



GLOBAL BUSINESS MANAGEMENT REVIEW

<http://e-journal.uum.edu.my/index.php/gbmr>

How to cite this article:

Islam, R. & Sivanantham, R. A. (2022). Selection of the best e-wallet in the Klang Valley, Malaysia: An application of the analytic hierarchy process. *Global Business Management Review*, 14(2), 16-36. <https://doi.org/10.32890/gbmr2022.14.2.2>

SELECTION OF THE BEST E-WALLET IN THE KLANG VALLEY, MALAYSIA: AN APPLICATION OF THE ANALYTIC HIERARCHY PROCESS

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Received: 23/07/2022

Revised: 18/11/2022

Accepted: 23/12/2022

Published: 30/12/2022

ABSTRACT

Parties conducting electronic businesses usually do not meet face-to-face, nor do they exchange currency or hard copies of documents hand-to-hand. When companies enter electronic commerce transactions, choosing an electronic payment (or E-Wallet) system that will work well is a major issue. In the present study, initially, after examining different E-Wallet systems in the Klang Valley, Malaysia, assessment criteria were identified based on previous research and experts interviews. The assessment criteria were used for questionnaire development to rank factors for selection of the best E-Wallet in the Klang Valley, Malaysia. The survey result was analyzed using the analytic hierarchy process (AHP), a mathematical model, and synthesized using Superdecisions® software. Then, applying the AHP, the five top E-Wallets used in the Klang Valley were ranked. Results show that Samsung Pay is the most preferred E-Wallet system, followed by Lazada Wallet and Boost. The findings of this research are intended to be useful for both academic researchers and companies planning to adopt or improve their electronic payment systems. The hierarchical model developed in this study is expected to provide valuable guidance to E-Wallet service providers, banking industry practitioners, financial institutions, and similar companies in optimizing their resources. E-Wallet service providers can use the results to increase the adoption of their E-Wallet transactions.

Keywords: E-Wallet; Electronic payment system; Internet; E-commerce; Malaysia

INTRODUCTION

The worldwide proliferation of the Internet has led to the birth of electronic commerce, a business environment that requires electronic transfer of transactional information. Electronic commerce flourished because of the transparency, speed, anonymity, digitization and globally accessible characteristics of the Internet. Electronic business transactions facilitate real-time business activities, including advertising, querying, sourcing, negotiation, auction, ordering and paying for merchandise (Yu & Singh, 2002). According to Tsiakis and Sthephanides (2005), the critical success factor for any commercial entity to implement and operate an electronic business mechanism is materials and information flow.

Currently, it is more common to download a Wallet from an apps store than to purchase one from a department store. The Mobile Wallet sector has made enormous strides in the past decade, shifting how individuals handle and spend their money, and the number of functions that these Wallets are capable of doing has risen fast. According to CB Insights Industry Analyst Consensus, the value of the Mobile Wallet industry is projected to surpass \$7 Trillion by 2027, making it one of the world's fastest-growing businesses (CBINSIGHT, 2022).

An E-Wallet functions in the same way as a traditional wallet, except that the money is digital and that the E-Wallet is an app on the phone. The only requirement is to keep on topping up the E-Wallet, and the vast majority of programmes allow users to do so using credit cards, debit cards, or online bank transfers. When there is cash in the E-Wallet, it can be used to pay stores via a variety of techniques, such as scanning a QR code, "press and pay" using the Near Field Communication (NFC) capability of the phone, or by using physical cards with some E-Wallets. Many E-Wallets provide instantaneous money transfers to mutual users who use the E-Wallet within the app (Alam et al., 2021).

The ease of use of E-Wallets encourages consumers to accept them as a form of payment (Lai et al., 2022). The E-Wallet is a transaction structure in which a web-based application or service enables clients to manage information related to acquisition, affiliation, loyalty, and financial transactions (Alam et al., 2021). E-Wallet is a system that enables and educates users about the benefits of digital transactions in their daily life. All electronic financial transactions, from a person's wage to cell phone recharging, lead to a more open and responsible culture (Alam et al., 2021).

Digital wallets are revolutionizing the way in which individuals handle all aspects of their life. Others are allowing users to store important documents and access cards on their smartphones for everyday use. With its extensive reach and everyday touch points, digital wallet technology is primed to have a significant influence on people's daily lives (CBINSIGHT, 2022).

Firms in different economic sectors use certain payment systems to transfer funds and to provide competitive financial services (Khiaonarong, 2000). To facilitate the Fourth Industrial Revolution (IR 4.0), the government of Malaysia has actively promoted the utilization of digital wallets (Lai et al., 2022). This research aims to identify and analyze the different kinds of E-Wallets in the Klang Valley, Malaysia. Specific research questions to be addressed include: What are the common E-Wallets in the Klang Valley, Malaysia? Which criteria are applicable for the evaluation of the E-Wallets? and What is the priority ranking amongst the top E-Wallets in the Klang Valley, Malaysian prime marketplace?

There are over 37 E-Wallet providers in Malaysia, making it difficult for customers to choose the most practical E-Wallet for everyday transactions in the Klang Valley, Malaysia. There is no literature on the selection of the finest E-Wallet in Klang, Malaysia. This study is intended to bridge the research gap. Therefore, this research contributes to choosing the best E-Wallet service provider in Malaysia, taking

into account all aspects, such as convenience, user experience, security, promotion, price, selections, and trust.

LITERATURE REVIEW

What is an E-Wallet?

Compared with a conventional retailer, an e-retailer is typically able to offer a wider range of product categories and a greater variety of products within any given category. A store in a mall is constrained by the availability and cost of the floor space, whereas its online counterpart does not have such limitations. E-retailers can also form alliances with other virtual suppliers to provide customers with a greater selection. To illustrate, an e-retailer may keep only a limited assortment of a given product category in its inventory but can form alliances with other suppliers and manufacturers that can ship products to customers of the e-retailer from their own. Customers have seamless access to the entire range of products carried by the alliance from the e-retailer's website. Generally, many customers do not want to deal with multiple vendors when shopping. An e-retailer who offers greater choice can emerge as the dominant destination for one-stop shopping for customers.

