JOURNAL OF INFORMATION SYSTEM AND TECHNOLOGY MANAGEMENT (JISTM)
www.jistm.com

DEVELOPING A MODEL OF MULTI-CRITERIA DECISION MAKING FOR CUSTOMER UNCERTAINTY IN ONLINE PURCHASING (MCDM-UnOP)

Wan Salmuni Wan Mustaffa [1*], Rafiduraida Abdul Rahman[2], Norlaile Saleh Hudin[3], Hariyaty Ab Wahid[4], & Siti Zubaidah Mohd Ariffin[5]

[1] Department of Business Management and Entrepreneurship, Faculty of Management and Economics, Universiti Pendidikan Sultan Idris, Malaysia.
Email: wan.salmuni@fpe.upsi.edu.my

[2] Department of Business Management and Entrepreneurship, Faculty of Management and Economics, Universiti Pendidikan Sultan Idris, Malaysia.
Email: rafiduraida@fpe.upsi.edu.my

[3] Department of Business Management and Entrepreneurship, Faculty of Management and Economics, Universiti Pendidikan Sultan Idris, Malaysia.
Email: norlaile@fpe.upsi.edu.my

[4] Department of Business Management and Entrepreneurship, Faculty of Management and Economics, Universiti Pendidikan Sultan Idris, Malaysia.
Email: hariyaty@fpe.upsi.edu.my

[5] Department of Business Management and Entrepreneurship, Faculty of Management and Economics, Universiti Pendidikan Sultan Idris, Malaysia.
Email: zubaidah.ariffin@fpe.upsi.edu.my

* Corresponding Author

Article Info:

Abstract:

The growth of the internet market has attracted more customers to purchase products online. Despite its popularity, there is a significant issue concerning customer uncertainty when making decisions to purchase online. Therefore, this research aims to develop, validate, and prioritize a model of multi-criteria decision making for customer uncertainty in online purchasing, known as the MCDM-UnOP model. This study used a mixed methods approach. The MCDM-UnOP model was developed based on the results of a comprehensive literature review and qualitative focus group interviews. A questionnaire was employed as the research instrument to collect quantitative data from internet users. A total of 348 usable questionnaires were collected and proceeded to the data analysis stage. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) using the split half method were conducted to validate the MCDM-UnOP model. The Analytical Hierarchy Process (AHP) technique was applied to prioritize the criteria associated with customer uncertainty in online purchasing. The validation process identified six key MCDM-UnOP criteria: security, shipping and delivery, privacy, product quality, financial risk,

and psychological factors. These six criteria were measured using 34 sub criteria. The results of the AHP analysis indicated that security was the most important criterion, followed by privacy, shipping and delivery, product quality, and financial risk. The least important criterion was psychological factors. The findings provide valuable implications for decision makers in the online business industry to develop effective strategic marketing tools and to achieve a competitive advantage.

Keywords:

Multi-Criteria Decision Making, Analytical Hierarchy Process, Uncertainty, Online Purchasing

Introduction

The rapid advancement of technology has created new opportunities for businesses to market and sell their products and services through online platforms. According to Kandel (2025), conducting business transactions online has become the primary mode of commercial activity today. A survey conducted by the Malaysian Communications and Multimedia Commission (MCMC) (2022) reported a 4.5% increase in the percentage of online shoppers among Malaysian internet users between 2019 and 2022. In recent years, this upward trend has continued, driven by the expansion of Malaysia's digital economy, accelerated digital transformation efforts, and the widespread adoption of remote work and hybrid lifestyles. Initiatives under the Malaysia Digital Economy Blueprint (MyDIGITAL) have also contributed to increased internet usage, with a significant portion of the population engaging in online activities, including shopping. Despite its growing popularity, a critical issue remains as customer uncertainty when making online purchase decisions (Handoyo, 2024, Durmus, Ulusu & Akgun, 2017; Bhukya & Singh, 2015). These feelings of uncertainty discourage many consumers from participating in online shopping.

