Kinetik: Game Technology, Information System, Computer Network, Computing, Electronics, and Control
Journal homepage: http://kinetik.umm.ac.id
ISSN: 2503-2267
Vol. 9, No. 4, November, Pp. 327-340

Exploring trust, privacy, and security in cloud storage adoption among generation Z: An extended TAM approach

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Article Info
Keywords:
Privacy, Security, Cloud Storage, Generation Z, Extended Technology Acceptance Model

Article history:
Received: February 23, 2024
Accepted: June 18, 2024
Published: November 01, 2024

Cite:
R. G. Utomo and R. Yasirandi, "Exploring Trust, Privacy, and Security in Cloud Storage Adoption among Generation Z: An Extended TAM Approach", *KINETIK*, vol. 9, no. 4, Nov. 2024.
https://doi.org/10.22219/kinetik.v9i4.2009

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Abstract
The incorporation of cloud storage technology holds the promise of significantly enhancing efficiency in various sectors, particularly from the perspective of Generation Z, a demographic known for its meticulous consideration of technology acceptance factors, especially security. This research thoroughly examines the level of acceptance of cloud storage technology among Generation Z. By augmenting the Technology Acceptance Model (TAM) with five core factors and introducing three novel factors—Perceived Security, Perceived Privacy, and Trust—this study not only adheres to traditional acceptance models but also ventures into uncharted territories, marking a significant contribution to understanding technology acceptance. This study meticulously collected data from 408 Generation Z respondents who actively use cloud storage technology, employing an innovative questionnaire disseminated via an online platform. Through sophisticated PLS-SEM data analysis, the study confirmed the positive and significant impact of all tested hypotheses, underscoring the importance of attitudes, perceived benefits, and usability in fostering the intention to use cloud storage. Notably, the added dimensions of privacy and security emerged as critical in enhancing users' trust in cloud storage solutions. Furthermore, this study paves the way for future explorations into technology acceptance across diverse populations and settings, underscoring the critical role of security and privacy in shaping technology adoption decisions among emerging generations.

1. Introduction

The rapid advancement in information technology has significantly influenced various sectors, notably impacting Generation Z's interaction with digital platforms. Among the plethora of technological innovations, cloud storage has become an option to be adopted by Generation Z, enabling data storage over remote server networks through the internet [1]. Recent statistics highlight an upsurge in internet usage in Indonesia, with numbers reaching 221 million in the 2024 period, a 2.8% increase from the previous period's 215 million users [2]. Notably, 98% of Generation Z using their devices have accessed the internet, with a significant portion categorized as addicted users [3]. This demographic's substantial engagement with cloud storage underscores the need for a deeper understanding of its adoption factors, particularly in light of data security concerns. Despite the numerous advantages of cloud storage—such as enhanced accessibility, ease of data management, and flexibility in data access—concerns surrounding potential data theft and privacy breaches present considerable challenges [4]. These issues necessitate a comprehensive examination of protective measures, including robust data encryption techniques and rigorous certification processes by independent entities to ensure elevated security standards.

This research seeks to explore the factors influencing Generation Z's acceptance of cloud storage technology, utilizing the Technology Acceptance Model (TAM) with additional variables. The necessity is rooted in the emergent need to navigate the complexities surrounding cloud storage adoption among Generation Z. With this demographic at the forefront of digital content creation and consumption, understanding the nuances of their interaction with cloud storage technologies is crucial [5]. Furthermore, the TAM is chosen for its robust model that provides insights into the determinants of new technology adoption, particularly analyzing user trust and the perceived efficacy of cloud storage in enhancing data management [6]. The selection of TAM over other models is justified by its specific focus on user perceptions and behavioral intentions toward technology adoption, making it particularly suited for studying cloud storage acceptance among Generation Z. Compared to models such as the Unified Theory of Acceptance and Use of Technology (UTAUT), the Technology Acceptance Model (TAM) is simpler. This simplicity is not a drawback but rather offers greater flexibility, particularly when contrasted with more intricate models like UTAUT [7]. This adaptability allows TAM to be more effectively tailored to investigate the intricate dynamics of technology implementation and usage. Specifically, in this study, it facilitates an in-depth exploration of the crucial factors influencing technology adoption

decisions among Generation Z. Moreover, compared with the existing work [8], which utilized traditional TAM variables alongside Cloud Storage Service Support and Self-efficacy without addressing Generation Z's unique concerns, this study explores into the nuanced perceptions of security, privacy, and trust that are crucial for understanding this demographic's adoption behavior.

Furthermore, while studies like [6] [9] [10] have acknowledged the significance of security within technology adoption models, they have not tailored their models to specifically address the combined impact of Perceived Security, Privacy, and Trust on cloud storage adoption among Generation Z. Additionally, research exploring broader themes, such as the psychological underpinnings of technology use [11] and the adoption of sustainable solutions [12], similarly lacks the focused application of these three critical variables within the context of Generation Z's cloud storage usage.

Moreover, by targeting Generation Z—a cohort deeply integrated with digital technology yet underrepresented in TAM-related cloud storage research—this study fills a significant gap in the current literature. Previous studies on cloud storage adoption have primarily focused on traditional Technology Acceptance Model (TAM) variables. However, emerging research suggests that additional factors such as Perceived Security, Perceived Privacy, and Trust are crucial for understanding technology adoption, especially among digital natives. Therefore, this study incorporates these variables based on recommendations from recent studies, which highlight their importance in technology adoption [13], [14].

In contrast to previous researches that primarily emphasize traditional TAM variables such as Perceived Ease of Use and Perceived Usefulness, this study extends the model to include Perceived Security, Perceived Privacy, and Trust, addressing a critical gap in the literature on cloud storage adoption among Generation Z. This expanded model provides a more comprehensive understanding of the factors influencing cloud storage adoption among this demographic.

