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This is an **author produced version** of a paper published in:

International Journal of Retail & Distribution Management 51.4 (2023): 546-566

DOI: <https://doi.org/10.1108/IJRDM-03-2022-0088>

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Technology: A Strategic Imperative for Successful Retailers

Abstract

Purpose: In the aftermath of the COVID-19 pandemic, technology is rewriting the way consumers shop as well as the retail operating models. In this context, investment in new technologies is a strategic imperative for retailers striving to remain relevant and profitable. Using Kahn’s Retail Success Matrix (2018) as our conceptual framework, the aim of the study is to propose a classification of emerging technologies based on their potential for sustaining retailers’ competitive strategies.

Design/methodology/approach: Following an initial qualitative study based on in-depth interviews and focus groups with 20 retail managers, we collected survey data from a sample of 168 retail and technology professionals. To achieve the research objectives, we carried out content, descriptive and multiple correspondence factor analyses.

Findings: The data analyses result on a map that plots the technological solutions that retail experts identify as enablers of four key competitive strategies: product superiority, enhanced customer experience, frictionless shopping experience and operational excellence.

Practical Implications: This research work provides valuable insight into how retail companies can capitalise on technology to create or reinforce their competitive positioning. The framework acts as a guide for retail companies to assess their technology priorities.

Originality/Value: This exploratory empirical study is the result of a collaboration between academic researchers and retail professionals. Thus, it addresses challenges experienced by key stakeholders. Our encompassing classification enables a better understanding of the impact of technology on retailers’ competitive positioning.

Keywords: retail technology, frictionless shopping, customer experience, operational excellence, competitive advantage, retail strategy, COVID-19.

Paper type: Research paper

1. Introduction

The retail sector is experiencing a revolutionary transformation where retailers that embrace technology as an enabler of competitive advantage are poised for success (Roggeveen and Sethuraman, 2020; Grewal et al., 2021b). With customers having ever-increasing options for researching and buying new products and services, retail firms are deploying technologies that support the integration of offline and online channels and enhance the shopping experience (Grewal et al., 2020). As a result, today's shoppers can order online via voice assistants, use augmented reality to try on products virtually, have packages delivered by autonomous vehicles and drones or buy in cashier-less stores. In this environment, the COVID-19 pandemic became a catalyst for technology adoption (Shankar et al., 2020), presenting firms with new challenges but also opportunities to rethink their business models and generate novel value propositions (Pantano et al., 2020; Donthu and Gustafsson, 2020).

Given the vast array of retail technologies available, firms risk investing in technological solutions without enough insight into their strategic fit (Inman and Nikolova, 2017), which might be especially harmful in the current scenario of energy scarcity and high inflation. As Willems et al. (2017, p. 229) noted, "technology in retailing is and should remain a means to an end". On this point, the extant literature highlights the need for more in-depth research on the usage of technology as a driver of new marketing strategies (Hoffman et al., 2022; Kumar, 2018; Roy et al., 2018; Verhoef and Bijmolt, 2019), which remains an area of investigation worthy of continued exploration (Gauri et al., 2021; Grewal et al., 2021a). This exploratory study contributes to current scholarly calls by proposing a classification of technologies based on their potential for sustaining retailers' competitive strategies.

Moving service research forward requires researchers to collaborate more – and more effectively – with practitioners (Ostrom et al., 2021). In this vein, the 7th Retail Forum, which took place in [name hidden to ensure blind review] in 2019, sparked the need for an investigation developed jointly by academics and retail executives to deepen the understanding of the opportunities and challenges posed by the technologies that were reshaping the industry. Thus, this study has a real-world focus (Moorman et al., 2022). Specifically, it addresses the following research question: which are the technological solutions that retail experts identify as enablers of a superior competitive advantage?

Although technology may serve as a point of differentiation for retailers (Savastano et al., 2019; Reinartz et al., 2019; Sethuraman and Parasuraman, 2005), to the authors' knowledge there are no prior empirical studies that have typified emerging technologies in terms of their potential to reinforce retailers' competitive strategies. To explore how retailers evaluate new technologies, we draw from Kahn's (2018, 2021) conceptualization of retail strategies, which states that customers trust successful retailers because they provide the goods and services that shoppers desire, while offering a better shopping experience than their competitors, and identifies four competitive strategies: product superiority, enhanced customer experience, frictionless shopping experience and operational excellence.

While existing research tends to focus on the impact of individual technological solutions (e.g.: Boudkouss and Djelassi, 2021; Bonetti et al., 2019; Mosquera et al., 2018), only a small number of studies incorporate an inventory of emerging technologies into a common framework (e.g.: Hoyer et al., 2020; Grewal et al., 2020; Roggeveen and Sethuraman, 2020; Linzbach et al., 2019; Reinartz et al., 2019; Pantano & Vannucci, 2019; Willems et al., 2017). A few of these studies take the retailers' perspective to categorize technologies. Despite their interest, most of them resulted from a screening of secondary data sources (e.g., Roggeveen and Sethuraman, 2020; Linzbach et al., 2019; Reinartz et al., 2019; Willems et al., 2017; Wolpert and Roth, 2020). Only Grewal et al. (2020) created their typology of in-store technologies based on interviews with seven key informants in the retail sector.

We built an inventory of retail technologies from a qualitative study aimed at managers and then assessed its merits in a survey. In both studies, participants were retail and technology professionals. Our research design takes advantage of the strengths of a mixed methodological approach (qualitative and quantitative), contributing to co-create relevant knowledge with practitioners while offering retailers a theoretical framework for their technology investments. The results suggest that retailers looking to support the experiential components of the shopping journey should consider investing in 3D printing, mixed reality and conversational platforms. Retail firms willing to remove obstacles from the purchase process should focus on voice assistants, advanced payment methods, in-store self-service solutions and geo-fenced, personalized offerings. Finally,

to enhance retailing operations and deliver superior efficiencies, companies could explore blockchain technology, AI-powered dynamic pricing and autonomous vehicles.

The rest of this article is organized as follows. In the first section, we review previous typologies of retail technologies and present the theory that underpins our classification. In the methodology section, we describe the empirical analyses. The third section is dedicated to the discussion of our results. The final section offers conclusions, limitations and future research pathways.

2. Theoretical framework: A classification of emerging retail technologies

Today's hyper-connected consumers expect excellent customer experience regardless of where they shop (Sebald and Jacob, 2020; Flavián et al., 2020; Goode and Main, 2019). In turn, retailers are pursuing omnichannel retailing, digitizing their stores with advancements like augmented reality (AR), in-shop navigation, geo-fencing, facial recognition, and smart dressing rooms (Bonetti et al., 2019; Mosquera et al., 2018; Grewal et al., 2017).

