DETERMINANTS OF 5G ADOPTION: A COMPARATIVE ANALYSIS OF VIETNAM AND THE UNITED STATES

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Abstract - Synthesizing TAM, UTAUT, and DOI frameworks, this study compares 5G acceptance drivers between consumers in Vietnam and the United States (N=522). PLS-SEM analysis evaluated the impact of perceived usefulness, ease of use, social influence, environmental and health awareness, and perceived value on usage intention and acceptance. Findings indicate that perceived usefulness, ease of use, social influence, and environmental awareness positively affect intention. While health awareness strengthens intention, perceived value unexpectedly exerts a negative moderating effect on the intention-acceptance relationship. Crucially, the moderating role of nationality proved insignificant, suggesting cross-market consistency in adoption behaviors. These results extend technology acceptance theories and imply that strategies promoting 5G should prioritize communicating functional benefits, ease of use, and distinct value propositions to overcome adoption barriers globally.

Key words - 5G Technology Adoption; Technology Acceptance Model (TAM); Unified Theory of Acceptance and Use of Technology (UTAUT); Cross - national Comparison

1. Introduction

The 5G network is becoming a key foundation of the digital economy thanks to its high speed, low latency, and capacity to connect a massive number of devices simultaneously. From 1G to 4G, each generation has reshaped how people use technology; 5G is expected to create another leap in telecommunications and digital services. However, its deployment and adoption remain uneven: in the United States, 5G is widely applied in healthcare, manufacturing, education, and entertainment; in Vietnam, commercialization is accelerating, but coverage still varies across operators. Along with optimism, users also express health and environmental concerns (e.g., radiofrequency radiation, ecological impact), making their attitudes and intentions toward 5G more complex. Hence, it is crucial to identify the factors influencing consumers' intentions and acceptance.

Theoretically, established models such as the Technology Acceptance Model (TAM) and the UTAUT indicate that behavioral intention is shaped by three main factors: PU (how beneficial the technology is), PEU (how easy it is to learn and operate), and SI (how family, friends, and communities affect behavior). Previous 5G studies have focused mostly on technical or safety issues; research from the consumer perspective, especially cross - country comparisons and evidence from Vietnam, remains limited. In reality, health and environmental concerns may interact with social norms and perceptions of usefulness and ease of use to shape adoption intention, yet comparative evidence between the United States and Vietnam is still scarce. This gap reduces the ability to forecast users' readiness and hinders the effective design of communication, service, and policy strategies.

This study therefore aims to assess and compare 5G acceptance among consumers in Vietnam and the United States by: (i) examining the effects of PU, PEU, and SI on IU; (ii) analyzing the roles of health consciousness and EA; (iii) testing the transition from intention to actual acceptance via perceived user value; and (iv) exploring the moderating role of nationality. The study contributes both academically, by integrating socio - environmental factors into technology adoption theory, and practically, by offering insights for firms and policymakers on positioning 5G's value, improving user experience, designing evidence - based communication, and addressing public concerns to foster responsible and effective 5G implementation.

2. Literature Review

2.1. Context and Role of 5G

The fifth - generation (5G) wireless network - the latest advancement in mobile communication - marks a major leap in telecommunication technology, offering capabilities far beyond previous generations. Designed to meet growing connectivity demands, 5G enables faster data transmission, lower latency, broader coverage, and greater reliability [1]. 5G - powered Internet systems are expected to modernize socio - economic structures, improve operational efficiency and flexibility, and support sustainable solutions.

Despite its advantages, 5G has also raised health and environmental concerns. Exposure to radiofrequency (RF) radiation from base stations has been linked to "microwave syndrome," with symptoms such as insomnia, headaches, and stress [2]. As a result, some regions like Belgium, Switzerland (Vaud), and San Francisco have applied precautionary measures. Questions have also emerged about 5G's carbon footprint and contribution to greenhouse gas emissions [3]. Meanwhile, Asian economies such as South Korea, Japan, and China have accelerated deployment to strengthen competitiveness and build connected societies. In Vietnam, major operators (notably Viettel) are commercializing 5G across provinces, creating opportunities to improve digital services and narrow regional gaps, though challenges remain in technology adaptation, infrastructure investment, and safe operation. Within this modernization process, 5G is recognized as a strategic enabler of sustainable socio - economic growth, national competitiveness, and integration into global value chains [4].

