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Determinants of Perceived Value and Loyalty in Automated Unmanned Marketplaces: Evidence from University Students in Chengdu, China

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Abstract

Purpose: This study examines the determinants of perceived value and loyalty toward Automated Unmanned Marketplaces among university students in Chengdu, China. **Research design, data and methodology:** A quantitative research design was adopted. Data were collected from 500 university students with prior experience using Automated Unmanned Marketplaces. A pilot test with 40 respondents was conducted to assess content validity and reliability before the main survey. The questionnaire employed a five-point Likert scale. Confirmatory factor analysis was used to evaluate reliability and validity, followed by structural equation modeling to test the hypothesized relationships. **Results:** All proposed relationships were statistically supported. Customer participation emerged as the strongest predictor of perceived value ($\beta = 0.307$), while ethics, aesthetic appeal, and perceived innovativeness also showed significant positive effects. Perceived value demonstrated the strongest effect on loyalty ($\beta = 0.394$), while satisfaction also contributed significantly to loyalty formation. **Conclusions:** The findings suggest that managers should prioritize value-driven strategies by strengthening ethical practices, service design, customer involvement, and innovation. The results highlight the central role of perceived value as a key mechanism linking service attributes to loyalty, and continuous improvement of satisfaction mechanisms can further reinforce loyalty and support sustainable development in unmanned retail settings.

Keywords: Perceived Value, Customer Loyalty, Automated Unmanned Marketplaces, University Students, China

JEL Classification Code: D12, L81, M31, O33

1. Introduction

With the shift of economic development from quantity to quality, retail markets are undergoing rapid transformation driven by technological progress and digital innovation. Automated unmanned marketplaces (AUM) have emerged as a new retail format that integrates artificial intelligence, the Internet of Things, and smart payment systems to provide cashierless and personnel-free shopping experiences (Ding et al., 2022; Zhong, 2018). Unlike traditional supermarkets, AUM relies on automated systems to complete product selection, payment, and inventory management, reducing labor dependency and operational costs.

Service automation has become increasingly common across industries. Manyika et al. (2017) estimated that up to 50 percent of existing work tasks can be automated using current technologies. In the retail context, automation can enhance efficiency and customer control during service encounters (Blut et al., 2016; Huang & Rust, 2018). However, automated interactions may reduce human warmth and emotional connection, which are critical elements of customer relationships (Wirtz et al., 2018). Therefore, managers must carefully balance technological innovation with customer experience to ensure long-term sustainability (Larivière et al., 2017).

In China, rising labor costs and rapid digitalization have accelerated the adoption of unmanned retail formats (Zhao, 2017; Zhu & Zhang, 2018). The AUM model offers cost advantages and supports low-contact services, which gained attention during recent economic and social transitions (Zhang & Chen, 2019). Despite its potential, the expansion of AUM remains limited. Only a small number of pilot

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projects have achieved stable development, and consumer acceptance remains uncertain (Ding et al., 2022; Wang, 2018). Existing studies largely focus on technological infrastructure or operational efficiency, while fewer studies examine customer-centered outcomes such as perceived value and loyalty, particularly in the context of university students (Hu et al., 2022).

University students represent an important consumer segment in Chengdu due to their high exposure to digital technologies and openness to innovation. Their perceptions of ethics, aesthetic appeal, customer participation, and innovativeness may influence how they evaluate AUM services. However, there is limited empirical evidence explaining how these factors shape perceived value and loyalty in this emerging retail format. This gap creates uncertainty for managers seeking to design effective strategies.

Therefore, this study aims to examine the factors influencing perceived value and loyalty toward AUM among university students in Chengdu, China. Specifically, it investigates the effects of ethics, aesthetic appeal, customer participation, and perceived innovation on perceived value, and further examines the roles of perceived value and satisfaction in shaping loyalty. By developing and empirically testing a structural model, this study contributes to the literature on automated retail and consumer behavior, and provides practical guidance for enhancing competitiveness and sustainable development in the unmanned retail industry.

