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Abstract: With a significant share of the Philippine population going online, online shopping has become an emerging trend. As the number of online shopping transactions increases daily, it has become increasingly important to understand the barriers that hinder the market. Despite its importance, current literature considers buyers' perspectives with limited insights on the sellers' perceptions. Understanding the sellers' point of view provides a holistic analysis of these barriers for better practical insights. As a case in point, with the Philippines, this study attempts to identify the barriers of online shopping and their interrelationships, both from the sellers' and buyers' perspectives,

using interpretive structural modelling and MICMAC analysis. Findings show that internet connection and the need for the product's sensory experience are highly relevant barriers to the sellers. On the other hand, buyers emphasise the need for the product's sensory experience than the rest of the barriers. The managerial implications of these findings are discussed.

Keywords: online shopping; barriers; interpretive structural modelling; ISM; MICMAC analysis; systems; the Philippines.

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1 Introduction

The growth of the internet has unarguably provided opportunities for businesses (Shaltoni, 2017; Gupta and Arora, 2017; Rahman et al., 2018). The availability of online transactions on the internet has become an indispensable part of the international retail framework experiencing a paradigm shift (Eastin, 2002). The market size of business-to-business (B2B) on the internet has forecast growth to $6.7 trillion in 2020, and the business-to-consumer (B2C) market is expected to double its size (Frost & Sullivan, 2015). E-commerce growth is projected to overtake conventional stores' sales growth in the proceeding years; thus, current works highlight the integration of online shopping into the business strategy (Bilgihan et al., 2016). In 2013, the UK's online sales were accounted for 9.7% of total retail sales, which increased to 18% in 2018 (MarkMonitor, 2018). In the USA, online sales were estimated at USD394.9 billion in 2016, with an increase of 15.1% from 2015 (US Department of Commerce, 2017). In 2017, about 1.66 billion people shopped online globally (Statista, 2020a), with USD1.92 billion from purchased goods and services in 2019 and online sales of USD3.5 trillion (Statista, 2020a).

On the other hand, the Philippines has more than 69 million internet users, with 92% of their online activity visiting online retail stores and 91% searching online for products or services to purchase (GlobalWebIndex, 2019; Statista, 2020c). With the significant share of the Philippine population going online, the market size of the Philippine e-commerce is valued at USD3 billion in 2019 and is projected to reach USD12 billion by 2025 (Statista, 2020b). The Filipino Gen Z and millennials are the country's most dominant internet user population (Statista, 2020c). The success of local online shopping sites like Lazada, Shopee, Zalora, and eBay seems to show that the online shopping trend is growing locally. In 2019, Lazada was the leading B2C e-commerce website in the Philippines, with approximately 25.2 million web visits monthly. eBay is the most popular C2C e-commerce website with monthly web visitors of 863.6 thousand. Thus, online browsing and shopping have become prevalent among Filipino internet users that have spent USD4.7 billion on online purchases in 2018 (Statista, 2020a).

With the competitive environment, sellers need to provide an excellent shopping experience and continuously innovate in providing a unique online experience (Bilgihan

et al., 2016). Online shopping offers sellers' additional distribution channels for their buyers and creates a demand for home delivery services (Gevaers et al., 2014; Beckers et al., 2018). Social media platforms (e.g., Facebook, Instagram) provide opportunities to gain access to customer feedbacks almost in real-time (e.g., through comments, reviews), as inputs for product and service innovation (Oinas-Kukkonen and Oinas-Kukkonen, 2013). With the onset of online shopping, sellers can effectively integrate online and offline channels (Rimmer and Kam, 2018). Online shopping promotes low prices, saves time, and eliminates physical challenges in conventional shopping (Shaltoni, 2017). Visa eCommerce Monitor (2014) highlighted that most Filipinos are satisfied with online shopping describing it as easy (73.3%), convenient (71.9%), or fun (64.4%), and expressing greater likelihood to purchase in the next six months (79.2%). Furthermore, online shoppers spend an average of 6.2 hours daily. As local and international e-commerce websites become more popular among Filipino consumers, a steady increase in popularity is expected to continue to be experienced in online shopping and e-commerce. The decision to shop online or in-store also depends on the type of product being purchased. For instance, buyers are more willing to purchase books online than shoes or food, though traditional stores are favoured across most product categories (Kacen et al., 2013). While non-physical items such as airline e-tickets or software downloads strongly favour online shopping platforms, other products may prefer one or the other depending on the trade-offs between convenience, price, selection and service (Levin et al., 2005).

Despite the Philippines being one of the emerging markets in e-commerce, its e-commerce spending is growing slowly compared to other countries in the region (Statista, 2020d). Evidently, in the ASEAN, Indonesia is leading online retail sales with USD20.9 billion in 2019. It is projected to grow to USD82 billion in 2025, accounting for over 50% of the ASEAN e-commerce market due to its growing number of middle classes and increased internet access (Statista, 2020d). It is followed by Thailand with USD5 billion in 2019 and USD18 billion in 2025, and Vietnam with USD4.6 billion in 2019 and USD23 billion. The Philippine online retail sales are USD2.5 billion in 2019 and are projected to grow to USD12 billion in 2025. Amidst the increasing demand for online presence, the country still has the lowest average revenue per e-commerce user. With the growth of e-commerce in the Philippine market, some barriers compromised its growth. For instance, the slow internet connectivity and the tendency to pay cash have discouraged Filipinos to transact online. The emergence of more reliable payment methods, like cash-on-delivery as well as free shipping for returns or exchanges, has made online shopping a preferable option for buyers that value time and convenience offered by the experience. In 2019, about 47% of the Filipinos preferred to pay cash for their online purchases, and only 10% are using their credit cards for payment (Statista, 2020b).