Tsiakis and sthephanides (2005) studied the concept of security and trust and issues in electronic payment. Their study reveals that these issues are essential for every electronic payment mechanism in order to be accepted and established as a common medium of financial transactions.

E-Wallets have developed user-friendly and time-saving alternatives to traditional mobile payment methods. In fact, it is a direct result of the widespread usage of smartphones and other network technologies (Teng & Khong, 2021). Khiaonarong (2000) examined the creation of modern E-Wallet systems in Thailand and concluded that this creation has helped facilitate the turnover of funds for Thailand's economy. The use of information technology in current payment arrangements has helped reduce human intervention and default cheques and has also helped strengthen the country's capability and competitiveness in providing financial services. Yu and Singh (2002) explored the advantages and limitations of several electronic payment systems, including online credit card payment, electronic cash, electronic cheques and small payments. After analyzing and comparing those payment systems, the authors envisaged that in future, the use of E-Wallets would escalate.

E-Wallets' contactless and cashless payment solutions have been more appealing to customers and merchants alike, especially in the wake of the COVID-19 pandemic. E-Wallets soon became a popular means of reducing the amount of time spent in face-to-face interactions and transactions (Yang et al., 2021). Professionals are now increasingly adopting mobile phones, while mobile payment usage has increased with time (Lai et al., 2022).

Hung et al. (2006) identified the factors that determine the public's acceptance of the Online Tax Filing and Payment System (OTFPS) in Taiwan. Investigating relevant previous studies, they identified the determinants for acceptance of the OTFPS. Then, they examined the causal relationship among the variables of the acceptable behaviour for the OTFPS. Using data collected from 1099 valid responses, they concluded that the proposed model explained up to 72% of the variance in behavioural intention. In addition, the important determinants of user acceptance of the OTFPS are perceived usefulness, ease of use, perceived risk, trust, compatibility, external influence, interpersonal influence, self-efficacy and facilitating condition.

Meanwhile, the E-Wallet evaluation system of this study is devised based on criteria used by previous related research and expert opinions. The criteria are convenience, promotion, security, user experience, pricing, selection, and trust.

Convenience

Convenience refers to the extent whereby a customer feels that the website is simple, intuitive and user-friendly. Accessibility of information and simplicity of the transaction processes are important antecedents for the successful completion of transactions. The quality of the website is particularly important because, for e-retailers, it represents the central or even the only interface with the marketplace (Palmer & Griffith, 1998). Today, E-Wallets actually serve the same purpose as traditional wallets, as E-Wallets allow customers to replenish electronic funds via mobile banking services (Kasirye & Mahmudul, 2021).

User Experience

According to Schaffer (2000), 30% of the customers who leave a website without purchasing anything do so because they are unable to find their way through the site. Sinioukov (1999) emphasizes that enabling customers to search for information easily and making the information readily accessible and visible is the key to creating a successful e-retailing business. Cameron (1999) highlights that there are a number of factors that make a website inconvenient from the user's perspective. For instance, information may not be accessible because it is not in a logical place or is hidden too deeply within the website. In other cases, information may not be presented in a meaningful format, or the desired information may be entirely missing.

Schaffer (2000) contends that a convenient website provides a short response time, facilitates fast completion of a transaction, and minimizes customer effort. Because of the nature of the medium itself, online customers expect fast and efficient processing of their transactions. If customers are frustrated in their efforts to seek information or encounter delayed transactions, they are less likely to come back. A website that is logical and convenient to use will also minimize the likelihood that customers make mistakes and will make their shopping experience more satisfying.

Promotion

Once loaded with debit or credit cards, E-Wallet users can conduct financial transactions (Kasirye & Mahmudul, 2021). Cashback and discounts are also noted as key drivers of E-Wallet adoption, and the ability to utilize a variety of Wallets allows users to enjoy a variety of perks. This may take place either as a consequence of the E-Wallets themselves providing a variety of bonuses or as a result of marketing partnerships that a particular Wallet may have with particular retailers (Augi et al., 2022).

Security

Security, in the form of keeping customers safe from an invasion of their privacy, affects trust and satisfaction. If companies wish to maintain customer trust, they need to keep their promises regarding privacy. Since security is closely related to trust, violations of security norms may backfire in terms of losing customers and negative word-of-mouth (Gummerus et al., 2004). Assuring security may be especially important to services that require customers to share personal information with the service provider in order to receive the required services, especially when the associated risks are high. Companies should also carefully weigh the benefits of customization allowed by data collection against psychological costs to customers. The unnecessary gathering of private data may chase customers away (Gummerus et al., 2004).

Trust

Trust is a critical success factor in successful service relationships because before conducting business with a company, customers need to trust the company. The marketing literature supports a positive relationship between trust and satisfaction since the presence of trust raises levels of performance and

causes greater satisfaction. It was pointed out that the lack of online customers' trust was the main barrier to customer participation in e-commerce and has been found to be one of the major obstacles to the popularity of internet transactions. E-trust is the degree of confidence customers have in online exchanges or in the online exchange channel. Online trust includes customer perception of how the website would deliver on expectation, how believable the website's information is, and the level of confidence in the site channel. Trust appears to be especially important in creating loyalty to online service as it is perceived as a high-level risk transaction since, in order to complete the transaction, customers lack direct contact with the company and have to furnish classified personal information such as credit card numbers. Kim et al. (1997) identified ability, benevolence and integrity as three principal components of trust. It is concluded that trust contributes to both commitment and loyalty. There is also some evidence supporting a positive relationship between e-retailer trust and customer loyalty which, in turn, increases customers' spending and intentions to purchase or repurchase.

Unfortunately, fraudulent businesses are common, especially those that are promoted via social media platforms. Actually, it is difficult to identify them, and even if it were feasible, due to inefficient law enforcement, there is nothing that can be done legally. There is more than a lack of faith in the safety of online payments; there is also a lack of trust in the organization or the business entity. Because of this, most customers who purchase online would rather pay using Automated Teller Machines (ATMs) or the Cash on Delivery (COD) option rather than use an E-Wallet (Augi et al., 2022).

