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Abstract

Smart retailing technologies are transforming retailers' operations, consumer shopping experiences, and perceptions about retailers. These technologies are becoming increasingly numerous and may have different interfaces and ways of implementation. Based on the literature review, this study develops a framework to measure the impacts of implementing non-store-based and store-based smart retailing technology pilot projects, with appropriate metrics based on brand leadership, market performance and word-of-mouth. The proposed method is based on a survey distributed to a sample of customers and control groups, using an experimental Latin square design that controls the effects of extraneous variables. With this methodology, different interfaces can be evaluated in the non-store-based pilot projects, and different locations in the store-based pilot projects implementation, controlling extraneous variables such as seasonality, customer profiles and store-specific characteristics. Finally, the academic and managerial contributions to retailers, consumers and technology companies are highlighted, as well as limitations and avenues for future research.

Keywords: Smart retailing technologies; Brand leadership; Market performance; Word of Mouth; Latin Square Design; Pilot implementation.

1. INTRODUCTION

Technological development and digitization have provided new ways of working, prospecting and approaching consumers, and influencing customer experience along his consumer journey in many industries, including retail. Retailers tend to sell their products in physical stores and e-commerce formats such as websites and apps (Pratas & Brito, 2019), and are adopting omnichannel operations as a survival requirement after the Covid-19 pandemic (Briedis et al, 2021), ensuring that consumers buy what, where, how and when they want.

Smart retailing technologies can differentiate and create memorable shopping experiences in the omnichannel environment. Retailers must invest in technologies that influence the buying process when the consumer researches a product immediately before purchase (Hall & Towers, 2017), and ensure that physical stores remain relevant. Smart retailing technologies allow innovation and

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enhance the consumer experience, collect data, and customize offers, and disrupt its omnichannel operation ensuring that physical stores remain relevant for consumers (Pratas & Amorim, 2022).

The technologies available to retailers have never been so many and so advanced (Inman & Nikolova, 2017). However, the decision to adopt them has never been so difficult due to the high costs and complexity involved (Pantano et al, 2018). The companies with the most significant technological knowledge of smart retailing innovation ecosystem are Microsoft, Google, Amazon, eBay, and Alibaba (Tsai et al, 2019). But retailers' adoption of smart retailing technologies involves uncertainty, significant investments, and extensive planning processes (Bock et al, 2016). This way, retailers tend to carry out pilot projects in a limited sample of stores (or customer groups) before adoption at a larger scale. After a positive pilot project evaluation, they move to the rollout phase for all the stores (or the total customer base). However, the methods and metrics used to analyze the cause-effect relationship between the smart retailing technologies implementation and the results for retailers are very different and heterogeneous between studies.

This work intends to present a framework to measure the impacts of smart retailing technology pilot implementation using appropriate methods and metrics. The results from the analysis will allow the decision-making process of rolling out these technologies to other stores of the retail chain and adopting these technologies by the total customer base.

The proposed method is Latin Square design, an experimental design type used in statistics to control for the effects of extraneous variables in an experiment. This method allows the manipulation of smart retailing technology implementation, managing the impact of extraneous variables that influence the results. The results evaluation uses metrics based on retailer brand leadership perception, market performance and word-of-mouth.

2. LITERATURE REVIEW

Smart retailing involves using technology and data analysis in several retail operations and processes as customer experience, supply chain management, and decision-making. It aims to offer customers a seamless and omnichannel shopping experience by integrating online and in-store shopping and gathering and analyzing data to optimize retail processes and inform business decisions. It involves organizational routines that influence data collection and mining methods affecting two-way communication, knowledge transfer between retailers and consumers, and customization of products and services (Leitner & Grechenig, 2009). It also allows the consumers access to retailers' products and services where, when and how they want (using an Internet connection), and the salesperson support need minimization in several buying processes (Pantano et al, 2018). Due to the challenges posed by the "new" online touchpoints, and the consumer behavior evolution based on convenience, price, choice and accessibility search reinforcement, smart retailing can be a component of physical stores' response to these developments (Hafner et al, 2021).

Smart retailing technologies can also minimize "pain points" in consumer experiences at physical stores, such as long checkout lines, lack of help from employees, difficulty in knowing the location of products in the store, and little to no product information (Langdoc & Joliet, 2021).