Despite the growing trend of online shopping, there are still buyers who prefer conventional channels and decline shopping online (Tandon et al., 2017). Yang et al. (2016) highlighted that most e-commerce firms suffer primarily from scale size, input congestion and economic effectiveness. Poor online customer experience is accounted for a 24% loss in annual online revenue equivalent to USD 50 billion lost in the USA (Econsultancy, 2011). Thus, online sellers must create a positive outlook of shopping online to affect buyers' behavioural intentions (Tandon et al., 2017). Pappas et al. (2017) identified the factors that influence consumer experience – the quality of personalisation, shopping enjoyment, persuasion and consumer motivation – price sensitivity, promotion

sensitivity, service quality sensitivity, store brand sensitivity and innovativeness. Buyers are inclined to online shopping for certain types of products due to the availability of product information. Trust plays an important role in making online purchases with uncertainty due to a lack of physical interaction (MarkMonitor, 2018). Cancelling purchases online can easily be taken, and buyers are likely to cancel the online purchase process before examining the products if the speed of web pages is too slow, the transaction process is too complicated, or the quality of the goods is questionable (Harrison-Walker, 2002). This results in losses of buyer opportunities for sellers. Given the lack of physical verification, consumers make purchases with the risk of not getting the assured quality. Buyers may also feel unsafe buying online due to concerns over trust and data privacy (Rahman et al., 2018). Cybercrime can also be a threat as websites may be used for phishing or hacking to retrieve critical customer information (Ali et al., 2016).

Domain literature on online shopping focuses much on consumer behaviour and the factors that motivate the public to buy online or not buy online (Levin et al., 2005). The majority of these works attempt to interpret the buyer perspective of online transactions. However, works from the standpoint of sellers has been limited. As online shopping has grown, so has the number of people who make money selling products online. From a sellers' perspective, several factors cause difficulty in continuing to sell online. One aspect is that customer loyalty is difficult to maintain. Competition on service and pricing is tight online, which may lead the seller to be outpriced. Online seller rating is an important determinant of online seller success and plays an essential role in building consumer trust (Qu et al., 2008). Online sellers also need to improve convenience and value for buyers and overcome their security and trust (MarkMonitor, 2018). Several works in the literature have pointed out barriers to online shopping, including risk, technology unfamiliarity and lack of physical contact (Rajamma et al., 2009; Hansen and Jensen, 2009; Tong, 2010; Lian and Yen, 2013; Qureshi et al., 2014; Tandon et al., 2015; Faqih, 2016). However, most of these works have not explored online shopping barriers with both the sellers' and buyers' perspectives. As online shopping transactions are becoming more popular, it is increasingly important to understand the barriers that hinder buyers and sellers from online shopping. Such an agenda provides a holistic understanding of barriers, which may be crucial inputs to product development, infrastructure support, marketing decision and controls development. This work presents a unique proposition in identifying the barriers affecting both the sellers and buyers to transact online. This work may provide insights to the sellers in designing their online platforms and develop strategies to motivate buyers to venture to online shopping.

Besides identifying these barriers, treating these barriers independently maybe counterintuitive due to the structural relationships present among them. These relationships reflect how a barrier affects other barriers, and in turn, is affected by them via transitive relations. For instance, considering online trust and product quality as barriers. It is straightforward to note that product quality impacts the online trust of buyers. Understanding the relationships of these barriers could provide useful and holistic insights to managers in developing initiatives in addressing these barriers. Thus, this paper highlights the interrelationships of online shopping barriers from both the sellers' and buyers' perspectives. These interrelationships are explored with the use of the interpretive structural modelling (ISM) approach. ISM is "the systematic application of some elementary notions of graph theory in such a way that theoretical, conceptual, and computational leverage is exploited to efficiently construct a directed graph, or network

representation, of the complex pattern of a contextual relationship among a set of elements" (Malone, 1975). With its vast applications in understanding the complexity of systems, the ISM has been a popular tool in the literature. Some recent applications include barriers in university technology transfer (Quiñones et al., 2020), barriers to green textile supply chain management (Majumdar and Sinha, 2019), challenges of Industry 4.0 adoption (Karadayi-Usta, 2019), barriers to supplying electricity (Sinaga et al., 2019), barriers of e-governance implementation (Gupta et al., 2019), and barriers of implementing digital transformation of the supply chain (Agrawal et al., 2019). Note that this list is not intended to be comprehensive.