Additionally, this study not only employs TAM but also extends it to provide a holistic understanding of cloud storage technology acceptance. This approach offers valuable insights into designing and implementing more secure, user-friendly cloud storage services tailored to meet the needs and expectations of Generation Z. Thus, the research contributes novel insights into the technology adoption field, emphasizing the unique concerns and preferences of today's digital natives and laying the groundwork for developing targeted cloud storage strategies that resonate with Generation Z's needs.

2. Research Method

2.1 Population and Sample

In the context of this research, the population refers to a group of individuals who possess specific attributes and characteristics defined by the researcher for observation, intending to draw relevant conclusions [15]. The specific population characteristics in this study include individuals who are active users of cloud storage services from Generation Z, defined as those born between 1997 and 2012, and who reside in Indonesia. Generation Z exhibits distinct characteristics when it comes to technology usage, primarily due to their upbringing in a digitally saturated environment. This cohort is not only technologically savvy but also highly dependent on digital platforms for communication, learning, and entertainment [5]. Unlike previous generations, Gen Z demonstrates a preference for mobile devices over traditional computers, using them as their primary tool for accessing the Internet and social media platforms [16]. Furthermore, this generation values the speed of information access and is adept at multitasking across various digital platforms, showcasing a heightened ability to filter and evaluate online content rapidly [17]. These technological inclinations significantly influence their learning styles, social interactions, and consumer behavior, setting them apart from older generations.

Moreover, the sample in this study is considered a representation of specific characteristics found within the researched population [18]. This study employs convenience sampling due to its practicality and ease of access to participants, making it a cost-effective and time-efficient method for data collection [19]. By using convenience sampling, the study aims to quickly gather preliminary insights or data from an accessible subset of the target population.

Additionally, given that the exact number of the target population for this study is not specifically known, the sample size determination is conducted using the Cochran formula [20]. This formula is a standard in research for estimating the required sample size in surveys. By using the Cochran formula, it was determined that the minimum sample size needed for this study is 385 respondents, ensuring that the research results can be considered representative of the studied population, considering the determined confidence level and margin of error.

2.2 Proposed Model and Hypothesis Development

This study extends the Technology Acceptance Model (TAM) by integrating traditional variables—Perceived Ease of Use, Perceived Usefulness, Attitude Toward Using, Behavioral Intention to Use, and Actual System Usage—with three innovative variables: Perceived Security, Perceived Privacy, and Trust. By adopting this expanded TAM framework, the research delves into a pioneering exploration of how these added factors influence Generation Z's behavioral intention to use cloud storage technology. The inclusion of Perceived Security, Perceived Privacy, and Trust

aims to uncover new dimensions in technology acceptance, particularly focusing on understanding and developing user acceptance relationships in the digital age, thereby providing fresh insights into the critical determinants of technology adoption among younger users. Figure 1 represents the research model of the Extended TAM in this research context.

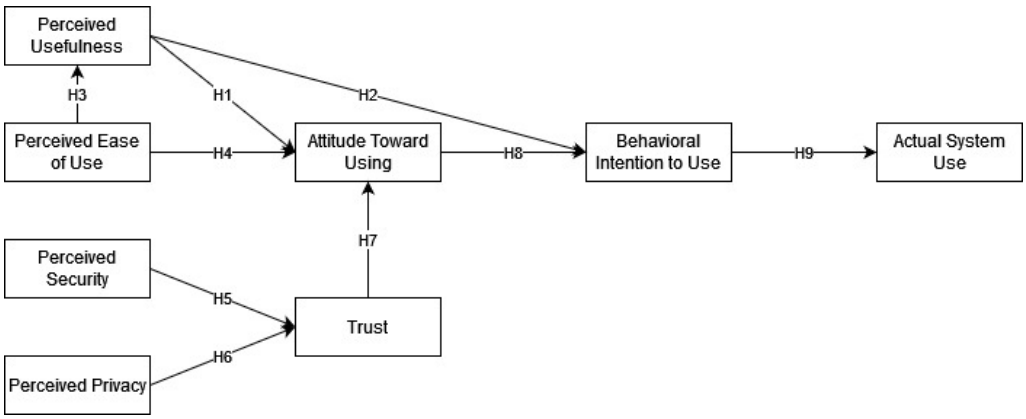

Figure 1. The Proposed Extended TAM Model

2.2.1 Perceived Usefulness

Perceived Usefulness is an individual's belief in the extent to which using a specific technology will enhance their job performance [21]. It is a critical determinant in the adaptation of innovation, positing that the greater the perceived benefits of using the technology, the higher the likelihood of its adoption [22]. Specifically, in the context of cloud storage services, as users recognize more advantages in terms of accessibility, efficiency, and productivity gains, the more inclined they are to incorporate cloud storage into their regular activities. Furthermore, the significance of this variable lies in its direct impact on users regarding technology adoption. By understanding that a technology like cloud storage can significantly contribute to their efficiency and effectiveness, users are more likely to embrace it. Highlighting the practical benefits and utility of cloud storage is essential for motivating users to integrate this technology into their daily routines, thereby supporting its widespread adoption. In this regard, the first and second hypothesis is reported:

Hypothesis 1 (H1): Perceived Usefulness positively influences Attitude Toward Using.

Hypothesis 2 (H2): Perceived Usefulness positively influences Behavioral Intention to Use

2.2.2 Perceived Ease of Use

Perceived Ease of Use describes how effortlessly users feel they can adopt and derive benefits from an innovation, significantly impacting their engagement with technologies like cloud storage [23]. It not only influences a user's initial willingness to try the technology but also affects their overall comfort and effectiveness in utilizing its features [24]. In the realm of cloud storage, ease of use directly contributes to how seamlessly users can navigate, manage, and share their data, enhancing the user experience and potentially increasing the technology's adoption rate. This perception is vital for technology acceptance, emphasizing the need for intuitive design and user-friendly interfaces to foster positive user interactions and satisfaction.

