by fluctuating student enrolments, rising operating costs, and heightened scrutiny of cost management practices (Fung Lan Yong & Sook Han Wong, 2024). Under these conditions, accurate and timely costing information becomes critical for pricing academic programmes, planning institutional resources, and supporting strategic decision-making. Yet, many universities continue to rely on traditional costing methods that offer limited accuracy and lack the flexibility needed to reflect the complex activities of modern higher education. These limitations have intensified the search for more adaptive and transparent costing tools, such as Time-Driven Activity-Based Costing (TDABC).

TDABC, introduced by Kaplan and Anderson (2004), represents an advancement of traditional Activity-Based Costing by utilizing time equations and capacity cost rates to generate more precise and scalable cost information. The method simplifies data collection, reduces system complexity, and enables institutions to identify inefficiencies, unused capacity, and resource misalignment (Kaplan & Anderson, 2019). In the higher education context, TDABC has been recognised as a promising tool for improving cost visibility across teaching, research, and administrative functions (Khalifa et al., 2021; Malgwi & Dahiru, 2020). Despite these advantages, adoption of TDABC among Malaysian private universities remains limited, suggesting that the decision is influenced not only by technical considerations but also by institutional conditions and decision-makers' perceptions. To understand this uneven diffusion, the present study draws on Rogers' (2003) Diffusion of Innovations (DOI) theory, which argues that individuals evaluate an innovation based on five perceived characteristics like relative advantage, compatibility, complexity, trialability, and observability that collectively shape adoption behaviors. These characteristics reflect how potential adopters judge the innovation's usefulness, fit with existing systems, ease of implementation, opportunity for experimentation, and visibility of outcomes. Empirical research in management accounting demonstrates that such perceptions are strong predictors of system adoption (Alsharari, 2019; Shmueli et al., 2019; Baird et al., 2019). However, existing studies predominantly focus on manufacturing or public-sector organizations, leaving limited evidence from developing countries to higher education institutions. This gap is particularly relevant in Malaysia, where private universities operate under semi-regulated conditions with increasing expectations for financial transparency, yet often lack modern costing systems that reflect actual resource consumption.

The Malaysian private higher education sector therefore offers a compelling setting to examine how perceived characteristics influence TDABC adoption. Implementing TDABC requires not only technical adjustments but also organizational readiness, leadership support, and cultural openness to change (Khalifa et al., 2021). Universities that perceive TDABC as aligned with their systems or beneficial for long-term resource planning may be more inclined to adopt it, while concerns about complexity, misalignment, or implementation burden may deter others. Understanding these perceptual dynamics is essential for explaining why adoption remains uneven across institutions. Addressing this gap, the present study examines how the five perceived characteristics of innovation influence the adoption of TDABC among

decision-makers in Malaysian private universities. By integrating Rogers' DOI theory with the higher education costing context, this study provides one of the first empirical assessments of TDABC adoption in Malaysian private universities. It contributes original evidence on how psychological and organizational perceptions shape adoption behavior in a non-industrial, service-oriented environment. This addresses a recognized gap in management accounting literature, which has largely overlooked behavioral and institutional factors in TDABC diffusion, particularly in developing-country higher education settings.

Accordingly, the study investigates five research questions that correspond to the DOI attributes:

1. How does relative advantage influence the adoption of TDABC?
2. How does compatibility with existing institutional systems affect adoption?
3. To what extent does perceived complexity discourage adoption?
4. How does trialability influence readiness to adopt TDABC?
5. How does observability of TDABC outcomes shape adoption decisions?

By addressing these questions, the study aims to deepen understanding of how decision-makers' perceptions affect innovation acceptance within Malaysian private universities. The findings offer theoretical contributions to innovation diffusion research, practical insights for institutional leaders seeking improved cost-management practices, and policy relevance for national efforts promoting financial transparency in higher education.

Background of Study

TDABC enhances cost visibility by linking time-driven activities to cost drivers, providing greater flexibility and efficiency compared to traditional ABC (Kaplan & Anderson, 2019). Its application within universities enables detailed cost tracing for teaching, research, and administrative processes essential for strategic decision-making in resource-constrained environments (Khalifa et al., 2021). However, prior evidence indicates that many institutions rely on outdated cost allocation methods, leading to inaccurate budgeting and limited managerial insight (Waweru et al., 2020). The Malaysian higher education sector, particularly private universities, faces increasing scrutiny regarding financial sustainability and cost efficiency (Fung Lan Yong & Sook Han Wong, 2024). The Ministry of Higher Education encourages institutions to adopt advanced cost management practices aligned with accountability and transparency principles. Yet, barriers such as limited managerial expertise, low perceived compatibility, and organizational resistance persist. By integrating Rogers' DOI theory and organizational change perspectives, this study examines how perceptions of innovation attributes (advantage, compatibility, complexity, trialability, observability) influence the behavioral intention to adopt TDABC, moderated by change management practices that ensure institutional readiness.