The ISM analyses and systematises the barriers through a visual systems model to illustrate their transitivity for sellers and buyers to consider when engaging in online shopping. Moreover, the barriers are described through their relative driving power and dependence power. Driving power is the capacity of a barrier to augment the other barriers, while dependence power refers to the tendency of the barrier to be affected by the others. Also, the level of priority for the barriers is established to help identify potential development areas that would improve the online shopping experience. Since online shopping is an important business model in the economic development of a developing country (e.g., the Philippines), the paper could provide holistic insights into the barriers of online shopping in the Philippines and help firms implement e-commerce more effectively. The rest of the paper is organised as follows: Section 2 reviews the relevant online shopping barriers and provides a brief overview of the ISM and matriced impacts 'croises-multiplication applique' and classment (MICMAC) analysis. Section 3 demonstrates the application of ISM and MICMAC analysis in analysing the barriers to online shopping in the Philippines. Results and discussion are presented in Section 4. It ends with a conclusions and future research directions in Section 5.

2 Preliminaries

2.1 Barriers to online shopping

Online shopping has increasingly become more attractive with the presence of the internet as a medium. It is perceived as more efficient than traditional physical shopping and offers ease of use, transparency of available products and cost reduction. Furthermore, online shopping mostly offers prices cheaper than a brick-and-mortar store – apart from the reduced costs of the internet due to today's highly competitive market. Below are the following barriers that impede both buyers and sellers from online shopping:

2.1.1 Online trust

The growth of e-commerce and internet-based information exchange has produced fear, distrust, and risk among online buyers and sellers (Casado-Aranda et al., 2019). B2C in e-commerce will be tenuous without online trust (Kim and Peterson, 2017). Thus, trust is an essential factor regarding the adoption and development of e-commerce. The key to an online seller to achieve long-term success against competitors and gain a competitive advantage is to build buyers' trust (Pavlou and Fygenson, 2006). Online trust is the stakeholder's reliance on the firm's online business activities (Kim and Peterson, 2017).

From the buyers' perspective, online trust assures them to mitigate the vulnerabilities in buying online, such as security and privacy breaches associated with online transactions (Blut et al., 2015; Talwar et al., 2020). It is characterised by integrity, ability and benevolence (Lee and Turban, 2001). There are several online sellers' trust-building mechanisms to build trust and reduce uncertainty (Casado-Aranda et al., 2019; Liu and Tang, 2018). Casado-Aranda et al. (2019) highlighted three types of online trust mechanisms which may increase trust in e-commerce retailers:

1 seals of approval where assurance is provided by a third-party vendor only after an independent evaluation of the retailer's website and related activities

2 rating systems where it rates the websites with stars based on customer feedback

3 assurance.

Presently, attacks against online transaction systems of e-commerce sites are systematically managed by organised groups of cybercriminals (Ali et al., 2016). Jiang et al. (2008) mention several surveys were showing that online customers make their purchases from websites that they trust and recognise sellers' credibility online. These buyers tend to seek first the security and credibility of online sellers before providing personal details. Ha (2004) identified security, privacy, brand name, word-of-mouth, good online experience, and quality of information as factors that strengthen the effect. Buyers are now aware of fake websites and the risk that is associated with online transactions, with 63% of the buyers check the trustworthiness of the websites through online reviews, 43% check for SSL certificates, 43% check on the return policy, and 39% check on the grammar and spelling on the website (MarkMonitor, 2018).

2.1.2 Shipping procedures

One of the concerns of online buyers is the shipment process at par with sales services and timely response (Tandon et al., 2017). Several works have indicated that shopping cart abandonment is one of the most significant concerns of online shopping retailers (Mulpuru et al., 2010). One of the barriers to online shopping is the inquiry process and shipping procedures and fees (Tandon et al., 2015). About 25% of this abandonment results from hidden charges during checkout that includes the shipping costs. High shipping costs have become a barrier to successful online shopping, which prompt retailers to usually promote free shipping to capture consumers who are sensitive to these additional costs. Apart from shipping costs, there are also other risks involved on the part of the buyer, which include product may not be shipped at all, the product could get lost or damaged during shipment, the product may not be shipped on time, or an incorrect product or lower quality product may be shipped (Utz et al., 2012). Shipping or home deliveries contributes to providing convenience to online buyers (Hsu et al., 2011). Online stores may gain a competitive advantage over their shipping and handling fees, exchange refund policy for returns and post-purchase service (Kacen et al., 2013; Chen et al., 2014). Thus, increasing numbers of logistic companies require fast, reliable, customised, and cost-effective processes and services, which are important factors in the economic success of the online shops (Persson and Virum, 2001; Chen et al., 2014).

2.1.3 Product and service quality

In terms of product quality, sellers may provide product information to the buyers to maximise product quality (Bakos, 1997). Online shopping enables comparative information about alternative products online but lacks physical product interaction based on their buying decisions (Park and Kim, 2003). There is less information about the product online than in physical stores where you can find what you need right away as the product is right in front of you. Online buyers are not able to touch or feel the product. Size, colour, and texture could look different on screen, depending on the browser or the gadget in use (Utz et al., 2012). As such, the online buyer's perceived quality may not match the actual quality once the customer receives the product. The majority of buyers (88%) are victims of counterfeiters online and believe that sellers should protect them from the online counterfeit threat (MarkMonitor, 2018). Sebastianelli et al. (2008) discussed seven online shopping quality dimensions: reliability, accessibility, ordering services, convenience, product content, assurance and credibility.