Furthermore, when users perceive a high level of ease of use, it positively affects their attitude toward utilizing technology [25]. This means that the more straightforward and user-friendly the technology is perceived to be, the more favorable the users' attitudes are towards adopting and continuously using it. This relationship underscores the importance of designing cloud storage interfaces and functionalities that minimize complexity and enhance user satisfaction, thereby encouraging wider acceptance and use. Consequently, the third and fourth hypotheses are proposed:

Hypothesis 3 (H3): Perceived Ease of Use positively influences Perceived Usefulness.

Hypothesis 4 (H4): Perceived Ease of Use positively influences Attitude Toward Using.

2.2.3 Perceived Security

Perceived Security is the subjective belief held by users that their personal information will remain confidential and secure against unauthorized access, storage, and manipulation during its storage [26]. This perception significantly boosts users' confidence in the technology, suggesting that if users feel cloud storage technology is secure, it positively influences their trust in using it [27]. The importance of this variable lies in its direct impact on user trust and willingness to adopt cloud storage solutions. In today's digital age, where data breaches are a growing concern, ensuring high

levels of perceived security is crucial for cloud storage providers to build and maintain trust with users, ultimately facilitating broader adoption and sustained use of their services. As a result, the fifth hypothesis is formulated:

Hypothesis 5 (H5): Perceived Security positively influences Trust.

2.2.4 Perceived Privacy

In general, privacy refers to an individual's capacity to acquire, control, and utilize their personal information. In the context of the Internet, privacy pertains to the management and use of personal data [28]. This implies that if users feel their privacy is protected within cloud storage technology, their trust in using the technology will increase. The importance of this variable lies in its critical role in fostering user confidence and promoting the adoption of cloud storage services. In an era where data breaches are increasingly common, ensuring robust privacy protections is essential for maintaining user trust and encouraging the continued use of cloud storage solutions. Hence, the sixth hypothesis is established:

Hypothesis 6 (H6): Perceived Privacy positively influences Trust.

2.2.5 Trust

Trust encompasses the user's beliefs about an object and the perceived importance of attribute quality in making decisions to adopt technology [29]. This variable's significance lies in its ability to influence the decision-making process regarding technology adoption. A positive user attitude, fostered by trust in the technology's attributes, such as security and functionality, encourages users to adopt and continuously use cloud storage solutions. Enhancing user trust through transparent and secure practices is crucial for cloud storage providers to positively shape user attitudes and facilitate wider acceptance of their technology. In this regard, the seventh hypothesis is proposed:

Hypothesis 7 (H7): Trust positively influences Attitude Toward Using.

2.2.6 Attitude Toward Using

Attitude, in general, refers to the influence on the behavioral intention to use technology and acts as a mediator between independent variables [30]. Theoretically, there is a strong correlation between the intention to engage in behavior [31]. A positive user attitude towards using cloud storage technology can influence other users' intentions to utilize the same technology. The importance of this variable lies in its ability to shape perceptions and behaviors toward technology adoption. A favorable attitude towards cloud storage can foster a positive community perception, thereby enhancing the likelihood of its broader acceptance. Essentially, cultivating a positive user attitude is crucial for technology providers as it can significantly impact the adoption rate of cloud storage solutions by demonstrating the technology's value and efficacy through user experiences. Thus, the eighth hypothesis is formulated:

Hypothesis 8 (H8): Attitude Toward Using positively influences Behavioral Intention to Use.

2.2.7 Behavioral Intention to Use

Behavioral Intention refers to an individual's likelihood of adopting technology [32]. Positive intentions and behaviors toward using technology can influence users' attitudes toward accepting the technology [33]. The importance of this variable lies in its predictive power for actual technology usage; it acts as a crucial indicator of whether an individual will engage with the technology in question. Essentially, fostering positive behavioral intentions towards cloud storage is key to encouraging its adoption as these intentions often translate into actual use. By understanding and enhancing the factors that contribute to positive behavioral intentions, technology providers can more effectively promote the acceptance and integration of cloud storage solutions into users' daily lives. Therefore, the eighth hypothesis is developed:

Hypothesis 9 (H9): Behavioral Intention to Use positively influences Actual System Use.

2.3 Validity Test

Validity testing aims to measure the research instrument, typically a questionnaire. The validity of each question within the questionnaire is assessed to ensure its effectiveness.

2.3.1 Convergent Validity

Convergent validity is a measure within reflective models, assessed based on the correlation among indicator components and construct values, which can be calculated using PLS-SEM. A correlation value greater than 0.7 is considered ideal and valid for construct value measurement [34]. Convergent validity can be evaluated using the Average Variance Extracted (AVE) value, which should ideally exceed 0.5 to meet convergent validity and reliability requirements [34].

2.3.2 Discriminant Validity

Discriminant validity in reflective models is evaluated through cross-loading, followed by a comparison of the AVE value with the square of the correlation values between constructs [35]. Discriminant validity assessment involves comparing the AVE value for each construct with the correlations between constructs [36].

The importance of these validity tests lies in their ability to ensure that the constructs measured by the questionnaire accurately reflect what they are intended to measure. Convergent validity confirms that items within the same construct are highly correlated, indicating that they measure the same concept. In contrast, discriminant validity ensures that items across different constructs are not overly similar, affirming that each construct is unique and distinct. Together, these validity tests are crucial for establishing the reliability and accuracy of research instruments, thereby enhancing the quality and credibility of the research findings.