2. Literature Review

2.1 Loyalty

Loyalty refers to a customer's favorable attitude and repeated behavioral intention toward a brand or service over time. It reflects both the desire to maintain a relationship and the likelihood of repeat purchases or positive word-of-mouth (Yang & Peterson, 2004). Reichheld (2003) highlighted loyalty through the Net Promoter Score concept, emphasizing customers' willingness to recommend a brand. In retail and digital service contexts, loyalty is commonly regarded as the outcome of superior value, service quality, and satisfying experiences (Tanković & Benazić, 2018).

Empirical studies consistently demonstrate that loyalty is influenced by customers' perceived value and satisfaction. Tanković and Benazić (2018) found that perceived value significantly strengthens both attitudinal and behavioral loyalty. Boisvert (2012) reported that brand experience and satisfaction positively affect brand loyalty. In digital commerce settings, Yang et al. (2023) confirmed that satisfaction plays an important role in enhancing loyalty. Similarly, Saoula et al. (2024) identified satisfaction as a key predictor of loyalty across service industries.

These findings suggest that loyalty in Automated Unmanned Marketplaces is likely shaped by customers' value perceptions and satisfaction evaluations.

2.2 Ethics

Ethics refers to principles that distinguish right from wrong and guide fair and responsible behavior in business practices (Carroll, 1991; Freeman & Gilbert, 1988; Velasquez, 1999). In the corporate context, ethics concerns moral standards in organizational activities, including pricing, advertising, and service delivery (Carroll & Shabana, 2010; Ferrell et al., 2019). From a consumer perspective, perceived corporate ethics reflects customers' evaluation of whether a firm acts honestly, transparently, and responsibly (Amoako et al., 2021).

Empirical research consistently indicates that ethical practices enhance consumers' value evaluations. Ethical transparency in pricing, advertising, and service delivery strengthens customers' perceptions of fairness and trust, which in turn increases perceived value (Hamenda, 2018; Liu et al., 2014). When firms demonstrate responsible and honest behavior, consumers tend to interpret such actions as signals of reliability and long-term commitment (Ramos et al., 2014). Ethical attributes may also enhance product attractiveness and reinforce value perceptions, particularly when price considerations are involved (Araque-Padilla et al., 2015). However, in highly automated settings, ethical signals may be less visible to customers. As a result, their influence on perceived value may be weaker. Overall, the literature suggests that ethical responsibility functions as both a trust-building mechanism and a value-enhancing factor in consumer evaluations.

In the context of Automated Unmanned Marketplaces, ethical concerns such as data privacy, transparent pricing, and fair transaction processes may influence how customers evaluate value. Therefore, the following hypothesis is proposed:

H1: Ethics has a significant influence on perceived value.

2.3 Aesthetic Appeal

Aesthetic appeal refers to the visual and sensory attractiveness of a product, service environment, or interface that enhances consumers' pleasure and satisfaction. In consumer research, it is defined as the degree to which design elements create positive sensory and emotional experiences that influence evaluation and behavioral intention (Le-Hoang, 2020). In service research, aesthetic appeal is reflected in design, layout, and environmental cues that shape customers' overall impressions (Baker et al., 2002;

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Bitner, 1992). It includes visual appeal, design originality, and entertainment value (Sreejesh & Ponnam, 2017).

Prior research highlights the important role of aesthetic elements in shaping consumer value perceptions. Attractive design, appealing layouts, and engaging sensory cues enhance enjoyment and improve overall evaluations of service experiences (Baker et al., 2002). Aesthetic features not only increase emotional responses such as pleasure and excitement but also strengthen cognitive assessments of value (Mathwick et al., 2002; Moshagen et al., 2009). Moreover, aesthetic appeal contributes to purchase intention indirectly by enhancing perceived value, suggesting that visual and sensory design influences consumer behavior through value formation (Gallarza et al., 2016; Toufani et al., 2017). However, in technology-based services, customers may focus more on usefulness and performance. In such cases, the role of aesthetics may be less important. These findings indicate that aesthetics serves as a key experiential factor in shaping value judgments.