Table 1 Barriers to online shopping based on the current literature

Barriers	*Description*	*Reference*
Online trust	The degree of difficulty in establishing trust between the buyer and the online merchant due to the lack of physical contact	Ha (2004), Pavlou and Fygenson (2006), Jiang et al. (2008), Blut et al. (2015), Ali et al. (2016), Kim and Peterson (2017), Liu and Tang (2018), MarkMonitor (2018), Casado-Aranda et al. (2019), Talwar et al. (2020)
Shipping unpredictability	Turnaround times are not always met	Persson and Virum (2001), Mulpuru et al. (2010), Hsu et al. (2011), Utz et al. (2012), Kacen et al. (2013), Chen et al. (2014), Tandon et al. (2015, 2017)
Product quality	The difference between the promised quality and the delivered quality	Bakos (1997), Park and Kim (2003), Sebastianelli et al. (2008), Utz et al. (2012), MarkMonitor (2018)
Local taxes or customs fees	Paid to the local government on top of the cost of the purchased product	Goolsbee (2000), Ballard and Lee (2007), Ellison and Ellison (2009), Alm and Melnik (2012), Einav et al. (2014)

2.1.4 Local taxes

Internet sales are highly sensitive to local tax, and enforcing existing sales taxes on online purchases could reduce the number of online buys by as much as 24% (Goolsbee, 2000). Einav et al. (2014) highlighted that sales tax influences buyer behaviour as online purchases increases to 1%–2% for each percentage point increase in sales taxes and further concluded that sales taxes could lead to a decline in online purchases. Ellison and Ellison (2009) highlighted that sales taxes are an important driver of online transactions. It is a current practice that it is the role of the seller to collect sales taxes online, but only when the seller has legal nexus. Several works in the literature have concluded that taxes substantially influence consumer choices that implicate that sales tax revenue losses are important (Alm and Melnik, 2012). Furthermore, people prefer to shop and sell online to avoid sales taxation (Ballard and Lee, 2007).

In summary, Table 1 shows these barriers to online shopping from the current literature.

2.2 The ISM and MICMAC analysis

ISM enables one to develop a map of complex relationships among many homogeneous elements (e.g., barriers to online shopping) represented by a directed graph or network. With a directed graph or a network, a better understanding of the relationship structure of these elements is achieved, which would convey some theoretical or practical insights. The foundations of ISM, including its mathematical formulations, were first put forward by Harary et al. (1965). The philosophical basis that led to the establishment of this approach has been demonstrated by Warfield (1973). A more detailed discussion of its conceptualisation and analysis was defined by Warfield (1973) and his associates at the Battelle Memorial Institute in Columbus, Ohio. The basic notion of the approach is to utilise people with sufficient knowledge in the desired field and then break down a complex system into several subsystems and establish a multilevel structural model. The required computational steps of the ISM are as follows:

1 List the system elements under consideration. This list must be homogeneous under the context of the given system. It could be obtained from a review of the domain literature or a consensus of an expert group or both.

2 Construct the self-structural interaction matrix (SSIM). With the list of elements, SSIM is developed that reflects the contextual relationships of the elements. Four notations are used to represent the direction of the relationship between any two system elements i and j, $i \neq j$:

   a V, where the element i affects j

   b A, where i is affected by j

   c X, where i and j are affected by each other

   d O, where i and j do not affect each other.

3 Establish the initial reachability matrix $M = D + I$, where D is constructed from the SSIM and I_n is an identity matrix of size n. For $D = (d_{ij})_{n \times n}$, where n is the number of system elements, d_{ij} representing the contextual relationship of element i on element j, $i, j \in \{1, \ldots, n\}$ obeys the following conditions:

   a If (i, j) entry in SSIM is V, then $d_{ij} = 1$ and $d_{ji} = 0$.

   b If (i, j) entry in SSIM is A, then $d_{ij} = 0$ and $d_{ji} = 1$.

   c If (i, j) entry in SSIM is A, then $d_{ij} = 1$ and $d_{ji} = 1$.

   d If (i, j) entry in SSIM is O, then $d_{ij} = 0$ and $d_{ji} = 0$.

   When M is translated as a directed graph, $d_{ij} = 1$ represents a directed edge from i to j.

4 Obtain the final reachability matrix M^* by introducing transitivity among system elements. Let $i, j, k \in \{1, \ldots, n\}$. From D, if $d_{ij} = 1$ and $d_{jk} = 1$, then $d_{ik} = 1$. M^* can be obtained using equation (1).

$$M^* = M^k = M^{k+1}, k > 1 \tag{1}$$

5 Level partition the system elements into a hierarchy. From M^*, the reachability set R_i and the antecedent set C_i for all i are obtained. The reachability set R_i consists of i, and all j with a directed edge from i to j. On the other hand, the antecedent set C_i consists of i, and all j with a directed edge from j to i. From these sets, an intersection set $R_i \cap C_i$ is obtained. The assignment of each element to a particular level (i.e., consider a maximum of m levels) follows an iterative process:

Step 1 For i, if $R_i = R_i \cap C_i$, then assign i to level 1.

Step 2 If i is assigned to level 1, assign $\{1, \ldots, n\} \setminus \{i\}$ elements.

Step 3 For $j \in \{1, \ldots, n\} \setminus \{i\}$, if $R_j = R_j \cap C_j$, then assign j to the next level (i.e., level 2).

Step 4 If j is assigned to level 2, assign $\{1, \ldots, n\} \setminus \{i, j\}$ elements.