2.4 Reliability Testing

Reliability testing is a critical step in assessing the strength and consistency of questions within a questionnaire. It measures the consistency of respondents' answers across the questionnaire, utilizing composite reliability as a testing method [37]. A variable is considered reliable if it achieves a composite reliability value of ≥ 0.7 and Cronbach's alpha value of ≥ 0.7 [37] [38]. The importance of this test lies in ensuring that the questionnaire produces stable and consistent results across different administrations, indicating that the instrument is dependable and accurately captures the constructs it intends to measure. High reliability is essential for affirming the research findings' validity, contributing to the study's overall credibility and the robustness of its conclusions.

2.5 Inner Model Testing

The Inner Model is a structured framework designed to depict the relationships between variables [39]. In the Partial Least Squares (PLS) approach, the structural model is evaluated based on the percentage of variance explained by R2 (R-Square), which observes changes in the structural path coefficients [40]. R2 is utilized to measure the extent of variation change in the dependent variable explained by the independent variables. A higher R2 value indicates a stronger model for the research, reflecting a better explanation of the dependent variable's variance by the model [40]. The importance of this theory lies in its ability to provide a clear understanding of the relationships and impact among variables within a study, thus offering valuable insights into the dynamics at play. It underscores the model's predictive power and its efficacy in capturing the essence of the relationships being investigated, enhancing the research's overall quality and interpretability.

2.6 Hypothesis Testing

Hypothesis testing in Partial Least Squares Structural Equation Modeling (PLS-SEM) is a critical process that evaluates the statistical significance of the relationships between constructs within the structural model [40]. This testing involves analyzing path coefficients, which represent the strength and direction of these relationships, and determining their statistical significance using bootstrapping procedures [41]. This test generates T-statistics and P-values for each path coefficient, providing a basis for accepting or rejecting the hypotheses [42]. The importance of hypothesis testing in PLS-SEM lies in its ability to substantiate theoretical predictions with empirical data, thereby confirming or refuting the proposed theoretical model.

3. Results and Discussion

3.1 Data Collection

In this study, a diverse group of 408 individuals from Generation Z, aged between 11 and 26 years, participated as respondents. These participants, who are active users of cloud storage services, were recruited through an online survey platform, enabling the collection of data across a broad demographic spectrum. The demographic analysis of the respondents revealed a variety of professions, with students constituting the largest portion of the sample at 27.5%. The remainder of the sample comprises individuals from a range of other professions, reflecting the sample's diversity and allowing the research to capture a wide perspective on cloud storage usage among Generation Z. The use of an online survey platform for data collection not only facilitated the participation of a diverse group but also ensured the study's findings are reflective of varying usage patterns and preferences related to cloud storage, thereby enhancing its relevance and applicability across different segments of Generation Z.

3.2 Validity and Reliability Testing

To ensure the robustness and credibility of the findings derived from this study, the data collected will be subjected to rigorous validity and reliability tests. These tests are instrumental in assessing whether the measurement instruments accurately and consistently capture the constructs they are intended to measure, serving as a foundational step in the research process. The purpose of conducting validity and reliability tests is to affirm the measurement instruments' ability to provide reliable and valid results, which are crucial for the integrity of the study's conclusions. Moreover, this

study conducted outer model testing to evaluate the relationships between observed variables and latent constructs, thereby assessing the measurement model's validity and reliability. Through confirmatory factor analysis, the study scrutinized the loadings of indicators onto their respective latent constructs, examining the extent to which the observed variables accurately reflected the underlying constructs. Additionally, discriminant validity was assessed by analyzing the correlations between indicators of different constructs to ensure their distinctiveness. Figure 2 displays the outcomes of the outer model testing, showcasing the strength of relationships between indicators and latent constructs, thereby providing insights into the robustness of the measurement model.