2.2. Previous studies

The acceptance of emerging technologies, especially the fifth - generation mobile network (5G), has gained strong academic interest in recent years. Consumers' adoption decisions are shaped not only by expectations of faster speed and enhanced digital experience but also by social, environmental, and institutional influences. Factors such as infrastructure readiness, policy support, and social media discourse play critical roles in shaping behavioral intentions. However, mixed information about 5G's benefits and risks has created skepticism, highlighting the need for transparent communication and effective perception management. To explain adoption behavior, classical models like TAM, UTAUT/ UTAUT2, and Diffusion of Innovations (DOI) remain widely applied.

Balassa and Gyurián [1] surveyed Hungarian consumers using PLS - SEM and found that health concerns and unclear economic benefits drive public hesitation toward 5G, recommending clearer communication to build trust. Yang et al. [5] applied UTAUT to mobile health adoption in Indonesia, showing that behavioral intention mediates the impact of usefulness, privacy, and accuracy on actual use, with PV moderating this effect. Al Mamun et al. [6] combined PLS - SEM and neural networks for wearable payment adoption in Malaysia, finding ease of use, usefulness, reliability, and lifestyle fit as positive predictors of intention, while intention strongly predicted actual behavior.

Mustafa et al. [7] extended UTAUT2 by adding curiosity, PV, and EA, revealing all factors except SI were significant - underscoring the growing importance of psychological and sustainability - related dimensions. A China–U.S. comparative study based on TAM showed cultural differences: Chinese respondents viewed 5G as national progress, while Americans were more concerned about health and privacy; yet, usefulness and speed remained universal motivators. Similarly, Shah et al. [8] confirmed through an extended VAM that PV is the strongest driver of willingness to pay for 5G, while environmental and health factors enhance trust and positive attitudes.

Hoo et al. [9] used a TAM–DOI framework with Malaysian Shopee data and found that ease of use, norms, and attitudes drive purchase intention and actual 5G smartphone adoption. Shahzad et al. [10], studying Beijing students via UTAUT2, revealed that SI, EA, and safety assurance affect 5G use through trust and intention, with facilitating conditions strengthening this link. Al - Maroof et al. [11] incorporated enjoyment, readiness, and gender into TAM, showing usefulness, ease of use, and security as key predictors, while gender moderated these relationships.

Overall, the literature highlights two main insights: (1) core cognitive factors - usefulness, ease of use, value, and SI - remain the strongest predictors of intention and adoption; and (2) sustainability and health dimensions - EA, safety, and health consciousness - affect adoption both directly and indirectly through trust and intention. Yet, a research gap persists in cross - national comparisons that account for cultural, policy, and infrastructural contexts, which could deepen theoretical understanding and guide sustainable digital transformation strategies.

2.3. Theoretical Framework and Behavioral Antecedents

The TAM, developed by Davis [12], is a classical framework for explaining technology adoption behavior, positing that behavioral intention (BI) is determined by two key factors: PU and PEU. PU reflects the extent to which users believe that technology enhances their performance, while PEU represents the perceived effortlessness of using it. Numerous studies have validated PU and PEU as the principal antecedents shaping intention and actual usage behavior. In the context of 5G, PU is associated with the benefits of applications such as IoT, telemedicine, online learning, and smart cities, whereas PEU is reflected through high speed, low latency, and stable connectivity.

DOI theory [13] explains how innovations spread through five stages: awareness, persuasion, decision, implementation, and confirmation. DOI elucidates why some individuals adopt new technologies earlier than others, emphasizing the roles of innovativeness and perceived convenience in shaping attitudes and intentions. In the 5G context, DOI provides insights into how consumers evaluate benefits and risks, form adoption intentions, and transform them into actual behaviors.

The UTAUT, developed by Venkatesh et al. [14], integrates preceding models and identifies four core determinants: performance expectancy (PE), effort expectancy (EE), SI, and facilitating conditions (FC). PE and EE capture perceptions of usefulness and ease of use; SI reflects SI; and FC concerns the availability of resources and technical support. The model has demonstrated strong empirical applicability and is particularly relevant for analyzing 5G adoption behavior across international contexts.

2.4. Research Hypotheses

Building on TAM, UTAUT, and DOI, the proposed model conceptualizes PU, PEU, and SI as cognitive–social antecedents shaping IU. EA influences HA, which in turn affects IU. PV strengthens the conversion from IU to AOU (Actual 5G Use). NA (Nationality) moderates the IU→AOU relationship. IU thus acts as a mediating mechanism transforming antecedents into 5G adoption behavior.