Uncertainty has been recognized as the primary obstacle preventing customers from making online purchases (Schreier & Gierl, 2024; Yazdanifard et al., 2011; Van Os, 2010). Previous studies have revealed that online shopping is associated with high risks, including cybercrime, hacking incidents, and delivery issues (Kamarul Ariffin, Mohan & Goh, 2018; Fortes & Rita, 2016; Littler & Melanthiou, 2006). According to Krishnan et al. (2024), security is a key determinant of consumer trust in Malaysian e-commerce, alongside privacy and transparency, which also significantly influence trust and purchasing behavior. However, there is a lack of comprehensive studies that develop and validate the multiple-criteria underlying customer uncertainty in online purchasing. Therefore, this research seeks to develop and validate a Multi-Criteria Decision-Making model for customer uncertainty in online purchasing (MCDM-UnOP). Additionally, the study aims to prioritize the criteria within the MCDM-UnOP model by ranking them according to customers perceived importance scores. The findings could provide valuable guidelines for online sellers to better understand the key factors influencing customer uncertainty and to focus on improving service excellence.

Customer Uncertainty in Online Purchasing and Theory

Customer uncertainty is conceptualized as the inability of customers to correctly and consistently assess the transactional outcome in e-commerce due to the unavailability of complete and perfect information (Phamthi et al., 2024). Uncertainty has been widely recognized as a primary obstacle for customers when purchasing products online (Dabić et al.

2025; Yazdanifard, 2011). Online shopping involves significant risks such as cybercrime, hacking incidents, spam, lack of personal interaction, and information asymmetry (Kamarul Ariffin, Mohan, & Goh, 2018). These risks often lead to feelings of uncertainty among customers. Consequently, customers tend to feel more uncertain about purchasing products online than they do when buying the same products in physical stores (Ji & Lee, 2024). This uncertainty discourages customers from engaging in online transactions. In conclusion, understanding and managing the factors contributing to customer uncertainty has become a critical issue for online sellers. To explore the nature of these uncertain feelings in the context of online purchasing, two theories were reviewed: Uncertainty Reduction Theory (URT) and Information Processing Theory (IPT).

Uncertainty Reduction Theory (URT)

Uncertainty Reduction Theory (URT), originally developed by Berger and Calabrese (1975), serves as a conceptual framework for examining customers' behavior in online service usage (Hogg, 2007). URT posits that uncertainty naturally arises during initial interactions between individuals, and that people are motivated to reduce this uncertainty by predicting the other person's behavior and potential responses. In the context of online purchasing, customer uncertainty can stem from various sources, including the product itself, the purchasing process, and emotional factors (Hu et al., 2008). This uncertainty tends to increase when customers lack prior experience or knowledge about a product or service. According to Brumfield (2008), uncertainty can be alleviated when consumers confirm their purchase decisions through peer reviews and product-related information shared by other customers.

Information Processing Theory (IPT)

According to Information Processing Theory (IPT), the customer decision-making process consists of three key stages: intelligence, design, and choice (Cook, 1993). In the intelligence stage, customers identify a problem and collect relevant information. During the design stage, they structure the problem, establish decision criteria, and explore alternative solutions. Finally, in the choice stage, customers evaluate the alternatives and select the one that best satisfies the established criteria, leading to a final purchasing decision. Previous research has introduced several techniques to interpret the multi-criteria aspects of customer decision-making, including network presentation models (Gao et al., 2012). However, more recent studies have found that the Analytical Hierarchy Process (AHP) is particularly effective for structuring decision-making criteria hierarchically and prioritizing them according to their relative importance (Abd Aziz et. al., 2024; Singh & Singh, 2017).

Methodology

Research Design

This research employed a mixed methods approach to develop, validate, and prioritize the MCDM- UnOP model. Figure 1 illustrates the step-by-step research process followed in this study. As shown in Figure 1, the research process is divided into two phases:
- **Phase 1: Developing the MCDM-UnOP Criteria**
  An extensive literature review was conducted to identify the leading studies related to customer uncertainty in online purchasing. This helped establish the initial multi-criteria for the MCDM-UnOP model. In the qualitative stage, three focus group interviews were conducted with internet users, including government employees,

private sector employees, and higher education students to identify additional relevant criteria.