2.1. Smart retailing technologies examples

Many smart retailing technologies have been developed in recent years (Pratas et al, 2022) as tools for retailers to evolve. Although smart technologies in retail are constantly development, the following smart retailing technologies have been reported to be leading retailers' adoption: a) Metaverse, virtual worlds, apps, digital mirrors and smart fitting rooms; b) Cashierless stores and payment technologies; c) Smart shelves; d) Digital signage and pervasive displays; e) Smart shopping carts, robots and shopping assistants; f) QR codes; g) Targeted and personalized advertising using facial recognition and other consumer's data; and h) Mobile loyalty cards and mobile couponing.

Metaverse, virtual worlds, apps, digital mirrors and smart fitting rooms

The first type of smart retailing technology relates to the metaverse, virtual worlds, apps, digital mirrors, and smart fitting rooms. Metaverse is a virtual world or universe that exists beyond the physical realm and is inhabited by people or avatars' digital representations. It can be seen as a convergence of physical and digital worlds, where individuals can interact with each other and engage in various activities such as gaming, socializing, education, and commerce (Abbate et al, 2022). This concept was the base for the ideas of virtual worlds and augmented, virtual and mixed reality. A virtual world is a computer-based simulated environment that multiple users can inhabit. It is a three-dimensional, interactive digital space where users can engage in activities, communicate, and create objects and avatars that represent themselves (Castronova, 2005). Augmented reality is a technology that enhances the perception of the real world by overlaying digital information on the physical environment (Azuma, 1997). Typically involves using a device such as a smartphone or a tablet camera to display digital content, including images, videos, sound, and other sensory information. Virtual reality, on the other hand, refers to realistic or imaginary environments' computer-generated simulations that can be experienced and interacted with through various input forms, allowing users to feel as though they are physically present in a virtual environment (Sherman & Craig, 2003). Mixed reality is a term used to describe a continuum of digital and physical environments that merge to create a single, seamless experience (Milgram & Kishino, 1994). Retailers and manufacturers use these technologies in mobile apps, touch screens, digital mirrors, and smart fitting rooms. Mobile apps permit products and services presentation, a customized relationship between customers and the brand, and personalized offers. Examples include the IKEA

Place app, Olay’s Skin Advisor, Sephora Visual Artist app, Tiffany’s Engagement Ring Finder app and RayBan Virtual Try-On. IKEA Place app virtually places furnishings in customers’ spaces. Olay’s Skin Advisor analyzes the consumer’s skin age using a selfie photo and gives customized recommendations for each consumer. Sephora Visual Artist app tests the makeup virtually on consumers, scan their face and match products with consumer’s skin tone and sit at digital workstations to attend classes on cheekbones know (Pratas et al, 2022). Tiffany has Engagement Ring Finder App that allows testing the perfect ring, and RayBan has a Virtual Try-On that allows trying on glasses and sunglasses (Pantano et al, 2018). Tan et al (2022) found that virtual reality usage on the retailer’s app is related to higher sales of less known brands, more expensive and less known products, and has stronger effects on customers new to the online channel or product category. Mobile apps also allow using geolocation to find the nearest store in the area, check its opening hours and facilities, and product categories inside the store layout. Some examples are the most prominent retailers such as Walmart, Tesco, and Target geolocation technology. Digital mirrors and fitting rooms typically permit electronic orders, make-up, and clothing "virtual trying-on", recommend accessories to complement an outfit, and let customers submit images of themselves wearing new clothing to social media (Pantano & Naccarato, 2010). As an illustration, Rebecca Minkoff boutiques have touchscreen digital mirrors that let shoppers explore clothing options and find inspiration. Then, customers can try them on in an interactive changing area with adjustable lighting. RFID technology is used in the fitting rooms' mirrors to track what consumers are trying on and inform them of available colors and sizes (Morgan, 2019; Pratas et al, 2022). Fashion retailers also use these technologies so their guests can participate remotely in fashion and virtual shows (Deloitte 2016; Grewal et al, 2017). According to Accenture’s study Consumer Pulse Survey 2022, 83% of consumers are interested in buying using the metaverse, and 42% of survey respondents said they have already done webrooming in virtual retailers when shopping for a physical item (Accenture, 2022).