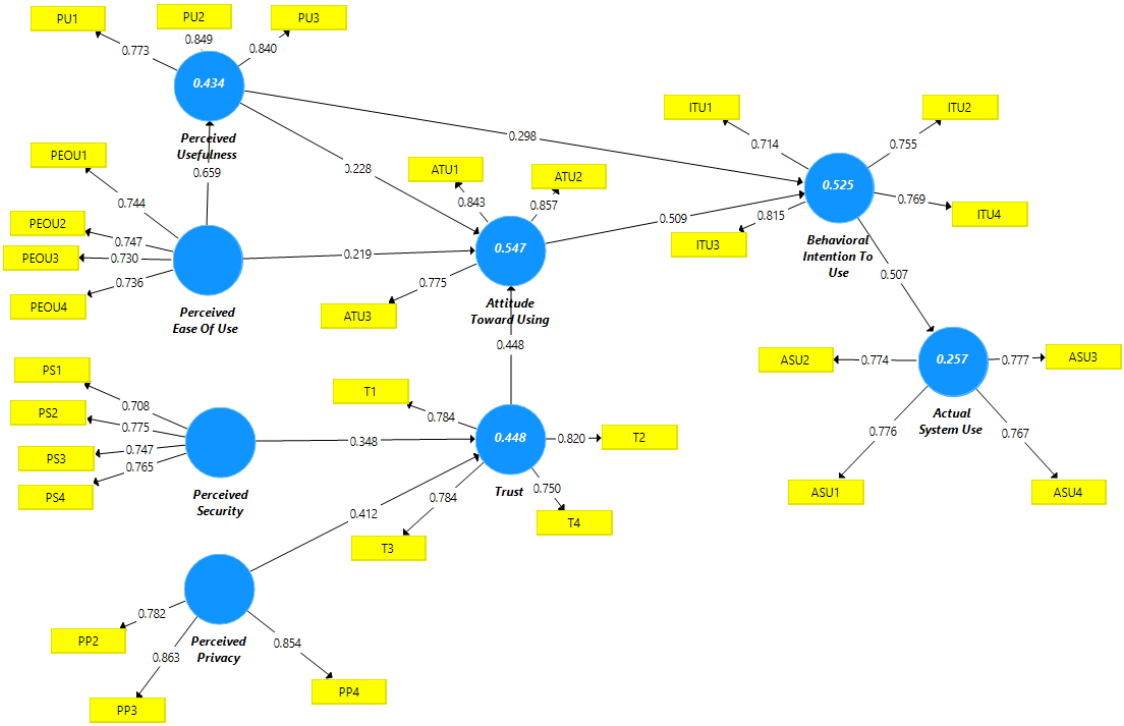

Figure 2. Outer Model Testing Results

Moreover, the validity test and reliability test from the outer model testing are indicative of the measurement model's overall strength and integrity. The validity test demonstrates the extent to which the measurement model accurately captures the intended constructs, encompassing aspects such as convergent and discriminant validity. Meanwhile, the reliability test evaluates the consistency and stability of the measurement model, assessing measures like Cronbach's alpha, composite reliability, or average variance extracted. These results, as shown in Table 1, offer critical insights into the quality and rigor of the measurement instruments employed in the study, thereby enhancing the confidence in the subsequent analyses and interpretations.

Table. 1 Validity and Reliability Assessment

Variable	Measurement Items	Outer Loading	Cronbach's Alpha	Composite Reliability	AVE
PU	PU1	0.773	0.757	0.861	0.674
	PU2	0.849			
	PU3	0.840			
PEOU	PEOU1	0.744	0.723	0.828	0.546
	PEOU2	0.747			
	PEOU3	0.730			
	PEOU4	0.736			
PS	PS1	0.708	0.739	0.836	0.561
	PS2	0.775			
	PS3	0.747			
	PS4	0.765			
PP	PP2	0.782	0.781	0.872	0.695

	PP3	0.863			
	PP4	0.854			
T	T1	0.784	0.792	0.865	0.616
	T2	0.820			
	T3	0.784			
	T4	0.750			
ATU	ATU1	0.843	0.766	0.865	0.682
	ATU2	0.857			
	ATU3	0.775			
ITU	ITU1	0.714	0.762	0.849	0.584
	ITU2	0.755			
	ITU3	0.815			
	ITU4	0.769			
ASU	ASU1	0.776	0.777	0.856	0.599
	ASU2	0.774			
	ASU3	0.777			
	ASU4	0.767			

As shown in Table 1, the Perceived Usefulness (PU) construct, as evidenced by outer loadings ranging between 0.773 and 0.849, demonstrates that the measurement items are highly effective indicators of the construct, supported by a Cronbach's Alpha of 0.757 and Composite Reliability of 0.861. This denotes a high level of internal consistency among items, with an Average Variance Extracted (AVE) of 0.674 surpassing the accepted threshold, thereby confirming the construct's validity.

Similarly, the Perceived Ease of Use (PEOU) showcases adequate internal consistency, with Cronbach's Alpha of 0.723 and Composite Reliability of 0.828, albeit a slightly lesser AVE of 0.546. This suggests that, despite the consistency, there is a marginally diluted variance of the construct captured by the items. In contrast, both Perceived Security (PS) and Perceived Privacy (PP) display commendable reliability metrics and AVEs (0.561 and 0.695, respectively), indicating not only consistent internal reliability but also a solid construct validity. Notably, PP's measurement items PP3 and PP4 exhibit particularly high outer loadings (0.863 and 0.854), marking them as strong representatives of the construct.

Furthermore, Trust (T) and Attitude Toward Using (ATU) are distinguished by their high reliability scores and substantial AVEs (0.616 and 0.682, respectively), signifying a robust representation of the constructs and reliability. The notable high outer loadings, especially for ATU1 and ATU2 (0.843 and 0.857), underscore the effectiveness of these items in capturing the constructs they are intended to measure.

Lastly, both Intention to Use (ITU) and Actual System Use (ASU) validate good internal consistency and construct validity, with AVEs slightly above the threshold of 0.5. This confirms that the constructs are reliably measured by the respective items, ensuring the scales accurately capture the intended constructs.

In essence, the analysis affirms that the measurement instruments wield strong validity and reliability across all evaluated constructs. The pronounced level of internal consistency and construct validity indicates that the scales are well-designed and proficient in consistently and validly capturing the constructs of interest. This thorough psychometric evaluation highlights the reliability of the data collected, paving the way for meaningful analysis and interpretation in this study.

3.3 Inner Model Testing

The inner model testing, focusing on R Square and R Square Adjusted values for various variables, provides insightful reflections on the model's explanatory power and the precision of the estimates after adjusting for the number of predictors as shown in Table 2.

Tabel 2. Inner Model Testing Results

Variable	R Square	R Square Adjusted
Actual System Use	0.257	0.256
Attitude Toward Using	0.547	0.544
Behavioral Intention to Use	0.525	0.523
Perceived Usefulness	0.434	0.433
Trust	0.448	0.445

The Inner Model Testing, detailed in Table 2, reveals nuanced insights into the model's explanatory capabilities across various constructs related to system use and acceptance. The R Square value for Actual System Use stands at 0.257, suggesting that the model accounts for approximately 25.7% of the variance in system usage, with a minimal reduction to 0.256 in the adjusted value, highlighting the model's efficiency despite the number of predictors. In contrast, Attitude Toward Using and Behavioral Intention to Use demonstrate significantly higher explanatory power, with R Square values of 0.547 and 0.525, respectively. These figures indicate that the model explains over half of the variance in users' attitudes and their intention to use the system, underscoring the effectiveness of the predictors.

Moreover, Perceived Usefulness and Trust are well captured by the model, with R Square values of 0.434 and 0.448, respectively, signifying that a substantial portion of the variance in how users perceive the system's usefulness and their trust in it is explained by the predictors. The close alignment between R Square and Adjusted R Square values across all variables affirms the model's robustness and its precise capture of the constructs with minimal loss in explanatory power due to the adjustment for predictors.