- **Phase 2: Validating and Prioritizing the MCDM-UnOP Criteria**
  Quantitative data analysis techniques were employed to validate and prioritize the criteria in the MCDM-UnOP model. The model was validated through face validity, Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA) using the split-half method. Subsequently, the Analytic Hierarchy Process (AHP) technique was applied to prioritize the criteria related to customer uncertainty in online purchasing.
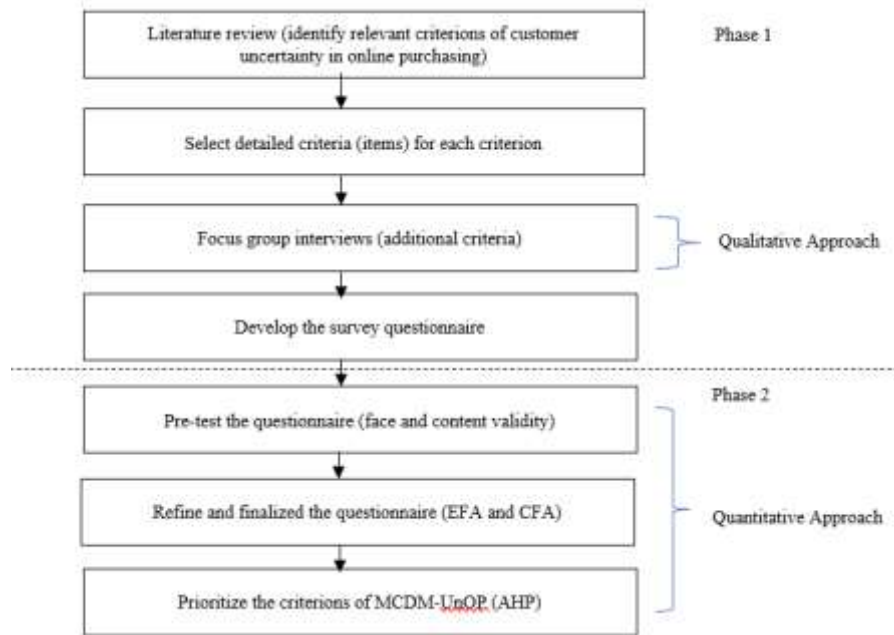

Figure 1 The Research Process

Population and Sampling Technique

The respondents of this research were internet users who engage in online activities. According to DataReportal (2025), approximately 34.9 million individuals in Malaysia were active internet users. Based on the recommendation by Krejcie and Morgan (1970), a sample size of 384 is required to represent a large research population. A cluster sampling technique was employed to select the respondents, as it is suitable for studies with large and geographically dispersed populations. Table 1 discusses the geographical clusters of internet users in Malaysia. The population was divided into four clusters based on the geographical zones of the internet users' locations: the South Zone, West Zone, North Zone, and East Zone. These zones reflect the country's demographic, socio-economic, and infrastructural distribution, which are known to influence internet usage patterns.

Table 1: Geographical Clusters of Internet Users in Malaysia

Zone / Cluster	States Included	Key Characteristics	Internet Usage Context
South Zone	Johor, Malacca, Negeri Sembilan	Rapid industrial growth, strong cross-border economy with Singapore, high urbanization	High internet penetration; active users from industrial, educational, and service sectors
West Zone	Selangor, Kuala Lumpur, Putrajaya	Most urbanized and economically advanced region; hub for business, government, and digital innovation	Highest internet penetration; dense population of digitally savvy users

| North Zone | Perak, Penang, Kedah, Perlis | Mix of industrial (Penang tech hub) and rural communities; diverse socio-economic background | Balanced internet use in urban and semi-urban areas; varying digital literacy levels |
| East Zone | Kelantan, Terengganu, Pahang. | Rural and semi-rural dominance; relatively lower infrastructure development; geographically dispersed | Lower but growing internet penetration; essential for inclusive national representation |

Instrumentation

The criteria for customer uncertainty in online purchasing were derived from both the findings of literature reviews and focus group interviews. A structured questionnaire was used as the primary research instrument and consisted of three sections. Section A included five questions related to the respondents' demographic profiles, such as gender, age, level of education, monthly income, and frequency of internet usage. Section B comprised 39 items addressing various aspects of customer uncertainty in online purchasing. These items were measured using a 7-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree). Section C required respondents to prioritize the main criteria contributing to customer uncertainty in online purchasing. The content validity of the questionnaire was evaluated by a panel of experts with subject matter expertise in e-commerce and consumer behavior.