In Automated Unmanned Marketplaces, store design, interface aesthetics, and sensory atmosphere may shape students' evaluations of value. Therefore, the following hypothesis is proposed:

H2: Aesthetic appeal has a significant influence on perceived value.

2.4 Customer Participation

Customer participation refers to the extent to which customers actively engage in the production and delivery of services. It involves the time, effort, knowledge, and other resources contributed by customers during service interactions (Chan et al., 2010; Mustak et al., 2013, 2016). Rather than acting as passive recipients, customers are viewed as active co-producers who collaborate with firms to create value (Bendapudi & Leone, 2003). In service settings, participation may include information sharing, feedback provision, cooperative behaviors, and involvement in service processes (Barrutia & Gilsanz, 2013; Dong et al., 2015).

Prior research indicates that customer participation enhances service outcomes and value perceptions. Active involvement improves service quality and strengthens customers' sense of control and self-efficacy (Mills & Morris, 1986; Wang, 2018). Empirical evidence shows that higher levels of participation are positively associated with perceived value, satisfaction, and loyalty intention (Chan et al., 2010; Dong & Sivakumar, 2017; Mustak et al., 2016; Yim et al., 2012). From a service-dominant logic perspective, participation enables resource integration between firms and customers, thereby facilitating value co-creation (Auh et al., 2007; Skålén et al., 2015). Nyadzayo et al. (2023) further confirmed that customer participation significantly contributes to perceived value formation. However, if participation requires too much effort, customers may feel burdened. This can reduce their perceived value, especially in self-service environments.

In the context of Automated Unmanned Marketplaces, customers actively complete transactions and manage service processes independently. Therefore, the following hypothesis is proposed:

H3: Customer participation has a significant influence on perceived value.

2.5 Perceived Innovativeness

Perceived innovativeness refers to consumers' subjective evaluation of how new and improved a product or service is compared with existing alternatives (Lowe & Alpert, 2015; Rogers et al., 2014). It reflects customers' judgments of novelty, creativity, and relative advantage rather than objective technological characteristics.

Empirical research consistently demonstrates that perceived innovativeness enhances customer evaluations and value perceptions. When consumers perceive an offering as innovative, they are more likely to interpret it as beneficial and superior to alternatives (Dahl & Hoeffler, 2004). Innovative features signal advancement and efficiency, which positively shape cognitive assessments of value (Kim et al., 2018). Ling et al. (2023) further confirmed that perceived innovativeness significantly strengthens perceived value and encourages value co-creation behavior. Similarly, prior studies indicate that innovation-related perceptions enhance customer attitudes and behavioral intentions by increasing perceived benefits (Boksberger & Melsen, 2011; Sukwadi, 2017). These findings suggest that innovation, when positively perceived, functions as a key driver of value formation in technology-enabled services.

In the context of Automated Unmanned Marketplaces, advanced systems and smart technologies may enhance students' perceptions of value. Therefore, the following hypothesis is proposed:

H4: Perceived innovativeness has a significant influence on perceived value.

2.6 Perceived Value

Perceived value refers to customers' overall evaluation of the benefits received relative to the costs incurred. It is commonly conceptualized as a trade-off between perceived benefits and sacrifices (Zeithaml, 1988). Consumer value theory further distinguishes utilitarian and hedonic dimensions of value, reflecting functional and experiential benefits (Babin et al., 1994; Sheth et al., 1991). In service contexts, perceived value represents a comprehensive assessment formed after customers evaluate quality, price,

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and overall experience (Wang et al., 2020).

Empirical research consistently demonstrates that perceived value plays a central role in shaping customer outcomes. Gallarza and Gil (2006) and McDougall and Levesque (2000) confirmed a clear causal relationship among perceived value, satisfaction, and loyalty. Perceived value has been shown to directly enhance loyalty and indirectly influence it through satisfaction and trust (Hur et al., 2013; Li & Green, 2011; Servera-Francés & Piqueras-Tomás, 2019). Koller et al. (2011) further indicated that functional, emotional, and social value dimensions contribute to loyalty formation. More recent studies continue to support the mediating and predictive role of perceived value in explaining consumer behavioral intentions (Tumaku et al., 2023; Vu et al., 2024). However, its effect may change across contexts. Factors such as trust or perceived risk can also influence customer decisions.