Overall, the analysis underscores the model's varying yet significant explanatory power across different dimensions of system uses and acceptance. While certain constructs like Attitude Toward Using and Behavioral Intention to Use are particularly well explained, suggesting a strong linkage between the predictors and these outcomes, Actual System Use reflects a lower R Square value, hinting at other factors not included in the model that may also influence system usage. The efficiency and effectiveness of the model in capturing the essential constructs with the selected predictors are evident from the consistency between the R Square and Adjusted R Square values.

3.4 Hypothesis Testing

The hypothesis testing results using PLS-SEM provide a comprehensive overview of the relationships between various constructs within the study. Each hypothesis was tested for significance using Original Sample values, Sample Means, Standard Deviations, T Statistics, P-Values as shown in Table 3.

Table. 3 Hypothesis Testing Results

No	Hypothesis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P-Values	Decision
H1	Perceived Usefulness -> Attitude Toward Using	0.228	0.232	0.061	3.761	0.000	Accepted
H2	Perceived Usefulness -> Behavioral Intention to Use	0.298	0.307	0.053	5.629	0.000	Accepted
H3	Perceived Ease of Use -> Perceived Usefulness	0.659	0.660	0.042	15.825	0.000	Accepted
H4	Perceived Ease of Use -> Attitude Toward Using	0.219	0.220	0.052	4.237	0.000	Accepted
H5	Perceived Security -> Trust	0.348	0.350	0.052	6.691	0.000	Accepted
H6	Perceived Privacy -> Trust	0.412	0.411	0.057	7.175	0.000	Accepted
H7	Trust -> Attitude Toward Using	0.448	0.441	0.056	8.027	0.000	Accepted
H8	Attitude Toward Using -> Behavioral Intention to Use	0.509	0.501	0.052	9.799	0.000	Accepted
H9	Behavioral Intention to Use -> Actual System Use	0.507	0.509	0.051	9.911	0.000	Accepted

The results outlined in Table 3 are instrumental in guiding the decision-making process on whether to accept or reject each hypothesis within the study. The analysis begins with H1, which establishes a positive link between Perceived Usefulness and Attitude Toward Using, as evidenced by an original sample coefficient of 0.228, a T Statistic of 3.761, and a P-Value of 0.000, suggesting a direct correlation between perceived usefulness and a positive attitude towards using the system. Similarly, H2's examination of the impact of Perceived Usefulness on Behavioral Intention to Use, with a coefficient of 0.298, a T Statistic of 5.629, and a P-Value of 0.000, reinforces the notion that perceived usefulness significantly influences behavioral intentions.

Further, H3 and H4 delve into the effects of Perceived Ease of Use on Perceived Usefulness and Attitude Toward Using, respectively, with H3 showing a substantial original sample value of 0.659 and H4 a coefficient of 0.219, both supported by strong T Statistics (15.825 and 4.237) and null P-Values, highlighting the critical role of ease of use. H5 and H6 assess the impacts of Perceived Security and Privacy on Trust, indicating significant enhancements to trust with coefficients of 0.348 and 0.412, supported by T Statistics of 6.691 and 7.175.

The exploration continues with H7, which looks at Trust's effect on Attitude Toward Using, revealing a coefficient of 0.448, and H8, which examines the relationship between Attitude Toward Using and Behavioral Intention to Use, with a coefficient of 0.509. Both hypotheses receive strong statistical backing, underlining the importance of trust and positive attitudes in influencing behavioral intentions. Finally, H9 assesses the linkage between Behavioral Intention to Use and Actual System Use, with a significant coefficient of 0.507 and a T Statistic of 9.911, emphasizing the predictive power of behavioral intentions on actual system usage.

Collectively, these findings paint a comprehensive picture of a coherent model in which Perceived Usefulness, Ease of Use, Security, and Privacy significantly impact Trust, Attitude Toward Using, and Behavioral Intention, which, in turn, predict Actual System Use. The substantial statistical support for each hypothesis not only validates the robustness of the theoretical framework but also highlights its effectiveness in dissecting the dynamics of system use.

3.5 Discussion

This study aimed to evaluate the influence of various variables on the adoption of cloud storage technology, with participation from 408 respondents through an online questionnaire. The findings indicate significant relationships between the variables, and all hypotheses were accepted, evidenced by P-Value limits of 0.05 and t-statistics greater than the threshold of 1.96. Moreover, the results indicating a significant positive effect of perceived usefulness on users' attitudes toward cloud storage are consistent with findings from recent studies. For example, a study on Digital Personal Data Stores (DPDSs) found that perceived trust positively influences perceived usefulness, which in turn positively affects attitudes toward using DPDSs, underlining the role of perceived usefulness in the technology acceptance process [43]. Similarly, Ahmed et al. [44] in the study of cloud storage services within supply chain management operations, highlighted performance expectancy as a significant determinant of behavioral intention, aligning with our findings on perceived usefulness. However, this contrasts with Warsono, Yuwono, & Putranti [45], who found that perceived ease of use, rather than perceived usefulness, had a more significant effect on attitudes toward using electronic public services in public administration. This discrepancy may arise from differences in the specific contexts of cloud storage versus broader electronic service acceptance, suggesting the need for further investigation into these distinct facets of technology acceptance.

Furthermore, the hypothesis that perceived usefulness significantly influences behavioral intentions toward using cloud storage is strongly corroborated by existing literature, highlighting a direct link between the perceived advantages of technology and the likelihood of users adopting it. This alignment is further evidenced by studies, such as a study conducted by Alsmadi et al. [46], which emphasizes the role of trust and performance expectancy in enhancing users' intentions to adopt cloud technology, suggesting that perceptions of cloud computing as both useful and reliable can positively sway behavioral intentions. Similarly, research by Kim, Park, and Bora [47] identifies a positive correlation between perceived value, encompassing usefulness, and the continued use of cloud services, underscoring the importance of perceived usefulness not only in initial adoption but also in sustained engagement with cloud computing. Additionally, the work of Ploysuayngam and Tangwannawit [10] brings to light the influence of social factors, self-efficacy, and concerns about security and privacy on the adoption of cloud storage, implicitly pointing to perceived usefulness as a key driver of user intentions, given its role in meeting performance change expectations.