Step 5 Repeat Steps 1–4 until all n elements are assigned to all levels.

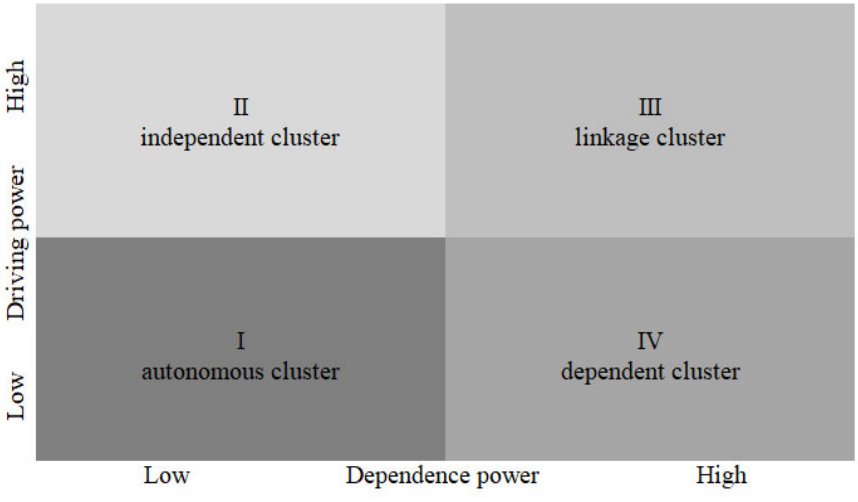
Step 6 If all n elements are assigned to all respective m levels, terminate the assignment process.

6 Form the multilevel digraph. Removing the transitive relations of the final reachability matrix, along with the level assignments in Step 5, forms a multilevel digraph representing a multilevel hierarchy structural model showing the relationship of element i on j.

MICMAC analysis

7 The MICMAC analysis explores the driving power and the dependence power of the system elements under consideration (Medalla et al., 2020). The system elements are classified into four clusters: autonomous, dependent, linkage and independent. The autonomous cluster possesses both weak driving and dependence powers. They are relatively disconnected from the system and represented in quadrant I. The independent cluster consists of elements with strong driving power with weak dependence power. They are described in quadrant II. These elements are considered the key elements in the system. Represented in quadrant III, the linkage cluster has both strong driving and dependence powers. Elements in the linkage cluster are usually unstable, as any action implemented would potentially impact the entire system. Lastly, the dependent cluster, represented in quadrant IV, consists of elements with weak driving power but strong dependence power. See Figure 1 for the four clusters in the MICMAC analysis.

Figure 1 Dependence and driving power diagram



3 Proposed procedure: the application of ISM and MICMAC analysis to model the barriers of online shopping both from sellers' and buyers' perspectives

The ISM and MICMAC analysis approach in this work consists of the following steps:

Step 1 Identify the list of barriers to online shopping from both perspectives. The first round of surveys was distributed to identified respondents based on a set of criteria designed to classify them as experts in the related field via various online messaging platforms. These experts were all residing and conducting business online in the Philippines either as a consumer or seller or both. All the experts met a set of criteria, which include:

1 conducting or involved in the online shopping business for at least three years

2 engagement of non-perishable items

3 frequency of purchases of at least six times annually of non-perishable items.

From the preliminary survey responses collected, they were asked to provide a set of barriers from their perspective and to supply a brief discussion on their chosen drivers. Eight sellers were asked to provide barriers to online shopping from their perspective. On the other hand, ten buyers were also asked to determine barriers from their perspective. Each was also requested to supply a brief discussion on their chosen barriers. Based on their responses, six significant barriers for each group were obtained. Table 2 provides a list of these barriers.

Table 2 List of barriers from both seller and buyer perspectives

Barriers to online shopping	*Description*
Sellers' perspectives	
Fraud	A common frustration among sellers wherein buyers do not push through with orders when they are already on hand and ready for shipping
Exchange and return	Dealing with after-sales or customer service
Shipping/delivery issues	Courier-related problems such as damaged in transit, lost in transit, turnaround time, among others
Internet connection	The Philippines is among the worst countries in internet service, at least in the ASEAN region
Need for a sensory experience	Sellers lose the potential market of those buyers who are not persuaded by mere product information and photos provided online
Risk of online payment security	Sellers need to establish 'consumer trust' to get customers to engage in online payment methods (e.g., credit cards, debit cards)
Buyers' perspectives	
Fraud	Fear that items might be fake, or counterfeit or quality might not be as expected
Exchange and return	A possible annoyance for customers
Shipping/delivery issues	Related issues with couriers such as not meeting the turnaround time or damage in transit
Internet connection	A common issue in the Philippines that deter users from making online transactions
Need for a sensory experience	Buyers would have wanted to have a thorough sensory experience of the product, which cannot be done online
Risk of online payment security	Buyers do not trust online payment transactions

Step 2 Gather individual structural self-interaction matrices. Each expert, either seller or buyer, was asked to establish an SSIM on the contextual relationships of online shopping barriers. A sample SSIM is shown in Table 3.