These findings suggest that perceived value functions as a key driver of loyalty in service and retail settings. Therefore, the following hypothesis is proposed:

H5: Perceived value has a significant influence on loyalty.

2.7 Satisfaction

Satisfaction refers to consumers' overall evaluation of their experience based on the comparison between expectations and actual performance (Tse & Wilton, 1988). It represents a post-consumption judgment that reflects whether a service or product meets or exceeds expectations (Kotler & Keller, 2011).

Extensive empirical research identifies satisfaction as a key determinant of loyalty. Satisfied customers are more likely to repurchase and engage in positive word-of-mouth (Babolian Hendijani, 2016; Esparza-Huamanchumo et al., 2022). In service contexts, satisfaction consistently predicts loyalty intentions and long-term relationship commitment (Chen & Chen, 2010; Mora et al., 2021; Özkan et al., 2020). Although the strength of the relationship may vary across industries, satisfaction remains a central explanatory factor of loyalty behavior (Tuu & Olsen, 2010). In digital and technology-enabled services, satisfaction has also been shown to mediate the effects of service quality and perceived value on loyalty (Santouridis et al., 2009). However, satisfaction alone may not be enough to keep customers loyal, especially when switching to other options is easy.

These findings suggest that higher satisfaction levels increase customers' likelihood of remaining loyal in service and retail environments, including Automated Unmanned Marketplaces. Therefore, the following hypothesis is proposed:

H6: Satisfaction has a significant influence on loyalty.

3. Research Methods and Materials

3.1 Research Framework

The conceptual framework of this study is grounded in five major theoretical perspectives: the Theory of Planned Behavior (Ajzen, 1987), the Theory of Reasoned Action (Fishbein & Ajzen, 1975), the Theory of Consumption Values (Sheth et al., 1991), Equity Theory (Adams, 1963), and Marketing Theory (Hunt, 1983). These theories explain how consumers evaluate offerings, form attitudes, and develop behavioral intentions. The Theory of Consumption Values supports the multidimensional nature of value perception, while Equity Theory explains how consumers assess fairness and benefits relative to costs. TPB and TRA justify how evaluations such as perceived value and satisfaction translate into loyalty intentions.

Drawing on these theoretical foundations and prior empirical findings, this study proposes that ethics, aesthetic appeal, customer participation, and perceived innovativeness influence perceived value. Perceived value is expected to enhance loyalty, and satisfaction is also proposed to directly affect loyalty. The conceptual framework is presented in Figure 1.

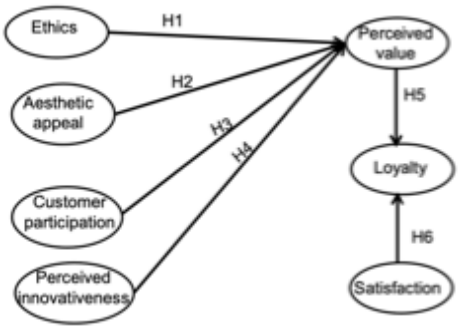

Figure 1: Conceptual Framework

3.2 Research Methodology

This study adopted a quantitative research design to examine the factors influencing perceived value and loyalty toward Automated Unmanned Marketplaces among university students in Chengdu, China. A non-probability sampling approach was adopted, incorporating stratified quota allocation and convenience sampling for data collection. Data were collected through online questionnaires distributed to students from 58 universities in Chengdu who had prior experience using AUM services. A total of 500 valid responses were obtained for analysis.

The questionnaire consisted of three sections. The first section included screening questions to ensure that

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respondents had experience with AUM. The second section measured seven constructs using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with measurement items adapted from prior empirical studies (Amoako et al., 2021; Nyadzayo et al., 2023). The final section collected demographic information, including gender, age, and educational level. Before the main survey, a pilot test was conducted with 40 respondents. Content validity was evaluated using the Item-Objective Congruence (IOC) method by three experts, and all items exceeded the acceptable threshold of 0.67 (Turner & Carlson, 2003). Reliability was assessed using Cronbach's alpha, and all constructs showed values above 0.70, indicating satisfactory internal consistency (Nunnally & Bernstein, 1994). As all items met the required validity and reliability criteria, no further modification to the measurement items was necessary prior to the main survey.