Technical functionality of a website makes use of the service effortless, and the small positive impact may depend on tolerance zones. Whereas low technical functionality evokes mistrust, high functionality often has very little impact. Users of E-Wallets have the impression that the process of using the system itself is engaging, entertaining, and pleasurable, and this sense of having a positive experience leads to unforeseen wants to make purchases (Lai et al., 2022).

Analytic hierarchy process (AHP) in digital payment

The use of the AHP technique in prioritizing issues in digital payment system is common (e.g., Syamsuddin & Hwang, 2009). Speed is one of the top factors of electronic Wallets, while money saving advantage is the second most important factor (Nabila et al., 2018). Debit Card is the most favoured ePayment framework, followed by credit card and electronic Wallet (Khalili, Ebrahimi & Nalchigar, 2012).

TOP E-WALLET SERVICE PROVIDERS IN MALAYSIA

Based on the number of transactions, Bank Negara Malaysia (BNM), the country's Central Bank, listed 37 E-Wallet service providers in Malaysia. The top five E-Wallets are:

1. Grab Pay
2. Boost
3. Lazada Wallet
4. Touch N Go Wallet
5. Samsung Pay

GrabTaxi Holdings Pte. Ltd. (branded as Grab) is a Singapore-based technology company that offers hail-riding, ride-sharing, food delivery service and logistics services through its app in Singapore and neighbouring Southeast Asian nations such as Malaysia, Indonesia, Philippines, Vietnam, Thailand, Myanmar, and Cambodia. While it originally competed with Uber Technologies (founded in 2009 as a German transportation company), Grab's acquisition of Uber's Southeast Asian operations in March 2018 has turned it into the only major ride-share service in the region.

Grab has introduced the Grab Pay in Malaysia. Grab Pay is a safe, convenient and flexible Mobile Wallet to pay both for services on the Grab app and in stores and restaurants. This launch is teamed with partnerships with local champions like Maybank, KLIA Ekspres and merchants such as Tealive. Grab Pay is not only accepted nationwide in eight cities but can also be used for a variety of services. Grab Pay – which previously only accepted debit or credit cards comes enhanced with a Mobile Wallet. Customers can now top-up and spend money or ‘Grab Pay credits’ from the Grab app. Customers can also use their Grab app to pay for Grab's services, such as Grab Food and rides and also pay their partners with the Grab Pay QR code. Moreover, customers can also transfer money directly to each other conveniently via the app with just a few simple clicks.

BOOST, the digital Mobile Wallet (E-Wallet) app developed by Axiata Digital Services Sdn. Bhd has set a lofty target of being a leading player in Malaysia. Boost began as a lifestyle loyalty and prepaid top-up app on Jan 6, 2017. Over the years, the app now supports gamification and social interaction features. Via its Boost app, users are able to collect loyalty rewards, send and receive e-vouchers, transfer and receive money. Finally, in October 2017, Boost added a mobile wallet functionality which empowers users to make payments in a convenient way.

Lazada Wallet is a new way for online shoppers to make payments for their purchases. Lazada Wallet offers a one-click payment and offers savings. Moreover, there is also an instant cashback of up to 10% and exclusive discounts for the customers but for a limited time only.

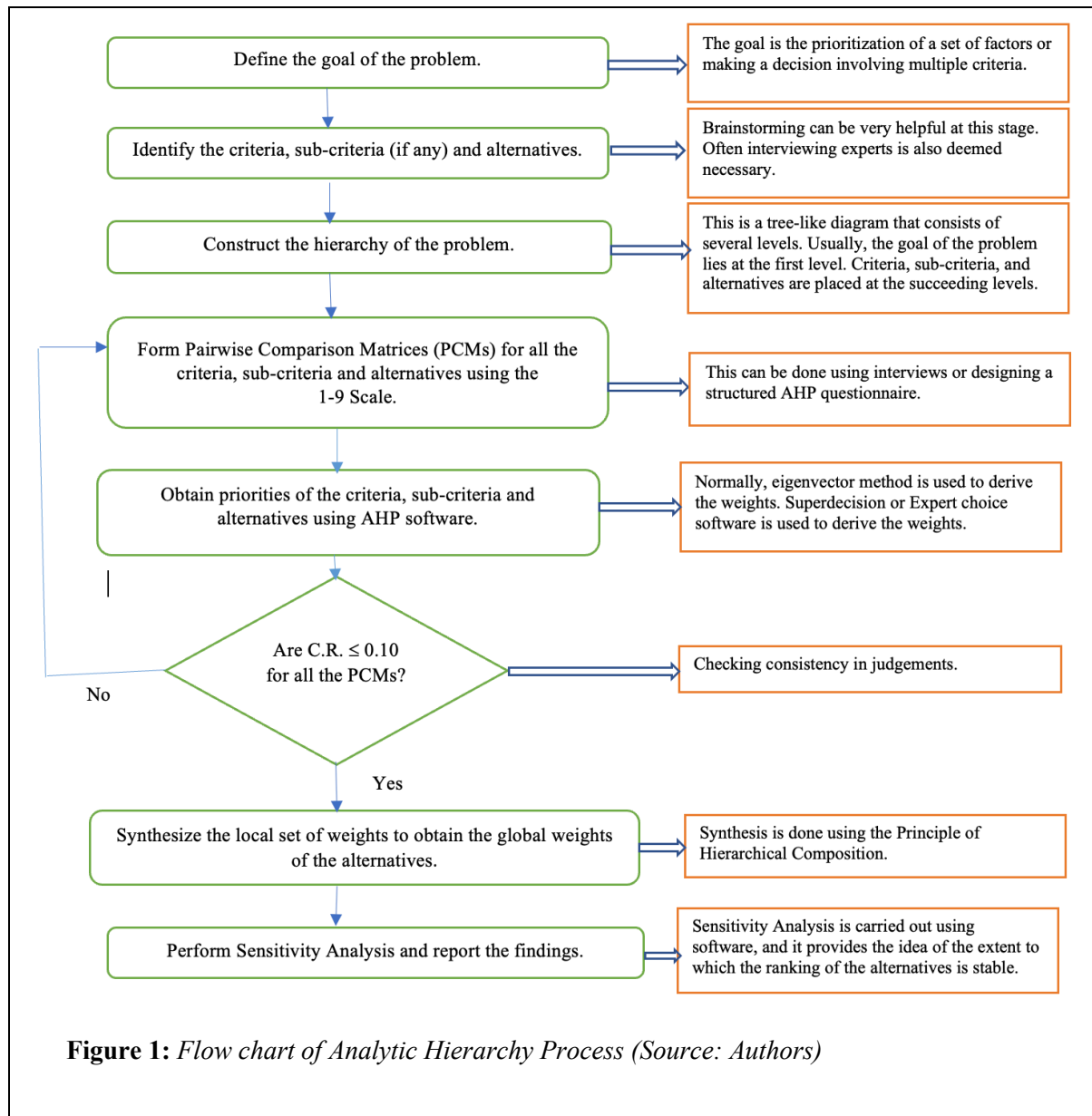
Touch N Go (TNG) is venturing into account-based ticketing as another means of payment for the Transit sector via the QR Code implementation. Touch N Go is engaging customers as a tester to experience the new technology and be the pioneer of the new cutting-edge feature via its app. Touch N Go E-Wallet is an all-in-one E-Wallet service system covering all existing and future Touch N Go products and services.