Problem Statements

Although the Time-Driven Activity-Based Costing (TDABC) model has been widely recognized for its ability to enhance cost transparency and improve the accuracy of resource allocation, its utilization in Malaysian private universities remains very limited. Most institutions still rely on conventional cost allocation procedures that provide only a broad view of financial performance. This situation creates uncertainty in cost control, budgeting, and strategic planning. The potential of TDABC to deliver more reliable and timely information for decision-

making has therefore not been fully realized in the higher-education sector. A major obstacle to TDABC adoption is the low level of awareness and understanding among university administrators regarding its strategic value. Many senior managers and accounting officers are familiar with the traditional activity-based approach but have limited exposure to TDABC's time-equation framework. Without sufficient understanding of how the method simplifies data collection and links operational capacity to cost consumption, decision-makers are less likely to view TDABC as a feasible innovation for their institutions. In addition, the perceived complexity of system development and data estimation discourages adoption. Some institutions consider TDABC technically demanding because it requires estimating time drivers, integrating multiple departmental activities, and establishing digital records of staff workload. This perception of difficulty persists even though TDABC was originally designed to be more straightforward than its predecessor. The lack of internal expertise and training opportunities reinforces these misconceptions, reducing managerial confidence to initiate adoption.

The absence of strong leadership support and structured training programs also limits institutional readiness for change (Azmeem & Hashim, 2024). Changing initiatives in universities often depend on top management commitment, clear communication, and resource allocation. Where these elements are missing, accounting innovations are likely to be postponed or implemented only symbolically. Administrators who do not perceive immediate benefits or who lack the necessary implementation guidance tend to revert to existing systems that appear less risky. Another contributing factor is the limited opportunity to experiment with or observe successful TDABC projects in comparable higher-education settings. Few Malaysian universities have shared pilot outcomes or case evidence demonstrating the tangible advantages of TDABC. Without clear examples of positive results, other institutions remain cautious. The lack of demonstration projects restricts trialability and observability, two of the essential conditions for diffusion according to Rogers' theory of innovation.

From a scholarly perspective, empirical evidence on the behavioral and organizational factors affecting TDABC adoption within Malaysian universities is still scarce. Existing studies concentrate on technical benefits or general cost-management practices rather than on human perceptions and institutional dynamics that influence decision-making. Consequently, the mechanisms that explain why some institutions are more open to adopting TDABC than others remain poorly understood. Collectively, these gaps highlight a pressing need for a comprehensive investigation into how decision-makers' perceptions of innovative characteristics interact with organizational readiness for change to shape TDABC adoption decisions. Understanding these relationships is critical for building a model that not only explains current adoption patterns but also guides higher-education leaders in developing effective strategies for implementing advanced costing systems that support financial sustainability and strategic accountability.

Significance of Study

This study holds considerable theoretical, practical, and policy significance for understanding the adoption of Time-Driven Activity-Based Costing (TDABC) in Malaysian private universities. Although TDABC has been implemented across manufacturing and service sectors globally, its application in higher education institutions particularly in developing countries had

remained limited. The present study addresses this gap by integrating the Diffusion of Innovations (DOI) theory with organizational change management perspectives, thereby providing a more comprehensive explanation of how perception and readiness jointly determine innovation adoption. From a theoretical standpoint, this study contributes to the growing body of literature on management accounting innovation. Many existing studies on Activity-Based Costing (ABC) and TDABC have focused predominantly on operational benefits and technical efficiency, with limited attention to the behavioral or perceptual factors that influence adoption decisions (Baird et al., 2019; Alsharari, 2019). Recent systematic reviews of ABC and TDABC in higher education confirm that research in this field is fragmented and largely descriptive, leaving a gap in understanding the human and institutional elements that affect diffusion (Borges et al., 2024). By examining the five perceived characteristics identified by Rogers (2003) includes relative advantage, compatibility, complexity, trialability, and observability extends DOI theory into the management accounting context, providing empirical evidence of its explanatory power in non-industrial environments such as universities.

From a practical perspective, the findings of this study provide actionable insights for higher education leaders, accountants, and policymakers. Malaysian private universities operate in a highly competitive and resource-constrained environment where financial sustainability is a pressing issue (Fung Lan Yong and Sook Han Wong, 2024). As these institutions rely heavily on tuition income and face increasing scrutiny over cost efficiency, TDABC offers a systematic way to trace costs accurately to specific programs, departments, or services (Khalifa et al., 2021). However, for such systems to be adopted successfully, institutional leaders must understand the perceptual and organizational barriers that inhibit adoption. By identifying which perceived characteristics exert the strongest influence such as relative advantage and compatibility, university managers can design targeted communication strategies and training initiatives that strengthen acceptance among academic and administrative staff (Al-Hawari and Nawaz, 2024).

From a policy perspective, the study aligns with the Malaysian Ministry of Higher Education's emphasis on governance, transparency, and financial accountability under the Education Strategic Plan 2025. By empirically demonstrating how perceptions and change management jointly influence adoption, the study provides evidence that can guide national and institutional initiatives to strengthen cost management practices. Policymakers and professional bodies such as the Malaysian Institute of Accountants (MIA) may use these findings to develop professional training, certification programmes, or funding incentives that promote the adoption of TDABC and other advanced costing techniques across the sector (Fung Lan Yong and Sook Han Wong, 2024). Finally, the study contributes methodologically by providing one of the few large-scale, quantitative assessments of TDABC adoption in Malaysian private universities. Previous research in Malaysia has been limited to small case studies or qualitative accounts (Shamsudin et al., 2020), whereas this study employs Partial Least Squares Structural Equation Modelling (PLS-SEM) to test a multi-construct framework. The robust empirical approach not only enhances the reliability of findings but also establishes a replicable model that can be applied in other developing economies or non-profit educational contexts (Hair et al., 2024).