Data Analysis

The data gathered were analysed by using the Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) through split half method (Li & Cai, 2011). The EFA analysis was performed to explore the underlying factors by demonstrating the relationship between criterion (latent factors) and criteria (items). The CFA, on the other hand, was used to confirm whether the items actually underpin the factor for which they were theoretically designed (Hair et al., 2010, Byrne, 2016). In this research, the CFA was performed by using the structural equation modelling (SEM) procedure. Next, the Analytical Hierarchy Analysis (AHP) technique was performed to prioritize the importance of the main criterions of customer uncertainty in online purchasing (Saaty, 1980).

The multi-criteria decision making (MCDM) tool is helpful and effective in solving complex decision problems. Thus, this research utilized the AHP technique to prioritize the MCDM-UnOP criteria. The AHP technique is an approach for quantifying an idea, feeling, or emotion by assigning a number scale to prioritize decision alternatives that exist in a problem under consideration (Taha, 1997). The first principle is to structure the problem hierarchically into three levels. The levels include 1) determining the objective of the problem, 2) the criteria considered in determining the objective of the problem, and 3) alternatives that exist in the problem. The second principle of AHP is a pair-wise comparison relative to every element at every level except the first level by constructing a comparison matrix *n x n* (refer to figure 2) in which a is a value of *ij* priority K_i compared to K_j. The third principle is priority synthesis, involving the process of prioritizing *ij* every criterion in the problem. The priority is determined by the weighting value.

$$
A = \begin{array}{c} \\ K_1 \\ K_2 \\ K_3 \\ K_4 \\ \vdots \\ K_n \end{array}
\begin{array}{cccccc}
K_1 & K_2 & K_3 & K_4 & \cdots & K_n \\
\left[\begin{array}{cccccc}
1 & a_{12} & a_{13} & a_{14} & \cdots & a_{1n} \\
\dfrac{1}{a_{12}} & 1 & a_{23} & a_{24} & \cdots & a_{2n} \\
\dfrac{1}{a_{13}} & \dfrac{1}{a_{23}} & 1 & \dfrac{1}{a_{34}} & \cdots & a_{3n} \\
\dfrac{1}{a_{14}} & \dfrac{1}{a_{24}} & & 1 & \cdots & a_{4n} \\
\vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\
\dfrac{1}{a_{1n}} & \dfrac{1}{a_{2n}} & \dfrac{1}{a_{3n}} & \dfrac{1}{a_{4n}} & \cdots & 1
\end{array}\right]
\end{array}
$$

Figure 2 Pair Wise Comparison Matrix

Findings and Discussions

Initially, a total of 768 questionnaires were distributed to the respondents. Of these, 412 were returned, resulting in a response rate of 53.64%. However, 64 questionnaires were excluded due to incomplete responses. Therefore, a total of 348 completed questionnaires were retained for data analysis. Among the 348 respondents, 40.82% were male, and 59.20% were female. The majority of respondents (57.18%) were in the age range of 31 to 40 years old, and 44.82% reported a monthly salary between RM2,000 and RM3,999. Additionally, nearly all respondents (99%) reported using the internet on a daily basis.

The data were assessed for normality as a prerequisite for applying parametric techniques. The skewness and kurtosis values fell within the acceptable ranges of -2 to +2 and -7 to +7, respectively, as recommended by Hair (2010) and Byrne (2016). These results indicate that the data were normally distributed. The Kaiser-Meyer-Olkin (KMO) measure yielded a value of 0.916, indicating that the sampling was adequate and that the criteria (factors) were appropriate for predicting the variability among the items. Table **2** presents the results of the Exploratory Factor Analysis (EFA) conducted to assess the criteria related to customer uncertainty in online purchasing. The analysis revealed a six-factor solution, explaining 65.71% of the total variance, with acceptable factor loadings (FL) greater than 0.5, as suggested by Hair et al. (2006) with no serious cross-loadings observed. This indicates that the measurement items were clearly aligned with their respective constructs. Each factor also demonstrated good reliability, with Cronbach's alpha coefficients ranging between 0.78 and 0.91, indicating internal consistency. The six criteria identified in Table 2 are described as follows:

Table 2 EFA Results

Criteria	Criterion					
	(1) Security	(2) Shipping & Delivery	(3) Privacy	(4) Product Quality	(5) Financial Risk	(6) Psychological
1. Unsecure transaction and transmission	0.853					
2. Data intercepted by hackers	0.850					
3. Unauthorized access	0.839					
4. Denial of service	0.807					
5. Theft and Fraud	0.744					
6. Unsecured website	0.741					
7. Insufficient sellers' information	0.671					
8. Cyber crime	0.593					
9. Insecure payment system	0.555					
10. Unclear policies and terms	0.544					
11. Misdelivery		0.824				
12. Late delivery		0.724				
13. Long waiting time		0.720				
14. Loss of products		0.616				
15. Damaged products		0.601				
16. High shipping fee		0.589				
17. Delivery on weekends		0.548				
18. Difficulty in order cancellation		0.530				
19. Information used by unauthorized parties			0.811			
20. Information disclosure			0.802			
21. Information misused			0.751			
22. Against data protection laws and regulations			0.744			
23. Usage data without knowledge			0.614			
24. User's rights unprotected			0.526			
25 Unavailability of product				0.764		
26. Misleading of product Images				0.700		
27. Inaccurate product description				0.655		
28. Lack of touch and feel (touch-feel-try)				0.577		
29. Unworthy product				0.560		
30. Invalid product information				0.506		
31. Overspend					0.732	
32. Unaffordable to shop online					0.656	
33. Waste of money					0.655	
34. Stores offer better prices					0.623	
35. No price negotiation					0.512	
36. Family disapproval						0.611
37. Unrecognized by family/friends						0.602
38. Distrust online company						0.587
39. Discomfort						0.511
Eigenvalue	8.19	5.15	4.25	3.76	3.17	2.58
% of variance	20.21	13.45	11.82	10.21	3.12	3.11
% cumulative of variance						65.71

- **Criterion 1: Security**
  Security is conceptualized as the protection of online purchasing assets from unauthorized access, alteration, use, or destruction, particularly of sensitive information such as credit card or bank account numbers and passwords, which may result in financial loss. This criterion is measured by ten uncertainty items, as presented in Table 2.

- **Criterion 2: Shipping and Delivery**
  Shipping and delivery refer to the process of ensuring that the correct product is delivered at the right time, to the right place, in appropriate packaging, with adequate quantity and quality, and at minimal cost. This criterion is measured by eight uncertainty items, as shown in Table 2.

- **Criterion 3: Privacy**
  Privacy refers to an individual's ability to control and manage the conditions under which their personal data is collected and used. This criterion is measured by six uncertainty items, as detailed in Table 2.

- **Criterion 4: Product Quality**
  Product quality is conceptualized as the customer's judgment of a product's superiority and overall excellence. This criterion is assessed through six uncertainty items, as outlined in Table 2.

- **Criterion 5: Financial Risk**
  Financial risk is defined as the potential for monetary loss due to errors or failures in the online purchasing system. This criterion is measured by five uncertainty items, as indicated in Table 2.

- **Criterion 6: Psychological Risk**
  Psychological risk refers to a customer's perception of social disapproval or regret arising from a poor purchasing decision. This criterion is assessed through four uncertainty items, as shown in Table 2.

Next, CFA was performed to confirm whether the criteria (items) are actually underlying the criterion (factors) for which they are theoretically designed. The results of the CFA measurement model revealed that five criteria were deleted due to low factor loading (FL< 0.50). The deleted criteria were: unclear policy and terms, FL: 0.491 (Security Criterion); delivery on the weekend, FL: 0.221 (Shipping and Delivery Criterion); difficulty in order cancellation, FL: 0.466 (Shipping and Delivery Criterion), stores offering better prices, FL: 0.410 (Financial risk criterion); and no price negotiation, FL: 0.481 (Financial risk criterion). Figure 3 illustrates the re-specified CFA-measurement model. The results revealed that the factor loadings > 0.50 and the hypothesized model has an overall good fit (ChiSq/df: 2.170; p value: 0.000; TLI: 0.912, CFI: 0.901; RMSEA: 0.09). The CFI and TLI are both above 0.90, indicating a good fit between the hypothesized model and the data structure.