Next, the hypothesis that ease of use directly impacts the perceived usefulness of cloud storage technology finds strong support in existing literature, indicating that user-friendly interfaces significantly boost the perceived benefits and value of such systems, potentially influencing both their adoption and sustained use. Research by Kholilah, Kawulur, and Subekti [48] underscores ease of use and facilitating conditions as key factors driving the intention to adopt cloud computing among students, suggesting that the accessibility and simplicity of the technology are crucial in enhancing its perceived value. Similarly, Sureshkumar et al. [49] suggest that the ease of implementing and using security features in cloud-based data storage can make these services appear more user-friendly and secure, thereby increasing their perceived usefulness. Additionally, Roslin Dayana & Shobha Rani [50] present a time-efficient cloud data storage technique, highlighting the significance of ease of data access and efficiency in contributing to the technology's perceived usefulness. These findings collectively suggest that cloud storage solutions designed with a focus on ease of navigation, comprehension, and use are more likely to be viewed as valuable by users.

Similarly, the hypothesis underscoring the positive impact of perceived ease of use on attitudes towards cloud storage technology adoption finds robust backing in the framework of technology adoption models. This linkage is consistently evidenced across various studies, demonstrating a universal trend across differing contexts and cloud-based offerings. Research by Kholilah, Kawulur, and Subekti [48] reveals that ease of use significantly shapes cloud computing adoption intentions among students, indicating that user-friendly technologies foster more favorable attitudes towards their use. This finding is paralleled by Tatić, Haračić, Činjarević, and Haračić [51], who note that social norms enhance the perceived ease of use, which in turn positively affects attitudes towards utilizing cloud computing services. Additionally, Mariani, Styvén, and Teulon [43] highlight that the simplicity of using digital personal data stores (DPDSs), alongside perceived trust, markedly influences the intent to use these services, further affirming that ease of use is pivotal in cultivating positive technological adoption attitudes. These observations collectively suggest that the

intuitiveness and user-friendliness of a cloud storage service significantly contribute to more positive user perceptions and engagement.

Moreover, the hypothesis that perceived security significantly influences trust in cloud storage technology is substantiated by a wealth of literature emphasizing the importance of data protection and privacy in technology adoption contexts. Studies such as Nagarajan & Sampath Kumar [52] stress the essential role of security measures, despite ongoing advancements, pointing out that persistent safety concerns can undermine trust in cloud storage. This sentiment is echoed by Dayana & Shobha Rani [53], who introduced a trust model based on cryptographic role-based access control, suggesting that monitoring user behavior to enhance security perceptions can significantly bolster trust in cloud systems. Furthermore, El Moudni & Ziyati [54] advocate for a zero-trust model in multi-cloud environments, reinforcing the "Never trust, always verify" principle to address security challenges and improve system redundancy, thereby fostering trust through enhanced security perceptions. These contributions collectively highlight the critical need for robust security measures and the effective communication of these protocols to users. By doing so, cloud service providers can address prevalent security concerns, thereby significantly enhancing user trust. Moreover, this relationship between perceived security and trust underscores the importance of adopting advanced security models and practices that not only protect data but also reassure users about the safety of their information in cloud storage environments.

Likewise, the hypothesis that perceived privacy significantly boosts trust in cloud storage technology finds strong backing within the realm of technology acceptance and the dynamics of user trust. This correlation is reinforced by various studies underscoring privacy's pivotal role in engendering trust among cloud storage users. For instance, Dayana & Shobha Rani [53] introduced a trust model emphasizing privacy through cryptographic role-based access control, showcasing a direct positive impact on user trust. Similarly, Tabassum, Naeem, & Batool [55] highlighted the importance of privacy protection mechanisms in building trust, affirming that prioritizing privacy enhances trust in cloud services. Furthermore, [26] focused on secure data-sharing algorithms in cloud storage, linking enhanced data confidentiality with increased trust, thus supporting the perceived privacy-trust nexus. These findings collectively indicate that perceived privacy protection levels significantly affect trust in cloud storage technology, spotlighting the imperative for cloud service providers to adopt and transparently showcase robust privacy measures. This multifaceted influence underscores the complexity of building trust, highlighting the essential role of privacy alongside other critical factors in cultivating a trustworthy environment for cloud storage service users.

Additionally, the hypothesis asserting that trust significantly shapes positive attitudes toward the adoption and usage of cloud storage technology is robustly supported by the literature. This is illustrated through various studies demonstrating that trust in cloud services markedly influences users' readiness to embrace these technologies. For instance, El Moudni & Ziyati [54] propose a zero-trust model for multi-cloud data storage, which underscores the importance of identity verification for accessing cloud resources, indirectly cultivating user trust by enhancing security measures. Similarly, Dayana & Shobha Rani [53] have developed a trust model based on cryptographic role-based access control, indicating that trust, as determined by user behavior, has a significant impact on attitudes towards cloud data storage. Moreover, Yamamoto & Hirotsu [56] introduced a secure cloud filesystem that automatically encrypts and decrypts files, bolstering trust through both ease of use and maintained confidentiality, thus supporting the notion that trust fosters a more positive disposition towards using cloud storage. These studies collectively affirm that trust, influenced by factors such as security protocols, ease of use, and the overall reliability of cloud services, is crucial in motivating users to adopt and continue utilizing cloud storage technologies. The correlation between trust and user attitudes underscores the essential role of trust-building measures in cloud storage service adoption, suggesting that providers must prioritize establishing and maintaining trust through transparent, user-friendly, and secure service offerings.