From a back-end perspective, current advancements in technology have the potential to facilitate retail operations related to supply chain, logistics and assortment planning in unprecedented ways (Roggeveen and Sethuraman, 2020; Willems et al., 2017). Sensors, blockchain technology, robots and autonomous vehicles are transforming how goods are tracked, stocked, and moved (Mollenkopf et al., 2020). Likewise, thanks to the Internet of Things (IoT), mobile technology and predictive analytical technics, companies can collect and interpret an immense amount of structured transactional data as well as unstructured behavioural data (Hofacker et al., 2016; Linzbach, 2019). As a result, retailers can reach their target consumers more efficiently and conveniently while delivering highly personalized products and offers.

Advances in technology not only make shopping more convenient and/or fun, but they also change the way customers interact with frontline employees (Grewal et al., 2020), thus impacting the codelivery of the retail service (Ostrom et al., 2021; Meyer et al., 2022). For example, in-store self-service technologies allow customers to perform the service traditionally provided by the store associates (Demoulin and Djelassi, 2016), changing the shopper-provider touchpoints substantially, and therefore the customer perception of the shopping journey (Verhoef, 2017).

The coronavirus pandemic made self-service technologies particularly relevant. The fear of infection pushed consumers towards contactless shopping and delivery that reduced exposure to the virus. Whilst many customers felt that e-commerce was the more convenient and safer shopping channel, the shoppers who remained loyal to the brick-and-mortar stores adopted solutions that reduced physical, in-store interaction (Akhtar et al., 2020), such as virtual try-on tools, contactless payment methods, and automated checkout systems. In addition, click&collect services allowed customers to shop online and collect their purchases with minimal contact, either in designated locker locations or via curbside pickup.

Under this environment, retail firms were able to leverage enhancing technology as a competitive differentiator (Shankar et al., 2020). Table AI in the Appendix shows several examples. Encouraged to put health and safety at the forefront of their strategy, the retailers who were considered “essential service” providers had to adapt their operations in record time to cope with dramatic disruption in supply chains (Mollenkopf et al., 2020) while adopting service delivery protocols that were mobile-compatible, complied with physical-distancing expectations, and offered low-touch delivery services.

In short, the pandemic compelled shoppers and retailers to dramatically hasten their adoption of digital technology. However, faced with a plethora of retail technologies, firms may be challenged to identify the technology investments that have the greatest pay-off potential (Linzbach et al., 2019). In this vein, scholars have explored several avenues for classifying emerging retail technologies according to different criteria. Table I shows the key typologies developed to date.

(Insert Table I here)

Some authors categorise technologies based on the shopper perspective and the impact of technology on the customer journey (Grewal et al., 2020; Willems et al., 2017). Other studies focus on the service provider’s point of view (Hoyer et al., 2020; Linzbach et al., 2019; Reinartz et al., 2019; Varadarajan, 2010). The third strand of research integrates

both approaches and develops their inventory of technologies by considering aspects related to both shoppers' perceptions and retailers' business models (Shankar et al., 2020; Wolpert and Roth, 2020). However, as outlined in the introduction, none of them organises technology according to the potential that each technological solution has for retailers' competitive strategy.

Business organization theory suggests that to optimize the value chain, companies choose between (1) meeting basic requirements at the best price, (2) offering the best product features, and (3) providing special services that meet targeted customer needs (Porter, 1985; Porter and Kramer, 2011). In the field of retailing, technology encourages new ways of value creation because it supports a host of activities and processes that help reduce operating costs and fulfil customer needs in groundbreaking ways (Reinartz et al., 2019; Sethuraman and Parasuraman, 2005). Thus, technology has been identified as pivotal in creating a sustainable competitive advantage for retailers (Inman and Nikolova, 2017).

This study builds on the Kahn Retailing Success Matrix (2018) to offer a classification of new technologies that retailers can deploy to support a superior competitive strategy. Similarly, Gauri et al. (2021) propose a customer-centric theoretical framework for the success of retail formats grounded on Kahn (2018). However, compared to Gauri et al. (2021), who only focus on an enhanced customer experience or a frictionless customer journey, we incorporate two additional routes for success into our framework: branded performance superiority and operational excellence.

Kahn (2018, 2021) suggests that, regardless of whether a retailer's proposition is based on product benefits or improving the customer experience, retail companies excel when they either provide more hedonic benefits to their customers or eliminate pain points from the shopping experience, thereby creating a superior competitive advantage. Kahn's theoretical framework is articulated around a 2x2 matrix where the horizontal axis represents the retail proposition (product benefit or customer experience), and the vertical axis represents the source of a superior competitive advantage (increase pleasure or eliminate pain points). The resulting matrix reveals four basic retailing strategies (Fig. 1):

1. *Branded performance superiority*. Retailers who lead on brand offer products that provide more differentiation and more confidence to customers, as compared to other goods and services in the market.

2. *Enhanced customer experience*. Retailers that excel in customer experience work hard to add experiential components to shopping tasks. Thus, they provide more pleasure and excitement than other retailers can provide.

3. *Frictionless shopping experience*. Retailers who choose to lead on frictionless shopping experiences prioritize offering customers the easiest and most convenient way to shop.

4. *Operational excellence strategy*. Retailers who deliver operational excellence strategies have developed operational models that can efficiently manage inventory, keep overhead costs down, and reduce transaction costs at every step. They provide reliable products at the lowest prices and, therefore, offer customers the best savings.

Arguably, some retailers could be good examples of more than one strategy. According to Kahn (2018), “leadership depends on offering superior value in two quadrants and meeting fair value in the other two” (p. 13). This means that leading retail firms excel in one of these four strategies and build on that particular competitive advantage, to have a strong positioning in one or more of the other three.

(Insert Figure 1 here)

Unlike our study, Khan (2018) does not “use actual data to plot these [retail] strategies, rather [uses] the tool as a way to communicate the four strategic choices simply and clearly” (p.15). We build on the graphic mechanism provided by Kahn (2018) and use empirical data to plot which technologies best enable each of these four strategies.

3. Empirical study

To carry out this empirical study, a mixed-approach design was used, taking advantage of the strengths of qualitative and quantitative methodologies.