Cashierless stores and payment technologies

The second type of smart retailing technology relates to cashierless stores and payment technologies. Cashierless stores use cameras, sensors, and self-shelves minimizing human interaction and being entirely computer-based and digital (Gazolla et al, 2022). With the Amazon Go store opening in Seattle in 2018, Amazon pioneered using these technologies, namely with totally automated checkouts. Customers might enter the store, choose their items, and leave using an app connected to a credit card without standing in checkout queues (Ives et al, 2019; Morgan, 2019). Other retailers are also using the "Just walk out" technology created by Amazon Go. It tracks the items customers take (or put back on) the shelves and records them in a virtual cart. After finishing their shopping, consumers can leave the store, and the products in their virtual cart will be charged to their credit card (Amazon, 2021). Other start-ups and established retailers are developing similar technologies.

A new Swedish retailer called Lifvs operates locations in isolated rural areas. The stores have no checkouts, are very small, and only two people can be in the store simultaneously. Shoplifting is reduced since the client uses the firm's app to open the door, and the company is always aware of who is inside the store (Savage, 2021). These stores are in remote rural areas where there is a low demand, which makes impossible to have human resources permanently to be profitable. Tesco opened its first cashierless store in London in 2021. Other examples such as Pingo Doce and Go Nova and Continente Labs stores, developed by Portuguese retailers Continente and Pingo Doce, are located near universities in Lisbon, opened in 2019 and 2021, respectively, and are serving as pilots to analyze these cashierless stores concept. Self-checkouts and self-scanning technologies are widespread. Since the advent of self-checkout equipment in 1992, customers can pay for their products without speaking to a cashier (Grewal et al, 2017). Consumers are using self-checkouts in smaller baskets (NCR Corporation, 2014). Customers and retail staff may check pricing, expiration dates, inventory levels and complete a sale anywhere in the shop thanks to self-scanning technologies such as mobile phones, tablets, scan-and-go technology, and handheld scanners, reducing lines at checkout counters (Grewal et al, 2020). Credit and debit cards, cash, mobile payments apps (such as Apple Pay, Google Pay, Samsung Pay), gift cards, loyalty cards and online bank transfers are the most common retail payment forms. Smart payment systems are based on near-field communications, Wi-Fi, or Bluetooth technologies (Menezes & Pinto, 2017), enabling transaction systems organized by financial institutions within a legal and monetary framework. The difference between regular payments is mainly the use of data. Smart payments, which employ mobile devices or a user's biometric traits to make purchases, include biometric and mobile payments (Stieninger et al, 2021). One illustration is Tesco, where Tesco Pay+ app users can already utilize their native device's fingerprint or face biometrics (Burt, 2022). Payments can also be made via apps that produce QR codes that can be scanned at the checkout in physical or virtual stores. Retailers are implementing this technology, including Walmart’s Walmart Pay and Target’s Target Wallet apps (Staff, 2019). Recently, some retailers have also started to accept cryptocurrencies and non-fungible tokens (NFTs) as a form of payment for goods and services, providing a secure and decentralized way to transfer value.

Smart shelves

The third type of smart retailing technology relates to smart shelves, an application of the Internet of Things in retail. They use sensors, cameras, and other technologies to monitor the products’ stock level on a shelf and customer behavior. The information collected by smart shelves improves inventory management, reduces waste, and enhances the customer shopping experience. Smart shelves can also detect and prevent theft, track customer preferences and purchase history, and generate sales reports. These shelves are typically connected to the internet and can be controlled and monitored remotely, making them a valuable tool for retailers looking to improve efficiency and boost sales (Kellermayr-Scheucher et al., 2022). Kroger is one retailer that is testing smart shelves. When a shopper enters an aisle while the Kroger app is open, the app can offer personalized pricing, let the shopper know if the items in the aisle are on his shopping list, or even make product recommendations based on previous customer purchases. To manage inventory and guarantee price compliance, some retailers also use and test self-scanning robots (Morgan, 2019).

Digital signage and pervasive displays

The fourth type of smart retailing technology relates to digital signage and pervasive displays. Digital signage in retail stores refers to using digital displays and multimedia technology to communicate with customers. Some common types are LCD and LED displays, video walls, inter-active kiosks, and digital menu boards. Retailers can easily and quickly update multimedia content on digital displays and signs inside the store or in shop windows and facades (Keränen et al., 2005). Pervasive displays in retail stores refer to digital displays' integration into various shopping experience aspects, such as shelves, walls, and even clothing, allowing an immersive and interactive customer shopping experience. Pervasive displays can be used for various purposes, including product information, promotional offers, virtual try-on experiences, and in-store navigation. They can also be linked to other digital devices, such as smartphones and tablets, providing a seamless and customized shopping experience. Additionally, association rules may change price levels, based on existing product stocks, the climate, or an event taking place that day (Stieninger et al, 2021). Shoppers tend to answer to contents and information that address their immediate tasks and needs (Burke, 2009).