From the CFA results, it can be concluded that the MCDM-UnOP model has achieved construct validity, which comprises six-criterion, namely security (9 criteria), delivery/shipping (6 criteria), privacy (6 criteria), product quality (6 criteria), financial risk (3 criteria), and psychological (4 criteria).
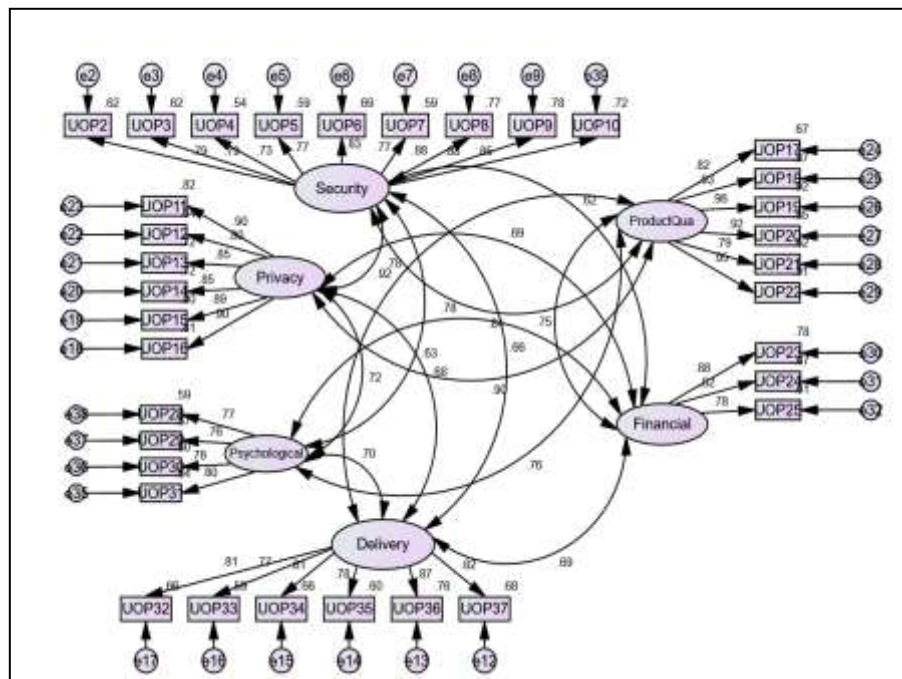

Figure 3 CFA Results (re-specified model)

Besides validating the MCDM-UnOP model, the aim of this research is to prioritize the criterions of customer uncertainty in online purchasing. Therefore, AHP analysis was performed to achieve this objective. Table 3 shows the results of prioritize the criterions of customer uncertainty in online purchasing, which is measured by the weighting score. The results revealed that the most important criterion of customer uncertainty in online purchasing was security (0.3569), followed by privacy (0.2272), shipping/delivery (0.1373), product quality (0.1365) and financial risk (0.0804). The most unimportant criterion of customer uncertainty in online purchasing was psychological (0.0630).

Table 3 AHP Results

Rank	Criterion	Weighted Score	Consistency Value
1st	Security	0.3569	0.0139
2nd	Privacy	0.2272	
3rd	Delivery/Shipping	0.1373	
4th	Product Quality	0.1365	
5th	Financial Risk	0.0804	
6th	Psychological	0.0630	