According to TAM and UTAUT, PU refers to the belief that a technology improves performance and user experience. It is a core determinant of behavioral intention. Empirical studies across digital contexts (e.g., banking/fintech, mobile shopping, contactless payment, wearable devices) consistently show a positive effect of PU on intention. In the 5G context, when users perceive clear benefits - such as higher speed, lower latency, and improved efficiency or entertainment - intention to adopt increases.

H1 (+): PU → IU - PU positively affects intention to use 5G.

In TAM, PEU is the degree to which a person believes using a technology requires minimal effort. PEU lowers cognitive barriers, boosts confidence, and thus reinforces intention. Prior studies (e.g., web services, mobile payment, contactless payment) show a significant positive impact of PEU on intention and on PU itself. In 5G, PEU reflects the user - friendliness of the ecosystem - devices, interfaces, and network setup. Systems that are intuitive and smooth shorten learning time and reduce switching costs, thereby promoting adoption.

H2 (+): PEU → IU - PEU positively affects intention to use 5G.

In UTAUT, SI is the extent to which individuals perceive those important others, such as family, friends, colleagues, or communities, to expect them to use a technology. At the early adoption stage, when personal experience is limited, reference signals - recommendations, positive feedback, or social norms - reduce uncertainty and strengthen motivation to conform. Empirical evidence across digital settings confirms SI's positive and significant impact on intention, particularly for emerging technologies. In the 5G context, favorable opinions and community endorsement (e.g., from media, influencers, or peers) make users more willing to adopt in line with prevailing norms.

H3 (+): SI → IU - SI positively affects intention to use 5G.

EA reflects an individual's understanding of and commitment to ecological responsibility. Higher EA is usually associated with sustainable choices. HA refers to one's positive orientation toward health - enhancing behavior - integrating wellness into daily life and preferring healthy lifestyles. In the 5G context, when users see 5G contributing to digital health (e.g., real - time monitoring, teleconsultation) and being deployed responsibly, EA may reinforce HA, which in turn enhances IU. This aligns with the "normative cognition → attitude → intention" logic in technology adoption models.

H4a (+): HA → IU - A positive HA increases intention to use 5G.

H4b (mediation): HA mediates EA → IU - EA enhances HA, which raises IU.

H5 (+): EA → HA - EA positively affects HA.

PV represents users' overall evaluation of the benefits received versus the costs incurred, including both functional (quality, efficiency, reliability) and experiential/psychological benefits (satisfaction, assurance, prestige). High PV is linked to stronger willingness to adopt and continue using technology. In 5G, PV captures the balance between performance (speed, latency, coverage, stability) and cost (pricing, device affordability), as well as real service experience. PV does not replace cognitive antecedents in TAM/UTAUT but amplifies the translation of intention into behavior: once users intend to adopt, perceiving 5G as "worth it" motivates actual acceptance.

H6 (moderation): PV moderates the IU → AOU relationship.

According to DOI, innovation adoption follows the process of awareness → persuasion → decision → use → confirmation, with intention marking the pivotal transition from consideration to action. Behavioral models (TRA/TPB, TAM, UTAUT) also affirm intention as the immediate predictor of behavior. When users hold positive expectations and perceive supportive norms, they tend to actualize their intention. In 5G, intention is driven by perceived benefits (speed, latency, reliability, IoT/VR/telehealth support) and enabling conditions (devices, plans, infrastructure). AOU reflects the real and sustained adoption of 5G in daily life. When IU is strong - and not hindered by cost, complexity, or infrastructure barriers - AOU increases accordingly.

H7 (+): IU → AOU - IU positively affects actual 5G acceptance.

In TAM/UTAUT, cognitive–social antecedents (PU, PEU, SI, HA) do not directly determine behavior but primarily shape IU, which then drives AOU. This follows the cognitive/normative → intention → behavior chain, where users weigh benefits, costs, social norms, and health motives before adopting 5G. Thus, indirect effects through IU are expected to be positive. Direct effects from PU/PEU/SI/HA to AOU may weaken or disappear once IU is included in the model (partial or full mediation).

Mediation hypotheses:

H8a (mediation): IU mediates PU → AOU - PU raises IU, which in turn increases AOU.

H8b (mediation): IU mediates PEU → AOU - Ease of use reduces learning costs, strengthens IU, and enhances AOU.