Table 3 A sample SSIM of barriers to online shopping

Codes	*Barriers to online shopping*	*B6*	*B5*	*B4*	*B3*	*B2*
B1	Fraud	X	O	O	X	V
B2	Exchange and return	O	O	A	X	
B3	Shipping/delivery issues	A	A	O		
B4	Internet connection	V	O			
B5	Sensory experience	O				
B6	Risk of online payment security					

Step 3 Convert individual SSIMs into initial reachability matrices. Applying Step 2 of Section 2.2, individual SSIMs are transformed into initial reachability matrices. A sample initial reachability matrix from an expert respondent is shown in Table 4.

Table 4 Initial reachability matrix for barriers of sellers

Barriers to online shopping	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*
Fraud	1	1	1	0	0	1
Exchange and return	0	1	1	0	0	0
Shipping/delivery issues	1	1	1	0	0	0
Internet connection	0	1	0	1	0	1
Sensory experience	0	0	1	0	1	0
Risk of online payment security	1	0	1	0	0	1

Step 4 Aggregate the initial reachability matrices. With eight experts and ten experts who were asked to determine the contextual relationships of barriers from sellers' and buyers' perspectives, respectively, the individual initial reachability matrices were then aggregated. The aggregation function assumes a majority rule. The majority rule is a decision rule that selects elements (or alternatives) that have a majority (i.e., more than half the votes). It is the binary decision rule used most often in influential decision-making bodies. According to May (1952), the majority rule is the only reasonable decision rule that is 'fair'. The following popularity in important decision-making processes and used in different contexts, the majority rule was used to aggregate the initial reachability matrices. Table 5 and Table 6 show the aggregate initial reachability matrices of online shopping barriers, both for the sellers and buyers.

Table 5 Aggregate initial reachability matrix for barriers of sellers

Barriers to online shopping	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*
Fraud	1	0	0	0	0	1
Exchange and return	0	1	1	0	0	0
Shipping/delivery issues	0	1	1	0	0	0
Internet connection	0	0	0	1	0	1
Sensory experience	0	1	1	0	1	0
Risk of online payment security	1	0	0	0	0	1

Table 6 Aggregate initial reachability matrix for barriers of buyers

Barriers to online shopping	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*
Fraud	1	1	0	0	0	1
Exchange and return	1	1	1	0	0	0
Shipping/delivery issues	0	1	1	0	0	0
Internet connection	0	0	0	1	0	0
Sensory experience	0	1	0	0	1	0
Risk of online payment security	1	0	0	0	0	1

Step 5 Obtain the final reachability matrices. From Table 5 and Table 6, the corresponding final reachability matrices were obtained using Step 4 of Section 2.2. Table 7 and Table 8 show the final reachability matrices of online shopping barriers from sellers' and buyers' perspectives, respectively.

Table 7 Final reachability matrix for barriers of sellers

Barriers to online shopping	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*Driving power*
Fraud	1	0	0	0	0	1	2
Exchange and return	0	1	1	0	0	0	2
Shipping/delivery issues	0	1	1	0	0	0	2
Internet connection	1*	0	0	1	0	1	3
Sensory experience	0	1	1	0	1	0	3
Risk of online payment security	1	0	0	0	0	1	2
Dependence power	3	3	3	1	1	3	14

Note: *Signifies transitivity.

Table 8 Final reachability matrix for barriers of buyers

Barriers to online shopping	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*Driving power*
Fraud	1	1	1*	0	0	1	4
Exchange and return	1	1	1	0	0	1*	4
Shipping/delivery issues	1*	1	1	0	0	1*	4
Internet connection	0	0	0	1	0	0	1
Sensory experience	1*	1	1*	0	1	1*	5
Risk of online payment security	1	1*	1*	0	0	1	4
Dependence power	5	5	5	1	1	5	22

Note: *Signifies transitivity.

Table 9 Levels of barriers of sellers of online shopping

Barriers to online shopping	*Reachability set*	*Antecedent set*	*Intersection set*	*Level*
Fraud	1, 6	1, 4, 6	1, 6	I
Exchange and return	2, 3	2, 3, 5	2, 3	I
Shipping/delivery issues	2, 3	2, 3, 5	2, 3	I
Internet connection	1, 4, 6	4	4	II
Sensory experience	2, 3, 5	5	5	II
Risk of online payment security	1, 6	1, 4, 6	1, 6	I

Table 10 Levels of barriers of buyers of online shopping

Barriers to online shopping	*Reachability set*	*Antecedent set*	*Intersection set*	*Level*
Fraud	1, 2, 3, 6	1, 2, 3, 5, 6	1, 2, 3, 6	I
Exchange and return	1, 2, 3, 6	1, 2, 3, 5, 6	1, 2, 3, 6	I
Shipping/delivery issues	1, 2, 3, 6	1, 2, 3, 5, 6	1, 2, 3, 6	I
Internet connection	4	4	4	I
Sensory experience	1, 2, 3, 5, 6	5	5	II
Risk of online payment security	1, 2, 3, 6	1, 2, 3, 5, 6	1, 2, 3, 6	I

Step 6 Assign the barriers of online shopping to appropriate levels. Using the algorithm for level partitioning presented in Step 5 of Section 2.2, each barrier is assigned

to a particular level. Table 9 and Table 10 identify each barrier's level from sellers' and buyers' perspectives.