Ethical considerations were strictly observed throughout the study. Participation was voluntary, and respondents were informed of the study's purpose. Anonymity and confidentiality were assured, and data were used solely for academic research purposes.

Data analysis was conducted using SPSS and AMOS 26.0. Confirmatory factor analysis was performed to assess convergent and discriminant validity. Model fit indices were evaluated to ensure the adequacy of the measurement model. Structural equation modeling was then applied to examine the hypothesized relationships among the constructs.

3.3 Population and Sample Size

The study examined seven latent variables measured by 24 observed items. Based on structural equation modeling requirements, the expected effect size was set at 0.20, statistical power at 0.80, and the significance level at 0.05. The minimum required sample size for model estimation was 425, as calculated using an online SEM sample size calculator (Soper, 2024). To ensure stable parameter estimation and improve analytical accuracy, 500 valid responses were collected. The target population consisted of university students aged 19 and above in Chengdu who had experience using Automated Unmanned Marketplaces.

3.4 Sampling Technique

This study employed a stratified quota sampling approach to enhance representation across different levels of higher education. The target population consisted of university students aged 19 and above from 58 universities in Chengdu, representing a broad range of public and private higher education institutions, who had prior experience using Automated Unmanned Marketplaces. Based on official statistics from the Chengdu Bureau of Statistics, the student population was categorized into three strata: undergraduate, master's, and doctoral students.

Proportional allocation was applied to determine the number of respondents required from each stratum according to its population size. This procedure ensured that the final sample reflected the actual distribution of students across educational levels. The population distribution and proportional sample allocation are presented in Table 1 below.

Table 1: Population Distribution and Proportional Sample Allocation

Educational Level	Population	Proportional Sample
Undergraduate Students	1,035,000	445
Master's Students	109,000	47
Doctoral Students	20,000	8
Total	**1,164,000**	**500**

Source: Chengdu Bureau of Statistics

After establishing the quota for each group, convenience sampling was used to collect data. The online questionnaire was distributed through platforms such as WeChat, QQ, Douyin, and email. Respondents were encouraged to share the survey link within their networks to improve response rates. Data collection was conducted between January and October 2025.

4. Results and Discussion

4.1 Demographic Information

A total of 500 valid responses were included in the demographic analysis. The detailed distribution is presented in Table 2. Female respondents accounted for 64.4% of the sample, while males represented 35.6%. Most respondents were aged between 19 and 25 years (62.8%), followed by those aged 26 to 35 years (21.4%). No respondents were over 45 years old. In terms of monthly income, the largest proportion fell within the range of 1,000 to 3,000 yuan (43.2%), indicating that most respondents were students with moderate personal income. Regarding educational level, the majority were undergraduate students (89%), while master's and doctoral students accounted for 9.4% and 1.6%, respectively.

Overall, the sample reflects a young and predominantly undergraduate student population, which is consistent with the study's target group of university students in Chengdu.

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Table 2: Demographic Profile

Demographic and General Data (N=500)		Frequency	Percentage
Gender	Female	322	64.4
	Male	178	35.6
Age	19-25 years	314	62.8
	26-35 years	107	21.4
	36-45 years	79	15.8
	Over 45 years	0	0.0
Monthly Income (RMB)	Less than 1,000	35	7.0
	1,000-3,000	216	43.2
	3,001-5,000	101	20.2
	5,001-7,000	97	19.4
	7,001-9,000	47	9.4
	More than 9,000	4	0.8
Educational Level	Undergraduate	445	89.0
	Master's	47	9.4
	Doctoral	8	1.6

Source: Data collected from university students in Chengdu, China

4.2 Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis was conducted to assess the measurement model, including reliability, convergent validity, discriminant validity, and overall model fit. The results are presented in Tables 3-5.