H8c (mediation): IU mediates SI → AOU - Social norms and expectations boost IU, then translate to AOU.

H8d (mediation): IU mediates HA → AOU - Positive health attitudes elevate IU, leading to higher AOU.

Although IU is a direct predictor of AOU, the IU→AOU relationship strength may vary across countries due to cultural, infrastructural, and economic differences. In markets with widespread 5G commercialization (e.g., greater device and plan accessibility), the intention–adoption conversion is stronger. In contrast, where coverage, cost, or administrative barriers persist, this linkage weakens.

H9 (moderation): Nationality (NA) moderates IU → AOU - For the same IU level, AOU differs across countries.

Finally, IU serves as a crucial bridge between HA and AOU. Although EA may directly influence AOU, structural equation modeling studies show that the indirect pathway via HA and IU is more significant. This implies that 5G acceptance (AOU) strengthens when consumers first develop health - conscious attitudes, which then lead to corresponding behavioral intentions.

H10: HA and IU mediate the relationship between EA and AOU.

3. Research Methodology

3.1. Research Model and Design

The research model was developed based on the integration of three behavioral frameworks - the TAM, the UTAUT, and DOI. The model captures cognitive, social, and sustainability - oriented factors influencing 5G technology acceptance in a comparative context between Vietnam and the United States.

Specifically, eight constructs were included: PU, PEU, SI, EA, HA, PV, IU, and AOU. Nationality (NA) was incorporated as a moderating variable to test cross - national differences. The hypothesized relationships among these constructs are grounded in prior studies on technology adoption and sustainability - driven consumer behavior.

A quantitative research design was employed to empirically test the proposed hypotheses. All measurement items were adapted from validated scales in previous studies on technology and telecommunication adoption to ensure content validity. A five - point Likert scale (1 = strongly disagree, 5 = strongly agree) was used for all observed variables. The questionnaire was bilingual (Vietnamese–English) and pilot - tested with 30 participants to verify clarity, translation accuracy, and cultural appropriateness.

3.2. Data Collection

Primary data were collected through an online survey targeting consumers in Vietnam and the United States. Convenience sampling was adopted due to the wide geographical scope of respondents. The final sample comprised 522 valid responses - 270 from Vietnam (51.7%) and 252 from the United States (48.3%) - ensuring a balanced cross - national representation.

Respondents were screened to ensure awareness of 5G technology, and duplicate or incomplete responses were removed prior to analysis. Data collection was conducted anonymously and voluntarily, complying with ethical research standards. The cleaned dataset was subsequently analyzed using SmartPLS 3 to test the measurement and structural models.

3.3. Data Analysis

Survey data were analyzed using the Partial Least Squares Structural Equation Modeling (PLS - SEM) method with SmartPLS 3, suitable for medium - sized samples and models with multiple latent constructs. The analysis followed a two - step process: (i) Measurement model assessment, including tests of reliability and validity through Cronbach's Alpha, Composite Reliability (CR), Average Variance Extracted (AVE), Fornell–Larcker criterion, and HTMT ratio; (ii) Structural model assessment, through path coefficient analysis, R^2 values, and bootstrapping (5,000 resamples) to test significance.

A multi - group analysis (PLS - MGA) was performed to compare structural differences between the two national groups. This approach ensures scale reliability and clarifies the interrelationships among constructs in the cross - national 5G TAM.

4. Research Results

4.1. Sample Characteristics

A total of 522 valid responses were collected, comprising 270 Vietnamese (51.7%) and 252 American (48.3%) participants. The sample was relatively balanced by gender, with 59.6% female, 38.5% male, and 1.9% others. The majority were under 30 years old (64.8%), followed by those aged 30–43 (17.8%) and above 43 (17.5%). Regarding employment status, students accounted for 56.7%, employed respondents 41.0%, and unemployed respondents 2.3%. This demographic distribution ensures adequate representation across age and occupation groups, supporting meaningful cross - national comparisons between Vietnam and the United States.

4.2. Measurement Model Assessment

The results of the reliability and validity analysis indicate that all measurement scales meet accepted thresholds. Specifically, Cronbach's Alpha values exceed 0.70, and CR values are above 0.80, confirming strong internal consistency. Convergent validity is established as all factor loadings are greater than 0.70 and the AVE values exceed 0.50. In addition, discriminant validity is confirmed according to the Fornell–Larcker criterion and the HTMT ratio, with all HTMT values below 0.85. Therefore, all constructs in the study demonstrate adequate reliability and validity, satisfying the requirements for proceeding to structural model analysis.