Step 7 Construct the interpretive structural model. With the final reachability matrices and the level partitions in Table 9 and Table 10, the multilevel digraph for sellers' and buyers' perspectives are shown in Figure 2 and Figure 3, respectively.

Figure 2 The structural model of barriers of online shopping from sellers' perspectives

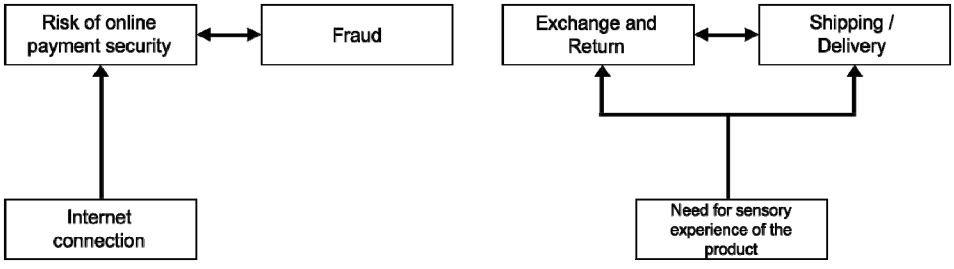


Figure 3 The structural model of barriers of online shopping from buyers' perspectives

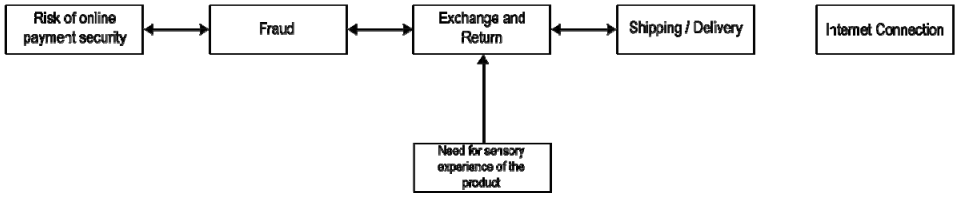
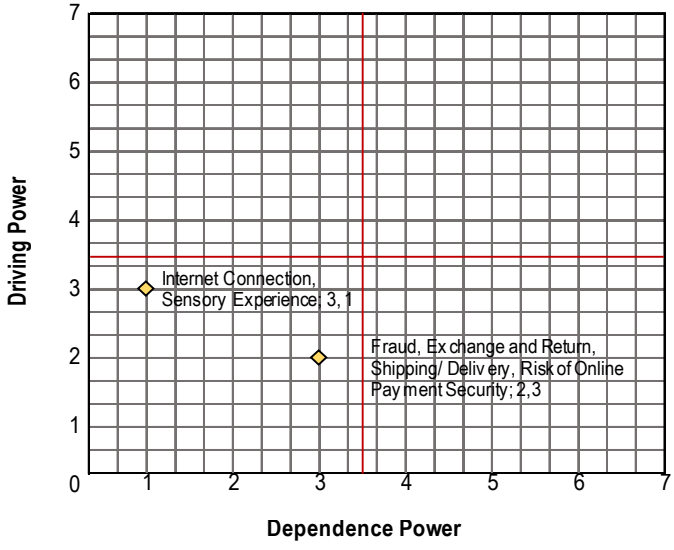
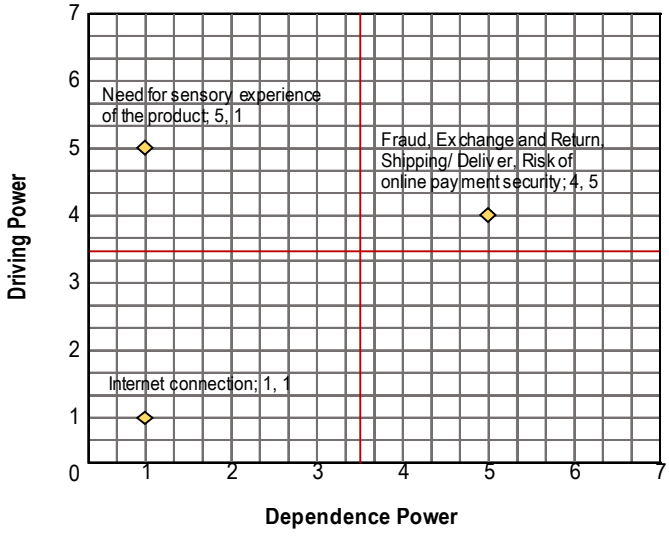


Figure 4 Dependence and driving power diagram for the online shopping barriers from the sellers' perspectives (see online version for colours)



Step 8 Perform the MICMAC analysis. Applying Step 7 of Section 2.2, the dependence and driving power diagrams are shown in Figure 4 and Figure 5 for online shopping barriers from sellers' and buyers' perspectives, respectively.

Figure 5 Dependence and driving power diagram for the online shopping barriers from the buyers' perspectives (see online version for colours)



4 Results and discussion

The preliminary survey results from the two expert groups showed little variation from the initial online shopping barriers obtained from the current literature. Since most recent works highlight the buyers' perspectives, this work extends such an analysis to the sellers' perspectives to provide holistic insights useful in practice. The sellers' perspectives offer a different point of view as they represent the other party in the online selling market.