As shown in Table 3, all standardized factor loadings exceeded 0.60 and were statistically significant, indicating acceptable item reliability (Hair et al., 2006). Cronbach's alpha and composite reliability values for all constructs were above 0.80, exceeding the recommended threshold of 0.70. In addition, the average variance extracted values ranged from 0.552 to 0.751, which are higher than the recommended level of 0.50 (Fornell & Larcker, 1981). These results confirm satisfactory convergent validity.

Discriminant validity was assessed using the Fornell and Larcker criterion. As shown in Table 4, the square root of the AVE for each construct was greater than the inter-construct correlations, indicating adequate discriminant validity.

Model fit was evaluated using multiple indices. As reported in Table 5, the CFA model demonstrated good fit, with CMIN/DF = 2.139 and RMSEA = 0.048. Other indices, including GFI, AGFI, NFI, CFI, and TLI, exceeded the recommended thresholds. Overall, the measurement model exhibits satisfactory reliability and validity, supporting subsequent structural model analysis.

Table 3: Confirmatory Factor Analysis (CFA), Composite Reliability (CR), and Average Variance Extracted (AVE) Results

Variable	Source of Questionnaire (Measurement Indicator)	No. of Item	Cronbach's Alpha	Factor Loading	CR	AVE
Ethics (ET)	Amoako et al. (2021)	3	0.839	0.756-0.889	0.847	0.651
Aesthetic appeal (AA)	Amoako et al. (2021)	5	0.856	0.630-0.846	0.859	0.552
Customer participation (CP)	Nyadzayo et al. (2023)	3	0.878	0.827-0.856	0.878	0.706
Perceived innovativeness (PI)	Nyadzayo et al. (2023)	3	0.886	0.793-0.916	0.888	0.727
Perceived value (PV)	Nyadzayo et al. (2023)	3	0.898	0.808-0.927	0.899	0.749
Satisfaction (SA)	Nyadzayo et al. (2023)	3	0.895	0.816-0.941	0.900	0.751
Loyalty (LO)	Nyadzayo et al. (2023)	4	0.833	0.605-0.843	0.836	0.564

Note: CR = Composite Reliability, AVE = Average Variance Extracted

Table 4: Discriminant Validity

Variable	Factor Correlations						
	ET	AA	CP	PI	PV	SA	LO
ET	**0.807**						
AA	0.319	**0.743**					
CP	0.285	0.323	**0.840**				
PI	0.215	0.223	0.329	**0.853**			
PV	0.363	0.356	0.412	0.333	**0.865**		
SA	0.247	0.261	0.332	0.201	0.355	**0.867**	
LO	0.412	0.307	0.341	0.327	0.401	0.337	**0.751**

Note: The diagonally listed value is the AVE square roots of the variables

Table 5: Goodness of Fit

Index	Criterion	CFA Value	SEM Value
CMIN/DF	< 5.00 (Al-Mamary & Shamsuddin, 2015; Awang, 2012)	2.139	3.404
GFI	≥ 0.85 (Sica & Ghisi, 2007)	0.925	0.867
AGFI	≥ 0.80 (Sica & Ghisi, 2007)	0.902	0.838
NFI	≥ 0.80 (Wu & Wang, 2006)	0.931	0.883
CFI	≥ 0.80 (Bentler, 1990)	0.962	0.914
TLI	≥ 0.80 (Sharma et al., 2005)	0.954	0.903
RMSEA	< 0.08 (Pedroso et al., 2016)	0.048	0.069

Note: CMIN/DF = The ratio of the chi-square value to degree of freedom, GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, NFI = normalized fit index, CFI = comparative fit index, TLI = Tucker Lewis index and RMSEA = root mean square error of approximation

4.3 Structural Equation Model (SEM)

Structural equation modeling was conducted using AMOS version 26 to examine the hypothesized relationships among the constructs. The overall fit indices of the structural model are presented in Table 5.

The results indicate that the proposed model demonstrates acceptable goodness of fit. The CMIN/DF value is 3.404, suggesting a reasonable ratio between the chi-square statistic and degrees of freedom. The RMSEA value of 0.069 indicates an adequate level of approximation error. In addition, the incremental fit indices, including GFI, AGFI, NFI, CFI, and TLI, all meet the recommended standards.