Table 1. *Reliability and Convergent Validity of Measurement Scales*

Scale	Cronbach's Alpha	CR	AVE	HTMT (max)
PU	0.85	0.89	0.65	0.72
PEU	0.83	0.88	0.63	0.75
SI	0.82	0.87	0.62	0.7
EA	0.81	0.86	0.61	0.68
HA	0.84	0.89	0.64	0.73
PV	0.86	0.9	0.67	0.71
IU	0.87	0.91	0.69	0.74
AOU	0.88	0.92	0.7	0.69

Source: Extracted results from SmartPLS

4.3. Results

The structural model was estimated using the bootstrapping procedure with 5,000 resamples in SmartPLS 3. The results reveal that PU, PEU, and SI exert positive and statistically significant effects on IU, with standardized path coefficients of $\beta = 0.28$, 0.19, and 0.21, respectively ($p < 0.01$). EA not only has a direct positive impact on IU ($\beta = 0.14$, $p < 0.05$) but also indirectly enhances HA ($\beta = 0.30$, $p < 0.01$), which in turn positively influences IU ($\beta = 0.16$, $p < 0.05$).

Among all predictors, IU emerges as the strongest determinant of AOU ($\beta = 0.30$, $p < 0.001$). In addition, PV exerts a statistically significant moderating effect on the IU → AOU relationship ($\beta = –0.069$, $p < 0.05$). Overall, the model explains 67% of the variance in IU and 59% in AOU, indicating substantial explanatory power and satisfactory model fit.

Complementary nonparametric bootstrapping with 1,000 resamples confirms the robustness of these findings, as all hypothesized paths yield p - values below 0.05, demonstrating statistical significance. The standardized coefficients further show that PU, PEU, SI, and HA have consistent positive effects on IU, while EA strongly predicts HA ($\beta = 0.67$) and IU significantly drives AOU ($\beta = 0.30$). The direction of all effects remains positive and aligned with theoretical expectations.

In summary, hypotheses H1, H2, H3, H4a, H5, and H7 are supported. Among the cognitive and attitudinal factors affecting IU, their relative influence ranks as follows: PEU → PU → SI → HA. The results collectively validate the proposed research model, as detailed in Table 2.

Table 2. *Summary of Hypothesis Testing Results*

Hypothesis	Path	Original Sample	T - Statistic	P - values	Results
H1	PU→IU	0.191	3.693	0.000	Accepted
H2	PEU→IU	0.226	4.147	0.000	Accepted
H3	SI→IU	0.161	3.043	0.002	Accepted
H4a	HA→IU	0.117	2.329	0.020	Accepted
H4b	EA → HA→ IU	0.078	2.360	0.018	Accepted
H5	EA→HA	0.670	22.828	0.000	Accepted
H6	IU*PV →AOU	- 0.069	2.240	0.025	Accepted
H7	IU→AOU	0.298	5.480	0.000	Accepted
H8a	PU→IU →AOU	0.057	2.950	0.003	Accepted
H8b	PEU→IU →AOU	0.068	2.952	0.003	Accepted
H8c	SI→IU →AOU	0.048	2.565	0.010	Accepted
H8d	HA → IU → AOU	0.035	2.378	0.018	Accepted
H9	IU*NA→ AOU	0.019	0.449	0.653	Rejected
H10	EA→HA→ IU→AOU	0.023	2.374	0.018	Accepted

Source: Compiled by the authors

As reported in Table 2, the majority of hypotheses are empirically supported. All direct structural paths exhibit positive and significant associations, while the interaction term IU×PV → AOU shows a significant negative moderating effect. The only non - significant relationship is H9, which is not validated due to its p - value (0.653 > 0.05).