Samsung Pay was launched in Malaysia, helping the nation take another step towards a cashless society and furthering mobile payment adoption. The smartphone's digital Wallet is a mobile payment system that is integrated into selected Samsung Galaxy models.

METHODOLOGY

The main research data of this study is obtained by distributing a questionnaire among 30 experts personally for them to answer the research questions. Thirty experts in the field of electronic commerce and electronic banking were interviewed (note that AHP data are usually collected through interviews). They comprised 12 IT managers and 18 specialists who were employed by various e-commerce enterprises in the Klang Valley. The questionnaire of this research consists of two sections: The First Section: The pairwise comparisons for the main criteria, and the Second Section: The pairwise comparisons for the selected alternatives with respect to the criteria. The questions are designed using the AHP 1-9 Scale, where respondents can select one of the options 1 to 9 for each question. The Delphi technique was applied to evaluate the content validity of the questionnaire, which was verified by the experts.

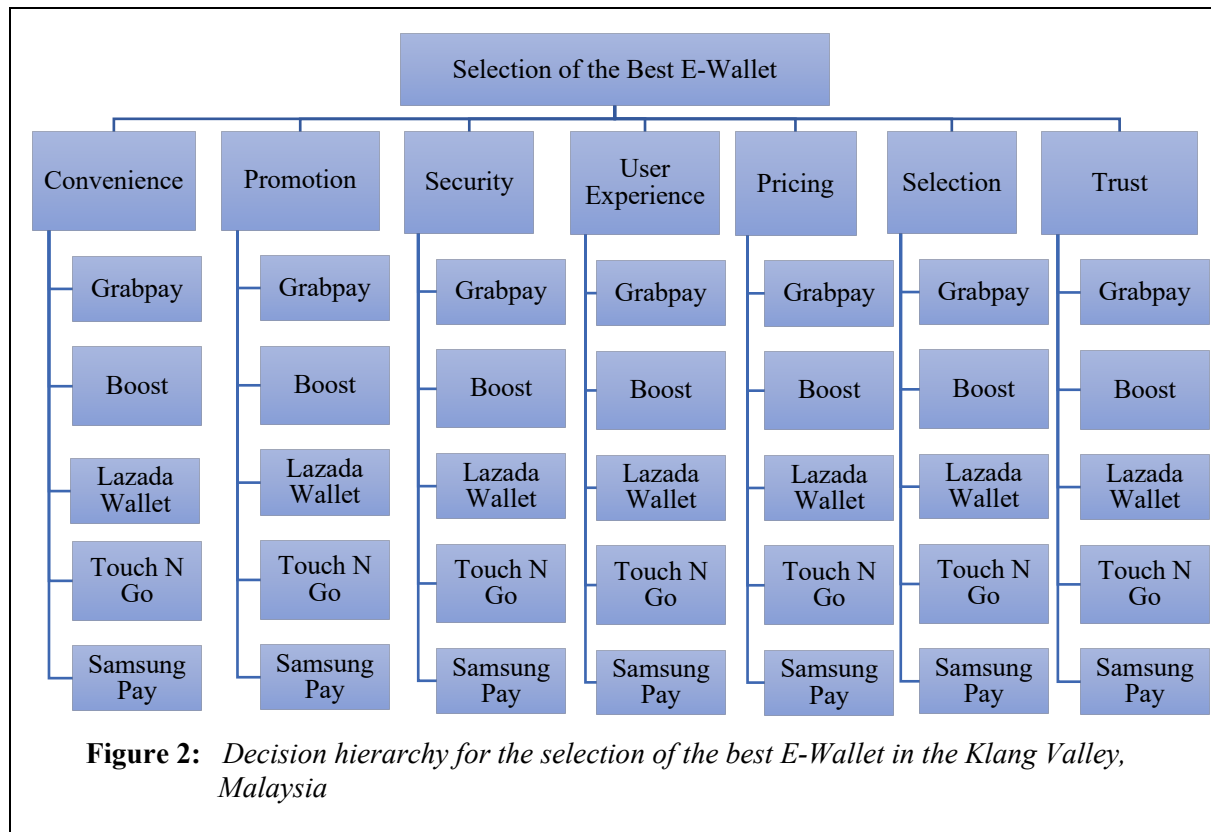
After collecting all the questionnaires, the data were analyzed using the AHP technique. The AHP flow chart, which was adopted for this study, is shown in Figure 1. The methodological details of AHP are provided in Appendix 2. Data for this study was made available via a combination of interviews and questionnaires.



RESULTS AND DISCUSSIONS

Identification of Criteria:

From the extensive literature review conducted for this research, seven main criteria were identified and employed to select the best E-Wallet providers in the Klang Valley, Malaysia. The seven criteria are convenience, promotion, security, user experience, pricing, selection, and trust. The complete hierarchy of the problem is shown in Figure 2. Appendix 1 then shows the criteria and their meaning.