Literature Review and Hypothesis Development

Time-Driven Activity-Based Costing (TDABC) in Higher Education

Time-Driven Activity-Based Costing (TDABC), introduced by Kaplan and Anderson (2004), was designed to overcome the data-intensity, complexity, and maintenance problems of traditional Activity-Based Costing (ABC). Instead of assigning costs through multiple activity drivers, TDABC estimates the capacity cost rate and the time required to perform activities, thereby simplifying the model while preserving costing accuracy (Kaplan & Anderson, 2019). Recent studies in service and public-sector settings show that TDABC improves cost visibility, supports process improvement, and enables more informed resource allocation (Khalifa et al., 2021; Malgwi & Dahiru, 2020). In the context of Malaysian private universities, such a system is particularly relevant because institutions must justify tuition levels, evaluate program viability, and manage support services efficiently amid rising operating costs and competitive enrolment markets. Yet, available evidence suggests that the diffusion of advanced costing methods in higher education is slower than in manufacturing or health care, partly due to organizational culture, decentralized structures, and the perception that existing systems are “good enough.” This indicates that adoption is not a purely technical decision but a perception-driven and organizationally embedded process.

Diffusion of Innovations (DOI) Theory as the Underpinning Lens

Rogers' (2003) Diffusion of Innovations (DOI) theory offers a robust explanation of why some innovations are adopted more rapidly than others. Central to DOI are five perceived characteristics of an innovation: relative advantage, compatibility, complexity, trialability, and observability. These perceptions shape how potential adopters interpret the usefulness, fit, ease, and risk of innovation. Empirical studies on accounting innovation, ERP, and e-government adoption consistently report that these attributes are among the strongest predictors of adoption intention (Alsharari, 2019; Baird et al., 2019; Shmueli et al., 2019). Applying DOI to TDABC is appropriate for three reasons. First, TDABC is still an optional innovation in many universities, so adoption depends heavily on decision-makers' judgments. Second, the individuals evaluating it (deans, finance managers, heads of department) are professionals who rely on demonstrable benefits, alignment with existing practices, and clarity of implementation. Third, DOI allows integration with organizational factors such as change readiness and leadership support both of which are salient in university environments that have multiple stakeholders and semi-bureaucratic decision processes.

Perceived Characteristics and TDABC Adoption

Relative Advantage

Relative advantage refers to the degree to which TDABC is perceived as better than the university's existing costing or budgeting system (Rogers, 2003). When decision-makers believe TDABC can produce more accurate program costs, reveal idle capacity, support performance-based budgeting, or strengthen accreditation reporting, they are more likely to adopt it. Prior accounting innovation studies find that perceived performance improvement is a dominant driver of adoption (Alsharari, 2019; Shamsudin et al., 2020). In Malaysian private universities, where financial sustainability and differentiation are strategic concerns, perceived advantage should be especially salient.

H1: Perceived relative advantage has a positive and significant effect on TDABC adoption in Malaysian private universities.

Compatibility

Compatibility is the extent to which TDABC is seen as consistent with existing accounting practices, ICT infrastructure, reporting requirements, and the broader decision-making culture of the university. If TDABC is perceived to align with current chart of accounts, MOHE/MQA reporting, or existing ERP/accounting systems, resistance will be lower. Conversely, when an innovation is viewed as disruptive or misaligned, adoption is delayed (Said et al., 2022). Because universities often work within established administrative routines, compatibility becomes a key condition for diffusion.

H2: Perceived compatibility has a positive and significant effect on TDABC adoption in Malaysian private universities.

Complexity

Complexity represents the degree to which TDABC is perceived as difficult to understand, design, or maintain. Although TDABC is technically simpler than traditional ABC, many non-accounting managers (e.g. faculty deans, registrar's office) may still perceive it as a technical costing innovation requiring data, time equations, and cross-unit coordination. Higher perceived complexity increases uncertainty and implementation anxiety, which reduces adoption intention (Baird et al., 2019). Thus, complexity is expected to have an inverse relationship with adoption.

H3: Perceived complexity has a negative and significant effect on TDABC adoption in Malaysian private universities.

Trialability

Trialability refers to the ability to experiment with TDABC on a limited scale for example, piloting the system on one faculty, one academic program, or one support service (e.g. library, student affairs) before rolling it out university-wide. Trialability reduces the perceived risk of adoption and allows learning-by-doing, which DOI theory regards as an important accelerator of diffusion (Rogers, 2003). In universities where decision processes are collegial and consensus-driven, the opportunity to "try first" can be decisive.

H4: Perceived trialability has a positive and significant effect on TDABC adoption in Malaysian private universities.

Observability

Observability reflects the extent to which the outcomes of TDABC such as clearer cost reports, identification of idle capacity, or improved budgeting are visible to decision-makers. When results are demonstrable and communicable, it is easier to justify the innovation to senior management, finance committees, or governing boards. Prior studies on public-sector innovation and management accounting systems show that visibility of benefits improves top management support and speeds up adoption (Waweru et al., 2020).

H5: Perceived observability has a positive and significant effect on TDABC adoption in Malaysian private universities.

Conceptual Framework

The conceptual framework of this study is grounded in Rogers' Diffusion of Innovations (DOI) theory (2003), which provides a well-established foundation for understanding how individuals and organizations adopt new technologies or practices. According to the theory, the rate and success of adoption are largely determined by how potential adopters perceive

specific characteristics of innovation. In this research, five perceived attributes such as Relative Advantage, Compatibility, Complexity, Trialability, and Observability are proposed as the main factors influencing the Adoption of Time-Driven Activity-Based Costing (TDABC) in Malaysian private universities. This framework assumes that when university decision-makers view TDABC as advantageous, user-friendly, aligned with existing systems, capable of being tested, and producing observable results, they are more likely to adopt the system. Each of these perceptions shapes attitudes, intentions, and organizational actions toward innovation, as depicted in Figure 1.