Smart shopping, robots and shopping assistants

The fifth type of smart retailing technology relates to smart shopping, robots, and shopping assistants. Smart shopping cart systems typically include a central server and at least one tablet computer for a computerized shopping cart (El Mahboul, 2014). The tablet computer's RFID reader reads the barcodes of the items loaded onto the cart. They are usually used to provide details about the next item on the customer's shopping list, to receive personalized advertising or information content, or to finish the checkout process (Inman & Nikolova, 2017). For instance, to introduce computer vision-enabled shopping carts at a Cincinnati supermarket, Kroger collaborated with artificial intelligence company Caper. Shopping carts have several useful features, including calculating totals, offering suggestions, and accepting payment for groceries right on the cart (Brown, 2021). Humanoid robots can be present physically in stores or mobile apps. They serve to assist customers by giving information about products and promotions, creating a shopping cart, locating products in store, checking products at the store, recommending items to customers based on historical data about their purchases or other personal characteristics, assisting payment activity, comparing gift packaging prices and dispensing coupons (Bertacchini et al, 2017; Stieninger et al, 2021).

QR Codes

The sixth smart retailing technology type relates to QR Codes. QR codes, which stand for "Quick Response codes", are two-dimensional images that, when scanned by the camera on a smartphone, cause the device to open a URL, a text, a video, or an image (Coleman, 2011). QR codes are cost-effective, highly versatile, simple to implement and allow for easy results measurement. Product packaging, in-store displays, flyers, brochures, catalogues, billboards, posters, TV, magazines, and other offline advertisements are just a few communication mediums that can use QR codes. QR codes allow access to information about a product or service, corporate websites, social media pages, or online stores (where they can buy the products they want), make mobile payments and participate in interactive and engaging experiences, such as product demonstrations, quizzes, or games (Albastroiu & Felea, 2015). They can also prevent counterfeit products, see the product's supply chain if link with blockchain records, and increase cashless payments in-store or on websites and apps. Amazon recently bet in QR codes, opening a 30.000 square foot clothing store in Los Angeles. Amazon Style outlet uses QR codes to allow customers to view product sizes, colors, and ratings. The customer can also place orders for other products via touchscreens in fitting rooms. Several other examples exist, namely in terms of retailers and manufacturers' communication using QR codes to promote information and virtual worlds linked to their product packaging.

Targeted and personalized advertising

The seventh smart retailing technology type relates to targeted and personalized advertising based on consumer data. Personalization is made possible by several consumer-facing retail technologies, which also aid in preventing underage customers from purchasing alcohol. Facial recognition enables personalized recommendations, offers, advertising and information based on customer data (Riegger et al, 2021). These technologies are based on artificial intelligence-powered algorithms, 3D cameras and computer vision. One example is the technology that is being tested by Tesco, Coop, Asda, Aldi and Morrisons to estimate the facial age of customers when purchasing Challenge 25 products. It is intended that technology facilitates alcohol sales faster than manual checks, also avoiding aggressive behaviors toward retail workers (Iddenden, 2022).

Mobile loyalty cards and couponing

The eighth type of smart retailing technology relates to mobile loyalty cards and couponing. Over the past few years, loyalty programs have shifted towards being based on mobile apps, using capabilities related to virtual reality and blockchain technology (Deloitte, 2017). Mobile loyalty cards replace physical loyalty cards, and mobile coupons are linked to retailers' apps use and sustainability issues. Mobile coupons can be redeemed at the store or online (Mobile Marketing

Association, 2007). Some stores in the US have a loyalty kiosk at the entrance of the stores that allow customer registration in the loyalty program, loyalty card activation, loyalty points or balances checking, and access to customized marketing messages, advertisements, and special promotions (Smith & Potter, 2010).

2.2. Metrics to assess smart retailing technologies impact.

Based on the smart retailing technologies presented, it is essential to present scales that measure three fundamental variables to perceive the importance of the subject: brand leadership, market performance and word-of-mouth.