3.1. Qualitative study

3.1.1. Methodology

The qualitative study comprised both in-depth interviews and focus groups, which involved “soliciting from study participants – the theory holders – the ideas they think are important and how they are linked to one another” (Zeithamal et al., 2020, p. 84). First, we conducted three in-depth interviews with distribution experts in senior management positions from the fashion, consumer packaged goods and DIY/home décor industries. Each interview lasted between 60 to 70 minutes. Afterwards, we held three focus groups

with retail professionals from the same sectors. Between six and eight experts participated in each meeting. The sample comprised retail executives working in the areas of digital transformation, information technologies and/or marketing. The average duration of each focus group was 2 hours.

The discussion guides consisted of written prefatory remarks that informed the individuals of the nature of the study and that outlined the topics to be addressed in the session. The questions, which were open-ended and designed to guide a broad discussion, ranked from more general to more specific in five thematic blocks. These blocks were: (1) general ideas about digital transformation in retail, (2) the actual situation of retailers' digitalization process, (3) key retailing technologies, (4) new business models, and (4) strategic alliances between retailers and technology providers.

To analyze the data, we used complete transcripts converted from the audio recording of the meetings. Using ATLAS.ti8 software, we coded and extracted the key comments from transcripts of the in-depth interviews and focus groups. Our analysis process was based on the principles and premises of the two most commonly used methodologies (Carrera-Fernandez et al., 2012): critical discourse analysis (Fairclough, 2003) and grounded theory (Goulding, 2000). Thus, we did not validate abstract hypotheses, but instead built concrete concepts derived from the empirical information and contrasted them with the literature review. Particularly, we looked for triggers, insights, signs, and symptoms that aided in interpreting the participants' speech. The validation process was founded on an immersion process and subsequent detachment from the text. This validation was pragmatic, seeking to uncover the circumstances or contexts in which communication makes sense and is understood by the applicable protagonists (Huang, 2014).

3.1.2. Results

The results from the qualitative study helped to clarify how technology is changing retail and what challenges retailers face amidst increasing digital adoption and collapsing traffic in physical stores. Table II shows the key findings relative to each of the blocks that were discussed with participants. In line with general qualitative studies, we illustrate our findings using quotations from informants (Bouncken et al., 2021).

(Insert Table II here)

Moreover, both the conceptual framework and the results of the qualitative study served to identify an inventory of twenty-one retail technologies and design a questionnaire for gathering further information.

3.2. *Quantitative study*

3.2.1. *Methodology*

At this stage, a survey was distributed to retail professionals. Before moving on to the validation stage, the researchers conducted a pre-test with 15 experts to assess the validity of the questionnaire and check that the questions were clearly formulated. Unclear items, not representative of the domain, or open for misinterpretation were eliminated or reworded. In addition, redundant or unnecessary items were eliminated.

After refining the questions, we developed the final survey using Qualtrics. The topics were organized in four blocks, including questions about the spontaneous association between the Retail Success Matrix quadrants and new technologies, the challenges for the retail sector, new business models and the most pressing technology investments.

To obtain the data, we collaborated with an agency that organises national retail events that bring together industry players regularly. 201 participants answered the questionnaire both via personal interviews (60%) and through a self-administrated link sent to the database provided by this company (40%). After the depuration of the responses, a total of 168 valid surveys were obtained.

The companies included in the sample operated in the following sectors: textile, food, furniture, and cosmetics. No excessive biases were observed in the sample. Almost 50% of the sample were companies with more than 501 employees. The respondents worked in the following business areas: marketing (23%), commercial or business development (18%), digital transformation and technology (11%) and logistics (6.5%). 11% of them were CEOs or company owners. Data were examined with SPSS 26.0. Descriptive statistics and Multiple Correspondence Analyses (MCA) were the statistical methods used for the quantitative inquiry. We chose MCA because of its flexibility in terms of the requirements it demands to represent graphically the relationships between several technological solutions and retail quadrants in a bi-dimensional space. This procedure only needs a rectangular data matrix, with non-negative entries. It is specially designed to analyze contingency tables, which are formed by positive numbers resulting from counting frequencies. MCA represents the rows and columns of a data matrix in a low-

dimensional space, based on an X^2 decomposition. The study of the dependency is carried out by means of a graphical representation and numerical parameters that help its interpretation.

3.2.2. Results

To investigate the key technologies that retail experts identify as enablers of a superior competitive strategy, we asked survey participants to assign each technological solution to the success strategy that they believed it influenced the most. Therefore, when presented with each of the twenty-one technologies, respondents could only associate each solution with one of the four winning strategies identified by Kahn (2018): branded product superiority, enhanced customer experience, frictionless shopping experience or operational excellence. Table III shows participants' spontaneous associations.

(Insert Table III here)

By applying MCA with SPSS 26.0, we obtained a map that plots the positioning of the technological solution with respect to the four retail strategies (Fig. A1 in the Appendix). MCA reveal the relative relationships between and within two groups of variables, based on data given in a contingency table with groups of variables on the rows (solutions) and columns (strategies). In this case, each cell in the contingency table represents the number of responses or counts associating one particular technology with a given strategy. The final MCA represented 17 technologies in the rows, and 4 competitive strategies in the columns. The technologies from the original inventory that were positioned in the origin of coordinates, and therefore did not contribute to the total inertia, were not included.

The two-axis model proved to be significant (Chi-square = 1414.7; $df=60$; Sign. = 0.000), accounting for almost 80% of the total information (axis 1 = 43.2%; axis 2 = 35.6%). Table AII in the Appendix shows the value of inertia, the Chi-square and the amount of information explained. Table AIII and Table AIV in the Appendix show the final output for both the rows (technologies) and the columns (strategies). Fig. A1 in the Appendix shows the original output map. Fig. 2. shows how we mapped each technology to the Kahn Retail Success Matrix.

(Insert Figure 2 here)

4. Discussion

Based on the above-mentioned findings, this section offers a discussion on how retail firms can harness technology to support their competitive positioning. This study introduces a 2x2 matrix of retail technologies focusing on their potential to support product superiority, enhance the shopping experience, remove points of friction from the purchase process and/or enhance operational excellence.