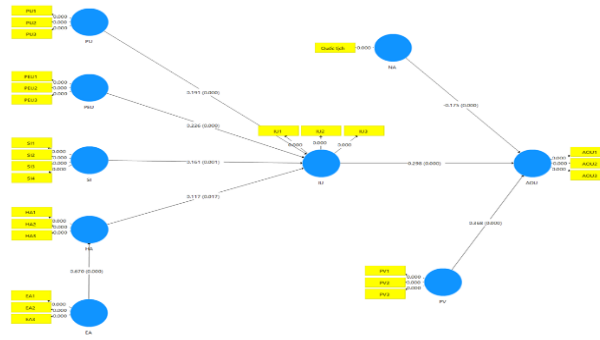

Figure 1. *Results of Proposed Research Model*

4.4. Multi - Group Analysis by Nationality

Regarding the moderating effects, the interaction term IU×PV → AOU exhibits statistical significance ($p = 0.025 < 0.05$), confirming H6. The negative coefficient ($\beta = –0.069$) indicates that higher PV weakens, rather than strengthens, the linkage between intention and actual use. In contrast, the moderating role of nationality is not substantiated, as the IU×NA → AOU effect is insignificant ($p = 0.653$), leading to the rejection of H9 (Table 3).

Table 3. *Summary Report of the Moderating Effects of Nationality (NA) and PV*

	Original Sample	**Sample Mean**	**Standard Deviation**	**P - values**
Mo_NA - > AOU	0.019	0.023	0.043	**0.653**
Mo_PV - > AOU	- 0.069	- 0.066	0.031	**0.025**

Source: Extracted results from SmartPLS

The inverse moderating effect of PV suggests that, within early - stage 5G markets, even users who perceive substantial value in the technology may not readily translate intention into actual adoption. Factors such as uneven network coverage, device incompatibility, and comparatively high service or handset costs likely constrain users' ability to act on their intentions. Consequently, PV alone is insufficient to overcome infrastructural or economic barriers, resulting in a dampened intention–behavior relationship. The absence of a significant nationality effect further implies that this attenuation is not culturally or institutionally idiosyncratic but reflects a shared adoption dynamic across both Vietnam and the United States. This interpretation is consistent with prior research indicating that external facilitating conditions can impede the realization of behavioral intentions for emerging technologies.

PLS - MGA results additionally show no significant structural differences between the two national groups ($p > 0.05$). Nonetheless, descriptive comparisons reveal that U.S. respondents tend to report marginally higher PU and intention to use, whereas Vietnamese respondents exhibit stronger environmental and health - related concerns - patterns that reflect divergent contextual sensitivities. Overall, the core behavioral mechanisms underlying 5G adoption appear broadly comparable across countries, despite nuanced differences in user priorities and value perceptions.

5. Conclusion

This study contributes to explaining 5G technology acceptance in a comparative context between Vietnam and the United States, through the integration of behavioral technology frameworks, TAM, UTAUT, and DOI. Based on data from 522 respondents, the findings reveal that PU, PEU, and SI are key predictors of Intention to Use 5G. In addition, EA and HA emerge as complementary factors exerting indirect but significant effects, reinforcing user confidence and fostering positive attitudes toward this emerging technology. Notably, PV serves as a crucial moderating factor, conditioning the conversion of intention into actual acceptance and indicating that higher PV does not automatically translate into stronger realization of intended 5G use. Although nationality was tested as a moderating variable, it did not produce statistically significant differences, suggesting that the fundamental behavioral factors associated with 5G adoption are largely universal and may be generalized across markets.

From an academic perspective, this study expands theoretical discussion by integrating environmental and health - related dimensions, often overlooked in traditional technology adoption models, into the analytical framework, thereby enriching the empirical evidence in 5G adoption research. The combination of TAM, UTAUT, and DOI reaffirms the explanatory power of usefulness, ease of use, and social influence, while highlighting that the inclusion of PV and environmental–social responsibility provides a more comprehensive understanding of 5G adoption behavior. This integration opens new directions for incorporating sustainability - oriented factors into consumer technology behavior research, enhancing the academic contribution of the study.

From a practical standpoint, the findings offer meaningful implications for both businesses and policymakers. Service providers should emphasize transparent communication about the benefits and safety of 5G, particularly by addressing public concerns regarding health and environmental impacts. Designing value - added service packages, such as IoT support, smart digital utilities, and eco - friendly solutions, can help users better perceive the tangible benefits of 5G and facilitate the shift from intention to actual adoption. At the same time, regulatory agencies may utilize these insights to develop communication strategies and policy frameworks that promote sustainable development, ensuring a balance between commercialization speed and public trust.

Finally, it is important to acknowledge certain limitations. Given the cross - sectional survey design, the relationships identified in this study should be interpreted as associative rather than strictly causal. Future research employing longitudinal or experimental approaches would be required to establish stronger causal inferences.

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