Brand leadership is a brand's capability to consistently achieve excellence using supportive brand processes (Aaker and Joachimsthaler, 2000). It involves the audience's perception of a strong, recognizable, innovative, updated, and dominant brand's position in the market (Miller & Mills, 2011; Pratas et al, 2022). Chang & Ko (2014) developed a brand leadership scale based on quality, value, innovativeness, and popularity as components. Each component is evaluated with three sentences that relate the evaluated brand to its competitors, using a seven-point Likert scale ranging from (1) 'Strongly Disagree' to (7) 'Strongly Agree' – see Table 1.

Brand leadership scale: components - adapted from Chang & Ko (2014)	1) Quality	***"When compared with other competing stores (or retailers), this store (or retailer)":*** 1.1.) Is higher in quality standards. 1.2.) Is superior in quality standards. 1.3.) Offers higher quality store features.
	2) Value	***"When compared with other competing stores (or retailers), this store (or retailer)":*** 2.1.) Is reasonably priced. 2.2.) Has better course features for the price. 2.3.) Offers more benefits for the price.
	3) Innovativeness	***"When compared with other competing stores (or retailers), this store (or retailer)":*** 3.1.) Is more dynamic in improvements. 3.2.) Is more creative in products and services. 3.3.) Is more of a trendsetter.
	4) Popularity	***"When compared with other competing stores (or retailers), this store (or retailer)":*** 4.1.) Is more preferred by consumers. 4.2.) Is more recognized by consumers. 4.3.) Is better known among consumers.

Table 1 – Brand leadership scale components.

Market Performance can assess the results of an organization's marketing activities, including smart retailing technologies adoption. It can be measured using a scale that includes increased awareness, positive brand image, new customers, higher customer satisfaction, loyalty, and market share as components (Schmidt et al, 2017). A seven-point Likert scale ranging from (1) 'Strongly Disagree' to (7) 'Strongly Agree' is used to measure each component – see Table 2.

Market performance scale: components – adapted from Schmidt et al (2017)	1) Among our target groups, the awareness of our retail stores brand is high. 2) The image of our retail stores brand is positive. 3) We constantly win new customers. 4) Our market share is high. 5) Our customers show a high loyalty towards our retail stores brand. 6) Our customers show a high satisfaction with our retail stores brand.

Table 2 – Market Performance scale components.

Word-of-mouth (WOM) is another metric related to smart retailing technologies adoption. Consumers frequently turn to private information sources to lessen the uncertainty surrounding their purchasing decisions and are influenced by social pressures to conform (Baker et al, 2016, Sweeney et al., 2012). Brand leadership and word-of-mouth elements also have a positive relationship (Chang et al., 2016). We have modified the seven-level scale of Chang et al. (2016) to measure WOM recommendation intention using the semantic differential approach – see Table 3.

Word of mouth recommendation intention scale: components – adapted from Chang et al (2016)	My future intention to recommend this retailer and this smart retailing technology to important others is: 1) Impossible / Possible 2) Very unlikely / Very likely 3) Improbable / Probable

Table 3 – Word-of-mouth recommendation intention scale components.

2.3. Pilot project experimentation and statistical methods to assess impacts.

Pilot project experimentation refers to testing and evaluating a smart retailing technology on a small scale before implementing it more broadly. This pilot project is based on the relevance and pertinence of the results of the studies developed by Chang & Ko (2014), Schmidt et al, 2017 and Chang et al., 2016, and it is proposed the conceptual model presented in Figure 1. It allows retail organizations to assess a new initiative's feasibility, effectiveness, and viability in a controlled and manageable environment. The pilot project provides an opportunity to identify and address any challenges or issues before scaling up, reducing the risk of a larger-scale implementation failure.

To correctly assess the pilot project experiment impact, it is necessary to define the objective clearly and choose the appropriate variables and metrics to measure. Controlling extraneous variables is essential because they can affect the results leading to wrong conclusions. These variables can produce false or misleading results if not controlled or accounted for, as they can influence the experiment's outcome in ways that are unrelated to the independent variable being tested.