Branded performance superiority

Retail firms that excel in this quadrant offer products that boost consumer confidence more than their competitors. Reinartz et al. (2019) suggested that processes and activities that provide the customer with transparent and superior information are a source of value creation for retailers. Accordingly, 41.8% of the participants in our study spontaneously associated blockchain with retailers' branded performance superiority. Blockchain's distributed ledger technology confers significant benefits to retailers. Blockchain applications may be used to enhance product safety and security, improve quality management, and reduce illegal counterfeiting (McKinsey and Co., 2018). With shoppers' decisions being increasingly driven by environmental or humane concerns (KPMG, 2020), having the ability to track a product back to its source could give customers increased confidence in the product or brand. From an operations and logistics management perspective, blockchain helps to advance inventory management and replenishment, while reducing the cost of supply chain transactions (Cole et al., 2019).

When asked about social media applications, over half of the survey respondents (54.3%) highlighted that their main purpose is to support strategies intended to lead on brand. Consumers seek information and engage in word-of-mouth communication through online ratings and reviews (Reinartz et al., 2019). In turn, companies are increasingly sending personalized product recommendations via advertisements on social media (Goode and Main, 2019). Therefore, our results suggest that presenting the firm in an authentic manner and openly sharing information on social media is a key determinant of brand trust. Moreover, successful retailers are thinking beyond the advertising function of social media and evolving towards social selling (Sorecu et al., 2011).

Finally, a high proportion of those who were surveyed (45.4%) believed that highly technological flagship stores emphasize brand trust above all the rest of Kahn's basic strategies, while 40% said that these shops mainly contribute to a more exciting and enjoyable customer experience. Their advanced technological solutions not only can

provide exciting in-store experiences to shoppers, but they can also engage in-store associates and improve their job experience (Lewis and Loker, 2014).

Enhanced customer experience

The participating experts highlighted that augmented reality (AR), virtual reality (VR), 3D printing, personalized recommendations and voice and image search technologies primarily served to enhance the experiential and hedonic aspects of the shopping journey. Supporting prior research (Watson et al., 2020; Bonetti et al., 2019; Beck and Crié, 2018), in our study, 77.3% of participants said that AR/VR technology enabled retailers to provide a more experiential customer journey. Retailers across several industries have integrated these technologies into the in-store experience (e.g.: Nike, Adidas, Ikea, Gap, Sephora). Moreover, with the pandemic undermining many of the hedonic benefits of shopping, augmented stores powered by AR/VR provide an immersive and engaging shopping trip, with all the benefits of a touch-free shopping environment. However, AR/VR experiences are not limited to assessing products in-store. This technology also allows shoppers to access virtual endless aisles from home or on the go, as well as to virtually try on or view how a product looks in their home before they buy them (Castillo and Bigné, 2021). When asked about in-store 3D printing, the large majority (76%) of retail experts listed enhanced shopping experience as the top-of-mind strategy that this technology supports.

In our study, 51.08% of experts associated voice assistants with a fun shopping experience. Conversational platforms range from virtual voice assistants (Amazon Echo, Google Home) and software agents on smartphones or computers (Apple's Siri or Microsoft's Cortana) to AI-powered chatbots that use voice or email to interact with customers along their shopping journey. In the current social distancing scenario, retailers could also leverage conversational platforms to interact with customers along a contactless shopping journey, thereby enhancing the customer experience.

In addition, 38.3% of retail experts mentioned that solutions that enable retailers to personalize advertising, content and product recommendations based on shoppers' habits and preferences create relevant and meaningful experiences.

Frictionless shopping experience

The participating experts identified several technological solutions that fundamentally contribute to making the shopping journey easier. Our results support prior research by

Boudkouss and Djelassi (2021), Reintzart et al. (2019), Inman and Nikolova (2017) and others suggesting that click&collect, scan&go, self-checkout, automated pickup and return systems are solutions that eliminate pain points from the customer journey and improve convenience.

Additionally, most respondents (78.8%) highlighted those mobile payments are most relevant to enabling a frictionless shopping experience. New payment methods are increasingly replacing both cash and traditional credit cards. Biometric technology will most likely enable new, sophisticated touch-free payment and check-out methods in the future. For instance, Amazon recently launched Amazon One, which the firm claims is a convenient, contactless identity service that allows shoppers to enter stores like Amazon Style and pay by scanning their palms.

Chatbots have been widely discussed for the service industry, particularly to facilitate customer satisfaction in the e-retail environment (Chen et al., 2021). In this study, 55% of experts believed that chatbots help eliminate pain points and 57% associated voice assistants with a frictionless shopping experience. In addition, 34% of our experts agreed that the automation of marketing and communication processes—such as wish-list reminders, in-stock alerts, and price changes—increases convenience by offering customers relevant real-time information and responses.

Geolocation allows retailers to produce geo-fenced offers that reflect locational information, both inside and outside of the store (Grewal et al., 2020). Using GPS, Bluetooth or in-store beacons, retailers can identify shoppers' positioning and deliver personalized offers to them. Half of the experts we interviewed agreed that firms that want to create a frictionless strategy could benefit from these technologies.

In retail, the use of smart tags powered with RFID (radio-frequency identification) technology helps firms manage their inventory and optimize the store layout, reducing customer pain points. In addition, tags that include QR codes offer customers additional product information, which enables more informed purchase decisions (Tanner et al., 2019). Approximately 40% of respondents said that smart tags and smart devices for in-store sales assistants contributed to a frictionless shopping experience for customers.

Before the coronavirus outbreak, retailers who wanted to excel in offering a frictionless experience were already investing in touch-free solutions to eliminate pain points from the customer journey. In the fear-of-touch months that followed the COVID -19 outbreak,

1 retail employees, who suffered unprecedented levels of stress and uncertainty (Voorhees
2 et al., 2020; Berry and Stuart; 2021), felt their physical and emotional safety threatened
3 as they interacted with very close proximity to potentially infectious customers or with
4 one another (Berry et al., 2020). Similarly, customers' service expectations included the
5 need to stay safe and healthy during the shopping journey (Esper, 2020). As a result,
6 retailers implemented technology-driven solutions that reduce in-store physical contact.
7 For example, chatbot adoption increased to provide real-time customer assistance and
8 promote safe interactions with customers (Pantano et al., 2020), while spatial sensors
9 were redeployed to track in-store traffic and promote social distancing.

10 *Operational excellence strategy*

11 According to this study, 50% of retail executives believed that technology that supports
12 unified commerce first helps deliver superior efficiencies, and then contributes to a
13 frictionless experience (21%). In this vein, retailers have the power to turn data collected
14 from IoT and sensors throughout the supply chain into meaningful insights with the help
15 of advanced analytics and artificial intelligence. In addition, robotics is automating
16 repetitive and physically demanding tasks, increasingly improving supply chain and store
17 management functions. The COVID-19 crisis could engender the adoption of last-mile
18 delivery solutions powered by robots, drones, and autonomous vehicles (Shankar et al.,
19 2020).