Conclusions

Managing customer uncertainty in online purchasing has become a critical issue for online sellers. Uncertain feelings discourage customers from participating in online transactions. Therefore, there is an urgent need to develop, validate, and prioritize a multi-criteria decision-making model of customer uncertainty in online purchasing, referred to as the MCDM-UnOP model. In this research, the development, validation, and prioritization of the MCDM-UnOP model were empirically tested using a mixed-methods approach. The findings identified and validated six customer uncertainty criteria in online purchasing: security, delivery and shipping, privacy, product quality, financial risk, and psychological risk. These six criteria were measured by 34 specific items. In terms of priority, the results of the AHP analysis revealed that the most important criterion was security, followed by privacy, delivery and shipping, product quality, financial risk, and psychological risk. Theoretically, the MCDM-UnOP model developed in this study is novel and provides valuable insights into the fields of decision-making, management, and marketing. Unlike traditional models such as the Technology Acceptance Model (TAM) (Davis, 1989), which primarily focuses on perceived usefulness and perceived ease of use as determinants of technology adoption, the MCDM-UnOP model extends the analysis by incorporating multiple dimensions of customer uncertainty in online purchasing. Practically, the research findings provide valuable guidance for online business decision-makers by identifying the multiple dimensions of customer uncertainty that influence purchasing behavior, thereby offering a diagnostic framework for action. The MCDM-UnOP model enables businesses to prioritize resources toward the most critical uncertainty factors, such as enhancing delivery reliability, strengthening transaction security, or improving product information credibility. By addressing these concerns, managers can design more targeted marketing strategies, build greater consumer trust through transparency and authenticity measures, and develop platform features that directly reduce hesitation in online purchasing. Consequently, the model equips businesses with a structured decision-support tool to improve customer confidence, increase conversion rates, and sustain competitiveness in the digital marketplace. One limitation of this research is that the developed model still requires empirical evidence to establish the causal relationships with outcome variables, as highlighted in the literature.

Acknowledgement

References

Abd Aziz, K. A., Wan Daud, W. S., Mohd Idris, M. F. I., & Zakaria, S. N. (2024). The ranking of factors in selecting the online shopping platform in Malaysia based on Fuzzy analytic hierarchy process. *Journal of Computing Research and Innovation*, 9(1), 31–42. https://doi.org/10.24191/jcrinn.v9i1.393

Berger, C.R. and Calabrese, R.J. (1975). Some explorations in initial interaction and beyond: toward a developmental theory of interpersonal communication. *Human Communication Research*, 1 (2), 99-112.

Bhukya, R., & Singh, S. (2015). The effect of perceived risk dimensions on purchased intention. *American Journal of Business*, 30(4), 218-230.

Brumfield, E.J. (2008). Using online tutorials to reduce uncertainty in information seeking behavior. *Journal of Library Administration*. 48 (3/4), 365-77.

Byrne, B. M. (2016). *Structural Equation Modelling with AMOS: Basic Concepts, Applications and Programming.* New Jersey: Lawrence Erlbaum Associates, Inc.

Cook, G. (1993). An empirical investigation of information search strategies with implications for decision support system design. *Decision Sciences*, 24(3): 683-698.

DataReportal. (2025). *Digital 2025: Malaysia state of digital in Malaysia (January 2025)*. DataReportal: Global Digital Insights.

Dabić, M., Mathew, M., Garanti, Z., & Fayvazov, E. (2025). Does perceived risk deter global e-commerce consumers? An empirical study of Tmall Global.
Information & Management, 62(3), 103749. https://doi.org/10.1016/j.im.2024.103749

Durmus, B., Ulusu, Y. & Akgun, S. (2017). The Effect of Perceived Risk on Online Shopping through Trust and WOM. *International Journal of Management and Applied Science*, 3(9), 103-108.

Fortes, N., & Rita, P. (2016). Privacy concerns and online purchasing behaviour: Towards an integrated model. *European Research on Management and Business Economics*, *22*(3), 167–176.

Gao, J., Zhang, C., Wang, K., & Ba, S. (2012). Understanding online purchase decision making: The effects of unconscious thought, information quality, and information quantity. *Decision Support Systems*, *53*(4).

Handoyo, S. (2024). The impact of trust, risk, and e-WOM on online purchase intentions: A meta-analytic review. *Heliyon,* 10(6), e25745. https://doi.org/10.1016/j.heliyon.2024.e25745

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate Data Analysis* (7th Eds). Upper Saddle River, NJ: Prentice Hall, Inc.