Determination of priorities of the criteria:

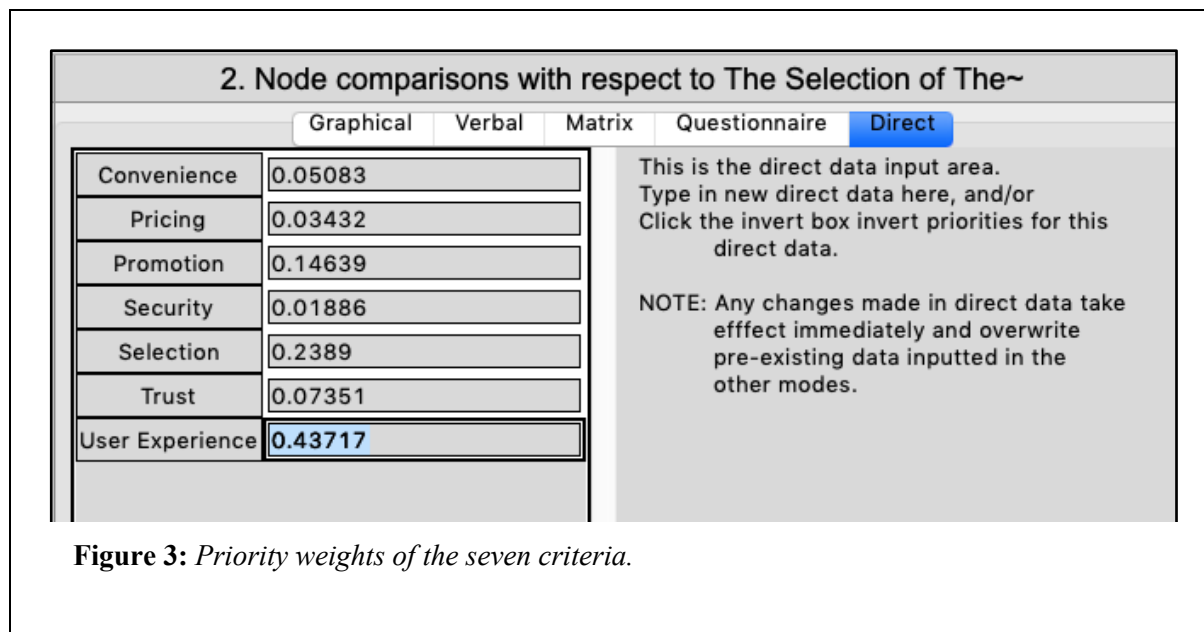
The geometric mean pairwise comparison matrix is shown in Table 3.

Table 3:

The Pairwise Comparison Matrix (PCM) for criteria.

	CON	PRO	SEC	UEX	PRI	SEL	TRU
CON	1	4.9	1.05	0.98	3.12	3.05	0.16
PRO	0.20	1	1.06	1.11	1.18	0.41	0.18
SEC	0.95	0.94	1	1.2	1.15	0.28	0.17
UEX	0.32	0.90	0.83	1	1.02	0.42	0.15
PRI	0.33	0.85	0.87	0.98	1	0.34	0.17
SEL	0.33	2.44	3.57	2.38	2.94	1	0.16
TRU	6.25	6.25	5.88	5.88	5.88	6.25	1

Legend: CON = Convenience, PRO = Promotion, SEC = Security, UEX = User experience, PRI = Pricing, SEL = Selection, TRU = Trust



As illustrated by Figure 3 (Figure 3 to Figure 10 are screenshots taken from Superdecision® software interface), the most important criterion is User Experience, with a weight of 0.4372, followed by selection, with a weight of 0.2389 and Promotion, with a weight of 0.1464. This means that users consider User Experience, Selection, and Promotion criteria first before they choose any of the existing E-Wallets.

In terms of User Experience, an E-Wallet should have some minimum features as listed below:

- An E-Wallet should have a user-friendly experience feature in terms of a bank-to-bank transfer facility that makes online purchases possible directly from the bank account without the need to download a third-party app
- Direct deduction from savings and current account and immediate credit to the merchant
- Transfer and receive money from one's smartphone to his/her bank account
- Allows easy access to real-time daily payment transactions and status up to 90 days.
- Multiple payment methods – Quick Pay, QR Code, In-app web-based, or Native in-app payments
- Transfer cash with Money Packet – an in-app feature that enables users to send funds individually or in groups
- Withdrawing E-Wallet balance at any bank in Malaysia
- Cross-border settlement – seamless payment transactions between foreign currency payments.

In terms of Selection, an E-Wallet should have a minimum assortment of:

- Use E-Wallet for online and offline purchases: 7-Eleven outlets, Berjaya Group merchants, Starbucks outlets, etc.
- RFID sticker attached to a vehicle for a more convenient toll payment system, and it can be linked to an E-Wallet
- Allows payment for public transportation, prepaid or post-paid phone bills and car parks, petrol, retail chains restaurant, healthcare and many more
- Purchase movie tickets or book a flight using the app
- Integrated with over 1,000 merchants

In terms of Promotion, an E-Wallet should have a minimum offer of:

- A plethora of the latest discounted offers on food, beauty, activities, travel, services and gifts
- An instant cashback of up to 20% when one uses a code provided by Fave Pay (30% for new users)
- Exclusive rebates when someone purchases from a specific merchant
- Points and redeem various attractive deals every time E-Wallet is used.
- Earning up to 50% cash rebate (with a cap) when purchasing with an E-Wallet.
- Discount vouchers for shopping and dining or sending them as gifts

Determination of priorities of the alternatives:

PCM for Selection:

SEL	GP	BT	LW	TNG	SP
GP	1	0.78	0.33	0.98	0.28
BT	7/9	1	0.33	0.98	0.28
LW	1/3	1/3	1	0.98	0.28
TNG	1	1	1	1.00	0.28
SP	2/7	2/7	2/7	2/7	1.00

Legend: GP = Grab Pay, BT = Boost, LW = Lazada Wallet, TNG = Touch n Go, SP = Samsung Pay.