20 Additionally, 65% of participants rated dynamic pricing as a technological application
21 that supports operational excellence strategies. The success of leading retail players has
22 made clear that AI-powered dynamic pricing is a critical capability for driving revenue
23 and margin growth (McKinsey and Co., 2017).

24 **5. Conclusions**

25 This study offers exploratory insights into the role of technology as a strategic imperative
26 for retailers striving to remain relevant and profitable. It maps twenty-one technological
27 solutions that retail experts consider enablers of four key competitive strategies: product
28 superiority, enhanced customer experience, frictionless shopping experience and
29 operational excellence. The findings show that technologies that support the experiential
30 components of the shopping journey include 3D printing, mixed reality and
31 conversational platforms. Voice assistants, advanced payment methods, in-store self-
32 service solutions and reliable geo-fenced offerings remove obstacles from the purchase
33

process. Finally, blockchain, AI-powered dynamic pricing and autonomous vehicles have the potential to deliver superior operational efficiencies. Thus, our research offers several theoretical contributions alongside managerial implications.

First, only a few academic articles compile research on a broad range of retailing technologies (Wolpert and Roth, 2020). Most existing research tends to focus on individual technologies. Therefore, this study sought to fill that gap by developing a new, encompassing classification of retail technologies which could guide retail practitioners when deciding in which technological solutions to invest.

Second, this study integrates twenty-one retailing technologies into the theoretical framework provided by Kahn's Retail Success Matrix. Our conceptual model expands on Gauri et al. (2021)'s by incorporating two additional routes for success into our theoretical proposal: branded performance superiority and operational excellence. In doing so, we develop the first known inventory of emerging technologies in terms of their impact on retailers' competitive strategy. Additionally, our categorization reveals that one technological solution could serve several retailing strategies. For example, voice assistants can add an experiential component to the shopping experience and increase convenience at the same time. Similarly, blockchain's immutable distributed ledger technology can be used to generate trust and increase operational efficiency.

Third, this empirical study contributes to current calls for collaboration between academic researchers and retail experts to address challenges experienced by key stakeholders. Our work enhances previous research by adopting the retailer perspective. In so doing, it offers a counterpoint to extant studies based on the more broadly exploited customer viewpoint. It has been previously acknowledged that data on shopper adoption of technologies are more commonly available than data on retailer technology adoption because firms tend to be reluctant to share information with academic researchers (Shankar et al., 2021). Moreover, while prior research focusing on classifying retail technologies has been limited by the preponderance of secondary data, our research uses qualitative and quantitative methods to co-create knowledge with practitioners.

Finally, as Grewal et al. (2018) state, it is important for retailing education to evolve at the same time as retailers change and, therefore, retail courses should reflect on technological advances. In this sense, our matrix provides a graphing tool that could be used in the classroom to engage students in active learning.

From a managerial point of view, the study offers several implications. First, it depicts the actual extent of retailing technologies. The input from the retailers who participated in the study suggests that only a small number of retail firms utilise technology at scale. The categorization of technological solutions that we provide offers practitioners an additional framework to support their evaluations of technologies. The matrix we developed allows for measurement on the underlying axes, therefore changes can be tracked over time. Firms could also use the matrix to plot users' expectations regarding each technology and gain greater insights into their customers and their evolution.

Second, our research provides valuable insight into how retail companies can capitalize on technology to create or reinforce their competitive positioning. Given that technology can help fuel omnichannel customer experience, smart offerings and lean operations, the adoption of retail technology is key to staying competitive and increasing profitability, especially for small retailers (Aithal et al., 2023). Retail managers should anchor on the firm's purpose and pursue the deployment of technologies in a manner that supports their competitive strategy.

Third, by providing examples of retail firms that leveraged technology as a competitive differentiator during the COVID-19 health crisis, the study contributes to deepening the understanding of how retailers can harness existing technology to protect consumers' health and mental well-being throughout a touch-free and highly automated shopping journey. Some of the solutions deployed during the toughest months of the pandemic may not be as needed now that the health crisis is mostly over (e.g.: spatial sensors and virtual queuing apps that controlled in-store traffic to ensure social distancing). Nevertheless, the technologies that continue to improve retailing operations sufficiently are likely to remain relevant and become an integral aspect of customers' shopping routines (Berry et al., 2020).

Finally, the present study revealed that retailers need to systematically assess their technology capabilities relative to emerging forms of service delivery. A strong technological foundation can extend retail business models beyond the traditional core business. With recent technological advances facilitating novel business models, some of these capabilities will need to be acquired or reinforced through mergers, acquisitions, and partnerships.

Limitations of the study and future research lines

Future research could address the limitations of this study. First, regarding the methodology, we adopted a non-random sampling method that merits some caution in interpreting the obtained results. Second, we did not claim to capture every retail technology but focused on the most relevant applications. As technology continues to pave the way for a more immersive online experience (modern retailers are already exploring the metaverse), forthcoming studies should incorporate new technologies and explore how they help retailers' differentiation. Additionally, with technology becoming a new actor that can co-create value on its own, future research should investigate how value is created when the exchange process takes place between a client and a smart technology rather than a human.

Moreover, given our focus on retailers, it would be advisable to replicate this study from the customer viewpoint. Future research should focus on customers' perceptions about the positioning of retailers who invest in technological solutions, as well as the potential gap between their expectations and those of retailers. Similarly, with the deployment of retail technology increasingly changing the traditional role of frontline employees in customer-service provider interactions, future research should analyze how retail workers perceive and cope with technology adoption in their workplace. Knowing if the frontline-employee perspective aligns with the opinion of retail managers on the value that technology can unlock could contribute to making better-informed technology investments.

In addition, the shopping motivations, preferences, and behaviours of consumers are known to vary among countries with different levels of economic development (Mishra et al., 2020). Also, retail structures are different in markets with deep cultural, demographic, and economic differences compared to the West. Therefore, a forthcoming study could explore how a technology's competitive advantage shifts across a broader spectrum of social and cultural contexts.

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Appendix

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Technology: A Strategic Imperative for Successful Retailers

Abstract

Purpose: In the aftermath of the COVID-19 pandemic, technology is rewriting the way consumers shop as well as the retail operating models. In this context, investment in new technologies is a strategic imperative for retailers striving to remain relevant and profitable. Using Kahn's Retail Success Matrix (2018) as our conceptual framework, the aim of the study is to propose a classification of emerging technologies based on their potential for sustaining retailers' competitive strategies.