Overall, these results confirm that the structural model fits the empirical data satisfactorily. The model is therefore considered appropriate for evaluating the hypothesized

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relationships among ethics, aesthetic appeal, customer participation, perceived innovativeness, perceived value, satisfaction, and loyalty.

4.4 Research Hypothesis Testing Result

The structural model analysis was used to assess all six hypothesized relationships. As shown in Table 6, each path was significant at $p < 0.05$, indicating full support for all hypotheses. Among the tested relationships, perceived value exerted the strongest positive effect on loyalty, while customer participation was the most significant predictor of perceived value.

Table 6: Hypothesis Testing Result

Hypothesis	Standardized path coefficients (β)	S.E.	t-value	Test Result
H1: PV ← ET	0.250	0.049	5.375*	Supported
H2: PV ← AA	0.216	0.055	4.640*	Supported
H3: PV ← CP	0.307	0.052	6.553*	Supported
H4: PV ← PI	0.203	0.051	4.460*	Supported
H5: LO ← PV	0.394	0.045	7.559*	Supported
H6: LO ← SA	0.214	0.036	4.466*	Supported

Note: *=p-value<0.05

H1: Ethics has a significant positive effect on perceived value (β = 0.250). This finding aligns with previous research showing that ethical practices enhance consumer value evaluations. Hamenda (2018) demonstrated that transparent and fair practices increase perceived value, while Araque-Padilla et al. (2015) found that ethical attributes strengthen value assessments by improving perceptions of trust and fairness.

H2: Aesthetic appeal significantly influences perceived value (β = 0.216). This result is consistent with Gallarza et al. (2016), who reported that sensory and design elements positively affect how consumers perceive value, and with Mathwick et al. (2002), who found that appealing service environments enhance value perceptions.

H3: Customer participation has a significant positive effect on perceived value (β = 0.307). This finding supports prior studies indicating that active involvement improves service outcomes. For example, Chan et al. (2010) and Mustak et al. (2016) demonstrated that participation strengthens perceived value by encouraging resource integration and co-creation.

H4: Perceived innovativeness significantly influences perceived value (β = 0.203). This result is in line with Ling et al. (2023), who showed that perceived innovativeness enhances value assessments, and with Kim et al. (2018), who confirmed that novelty perception drives higher value evaluations.

H5: Perceived value has a significant positive effect on loyalty (β = 0.394). This result agrees with Gallarza and Gil (2006) and McDougall and Levesque (2000), both of whom showed that higher perceived value leads to stronger loyalty intentions. It also supports findings by Koller et al. (2011) that value dimensions drive loyalty behaviors.

H6: Satisfaction has a significant positive effect on loyalty (β = 0.214). This confirms results from Özkan et al. (2020) and Mora et al. (2021), which highlighted satisfaction as a key predictor of loyalty in service settings.

Overall, the empirical evidence from this study is consistent with earlier research and supports the proposed conceptual framework, reinforcing the roles of ethics, aesthetics, participation, and innovativeness in shaping perceived value and loyalty.

5. Conclusions and Recommendation

5.1 Conclusions

This study aimed to examine the factors influencing perceived value and loyalty toward Automated Unmanned Marketplaces among university students in Chengdu, China. Specifically, it investigated how ethics, aesthetic appeal, customer participation, and perceived innovativeness shape perceived value, and how perceived value and satisfaction influence loyalty. By integrating multiple theoretical perspectives and testing the model using structural equation modeling, the study achieved its research objectives.

The findings indicate that perceived value has the strongest positive effect on loyalty. This result is consistent with previous studies that identified perceived value as a key driver of behavioral loyalty and repurchase intention (Hur et al., 2013; Hwang & Griffiths, 2017). This finding also reflects a broader trend in digital retail, where customers evaluate automated services based on the overall benefits gained from efficiency, convenience, and experience rather than individual service attributes alone. Satisfaction also significantly influences loyalty, supporting earlier research that emphasizes satisfaction as an important predictor of long-term customer relationships (Mora et al., 2021; Özkan et al., 2020). However, in automated environments, satisfaction is often shaped by system performance and ease of use, indicating that technological reliability plays an important role in maintaining positive user experiences.