2. Node comparisons with respect to Selection

Graphical Verbal Matrix Questionnaire Direct

Boost	0.19384
Grabpay	0.10803
Lazada Wallet	0.37986
Samsung Pay	0.26307
Touch N Go	0.05521

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Type in new direct data here, and/or
Click the invert box invert priorities for this direct data.

NOTE: Any changes made in direct data take effect immediately and overwrite pre-existing data inputted in the other modes.

Figure 4: Priority weights of the five alternatives with respect to selection.

With respect to the selection criterion, the best E-Wallet is Lazada Wallet with a priority value of 0.3799 followed by Samsung Pay with a priority value 0.2631, followed by Boost with 0.1938 priority value (see Figure 4).

Lazada Wallet scored a high priority value compared to other E-Wallets. The main reason for this is that Lazada E-Wallet has 300,000,000 product selections where customers can purchase by using E-Wallet. Basically, a customer can buy anything, anytime and anywhere in Southeast Asia with one single click, and the product will be delivered right to the customer's doorstep.

PCM for Trust:

TRU	GP	BT	LW	TNG	SP
GP	1.00	0.71	0.70	0.63	0.58
BT	5/7	1	0.70	0.63	0.58
LW	2/3	2/3	1	0.63	0.58
TNG	5/8	5/8	5/8	1	0.58
SP	4/7	4/7	4/7	4/7	1.00

2. Node comparisons with respect to Trust

Graphical
Verbal
Matrix
Questionnaire
Direct

Boost	0.19302
Grabpay	0.20628
Lazada Wallet	0.35349
Samsung Pay	0.22534
Touch N Go	0.02187

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Figure 5: Priority weights of the five alternatives with respect to Trust.

As per Figure 5, for the Trust criterion, the best E-Wallet is Lazada Wallet with a priority value of 0.3535 followed by Samsung Pay (0.2353) and Grab Pay (0.2063). To consolidate security, Lazada Wallet encrypts all transactions with a Secure Sockets Layer (SSL) security to safeguard users' personal information. Notifications to the mobile device and an instant SMS to the account's registered phone number alert users whenever money enters or leaves their Lazada account.

While every transaction requires a 6-digit Personal Identification Number (PIN) or fingerprint authentication, Lazada Wallet also has a support team that can quickly respond to fraudulent activity and freeze the account should there be any discrepancies in the user's transaction history. Furthermore, Lazada Wallet received a license from Bank Negara Malaysia, and it is Payment Card Industry Data Security Standards (PCI DSS) compliant.

PCM for User Experience:

UEX	GP	BT	LW	TNG	SP
GP	1	0.50	0.33	1.00	0.22
BT	1/2	1	0.33	1.00	0.22
LW	1/3	1/3	1	1.00	0.22
TNG	1	1	1	1	0.22
SP	2/9	2/9	2/9	2/9	1.00

2. Node comparisons with respect to User Experience

Graphical
Verbal
Matrix
Questionnaire
Direct

Boost	0.3723
Grabpay	0.06787
Lazada Wallet	0.12963
Samsung Pay	0.22225
Touch N Go	0.20795

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direct data.

NOTE: Any changes made in direct data take
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other modes.

Figure 6: Priority weights of the five alternatives with respect to User Experience.

For User Experience, the best E-Wallet is Boost, with a priority value of 0.3723 followed by Samsung Pay (0.2222) and Touch N Go (0.2079) (see Figure 6).

On User Experience, Boost users can upgrade to Boost Premium Wallet for free when they provide their National Registration Identification Card (NRIC) details. Boost Premium Wallet users can

- Add money up to RM1,500 into their Boost Wallet
- Spend/transfer up to RM1,500 daily
- Spend/transfer up to RM4,500 monthly
- Send money to friends and family up to RM500 monthly
- Transfer money from the Boost Wallet to a bank account

PCM for Security:

SEC	GP	BT	LW	TNG	SP
GP	1	1.07	0.39	0.95	0.49
BT	1	1	0.39	0.95	0.49
LW	2/5	2/5	1	0.95	0.49
TNG	1	1	1	1	0.49
SP	1/2	1/2	1/2	1/2	1.00

2. Node comparisons with respect to Security

Graphical
Verbal
Matrix
Questionnaire
Direct

Boost	0.10068
Grabpay	0.11227
Lazada Wallet	0.1427
Samsung Pay	0.46482
Touch N Go	0.17953

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NOTE: Any changes made in direct data take
effect immediately and overwrite
pre-existing data inputted in the
other modes.

Figure 7: Priority weights of the five alternatives with respect to Security.

For the Security criterion, the best E-Wallet is Samsung Pay with a priority value of 0.4648 followed by Touch N Go and Lazada Wallet (see Figure 7). On security measure, Samsung Pay can keep track of all users' purchases. As soon as a user completes a transaction, the user can see a payment confirmation that shows exactly where the transaction occurred, along with the merchant's name and number. So it is easy to detect any suspicious activity.

User transactions and card information are secure. Samsung Pay requires users to authenticate every transaction. In addition, Samsung Pay does not keep user payment information on its servers, and users' account details are not stored on the user phone or shared with merchants. When a payment is made at the terminal, the merchants only see the Digital Account Number. When the user sets up Samsung Pay, the user has to establish an authentication method to authorize payments (either via the PIN or biometrics identifier, e.g. fingerprint).

If the user's phone is lost or stolen, the user can use Samsung's Find My Mobile service to instantly lock his or her phone from anywhere, secure it with a new password or even erase the user personal information.

PCM for Pricing:

PRI	GP	BT	LW	TNG	SP
GP	1	0.87	0.67	1.19	0.24
BT	7/8	1	0.67	1.19	0.24
LW	2/3	2/3	1	1.19	0.24
TNG	1 1/5	1 1/5	1 1/5	1	0.24
SP	1/4	1/4	1/4	1/4	1.00

2. Node comparisons with respect to Pricing

Graphical
Verbal
Matrix
Questionnaire
Direct

Boost	0.14412
Grabpay	0.09561
Lazada Wallet	0.14806
Samsung Pay	0.54449
Touch N Go	0.06772

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Click the invert box invert priorities for this
direct data.