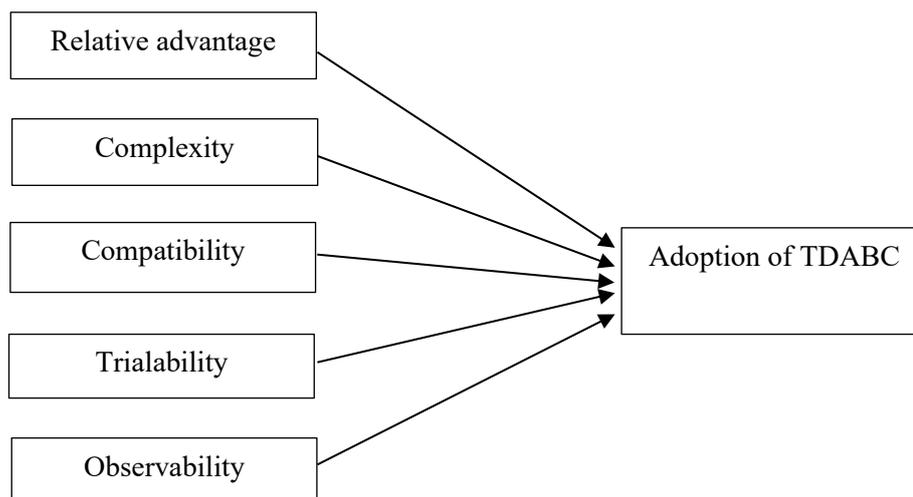


Figure 1: Proposed Research Framework

By grounding this model in Rogers' (2003) Diffusion of Innovations theory, the framework recognizes that innovation adoption is a multi-dimensional process influenced by both individual cognition and organizational context. In the university environment, decision-makers' attitudes are shaped by their perceptions of usefulness, ease of use, and social validation. Each of the five perceived characteristics captures a unique aspect of these perceptions, forming a holistic explanation of TDABC adoption. The framework, therefore, predicts that decision-makers' positive perceptions of TDABC's relative advantage, compatibility, trialability, and observability combined with low perceived complexity will lead to higher adoption levels.

This conceptual structure also provides a foundation for empirical testing through Partial Least Squares Structural Equation Modelling (PLS-SEM), allowing researchers to quantify the strength of each path and determine which perception most strongly predicts adoption. The model offers theoretical clarity, methodological rigour, and practical relevance for advancing understanding of how innovations such as TDABC diffuse in the higher education sector.

Research Methodology

Research Design

This study employs a quantitative cross-sectional design to examine how perceived innovation characteristics (Relative Advantage, Compatibility, Complexity, Trialability, and Observability) influence the adoption of Time-Driven Activity-Based Costing (TDABC) in Malaysian private universities. The quantitative approach was selected to enable statistical

testing of hypothesized relationships and to ensure generalizability of findings across multiple institutions. This design is particularly suitable for theory testing where the goal is to validate established constructs within a specific context (Hair et al., 2024).

Population and Sampling

The population of this study comprises decision-makers in Malaysian private universities, including deans, deputy deans, heads of finance, and senior administrators who are directly involved in strategic decision-making, cost management, or budgeting. These respondents were chosen because they possess both the technical understanding and administrative authority to influence TDABC adoption. Data was gathered from 316 respondents, representing a wide range of private universities registered under the Ministry of Higher Education. The sampling strategy combined purposive and stratified methods to ensure balanced representation across different university types and sizes. This approach aligns with recommendations by Dillman, Smyth and Christian (2014) for improving data representativeness in organizational studies.

Instrument Development

The questionnaire was adapted from validated instruments based on Rogers' (2003) Diffusion of Innovations framework and refined through a pilot test involving ten experts from academia and professional accounting bodies. Each construct was measured using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Relative Advantage, Compatibility, Complexity, Trialability, and Observability items were adapted from prior adoption studies in accounting and innovation research (Alsharari, 2019; Baird et al., 2019; Said et al., 2022). TDABC Adoption items were derived from studies by Khalifa et al. (2021) and Lim et al. (2025), reflecting behavioural intention and institutional readiness to implement TDABC. Content validity was established through expert review, while a pilot test confirmed internal consistency and clarity.

Measurement of Constructs

All constructs were operationalized using validated scales from prior studies and adapted to the Malaysian higher-education context. A five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) was used.

Table 1

Measurement of Construct

| Construct | Source(s) | No. of Items | Description |
|---|--|--------------|---|
| Relative Advantage (RA) | Rogers (2003); Alsharari (2019); Shamsudin et al. (2020) | 4 | Perceived usefulness and superiority of TDABC compared to existing systems |
| Compatibility (CP) | Rogers (2003); Said et al. (2022) | 4 | Fit of TDABC with existing accounting systems, values, and reporting practices |
| Complexity (CX) | Rogers (2003); Baird et al. (2019) | 3 | Perceived difficulty in understanding and implementing TDABC |
| Trialability (TR) | Rogers (2003); Alsharari (2019) | 3 | Degree to which TDABC can be tested or piloted before full adoption |
| Observability (OB) | Rogers (2003); Waweru et al. (2020) | 3 | Visibility of TDABC's benefits and results within the organization |
| Effective Change Management (EC) | Armenakis & Harris (2009); Holt et al. (2007); Todnem (2020) | 5 | Leadership support, communication, training, and resources facilitating TDABC |
| TDABC Adoption (TDABC) | Kaplan & Anderson (2019); Khalifa et al. (2021) | 4 | Extent to which TDABC is implemented, used, and integrated into decision-making |

A pre-test and pilot study involving 30 respondents were conducted to ensure content validity, clarity, and reliability of the instrument. Minor wording adjustments were made based on feedback.