Among the antecedents of perceived value, customer participation shows the strongest influence. This finding aligns with Mustak et al. (2013, 2016), who highlighted the role of customer involvement in value co-creation. In the context of Automated Unmanned Marketplaces, this result suggests that customers actively engage in self-service processes, and their ability to complete transactions

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smoothly enhances their perception of value. This supports recent discussions on self-service behavior, where user control and interaction directly influence service outcomes. Ethics, aesthetic appeal, and perceived innovativeness also significantly enhance perceived value, which is consistent with prior empirical evidence demonstrating that ethical practices, attractive design, and innovative features improve customers' value evaluations (Gallarza et al., 2016; Hamenda, 2018; Ling et al., 2023). In addition, ethical considerations such as data privacy and transaction transparency may strengthen trust in automated systems, which is increasingly important in AI-driven retail environments.

Overall, the study confirms that ethics, aesthetic appeal, customer participation, and perceived innovativeness indirectly influence loyalty through perceived value, while perceived value and satisfaction directly strengthen loyalty. These findings highlight that in unmanned retail settings, customers rely on both functional performance and psychological assurance, such as trust and perceived control, when forming loyalty intentions. These results provide theoretical support for understanding consumer behavior in automated retail settings and offer practical insights for firms seeking to enhance competitiveness in the unmanned marketplace environment.

5.2 Recommendations

Based on the findings, managers of Automated Unmanned Marketplaces should prioritize strategies that enhance perceived value and satisfaction, as both constructs directly strengthen customer loyalty. Since perceived value exerts the strongest influence on loyalty, firms should concentrate on improving the factors that shape customers' value evaluations, including ethics, aesthetic appeal, customer participation, and perceived innovativeness.

Ethical practices should be clearly demonstrated in daily operations. Transparent pricing, secure data management, and fair transaction procedures can enhance customers' trust and reinforce value perception. Communicating ethical commitments in visible and practical ways helps transform abstract principles into tangible customer experience.

Aesthetic appeal also requires careful attention. Store layout, interface design, lighting, and visual presentation should create a pleasant and intuitive environment. An attractive and well-organized setting improves emotional experience and supports stronger perceptions of value.

Encouraging customer participation is equally important in unmanned retail settings. Clear instructions, user-friendly interfaces, and responsive support systems can increase customers' confidence in self-service processes. Active involvement enhances customers' sense of control and contributes to higher value evaluation.

Continuous technological innovation should be maintained to strengthen perceived innovativeness. Intelligent payment systems, personalized recommendations, and efficient service processes can reinforce the perception that the platform is modern and beneficial.

Finally, satisfaction should be monitored through systematic feedback mechanisms and regular service evaluation. By consistently improving service quality and user experience, firms can translate perceived value into long-term loyalty. Overall, the study suggests that a value-centered and customer-focused strategy is essential for sustainable development in Automated Unmanned Marketplaces.

5.3 Limitation and Further Study

This study has several limitations that should be acknowledged. The sample was restricted to university students in Chengdu, which may limit the generalizability of the findings. Although the sample size was adequate for structural equation modeling, consumer behavior in Automated Unmanned Marketplaces may vary across regions, age groups, or cultural contexts. Future research could expand the scope to include different cities or countries in order to examine cross-cultural differences and enhance external validity.

The study employed a cross-sectional survey design, and data were collected at a single point in time. As a result, changes in perceived value and loyalty over time could not be observed. Longitudinal research would allow scholars to track how customer perceptions evolve as unmanned retail technologies mature and become more widely adopted.

The research relied on self-reported questionnaire data, which may be influenced by response bias. Future studies could incorporate objective behavioral data, such as transaction frequency or usage patterns, to strengthen the robustness of the results.

Additional variables such as trust, service quality, or technology readiness may also be integrated into future models to further explain consumer loyalty in Automated Unmanned Marketplaces.

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