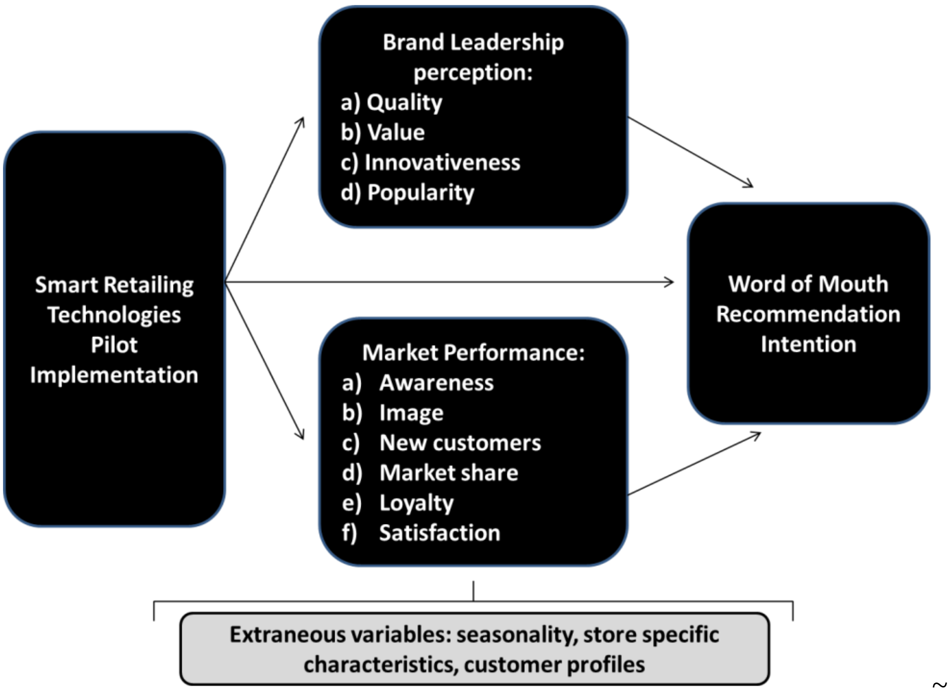

Figure 1 – The conceptual framework model

The framework proposal, presented in Figure 1, is a prevalent type of statistical design called Latin square design. The Latin square design is often used when a researcher wants to control for the effects of two or more sources of variation in an experiment. To measure the effect of a treatment, researchers often use statistical analysis to compare the outcomes of the treatment group to a control group. They may use various measures of effect size, such as the mean difference, the effect size coefficient, or the odds ratio, to determine the magnitude of the treatment effect. They may also use inferential statistics, such as a t-test or an ANOVA, to determine whether the treatment effect is statistically significant.

Nordfält et al (2014) used Latin Square design and studied in-store marketing experiments addressing in-store signage, display organization, product location, retail atmospherics, and merchandise demonstration effects. They found that digital screens and signage attract customers toward merchandise and shopping aisles. Other studies have also used this method to analyze the impact of packaging nutrition labels (Hamlin et al, 2014).

3. GENERALIZATION OF THE MAIN STATEMENTS

A pilot project implementation in retail can be seen as a controlled experiment done in limited but carefully selected test markets, such as stores or a sample of customers. If successful, it generally involves replicating and adopting the experiment in all other stores or customers as a marketing action of the retailer.

In the proposed framework, causality applies when the smart retailing technology implementation by a retailer increases the probability of growing brand leadership perception, market performance indicators or word-of-mouth recommendation intention. The two significant objectives of pilot projects implementation are to determine market acceptance of the new smart retailing technology and to test alternative "levels" or operationalizations.

In the retail industry, several extraneous variables such as seasonality, user interfaces, customer profiles, and store-specific characteristics can affect the impacts of smart retailing technology on brand leadership perception, market performance indicators or word-of-mouth recommendation intention assessment.

The data collection instrument should be the questionnaire, and the questions and scales should regard brand leadership, market performance, and word-of-mouth recommendation intention components. The number of customers and market share should be analyzed based on the total customer base that visited the store after the smart retailing technology implementation (using secondary information sources).

Omni-channel retailers can have two generic situations: non-store-based smart retailing technologies such as those used in mobile apps or websites, and store-based smart retailing technologies. In Table 4 it is presented information about the variables that should be used in the questionnaire.

In non-store-based smart retailing technology pilot implementation, it is proposed a design a table, with the extraneous variables of seasonality (week) and customer profile. It will be analyzed three weeks (n, n+1, and n+2), and three customer segments (1, 2, 3) – see Table 5. The treatments can be designated as "A - No smart retailing technology", "B-User interface α", and "C-User interface β".