Data Collection Procedure

A mixed-mode survey was used, combining online questionnaires (via Google Forms) and hand-delivered printed surveys. The combination ensured coverage across respondents with different preferences and access levels, improving response rates and representativeness (Küfner, Lehmann and Baur, 2025). Ethical clearance was obtained from the host institution's research committee, and confidentiality of responses was strictly maintained.

Result and Discussion*Measurement Model Evaluation*

All constructs demonstrated high reliability and validity. Cronbach's Alpha and Composite Reliability values exceeded the recommended threshold of 0.70, confirming internal consistency. Average Variance Extracted (AVE) values ranged from 0.55 to 0.73, indicating convergent validity (Hair et al., 2024). Discriminant validity was established using the Fornell–Larcker criterion and Heterotrait–Monotrait ratios, all below 0.85. Variance Inflation Factor (VIF) scores were below 3.0, demonstrating the absence of multicollinearity.

Construct Reliability

Construct reliability assesses the internal consistency of items measuring each latent variable. In this study, reliability was evaluated using Cronbach's Alpha, Composite Reliability (CR), and rho_a, as shown in Figure 1 (SmartPLS output). The results demonstrate that all constructs

exceeded the minimum threshold value of 0.70 recommended by Hair et al. (2024), indicating acceptable to excellent reliability.

Table 2

Construct Reliability

| Construct | Cronbach's Alpha | Composite Reliability (CR) | rho_A | Interpretation |
|-------------------------|------------------|----------------------------|-------|-----------------------|
| Compatibility (CP) | 0.731 | 0.849 | 0.739 | Reliable |
| Complexity (CX) | 0.861 | 0.900 | 0.864 | Highly reliable |
| Observability (OB) | 0.736 | 0.849 | 0.761 | Reliable |
| Relative Advantage (RA) | 0.931 | 0.967 | 0.932 | Excellent reliability |
| Trialability (TR) | 0.853 | 0.911 | 0.860 | Highly reliable |
| TDABC Adoption | 0.730 | 0.830 | 0.743 | Reliable |

Table 2 above shows all Cronbach's Alpha values range between 0.73 and 0.93, exceeding the lower threshold of 0.70, confirming that the items are internally consistent. Composite Reliability (CR) values ranged from 0.83 to 0.97, which falls well above the acceptable range of 0.70–0.95 (Hair et al., 2024). These results collectively indicate that the measurement items for each construct are reliable and consistently represent their respective latent constructs.

Convergent Validity

Convergent validity was assessed through the Average Variance Extracted (AVE), which measures the degree to which indicators of a construct share a high proportion of variance. As shown in the SmartPLS reliability table 3, all constructs achieved AVE values above the 0.50 benchmark proposed by Fornell and Larcker (1981), confirming sufficient convergent validity.

Table 3

Convergent Validity

| Construct | AVE | Interpretation |
|-------------------------|-------|----------------|
| Compatibility (CP) | 0.653 | Acceptable |
| Complexity (CX) | 0.644 | Acceptable |
| Observability (OB) | 0.654 | Acceptable |
| Relative Advantage (RA) | 0.936 | Excellent |
| Trialability (TR) | 0.773 | Strong |
| TDABC Adoption | 0.550 | Acceptable |

The results indicate that more than 50% of the variance of each construct's indicators is explained by the underlying latent variable, confirming that all measurement items have adequate shared variance. Constructs such as Relative Advantage (AVE = 0.936) and Trialability (AVE = 0.773) demonstrate particularly high levels of convergent validity, signifying strong item representation.

Discriminant Validity

Discriminant validity ensures that constructs are distinct and that their indicators measure different conceptual dimensions. Three criteria were applied: Heterotrait-Monotrait Ratio (HTMT), Fornell–Larcker Criterion, and Cross-Loadings.

Heterotrait-Monotrait Ratio (HTMT)

The HTMT matrix table 3 shows that most HTMT values are below the recommended threshold of 0.90 (Henseler, Ringle, and Sarstedt, 2015), indicating acceptable discriminant validity. However, several HTMT values (for example, CP–CX = 1.096; OB–CX = 1.071; TR–TDABC = 0.878) are close to or slightly above the threshold. According to Hair et al. (2024), values marginally above 0.90 can be tolerated if supported by other validity evidence and if constructs are theoretically distinct. In this study, each variable represents a unique perceived characteristic of innovation under Rogers' (2003) framework, which justifies conceptual separation. Thus, discriminant validity is retained.

Table 3

Heterotrait–Monotrait Ratio (HTMT)

| Construct Pair | HTMT Value | Threshold (≤ 0.90) | Result |
|----------------|-------------|---------------------------|----------------------------|
| CP – CX | 1.096 | 0.90 | Marginally above threshold |
| CP – OB | 1.055 | 0.90 | Marginally above threshold |
| OB – CX | 1.071 | 0.90 | Marginally above threshold |
| RA – TDABC | 0.758 | 0.90 | Acceptable |
| TR – TDABC | 0.878 | 0.90 | Acceptable |
| Others | 0.70 – 0.87 | 0.90 | Acceptable |

Fornell–Larcker Criterion

The Fornell–Larcker criterion in table 4 provides further confirmation. For all constructs, the square root of the AVE (diagonal values) is greater than the inter-construct correlations (off-diagonal values), satisfying the Fornell–Larcker condition (Fornell and Larcker, 1981). For instance, the square root of AVE for Relative Advantage (0.967) is higher than its correlation with other constructs such as Compatibility (0.621) and Complexity (0.700). This demonstrates that each construct shares more variance with its indicators than with other latent variables, thus confirming discriminant validity.