Design/methodology/approach: Following an initial qualitative study based on in-depth interviews and focus groups with 20 retail managers, we collected survey data from a sample of 168 retail and technology professionals. To achieve the research objectives, we carried out content, descriptive and multiple correspondence factor analyses.

Findings: The data analyses result on a map that plots the technological solutions that retail experts identify as enablers of four key competitive strategies: product superiority, enhanced customer experience, frictionless shopping experience and operational excellence.

Practical Implications: This research work provides valuable insight into how retail companies can capitalise on technology to create or reinforce their competitive positioning. The framework acts as a guide for retail companies to assess their technology priorities.

Originality/Value: This exploratory empirical study is the result of a collaboration between academic researchers and retail professionals. Thus, it addresses challenges experienced by key stakeholders. Our encompassing classification enables a better understanding of the impact of technology on retailers' competitive positioning.

Keywords: retail technology, frictionless shopping, customer experience, operational excellence, competitive advantage, retail strategy, COVID-19.

Paper type: Research paper

1. Introduction

The retail sector is experiencing a revolutionary transformation where retailers that embrace technology as an enabler of competitive advantage are poised for success (Roggeveen and Sethuraman, 2020; Grewal et al., 2021b). With customers having ever-increasing options for researching and buying new products and services, retail firms are deploying technologies that support the integration of offline and online channels and enhance the shopping experience (Grewal et al., 2020). As a result, today’s shoppers can order online via voice assistants, use augmented reality to try on products virtually, have packages delivered by autonomous vehicles and drones or buy in cashier-less stores. In this environment, the COVID-19 pandemic became a catalyst for technology adoption (Shankar et al., 2020), presenting firms with new challenges but also opportunities to rethink their business models and generate novel value propositions (Pantano et al., 2020; Donthu and Gustafsson, 2020).

Given the vast array of retail technologies available, firms risk investing in technological solutions without enough insight into their strategic fit (Inman and Nikolova, 2017), which might be especially harmful in the current scenario of energy scarcity and high inflation. As Willems et al. (2017, p. 229) noted, “technology in retailing is and should remain a means to an end”. On this point, the extant literature highlights the need for more in-depth research on the usage of technology as a driver of new marketing strategies (Hoffman et al., 2022; Kumar, 2018; Roy et al., 2018; Verhoef and Bijmolt, 2019), which remains an area of investigation worthy of continued exploration (Gauri et al., 2021; Grewal et al., 2021a). This exploratory study contributes to current scholarly calls by proposing a classification of technologies based on their potential for sustaining retailers’ competitive strategies.

Moving service research forward requires researchers to collaborate more – and more effectively – with practitioners (Ostrom et al., 2021). In this vein, the 7th Retail Forum, which took place in [name hidden to ensure blind review] in 2019, sparked the need for an investigation developed jointly by academics and retail executives to deepen the understanding of the opportunities and challenges posed by the technologies that were reshaping the industry. Thus, this study has a real-world focus (Moorman et al., 2022). Specifically, it addresses the following research question: which are the technological solutions that retail experts identify as enablers of a superior competitive advantage?

Although technology may serve as a point of differentiation for retailers (Savastano et al., 2019; Reinartz et al., 2019; Sethuraman and Parasuraman, 2005), to the authors' knowledge there are no prior empirical studies that have typified emerging technologies in terms of their potential to reinforce retailers' competitive strategies. To explore how retailers evaluate new technologies, we draw from Kahn's (2018, 2021) conceptualization of retail strategies, which states that customers trust successful retailers because they provide the goods and services that shoppers desire, while offering a better shopping experience than their competitors, and identifies four competitive strategies: product superiority, enhanced customer experience, frictionless shopping experience and operational excellence.

While existing research tends to focus on the impact of individual technological solutions (e.g.: Boudkouss and Djelassi, 2021; Bonetti et al., 2019; Mosquera et al., 2018), only a small number of studies incorporate an inventory of emerging technologies into a common framework (e.g.: Hoyer et al., 2020; Grewal et al., 2020; Roggeveen and Sethuraman, 2020; Linzbach et al., 2019; Reinartz et al., 2019; Pantano & Vannucci, 2019; Willems et al., 2017). A few of these studies take the retailers' perspective to categorize technologies. Despite their interest, most of them resulted from a screening of secondary data sources (e.g., Roggeveen and Sethuraman, 2020; Linzbach et al., 2019; Reinartz et al., 2019; Willems et al., 2017; Wolpert and Roth, 2020). Only Grewal et al. (2020) created their typology of in-store technologies based on interviews with seven key informants in the retail sector.

We built an inventory of retail technologies from a qualitative study aimed at managers and then assessed its merits in a survey. In both studies, participants were retail and technology professionals. Our research design takes advantage of the strengths of a mixed methodological approach (qualitative and quantitative), contributing to co-create relevant knowledge with practitioners while offering retailers a theoretical framework for their technology investments. The results suggest that retailers looking to support the experiential components of the shopping journey should consider investing in 3D printing, mixed reality and conversational platforms. Retail firms willing to remove obstacles from the purchase process should focus on voice assistants, advanced payment methods, in-store self-service solutions and geo-fenced, personalized offerings. Finally,

to enhance retailing operations and deliver superior efficiencies, companies could explore blockchain technology, AI-powered dynamic pricing and autonomous vehicles.

The rest of this article is organized as follows. In the first section, we review previous typologies of retail technologies and present the theory that underpins our classification. In the methodology section, we describe the empirical analyses. The third section is dedicated to the discussion of our results. The final section offers conclusions, limitations and future research pathways.

2. Theoretical framework: A classification of emerging retail technologies

Today’s hyper-connected consumers expect excellent customer experience regardless of where they shop (Sebald and Jacob, 2020; Flavián et al., 2020; Goode and Main, 2019). In turn, retailers are pursuing omnichannel retailing, digitizing their stores with advancements like augmented reality (AR), in-shop navigation, geo-fencing, facial recognition, and smart dressing rooms (Bonetti et al., 2019; Mosquera et al., 2018; Grewal et al., 2017).