NOTE: Any changes made in direct data take
effect immediately and overwrite
pre-existing data inputted in the
other modes.

Figure 8: Priority weights of the five alternatives with respect to Pricing.

For the Pricing criterion, the best E-Wallet is Samsung Pay with a priority value of 0.5445, followed by Lazada Wallet (0.1481) and Boost (0.1441) (Figure 8).

While other digital wallet apps work only with specific types of card readers and terminals, Samsung Pay can be used wherever magnetic stripe, NFC, Europay, Mastercard and Visa (EMV) chip cards are accepted. This means that businesses can start offering convenient, contactless payments to their in-store customers without having to update their card readers and registers. Note that Samsung Pay does not charge users additional fees for utilizing the app.

PCM for Convenience:

CON	GP	BT	LW	TNG	SP
GP	1.00	0.87	0.67	1.19	0.24
BT	7/8	1.00	0.29	0.67	0.17
LW	2/3	2/7	1.00	0.67	0.17
TNG	1 1/5	2/3	2/3	1.00	0.17
SP	1/4	1/6	1/6	0.17	1.00

2. Node comparisons with respect to Convenience

Graphical Verbal Matrix Questionnaire **Direct**

Boost	0.23357
Grabpay	0.23843
Lazada Wallet	0.14542
Samsung Pay	0.32624
Touch N Go	0.05634

This is the direct data input area.
Type in new direct data here, and/or
Click the invert box invert priorities for this
direct data.

NOTE: Any changes made in direct data take
effect immediately and overwrite
pre-existing data inputted in the
other modes.

Figure 9: Priority weights of the five alternatives with respect to Convenience.

With respect to Convenience, Figure 9 shows that the three best E-Wallets are Samsung Pay (0.3262), Grab Pay (0.2384) and Boost (0.2336). Samsung Pay makes payment for one's purchases easier than ever.

Determination of Overall Priorities of the five alternatives:

Here are the overall synthesized priorities for the alternatives. You synthesized from the network Super Decisions Main Window: Unnamed file 0

Name	Graphic	Ideals	Normals	Raw
Boost	<div style="width: 26.4683%;"></div>	0.264683	0.144117	0.072059
Grabpay	<div style="width: 17.5602%;"></div>	0.175602	0.095613	0.047807
Lazada Wallet	<div style="width: 27.1925%;"></div>	0.271925	0.148060	0.074030
Samsung Pay	<div style="width: 100%;"></div>	1.000000	0.544490	0.272245
Touch N Go	<div style="width: 12.4371%;"></div>	0.124371	0.067719	0.033859

Figure 10: Overall synthesized priorities for the alternatives

Samsung Pay scored the overall highest priority at 0.5445 (see Figure 10). Samsung Pay Wallet is compatible with Samsung Android mobile devices, including Galaxy S6, Galaxy S6 active, Galaxy S6

edge, Galaxy Note5, Galaxy S6 edge+, Galaxy S7, Galaxy S7 edge, Galaxy S8+, Galaxy S8, Galaxy Note8, Galaxy S9+ and the Galaxy S9.

When users use this electronic Wallet, they can add any qualifying Visa, MasterCard, American Express and Discover credit cards. Additionally, more than 1,000 banks and credit unions support Samsung Pay, including Chase, Navy Federal Credit Union, and banks nationally and internationally. Users can add gift cards and loyalty cards. This helps users manage and use them more easily. If a card has a barcode located on it, it can be stored on Samsung's electronic Wallet.

One of the advantages of Samsung Pay is that it works with most card readers. It uses both NFC and Magnetic Secure Transmission (MST) technologies. MST technology emits a magnetic signal that acts like a magnetic strip that one finds on most credit cards. This allows users to use this electronic Wallet at more terminals than some similar applications.

Samsung Pay is accepted in stores, in apps and online. Because of the flexible types of technology that work with Samsung Pay, it is accepted by any magnetic stripe payment terminal. But it will not work at gas station pumps or ATM machines where one physically sticks his/her card into a reader. Samsung also made a deal with Visa to make Samsung Pay work at its more than 350,000 retail websites.

When it comes to the security of Samsung Pay, numerous security measures are in place. Users must verify every purchase with a fingerprint, iris scan or by entering a PIN. Additionally, credit card number is not used for transactions; instead, a random set of numbers is transmitted. There is no fee for using Samsung Pay. If users fear storing all of their credit card information in their user phones, users may be comforted to know that Samsung ensures that all account information is encrypted and stored in a data vault. Moreover, users can lock or erase their accounts with Find My Mobile even at a distance.

Samsung ties its electronic Wallet with its own Rewards program, too. So, with every purchase, users earn points that can be redeemed, like gift cards. Notably, many of the items in the rewards catalogue are also Samsung products. The company is regularly running promotions that change with a season.

CONCLUSIONS

The usage of E-Wallets systems as a means of payment is on the rise, not only in Malaysia but in the whole world. Currently, there are altogether 37 E-Wallet systems operating in the Malaysian market. This high availability of E-Wallets poses a decision-making problem in the selection of the best E-Wallet for making payments to merchants. By means of a detailed AHP analysis, this paper finds that Samsung Pay is the most desired E-Wallet system for Malaysian customers. The ranking of the five selected E-Wallets is done on the basis of seven criteria. Consequently, it is found that even though Samsung Pay is not the best with respect to all the criteria but it is the best overall E-Wallet system. This is judged by all the criteria and synthesizing the local priorities to obtain the global priority. However, it is reckoned that the ranking is only a temporary one as the set of criteria may evolve over time and that the performance of the E-Wallet providers may also change from the present level of performance.

Implications

The current findings reveal that Samsung Pay is the most preferred E-Wallet in the Klang Valley, Malaysia. Existing E-Wallet service providers must ensure that their product provides an outstanding user experience and is beneficial for their customers' daily transactions. The product designers of the E-Wallet system should keep in mind that E-Wallet is used by a diverse range of users of varying ages and education levels. An intuitive E-Wallet application can help maintain the app's presence in customers' installed programme lists. The operational constraints experienced by users have a

detrimental effect on the intention to continue using the E-Wallet. As a result, E-Wallet service providers are recommended to build a system with the fewest possible technical complications. A system failure or defect in the system will result in significant financial and customer losses.