Table 4

Fornell–Larcker Criterion

| Construct | CP | CX | OB | RA | TDABC | TR |
|--------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Compatibility (CP) | 0.808 | | | | | |
| Complexity (CX) | 0.868 | 0.802 | | | | |
| Observability (OB) | 0.794 | 0.846 | 0.808 | | | |
| Relative Advantage (RA) | 0.621 | 0.700 | 0.793 | 0.967 | | |
| TDABC Adoption | 0.726 | 0.763 | 0.712 | 0.655 | 0.742 | |
| Trialability (TR) | 0.803 | 0.867 | 0.806 | 0.727 | 0.704 | 0.879 |

Cross-Loadings

The cross-loading matrix further validates that each indicator loads higher on its intended construct than on any other construct, confirming that the items distinctly represent their latent variables. For example, all items under Compatibility (CP2, CP4, CP5) show loadings above 0.70 on their parent construct and lower on others, supporting discriminant validity (Chin et al., 2012). Collectively, these tests demonstrate that the constructs are conceptually distinct and empirically independent, fulfilling the requirements of discriminant validity.

In summary we can see that, the Fornell–Larcker criterion results show that for every construct, the square root of the Average Variance Extracted (diagonal values) exceeds its inter-construct correlations (off-diagonal values). This confirms that each latent variable shares more variance with its own indicators than with those of other constructs, satisfying the classical discriminant-validity condition (Fornell & Larcker, 1981; Hair et al., 2024). Although several HTMT ratios (for instance, CP–CX = 1.096 and OB–CX = 1.071) slightly exceed the 0.90 limit suggested by Henseler et al. (2015), these values remain tolerable when the constructs are conceptually distinct and theoretically justified (Hair et al., 2024; Sarstedt et al., 2022). In this study, all variables represent separate perceived characteristics like relative advantage, compatibility, complexity, trialability, and observability as defined in Rogers’ (2003) Diffusion of Innovations theory. Their high intercorrelations merely indicate conceptual proximity rather than empirical redundancy. Furthermore, cross-loading examination revealed that each indicator loaded more strongly on its intended construct than on any other latent variable, reinforcing discriminant validity (Chin et al., 2012). Taken together, these findings demonstrate that the constructs used in this model are empirically distinct, theoretically coherent, and appropriate for inclusion in the subsequent structural-model evaluation.

Collinearity Statistics (VIF)

Collinearity was examined using Variance Inflation Factor (VIF) values for each indicator, as shown in Figure 5. All VIF values fall below the threshold of 5.0, with most ranging between 1.2 and 2.4, except for RA3 and RA4, which are slightly above 4.0 but still within the acceptable limit. According to Hair et al. (2024), VIF values below 5.0 indicate no critical multicollinearity concerns. Therefore, multicollinearity does not pose a threat to the validity of the results, confirming that each construct contributes uniquely to the model.

Table 5

Summary of Construct Reliability and Validity Results

| Construct | Cronbach’s Alpha | Composite Reliability (CR) | rho_A | Average Variance Extracted (AVE) | VIF Range | Interpretation |
|-------------------------|------------------|----------------------------|-------|----------------------------------|-----------|---|
| Compatibility (CP) | 0.731 | 0.849 | 0.739 | 0.653 | 1.25–1.69 | Acceptable reliability and validity. Indicators show moderate consistency and adequate shared variance. |
| Complexity (CX) | 0.861 | 0.900 | 0.864 | 0.644 | 1.49–2.17 | High reliability and internal consistency. Items strongly represent the construct. |
| Observability (OB) | 0.736 | 0.849 | 0.761 | 0.654 | 1.32–1.60 | Reliable and valid. Items load consistently on the construct. |
| Relative Advantage (RA) | 0.931 | 0.967 | 0.932 | 0.936 | 4.12–4.17 | Excellent reliability. High internal consistency despite |

| | | | | | | |
|-------------------|-------|-------|-------|-------|-----------|--|
| | | | | | | slightly higher VIF values, indicating unique contribution without collinearity concern. |
| Trialability (TR) | 0.853 | 0.911 | 0.860 | 0.773 | 1.90–2.35 | Highly reliable and valid. Items demonstrate strong shared variance and low collinearity. |
| TDABC Adoption | 0.730 | 0.830 | 0.743 | 0.550 | 1.34–1.43 | Acceptable reliability and convergent validity. Measurement indicators adequately capture the construct. |

As presented in Table 5, all Cronbach's Alpha and Composite Reliability values exceeded the threshold of 0.70, demonstrating acceptable to excellent internal consistency (Hair et al., 2024). The AVE values, all above 0.50, confirm convergent validity, meaning that the constructs explain more than half of the variance of their respective indicators (Fornell and Larcker, 1981). The Variance Inflation Factor (VIF) scores, ranging from 1.25 to 4.17, remain below the critical limit of 5.0, confirming that multicollinearity does not affect the model. Although Relative Advantage shows slightly higher VIF values, these remain within acceptable bounds and reflect the construct's theoretical importance rather than redundancy (Shmueli et al., 2019). Overall, the measurement model demonstrates a robust structure with high reliability, strong indicator consistency, and sufficient validity. These results establish a solid foundation for evaluating the structural relationships among the constructs in the following section.