Variables	Non-store-based	Store-based
Independent variable	Smart retailing technology implementation	Smart retailing technology implementation
Experiment	App or website with smart retailing technology with interface α, interface β, or no smart retailing technology. 3 “levels”: user interface α, user interface β, and no smart retailing technology.	Smart retailing technology in the entrance of the store, smart retailing in the shelfs of promoted products, or no smart retailing technology in the store. 3 “levels”: smart retailing technology in the entrance, smart retailing technology in the shelf, and no smart retailing technology.
Dependent variables	Brand leadership perceptions, market performance, and word of mouth recommendation intention	Brand leadership perceptions, market performance, and word of mouth recommendation intention
Test units	Customers that used the app or transactional website in the analyzed week and didn’t use it in the other analyzed weeks.	Customers that visited the store in the analyzed week and didn’t visit it in the other analyzed weeks.
Extraneous variables	Seasonality (weeks), customer profiles	Seasonality (Weeks), store specific characteristics
Seasonality	Week – analysis in week n, (n+1) and (n+2)	Week – analysis in week n, (n+1) and (n+2)
Customer Profiles	3 “Levels”: Segment 1, Segment 2 and Segment 3.	(-)
Store specific characteristics	(-)	3 “levels”: Flagship or premium stores, standard stores, and low cost or low maintenance stores

Table 4 – Non-store-based and store-based smart retailing technology implementation.

	Seasonality (Week)		
Store specific characteristics	**Week n**	**Week (n+1)**	**Week (n+2)**
Flagship or premium stores	D	F	E
Standard stores	E	D	F
Low-cost (or low-maintenance) stores	F	E	D

Table 5 – Store-based smart retailing pilot implementation latin square design.

The results will allow measuring the differences of smart retailing technologies in store's entrance and on the shelves of promoted products versus no smart retailing technology implementation, eliminating store-specific characteristics and seasonality.

To measure the effects of "D - No smart retailing technology", "E – Smart retailing technology in the entrance of the store", and "F – Smart retailing technology in the shelves of promoted products" treatments, the proposal is to use an analysis of variance (ANOVA) to determine whether there are any significant differences in the means of the treatments.

4. DISCUSSION

This research has theoretical and managerial contributions. In recent academic studies, the analysis of smart retailing technologies has focused on retailers' cost-benefit analysis, associated risks, and customer acceptance of technologies. Other studies have referred to positive impacts in the disruption's degree, valuable data gain, staff savings and personalized shopping experiences. The negative impacts that have been appointed are the high cost of implementation, maintenance intensity, error-proneness, privacy concerns, customer acceptance risk and reduced contact with the customers (Hafner et al, 2021). Despite this extensive list, to the best of our knowledge, the impacts of smart retailing technologies adoption in terms of competitive advantage to retailer brands are not referred to.

The first academic contribution of this framework is to measure smart retailing technologies pilot implementation using metrics such as brand leadership, market performance and word of mouth that can capture this competitive advantage over competitors using a simple survey.

The second academic contribution relates to the proposed method to evaluate the pilot project implementation. Generally, smart retailing technologies tend to be tested in pilot projects in limited samples before the rollout process to other stores or customers. The proposed method, based on the Latin Square design, allows a correct measurement of pilot implementation, controlling two non-interacting extraneous (or external) variables. Thus, retailers have a method that will control extraneous variables such as seasonality, store-specific characteristics, customer profiles, or other variables that may confuse the results and provide wrong conclusions for retail managers.

The third academic contribution is evaluating non-store-based and store-based smart technologies implementation. A model was proposed for each situation. For non-store-based technology implementation, two alternative interfaces are evaluated and compared with no smart retailing technology implementation, controlling customer profile and seasonality as extraneous variables. For store-based technology implementation, two alternative locations of smart technology in the store (at the store's entrance or the shelves of promoted products) can be evaluated and compared with no smart technology implementation, controlling store-specific characteristics and seasonality as extraneous variables.