The application of the ISM offers the following findings. Table 7 shows that internet connection and the need for sensory experience have high driving power with low dependence power for the sellers' perspectives. All other barriers have low driving power but high in dependence power. This is consistent with observation as these two barriers are highly relevant in the Philippine scenario, particularly about the internet connection, which is costly and unstable in the country. The prevalence of these conditions prevents sellers from responding to buyers' queries and after-sales support efficiently. The need for sensory experience for the products sellers offering online is a barrier relevant to the Philippine case and other regions. With limited options to better demonstrate the product's sensory qualities, sellers put resources and emphasis on improving sensory experience via existing graphics technologies. On the other hand, fraud, exchange and return, shipping/delivery issues, and the risk of online payment security are under the level 1 in the hierarchy shown in Figure 2, while internet connection and the need for sensory experience are in level 2. Figure 2 demonstrates the driving force of internet

connection and the need for the sensory experience of the product. The former drives the risk of online payment security, which is a linkage barrier to fraud. The latter is a driver for exchange and return and shipping/delivery issues, both linkage barriers. The MICMAC analysis shows that all barriers are autonomous. However, there is a distinction between the internet connection and the need for the sensory experience of the product from the rest. They have a relatively higher driving power than the rest of the barriers.

Under the buyers' perspectives, Table 8 shows that the need for the sensory experience of the product has a high driving power but low in dependence power. However, in contrast to the sellers' perspectives, the internet connection barrier has low driving power and dependence power. This implies that, unlike how sellers consider the internet connection necessary, the buyers put low emphasis on this barrier. This may be due to the buyers' limited interaction with the online shopping platform with the need for internet connection is comparatively less. Figure 3 shows that the need for the sensory experience of the product is in level 2, while all other barriers are in level 1. It indicates that the need for the sensory experience of the product is a driving factor for exchange and return, which is a linkage variable to all other barriers. It should also be noted that internet connection is autonomous, and thus, it is neither dependent nor driver to other barriers. Figure 5 shows that the internet connection barrier is in quadrant I, making it an autonomous barrier. The need for the sensory experience of the product is in quadrant II, which belongs to the independent cluster. All other barriers are linkage barriers, which are found in quadrant III. This finding implies that the key barrier of the buyers, which must be addressed in an online selling platform, is the need to provide a mechanism that improves the sensory experience of the buyers, which is a crucial input in purchase decisions.

From these findings, some practical insights are useful to the online shopping industry. From a sellers' perspective, internet connection and the need for the sensory experience of the product have a higher driving power than fraud, exchange and return, risk of online payment security and shipping/delivery issues. Based on their contextual relationships, an internet connection is vital to the risk of online payment security, which eventually leads to fraud. Likewise, the need for the sensory experience of the product is a vital factor for exchange and return as well as shipping/delivery issues. Following these relationships, managers should work closely with their website developers and information security personnel to ensure that their online shopping websites work properly under standard internet connection speeds. Another option would be to work with a reputable e-commerce solutions provider that already offers reliable features. Online payment information security also needs to be secured from potential hackers and fraudsters to alleviate the buyers' concerns on fraud and risk of online payment security. Offering a cash-on-delivery payment option would also be an excellent feature to add to the benefit of buyers who are not comfortable providing their sensitive information online. Policymakers should also incorporate in their marketing campaigns or the online product descriptions some measures that would alleviate the need for a sensory experience of the product. The possibility of an advanced 360 degrees graphics website to feature the products to make them look more realistic online would be significant leverage, but the cost of development needs must be likewise considered. Offering additional options such as a money-back guarantee or a flexible returns and exchange policy can help reduce the buyers' reservations on the matter of sensory experience of the product.

5 Conclusions and future work

To identify the barriers of online shopping as well as determine their relationships from the holistic perspectives of both the sellers and buyers, this work adopts an ISM and MICMAC analysis, which are graph-theoretic tools used for mapping crucial relationships among homogeneous system elements. With the Philippines as a case in point, crucial insights were revealed. From the sellers' perspectives, both internet connection and the need for the sensory experience of the product have high relevance for online shopping. These barriers have high driving power with low dependence, which implies their crucial roles in addressing other barriers under consideration. In contrast, the barriers from the buyers' perspectives show that the need for the sensory experience of the product is the only barrier with high emphasis. This can be attributed to higher risks involved in online payments, fraud, exchange and return, internet connection, and shipping/delivery issues, which pose greater concerns for buyers purchasing online. With these findings, decision-makers must pay more attention to their website developers and information security personnel to ensure that online shopping platforms are running under stable internet connection. They must also implement initiatives that would promote detailed product descriptions for better pre-purchase decisions of buyers.

While these findings are crucial in online shopping, they are not free from limitations. First, the results are highly relevant to the Philippine case and may not resonate well in other regions. Future work may consider a comparative analysis with the findings of this work and those in other regions. Secondly, this work considers the general online shopping industry. An industry-specific analysis (e.g., fashion, food, electronics, travel) would better address the needs of the different sectors operating under online shopping platforms. Third, an analysis of online shopping drivers would provide a different perspective that may be useful to sellers and buyers. Fourth, the use of other network modelling tools for analysing the relationships of barriers of online shopping, such as decision-making trial and evaluation laboratory (DEMATEL), fuzzy cognitive mapping, and system dynamics, would be interesting future work. Finally, a longitudinal analysis of these barriers' impact on the online shopping industry is crucial for future work.

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