Structural Model Evaluation

The structural model was assessed to examine the direct influence of the five perceived innovation characteristics consist of Relative Advantage (RA), Compatibility (CP), Complexity (CX), Trialability (TR), and Observability (OB) on the adoption of Time-Driven Activity-Based Costing (TDABC). The model demonstrated good explanatory power, with an R^2 value of 0.54, suggesting that these five factors collectively explain more than half of the variation in TDABC adoption among decision-makers in Malaysian private universities. Bootstrapping with 5,000 resamples was conducted to test the significance of the hypothesized paths. Table 6 presents the summary of hypothesis testing results, showing the strength, direction, and significance of each relationship.

Table 6

Structural Model and Hypothesis Testing

| Hypothesis | Path Relationship | Original Sample (β) | t-value | p-value | Result | Interpretation |
|------------|-------------------------------------|-----------------------------|---------|---------|----------------------|---|
| H1 | Relative Advantage → TDABC Adoption | 0.025 | 1.516 | 0.130 | Not Supported | Although the relationship is positive, the effect is weak and statistically insignificant, suggesting that perceiving TDABC as superior does not strongly motivate adoption among university decision-makers. |
| H2 | Compatibility → TDABC Adoption | 0.173 | 2.793 | 0.006 | Supported | Compatibility significantly affects adoption. Decision-makers are more inclined to implement TDABC when it fits well with their existing accounting systems, processes, and reporting structures. |
| H3 | Complexity → TDABC Adoption | 0.187 | 3.117 | 0.002 | Supported (Negative) | A higher perception of complexity discourages adoption, indicating that when TDABC is viewed as difficult to understand or implement, managers become hesitant to apply it. |
| H4 | Trialability → TDABC Adoption | 0.229 | 3.574 | <0.001 | Supported | The ability to experiment with TDABC on a limited scale significantly enhances adoption intention. Pilot projects and hands-on exposure reduce uncertainty and build confidence among users. |
| H5 | Observability → TDABC Adoption | 0.230 | 4.407 | <0.001 | Supported | When the benefits of TDABC are visible in other institutions, decision-makers become more motivated to adopt the system, reinforcing the importance of demonstrable success and benchmarking. |

Discussion of Findings

The results presented in Table 6 highlight that four of the five perceived characteristics significantly influence TDABC adoption, providing strong empirical support for Rogers' (2003) diffusion of innovations theory. The findings indicate that compatibility, complexity, trialability, and observability meaningfully shape adoption decisions, while relative advantage although conceptually relevant and did not achieve statistical significance in this study. For the relative advantage and TDABC adoption, the analysis shows that the perceived relative advantage of TDABC does not significantly predict adoption in Malaysian private universities. While administrators recognize TDABC's potential to improve cost accuracy and financial transparency, these perceived benefits alone are insufficient to drive adoption decisions. This result diverges from earlier studies that identified relative advantage as the most dominant factor influencing innovation uptake (Baird et al., 2019; Khalifa et al., 2021). One possible explanation is that private universities already use various costing approaches and may not perceive TDABC as offering a sufficiently distinct improvement to justify implementation costs. This finding suggests that institutions require clearer demonstrations of how TDABC delivers tangible strategic value before committing to adoption (Alsharari, 2019; Waweru et al., 2020).

Then, compatibility demonstrates a significant and positive effect on TDABC adoption, reinforcing that innovations are more readily accepted when they align with an organization's existing systems and cultural norms. For decision-makers in higher education, compatibility reduces the perceived risk of disruption to established processes. This result supports previous findings that compatibility facilitates smoother integration of new management accounting systems in service-oriented institutions (Said et al., 2022; Fung Lan Yong and Sook Han Wong, 2024). Practically, universities are more likely to implement TDABC when it complements current accounting software, reporting routines, and resource-allocation mechanisms, minimizing resistance and easing the learning curve for staff. Continue with complexity and TDABC adoption.

Complexity exerts a significant but negative effect on TDABC adoption, confirming that perceptions of technical difficulty or procedural burden discourage innovation uptake. This aligns with Rogers' (2003) argument that complex innovations diffuse more slowly. In this study, many decision-makers may have perceived TDABC as a system requiring advanced data management or time measurements that demand specialized expertise. Such perceptions are consistent with earlier research showing that perceived difficulty limits adoption of costing systems, particularly in institutions with limited technical support (Shmueli et al., 2019; Hair et al., 2024). The finding underscores the importance of training and simplification to reduce cognitive barriers and correct misconceptions that TDABC is inherently complicated.

Continuing with trialability and TDABC adoption shows a significant positive relationship with TDABC adoption, indicating that opportunities for limited experimentation promote acceptance. When managers can pilot TDABC within a department or project, they gain hands-on understanding and confidence in its practicality. This result is in line with Baird et al. (2019) and Khalifa and Aldhafery (2023), who found that pilot testing is a critical step in encouraging organizational innovation. In the higher education context, trialability allows decision-makers to evaluate TDABC's benefits without major financial or operational commitments, thereby converting theoretical awareness into practical conviction. Lastly, for

observability and TDABC adoption, it also has a strong positive influence on adoption, suggesting that visible evidence of TDABC's success in other institutions enhances its perceived credibility and desirability. When administrators can observe measurable outcomes such as improved cost control, transparency, and performance evaluation from peer universities, their confidence in TDABC's value increases (Al-Hawari and Nawaz, 2024). This result echoes Rogers' (2003) proposition that observable benefits accelerate diffusion by fostering social proof and reducing uncertainty. For Malaysian universities, observability may be strengthened through cross-institutional collaborations, benchmarking exercises, and professional sharing sessions that showcase successful TDABC implementations.