Hu, N., Liu, L. and Zhang, J.J. (2008). Do online reviews affect product sales? The role of reviewer characteristics and temporal effects. *Information Technology and Management*, 9 (3), 201-14.

Hogg, M.A. (2007). Uncertainty-identity theory, in Zanna, M.P. (Ed.), *Advances in Experimental Social Psychology*, 39, Academic Press, San Diego, CA, 69-126.

Ji, Y., & Lee, J. (2024). Consumer review confusion and cart abandonment: The mediating role of perceived risk and the moderating effect of mindfulness. *Journal of Retailing and Consumer Services*, 78, 103555. https://doi.org/10.1016/j.jretconser.2024.103555

Li, M., & Cai, L. a. (2011). The Effects of Personal Values on Travel Motivation and Behavioral Intention. *Journal of Travel Research*, *51*(4), 473–487.

Kamarul Ariffin, S., Mohan, T., & Goh, Y. N. (2018). Influence of Consumers' Perceived Risk on Consumers' Online Purchase Intention. *Journal of Research in Interactive Marketing*, 12(3), 309-327.

Kandel, R. R. (2025). Online purchase behaviour and perceived risk: Evidence from Karnali Province, Nepal. *Journal of Entrepreneurship and Management Studies,* 7(1), 45–58. https://doi.org/10.3126/jems.v7i1.67795

Krejcie, R. V, & Morgan, D. W. (1970). Determining sample size for research activities. *Educational & Psychological Measurement*, 30, 607–610.

Krishnan, V., Jayabalan, N., Guo, J., & Susanto, P. (2024, December 4). Decoding Online Shopping Behavior in Malaysia: The Critical Influence of Consumer Trust. *Journal of Ecohumanism, 3*(8). https://doi.org/10.62754/joe.v3i8.5095

Littler, D., & Melanthiou, D. (2006). Consumer perceptions of risk and uncertainty and the implications for behaviour towards innovative retail services: The case of Internet Banking. *Journal of Retailing and Consumer Services*, 13(6), 431–443.

Mat Arisah, F., Shamsul Azahari Zainal Badari & Ahmad Hariza Hashim (2016). Amalan Pembelian Secara Atas Talian dan Faktor-Faktor Mempengaruhi. *Journal of Social Sciences and Humanities*, 1(3), 111-123.

Malaysian Communication and Multimedia Commission. (2022). *Internet users survey.* Malaysia.

Norazila, M., Nurmaizura, M., Jamsari A. & Nur Atikah, A. (2016). Penglibatan mahasiswa dalam e- dagang: Kajian kes di UKM. *Jurnal Personalia Pelajar*, 19(2), 59-69.

Saaty, T.L. (1980). *The Analytic Hierarchy Process*. McGraw-Hill. United Stated of America.

Singh, P., & Singh, M. (2017). Analysing and prioritizing the antecedents of customer shopping experience using Analytical Hierarchy Process (AHP) modelling. *IIM Kozhikode Society & Management Review*, *7*(1), 59–74.

Schreier, M., & Gierl, H. (2024). *The paradox of recommendation agents: When helpful tools increase uncertainty*. Electronic Commerce Research, 24, Article 8087. https://doi.org/10.1007/s10660-024-09808-7

Taha, H. 1997. *Operations research. An introduction.* Sixth edition. New Jersey: Prentice Hall.

Pavlou, P. A., Liang, H. and Xue, Y. (2007). Understanding and mitigating uncertainty in online exchange relationships: A principal-agent perspective. *MIS Quarterly*, 31, 105.

Phamthi, H. T., Doan, T. T. T., & Nguyen, Q. D. (2024). A systematic literature review of online shopping behavior: The role of perceived risk. *International Journal of Consumer Studies,* 48(3), 578–592. https://doi.org/10.1111/ijcs.13067

Van Os, L. (2010). *Consumer Uncertainty in the E-Commerce*. Tilburg University.

Yazdanifard, R., NegeduWada, G., Abu Bakar Sade & Wan Fadzilah Wan Yusoff. (2011). Uncertainties Faced in E-Shopping; Suggesting Possible Solutions. *International Journal of e-Education. E-Business, e-management,* 1(2), 110 – 121.