Moreover, the affirmation of the hypothesis that a positive attitude towards cloud storage technology significantly influences users' intentions to adopt and continuously use such services is well-founded in contemporary research. This connection is crucial for grasping the dynamics of user engagement with cloud storage solutions. Evidence from various studies corroborates this relationship, shedding light on the determinants of users' behavioral intentions towards cloud storage technologies. Research by Dajani et al. [57] on the behavioral intention to use sustainable cloud-based quality management systems among academics in Jordan highlights the role of performance expectancy, closely tied to user attitudes, in fostering the intention to utilize these technologies. Similarly, Alsmadi et al. [46] identify trust and performance expectancy as factors influencing cloud computing usage intentions, pointing out that trust, influenced by a positive attitude towards the technology, significantly affects user behavior. Additionally, Mohd-Any et al. [58] employ the push-pull-mooring framework to examine users' switching behaviors between cloud storage providers, revealing that satisfaction—a key aspect of attitude—deters switching intentions, whereas the allure of alternatives encourages it. This finding indirectly substantiates the hypothesis by showing that favorable attitudes towards a service diminish the propensity to switch providers. Collectively, these studies validate that a positive disposition towards cloud storage technology is a critical forecaster of the intention to engage with and remain loyal to these services. This interrelation

highlights the imperative for cloud service providers to enhance user experiences and perceptions, aiming to foster positive attitudes towards their platforms.

At last, the hypothesis that behavioral intention significantly impacts actual usage of cloud storage technology is robustly supported by current research, underlining the crucial bridge between theoretical intentions and practical user actions in technology adoption. Tubay's [59] exploration into students' usage of cloud storage systems confirms the direct connection between the intention to use and actual usage, highlighting the influence of performance expectancy and social influence. Similarly, Yap & Lee [60] reveal that employees' behavioral intentions towards using SaaS ERP sub-modules, driven by factors like perceived enjoyment and system performance, play a pivotal role in actual usage patterns in a professional setting. Further, Ploysuayngam & Tangwannawit's [10] research on cloud storage adoption in higher education points to the significant effects of social influence, self-efficacy, and concerns over security and privacy on both the intention and actual use of these services. Collectively, these studies confirm that behavioral intention is a significant forecaster of actual system usage in the context of cloud storage technology, suggesting that strategies aimed at enhancing user intentions—through improved perceptions of performance, trust, privacy, and security—can effectively increase actual adoption rates.

In summary, the insights from this study into cloud storage technology adoption have far-reaching implications, particularly when considering Generation Z's interaction with such technologies. By examining factors that shape attitudes, intentions, and usage behaviors, this research not only enriches the theoretical landscape, with a nod to the Technology Acceptance Model (TAM), but also carves out actionable paths for cloud service providers keen on capturing the Gen Z market. The study underscores the significant sway of perceived usefulness on Gen Z's attitudes towards cloud storage, suggesting that for this digitally native cohort, the practical benefits and efficiencies of cloud storage must be vividly communicated and demonstrated. This finding dovetails with the work of Mariani et al. [43] and Ahmed et al. [44], who also spotlight the pivotal role of perceived benefits in technology adoption among younger users.

Moreover, the emphasis on ease of use as a crucial determinant for Gen Z echoes the broader validation of TAM principles, pointing to a generation that values intuitive design and straightforward functionality in their technological interactions. The importance of perceived security and privacy in building trust further illuminates Gen Z's nuanced relationship with digital services, highlighting their demand for robust security measures and transparent privacy policies. For cloud service providers, these insights translate into a need for strategies that not only enhance the perceived usefulness of their services through clear communication of benefits but also prioritize the development of user-friendly interfaces that appeal to Gen Z's tech-savvy preferences. Moreover, addressing security and privacy concerns is paramount in fostering trust among this demographic, suggesting that efforts to implement advanced security protocols and ensure data privacy could significantly influence Gen Z's willingness to adopt cloud storage technologies.

Finally, this research highlights the critical role of perceived ease of use, security, and privacy in fostering trust and positive attitudes toward cloud storage among Generation Z. These factors emerge as crucial determinants of Gen Z's intention to use and actual engagement with cloud storage services. The findings suggest that for cloud storage services to resonate with Gen Z—a demographic known for its digital savviness and high expectations for technology—they must be user-friendly, secure, and committed to protecting privacy. This underscores an essential directive for cloud service providers: to prioritize and enhance these aspects in their offerings to meet the unique needs and preferences of Gen Z, thereby driving higher adoption and sustained usage rates within this key demographic.

4. Conclusion

This research presents an extended Technology Acceptance Model (TAM) by integrating three novel factors—Perceived Security, Perceived Privacy, and Trust—into the model to explore cloud storage technology adoption among Generation Z. The study's robust data collection and analysis have confirmed that these additions significantly enhance the model's predictive power regarding users' attitudes, intentions, and actual usage behaviors. The empirical evidence underscores the pivotal roles of perceived usefulness, ease of use, security, and privacy in shaping Generation Z's trust and positive attitudes towards cloud storage services, leading to higher intentions to use and actual usage. This extension of TAM not only enriches the theoretical understanding of technology adoption but also highlights the critical importance of addressing security and privacy concerns to foster trust among users, particularly within the context of Generation Z.

For practitioners, the findings elucidate the necessity for cloud service providers to prioritize the development of user-friendly, secure, and privacy-respecting cloud storage solutions to meet the unique demands of Generation Z. This demographic's distinct characteristics and high digital fluency necessitate a focus on enhancing perceived usefulness through clear communication of benefits, ease of use through intuitive design, and users' trust through robust security and transparent privacy policies. By doing so, service providers can significantly influence Generation Z's adoption rates and foster long-term engagement with cloud storage technologies, leveraging the extended TAM as a strategic framework for understanding and catering to this key user segment's needs and preferences.

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