From a back-end perspective, current advancements in technology have the potential to facilitate retail operations related to supply chain, logistics and assortment planning in unprecedented ways (Roggeveen and Sethuraman, 2020; Willems et al., 2017). Sensors, blockchain technology, robots and autonomous vehicles are transforming how goods are tracked, stocked, and moved (Mollenkopf et al., 2020). Likewise, thanks to the Internet of Things (IoT), mobile technology and predictive analytical technics, companies can collect and interpret an immense amount of structured transactional data as well as unstructured behavioural data (Hofacker et al., 2016; Linzbach, 2019). As a result, retailers can reach their target consumers more efficiently and conveniently while delivering highly personalized products and offers.

Advances in technology not only make shopping more convenient and/or fun, but they also change the way customers interact with frontline employees (Grewal et al., 2020), thus impacting the codelivery of the retail service (Ostrom et al., 2021; Meyer et al., 2022). For example, in-store self-service technologies allow customers to perform the service traditionally provided by the store associates (Demoulin and Djelassi, 2016), changing the shopper-provider touchpoints substantially, and therefore the customer perception of the shopping journey (Verhoef, 2017).

The coronavirus pandemic made self-service technologies particularly relevant. The fear of infection pushed consumers towards contactless shopping and delivery that reduced exposure to the virus. Whilst many customers felt that e-commerce was the more convenient and safer shopping channel, the shoppers who remained loyal to the brick-and-mortar stores adopted solutions that reduced physical, in-store interaction (Akhtar et al., 2020), such as virtual try-on tools, contactless payment methods, and automated checkout systems. In addition, click&collect services allowed customers to shop online and collect their purchases with minimal contact, either in designated locker locations or via curbside pickup.

Under this environment, retail firms were able to leverage enhancing technology as a competitive differentiator (Shankar et al., 2020). Table AI in the Appendix shows several examples. Encouraged to put health and safety at the forefront of their strategy, the retailers who were considered “essential service” providers had to adapt their operations in record time to cope with dramatic disruption in supply chains (Mollenkopf et al., 2020) while adopting service delivery protocols that were mobile-compatible, complied with physical-distancing expectations, and offered low-touch delivery services.

In short, the pandemic compelled shoppers and retailers to dramatically hasten their adoption of digital technology. However, faced with a plethora of retail technologies, firms may be challenged to identify the technology investments that have the greatest pay-off potential (Linzbach et al., 2019). In this vein, scholars have explored several avenues for classifying emerging retail technologies according to different criteria. Table I shows the key typologies developed to date.

(Insert Table I here)

Some authors categorise technologies based on the shopper perspective and the impact of technology on the customer journey (Grewal et al., 2020; Willems et al., 2017). Other studies focus on the service provider’s point of view (Hoyer et al., 2020; Linzbach et al., 2019; Reinartz et al., 2019; Varadarajan, 2010). The third strand of research integrates

both approaches and develops their inventory of technologies by considering aspects related to both shoppers' perceptions and retailers' business models (Shankar et al., 2020; Wolpert and Roth, 2020). However, as outlined in the introduction, none of them organises technology according to the potential that each technological solution has for retailers' competitive strategy.

Business organization theory suggests that to optimize the value chain, companies choose between (1) meeting basic requirements at the best price, (2) offering the best product features, and (3) providing special services that meet targeted customer needs (Porter, 1985; Porter and Kramer, 2011). In the field of retailing, technology encourages new ways of value creation because it supports a host of activities and processes that help reduce operating costs and fulfil customer needs in groundbreaking ways (Reinartz et al., 2019; Sethuraman and Parasuraman, 2005). Thus, technology has been identified as pivotal in creating a sustainable competitive advantage for retailers (Inman and Nikolova, 2017).

This study builds on the Kahn Retailing Success Matrix (2018) to offer a classification of new technologies that retailers can deploy to support a superior competitive strategy. Similarly, Gauri et al. (2021) propose a customer-centric theoretical framework for the success of retail formats grounded on Kahn (2018). However, compared to Gauri et al. (2021), who only focus on an enhanced customer experience or a frictionless customer journey, we incorporate two additional routes for success into our framework: branded performance superiority and operational excellence.

Kahn (2018, 2021) suggests that, regardless of whether a retailer's proposition is based on product benefits or improving the customer experience, retail companies excel when they either provide more hedonic benefits to their customers or eliminate pain points from the shopping experience, thereby creating a superior competitive advantage. Kahn's theoretical framework is articulated around a 2x2 matrix where the horizontal axis represents the retail proposition (product benefit or customer experience), and the vertical axis represents the source of a superior competitive advantage (increase pleasure or eliminate pain points). The resulting matrix reveals four basic retailing strategies (Fig. 1):

1. *Branded performance superiority*. Retailers who lead on brand offer products that provide more differentiation and more confidence to customers, as compared to other goods and services in the market.

2. *Enhanced customer experience*. Retailers that excel in customer experience work hard to add experiential components to shopping tasks. Thus, they provide more pleasure and excitement than other retailers can provide.

3. *Frictionless shopping experience*. Retailers who choose to lead on frictionless shopping experiences prioritize offering customers the easiest and most convenient way to shop.

4. *Operational excellence strategy*. Retailers who deliver operational excellence strategies have developed operational models that can efficiently manage inventory, keep overhead costs down, and reduce transaction costs at every step. They provide reliable products at the lowest prices and, therefore, offer customers the best savings.

Arguably, some retailers could be good examples of more than one strategy. According to Kahn (2018), “leadership depends on offering superior value in two quadrants and meeting fair value in the other two” (p. 13). This means that leading retail firms excel in one of these four strategies and build on that particular competitive advantage, to have a strong positioning in one or more of the other three.

(Insert Figure 1 here)

Unlike our study, Khan (2018) does not “use actual data to plot these [retail] strategies, rather [uses] the tool as a way to communicate the four strategic choices simply and clearly” (p.15). We build on the graphic mechanism provided by Kahn (2018) and use empirical data to plot which technologies best enable each of these four strategies.

3. Empirical study

To carry out this empirical study, a mixed-approach design was used, taking advantage of the strengths of qualitative and quantitative methodologies.

3.1. Qualitative study

3.1.1. Methodology

The qualitative study comprised both in-depth interviews and focus groups, which involved “soliciting from study participants – the theory holders – the ideas they think are important and how they are linked to one another” (Zeithamal et al., 2020, p. 84). First, we conducted three in-depth interviews with distribution experts in senior management positions from the fashion, consumer packaged goods and DIY/home décor industries. Each interview lasted between 60 to 70 minutes. Afterwards, we held three focus groups

with retail professionals from the same sectors. Between six and eight experts participated in each meeting. The sample comprised retail executives working in the areas of digital transformation, information technologies and/or marketing. The average duration of each focus group was 2 hours.