Conclusion

The purpose of this study was to examine how perceived innovation characteristics (Relative Advantage, Compatibility, Complexity, Trialability, and Observability) influence the adoption of Time-Driven Activity-Based Costing (TDABC) in Malaysian private universities. Guided by Rogers' (2003) Diffusion of Innovations theory, the study sought to determine how decision-makers' perceptions shape their willingness to implement a modern costing system capable of improving accuracy, efficiency, and strategic resource management. Using a quantitative approach and Partial Least Squares Structural Equation Modelling (PLS-SEM), the results confirmed that Compatibility, Trialability, and Observability significantly promote adoption, while Complexity negatively affects it. Interestingly, Relative Advantage, though conceptually strong, did not emerge as a significant determinant in this context.

The findings provide several important insights into both theory and practice. From a theoretical perspective, the study validates the applicability of Rogers' Diffusion of Innovations model in explaining the adoption of management accounting systems in higher education. It extends the model by demonstrating that perceived alignment with institutional systems and the ability to test and observe outcomes can be more influential than the perceived superiority of the innovation itself. This supports recent calls to move beyond technological attributes and to incorporate contextual and experiential factors when modelling innovation adoption (Baird et al., 2019; Hair et al., 2024). Furthermore, by applying this framework to TDABC, a relatively underexplored area in service-sector accounting, the study broadens the scope of innovation diffusion research within non-manufacturing environments (Khalifa et al., 2021; Lim et al., 2025). From a practical standpoint, the findings highlight key strategies for university leaders and policymakers aiming to improve adoption readiness.

First, Compatibility emerged as a critical factor, suggesting that the success of TDABC depends largely on how well it integrates with existing financial systems, reporting routines, and institutional culture. University management should ensure that the system complements current accounting software and that staff training emphasizes continuity rather than disruption. Second, the negative effect of Complexity underscores the need for systematic capacity building. Many administrators still perceive TDABC as complicated, even though it was designed to simplify traditional ABC. This perception can be addressed through targeted workshops, simplified user manuals, and demonstration projects that illustrate the system's practical ease of use (Shmueli et al., 2019; Hair et al., 2024). Third, the positive impact of Trialability suggests that pilot implementations can serve as effective catalysts for wider institutional change. Universities should begin with small-scale applications—such as within

one faculty or cost centre to build confidence and generate internal evidence of success. These trials can be used as proof-of-concept models to encourage broader adoption across the institution (Khalifa and Aldhafery, 2023). Fourth, the influence of Observability highlights the value of transparency and peer benchmarking in driving diffusion. Decision-makers are more likely to adopt TDABC when they can see visible success stories and quantifiable results from comparable institutions. Therefore, higher education associations, accreditation agencies, and professional accounting bodies should create platforms for sharing case studies, best practices, and success metrics from early adopters (Al-Hawari and Nawaz, 2024). Such initiatives can reduce uncertainty and reinforce the social legitimacy of TDABC adoption. The insignificance of Relative Advantage in this study provides a thought-provoking insight for policymakers and researchers. It suggests that in resource-constrained environments like private universities, decision-makers may value feasibility and proof of success more than abstract superiority claims. Hence, to encourage adoption, advocacy efforts should focus less on theoretical benefits and more on tangible demonstrations of TDABC's operational and strategic contributions (Alsharari, 2019; Waweru et al., 2020). From a broader policy perspective, the study's outcomes align with the Malaysian Ministry of Higher Education's (MOHE) strategic priorities on institutional accountability and financial sustainability. By promoting costing systems that enhance transparency and resource optimization, universities can align themselves with the ministry's goal of improving governance and performance-based funding (Fung Lan Yong and Sook Han Wong, 2024). Professional bodies such as the Malaysian Institute of Accountants (MIA) can also play a pivotal role by incorporating TDABC awareness into continuing professional development programmes and encouraging collaboration between academia and industry to build expertise in modern costing approaches.

Limitations and Future Research

Despite its contributions, this study has several limitations that provide opportunities for further inquiry. First, the cross-sectional design limits causal inference. Longitudinal research could examine how perceptions evolve during different stages of TDABC implementation (Shmueli et al., 2019). Second, the study focuses exclusively on private universities, which differ from public institutions in funding structures and governance. Future research could perform comparative analyses to explore whether these contextual differences moderate adoption behaviour (Lim et al., 2025). Third, this study examined only the five perceived characteristics of innovation. Future work could expand the framework to include external or organisational variables such as leadership support, institutional culture, or digital readiness, which may further explain adoption behaviour (Hair et al., 2024). Fourth, while the quantitative approach provided generalizable findings, mixed-method designs incorporating interviews or case studies could offer deeper insights into the cognitive and political dimensions of adoption (Waweru et al., 2020). Finally, as higher education transitions toward data-driven governance and sustainability, integrating TDABC with emerging digital technologies such as enterprise resource planning (ERP) systems or artificial intelligence-based costing analytics represents a promising avenue for future exploration (Al-Hawari and Nawaz, 2024). Such research could clarify how digital transformation enhances the visibility, flexibility, and strategic value of TDABC in the years ahead.

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