This study also has managerial implications. Retailers can correctly evaluate the impact of smart retailing technologies pilot implementation in consumers' perception and positioning about quality, value, innovativeness, popularity, market performance measures such as awareness, image, new customers, market share, loyalty and satisfaction, and word of mouth and recommendation intention. In non-store-based technology, retailers evaluate the incremental effects in these variables of two different interfaces versus no technology implementation, deciding to roll out the technology or not, and choose the best interface option for the rollout process. In store-based techno-logy, retailers evaluate the results of smart retailing technologies implementation at the store's entrance or on the shelves of promoted products versus no technology implementation and decide whether to roll out or not the technology by choosing the best location. This will allow investing only in the smart retailing technologies that benefit retailers, choosing the best implementation possibility. The evaluation using pilot implementation projects also allows testing of a significant number of smart retailing technologies in a short time, rolling them only when the positive results increase the retailer's perception in customers' minds and performance measures, reducing the investments of the rollout phase.

This study also has advantages for consumers. Through the proposed methodology, retailers can implement the preferred options of consumers and roll out smart retailing technologies more quickly to their entire network of stores or customer base. This implementation can enhance customer experience, making them more autonomous with active participation. Thus, taking into consideration the competition is possible to understand which attributes are most valued by customers when new technologies are adopted and if these attributes have a real impact on key variables in business performance. It also allows not to implement the smart retailing technologies that consumers don't evaluate positively, avoiding unnecessary costs and their potential consequences on prices paid by consumers. Some customers may think that new smart retailing technologies are not worth it or have adverse effects, such as losing personal contact between customers and employees, making the shopping experience more impersonal, and losing service characteristics such as empathy and promptness (characteristic attributes of services).

This study also has advantages for technological companies. The proposed model can easily measure the pilot implementation results, giving visibility to the developed smart retailing technologies and enhancing the pace of implementation of the rollout phase. This visibility can also allow the communication of the results to other retailers, increasing their interest in implementing a pilot project.

However, this study has several limitations and avenues for future research that should be highlighted. Regarding limitations, no importance is defined for each component of brand leadership, market performance and word-of-mouth recommendation intentions. Thus, if the indicators have opposite results, the retail managers must determine the most critical element to decide whether to roll out or not and choose the best implementation option. This model doesn't also have an economic cost-benefit analysis. It only focuses on brand leadership, market performance and word-of-mouth recommendation intentions. However, retailers adopt new technologies to improve the customer experience and their image, positioning, and preference over competitors. The economic cost-benefit analysis can be done in a complementary way.

In terms of avenues for future research, enriching the used metrics in the long time (such as retailer's brand equity and brand trust) and different smart retailing technologies can be measured as technological developments occur. Other extraneous (or external) causal variables can also be analyzed beyond seasonality, customer profiles and store-specific characteristics. Using a structural equation modelling, it also seems interesting to establish a relationship between brand leadership, market performance and word of mouth, and mediator factors (or extraneous variables).

5. CONCLUSIONS

This work conceptually developed a framework for measuring the impacts of smart retailing technologies on brand leadership, market performance and word-of-mouth recommendation intentions through different pilot implementations. A literature review on the subject was made, and some techniques were identified and considered to be the most incisive regarding customer experience according to the retailer's objective. These technologies can be adopted by retailers in their stores (physical and non-physical formats) and have several benefits to achieve higher consumer satisfaction and competitive advantages over competitors. However, these smart retailing technologies tend to have high implementation costs, so tests tend to be carried out in a limited sample of stores or customers through pilot project implementation. If the pilot project implementation is successful, a rollout to other stores and customers is made. The main problem arises with the metrics and methods used to assess smart retailing technologies' impact because different metrics and methods tend to be used by retailers. Simultaneously, several methods don't differentiate extraneous (or external) variables such as seasonality, customer profiles, or store characteristics impacts from smart retailing technologies implementation.

Based on this, a framework was developed to identify some metrics, such as brand leadership, market performance and word of mouth, to assess this impact. These metrics were not considered in previously developed frameworks. For the methodologic approach, a Latin Square design was proposed to analyze the pilot implementation that should be done to establish the cause-effect relationship found in the pilots, controlling non-interacting external variables. An extensive set of smart retailing technologies pilot implementations can be evaluated. We have conceptually presented these smart retailing technologies, and a set of implementation examples was referred. This framework also allowed the establishment of different methods to assess smart retailing technologies in physical stores (store-based), or non-store-based such as apps or websites, with different implementations, and can be used to analyze the smart retailing technologies' implementation pilot projects' success.

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