The findings of this study could also assist the Malaysian government in its efforts to promote E-Wallet usage for a secure, contactless payment experience. Continued adoption of E-Wallet may help the government achieve its goal of curbing COVID-19. Indeed, cashless transactions would aid the government in containing the COVID-19 outbreak as tangible cards and cash may accelerate viral transmissions within the community. The government may also continue motivating citizens by offering incentives to E-Wallet users.

Limitations

The respondents were drawn from the working group and were classified according to Managers and Specialists from the E-Commerce and Digital Banking industries that use E-Wallets. However, the survey did not include respondents from the non-working group, which would have otherwise presented a more balanced picture of the E-Wallet clientele..

The AHP questionnaire has been criticized for being excessively lengthy and confusing for some, and for preventing many respondents from finishing the survey due to the lack of incentive to do so. Over 50 invitation emails were sent to the customers, and weekly follow-up emails were sent to remind possible responses. Finally, a total of 30 respondents agreed to participate in the data collection stage of this research.

Future Studies

It is preferred that the study collect a representative sample of respondents from each working and non-working groups and from all regions in Malaysia to obtain more generalizable findings.

ACKNOWLEDGEMENT

The authors would like to thank the anonymous reviewers for their insightful and constructive comments which have been helpful to improve the content as well as quality of the article.

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APPENDIX 1: CRITERIA AND THEIR MEANING

Criteria	Meaning
Convenience	Convenience refers to the extent whereby a customer feels that the website is simple, intuitive, and user-friendly. Accessibility of information and simplicity of the transaction processes are important requirements to make a system user-friendly.
Promotion	Cash Back Promotion, Rebate Promotion, Promo Code, Discount, when using E-Wallets as payment option.
Security	In the form of keeping customers safe from an invasion of their privacy.
User Experience	Site makes use of the service effortless, and the small positive impact may depend on tolerance zones.
Pricing	Transaction fees, service fees for using the E-Wallet as a payment option.
Selection	Offer a wider range of product categories and a greater variety of products within any given category. The customer has seamless access to the entire range of products.
Trust	The degree of confidence customers have in online exchanges, or in the online exchange channel. Online trust includes customer perception of how the website would deliver on expectation, how believable the website's information is, and the level of confidence in the site channel.

APPENDIX 2: THE ANALYTIC HIERARCHY PROCESS

The Analytic Hierarchy Process (AHP) was developed by Thomas L. Saaty of University of Pittsburgh in 1977, which solves a multiple criteria decision making problem using three steps: (1) Find out the overall goal, criteria, subcriteria, and alternatives and form a linear hierarchy involving all of them in several levels, (2) Form pairwise comparison matrices for all the criteria, subcriteria and alternatives and compute their weights by using a suitable weight determination technique, (3) Synthesize all the local set of weights to obtain a set of overall or global weights for the alternatives. A pairwise comparison matrix in Step 2 has the form:

$$A = \begin{array}{c|cccc} & F_1 & F_2 & \dots & F_n \\ \hline F_1 & a_{11} & a_{12} & \dots & a_{1n} \\ F_2 & a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ F_n & a_{n1} & a_{n2} & \dots & a_{nn} \end{array}$$

where F_i 's are the factors (meaning either criteria or alternatives whose weights are to be determined), $a_{ij} = w_i / w_j$, for all i, j , and $w = (w_1, w_2, \dots, w_n)^T$ is the underlying weight vector for the n factors. Each entry a_{ij} of A is the answer to a typical question, "between the two factors F_i and F_j , which one is more dominant (or preferable or important) and what is the degree of this dominance?" The answers are usually given verbally, like F_1 is weakly (or strongly) more dominant over F_j . Later, these verbal qualitative phrases (weakly or strongly more) are quantified by means of the (1-9) ratio-scale. For example, if F_1 is strongly more dominant over F_2 , then $a_{12} = 5$. The interpretation of all the numerical judgments of the (1-9) scale is given in the following table.

Verbal Judgment of Importance	Numerical Rating
Equal importance	1
Equal to moderate importance	2
Moderate importance	3
Moderate to strong importance	4
Strong importance	5
Strong to very strong importance	6
Very strong importance	7
Very strong to extreme importance	8
Extreme importance	9

Note: If any factor F_i has importance strength over F_j as any of the above non- zero numbers, then F_j has the reciprocal importance strength with F_i , i.e., $a_{ji} = 1 / a_{ij}$.

It has been stated that each a_{ij} is the ratio of the two weights w_i and w_j . Now, if we multiply A by the weight vector w from the right, we get

$$Aw = nw \quad (1)$$

where n is the order of the matrix, i.e., the number of factors compared. So, we can recover the weight vector w from (1), provided $(A-nI)w = 0$ has non-trivial solution, i.e., $|A-nI| = 0$, i.e., n is the eigenvalue of A . We also note that $a_{ij} = (w_i / w_k) (w_k / w_j) = a_{ik} a_{kj}$, which is known as cardinal consistency relation. If all the elements of A satisfy this relation, then we say that the matrix is consistent, otherwise it is inconsistent. In reality, especially within the framework of the AHP, the matrix A is hardly consistent. In the inconsistent case, Equation (1) becomes

$$A'w' = \lambda_{\max} w' \quad (2)$$

where λ_{\max} is the largest eigenvalue of A' . Here the matrix A has been perturbed to A' and the consistency relation is violated at least once. For simplicity, the primes are omitted in the following notations and expression. To find out the weights, at first, we determine the largest eigenvalue λ_{\max} of A . Then the weights w_i 's are determined by solving the following system of linear simultaneous equations:

$$w_i = \frac{1}{\lambda_{\max}} \sum_{j=1}^n a_{ij} w_j, \quad i = 1, 2, \dots, n \quad (3)$$

For uniqueness, we normalize the set of weights such that $\sum_{i=1}^n w_i = 1$. In practice, Superdecision[®] software is used to compute the weights from the pairwise comparison matrices.