The discussion guides consisted of written prefatory remarks that informed the individuals of the nature of the study and that outlined the topics to be addressed in the session. The questions, which were open-ended and designed to guide a broad discussion, ranked from more general to more specific in five thematic blocks. These blocks were: (1) general ideas about digital transformation in retail, (2) the actual situation of retailers' digitalization process, (3) key retailing technologies, (4) new business models, and (4) strategic alliances between retailers and technology providers.

To analyze the data, we used complete transcripts converted from the audio recording of the meetings. Using ATLAS.ti8 software, we coded and extracted the key comments from transcripts of the in-depth interviews and focus groups. Our analysis process was based on the principles and premises of the two most commonly used methodologies (Carrera-Fernandez et al., 2012): critical discourse analysis (Fairclough, 2003) and grounded theory (Goulding, 2000). Thus, we did not validate abstract hypotheses, but instead built concrete concepts derived from the empirical information and contrasted them with the literature review. Particularly, we looked for triggers, insights, signs, and symptoms that aided in interpreting the participants' speech. The validation process was founded on an immersion process and subsequent detachment from the text. This validation was pragmatic, seeking to uncover the circumstances or contexts in which communication makes sense and is understood by the applicable protagonists (Huang, 2014).

3.1.2. Results

The results from the qualitative study helped to clarify how technology is changing retail and what challenges retailers face amidst increasing digital adoption and collapsing traffic in physical stores. Table II shows the key findings relative to each of the blocks that were discussed with participants. In line with general qualitative studies, we illustrate our findings using quotations from informants (Bouncken et al., 2021).

(Insert Table II here)

Moreover, both the conceptual framework and the results of the qualitative study served to identify an inventory of twenty-one retail technologies and design a questionnaire for gathering further information.

3.2. Quantitative study

3.2.1. Methodology

At this stage, a survey was distributed to retail professionals. Before moving on to the validation stage, the researchers conducted a pre-test with 15 experts to assess the validity of the questionnaire and check that the questions were clearly formulated. Unclear items, not representative of the domain, or open for misinterpretation were eliminated or reworded. In addition, redundant or unnecessary items were eliminated.

After refining the questions, we developed the final survey using Qualtrics. The topics were organized in four blocks, including questions about the spontaneous association between the Retail Success Matrix quadrants and new technologies, the challenges for the retail sector, new business models and the most pressing technology investments.

To obtain the data, we collaborated with an agency that organises national retail events that bring together industry players regularly. 201 participants answered the questionnaire both via personal interviews (60%) and through a self-administrated link sent to the database provided by this company (40%). After the depuration of the responses, a total of 168 valid surveys were obtained.

The companies included in the sample operated in the following sectors: textile, food, furniture, and cosmetics. No excessive biases were observed in the sample. Almost 50% of the sample were companies with more than 501 employees. The respondents worked in the following business areas: marketing (23%), commercial or business development (18%), digital transformation and technology (11%) and logistics (6.5%). 11% of them were CEOs or company owners. Data were examined with SPSS 26.0. Descriptive statistics and Multiple Correspondence Analyses (MCA) were the statistical methods used for the quantitative inquiry. We chose MCA because of its flexibility in terms of the requirements it demands to represent graphically the relationships between several technological solutions and retail quadrants in a bi-dimensional space. This procedure only needs a rectangular data matrix, with non-negative entries. It is specially designed to analyze contingency tables, which are formed by positive numbers resulting from counting frequencies. MCA represents the rows and columns of a data matrix in a low-

dimensional space, based on an X^2 decomposition. The study of the dependency is carried out by means of a graphical representation and numerical parameters that help its interpretation.

3.2.2. Results

To investigate the key technologies that retail experts identify as enablers of a superior competitive strategy, we asked survey participants to assign each technological solution to the success strategy that they believed it influenced the most. Therefore, when presented with each of the twenty-one technologies, respondents could only associate each solution with one of the four winning strategies identified by Kahn (2018): branded product superiority, enhanced customer experience, frictionless shopping experience or operational excellence. Table III shows participants' spontaneous associations.

(Insert Table III here)

By applying MCA with SPSS 26.0, we obtained a map that plots the positioning of the technological solution with respect to the four retail strategies (Fig. A1 in the Appendix). MCA reveal the relative relationships between and within two groups of variables, based on data given in a contingency table with groups of variables on the rows (solutions) and columns (strategies). In this case, each cell in the contingency table represents the number of responses or counts associating one particular technology with a given strategy. The final MCA represented 17 technologies in the rows, and 4 competitive strategies in the columns. The technologies from the original inventory that were positioned in the origin of coordinates, and therefore did not contribute to the total inertia, were not included.

The two-axis model proved to be significant (Chi-square = 1414.7; df=60; Sign. = 0.000), accounting for almost 80% of the total information (axis 1 = 43.2%; axis 2 = 35.6%). Table AII in the Appendix shows the value of inertia, the Chi-square and the amount of information explained. Table AIII and Table AIV in the Appendix show the final output for both the rows (technologies) and the columns (strategies). Fig. A1 in the Appendix shows the original output map. Fig. 2. shows how we mapped each technology to the Kahn Retail Success Matrix.

(Insert Figure 2 here)

4. Discussion

Based on the above-mentioned findings, this section offers a discussion on how retail firms can harness technology to support their competitive positioning. This study introduces a 2x2 matrix of retail technologies focusing on their potential to support product superiority, enhance the shopping experience, remove points of friction from the purchase process and/or enhance operational excellence.

Branded performance superiority

Retail firms that excel in this quadrant offer products that boost consumer confidence more than their competitors. Reinartz et al. (2019) suggested that processes and activities that provide the customer with transparent and superior information are a source of value creation for retailers. Accordingly, 41.8% of the participants in our study spontaneously associated blockchain with retailers' branded performance superiority. Blockchain's distributed ledger technology confers significant benefits to retailers. Blockchain applications may be used to enhance product safety and security, improve quality management, and reduce illegal counterfeiting (McKinsey and Co., 2018). With shoppers' decisions being increasingly driven by environmental or humane concerns (KPMG, 2020), having the ability to track a product back to its source could give customers increased confidence in the product or brand. From an operations and logistics management perspective, blockchain helps to advance inventory management and replenishment, while reducing the cost of supply chain transactions (Cole et al., 2019).

When asked about social media applications, over half of the survey respondents (54.3%) highlighted that their main purpose is to support strategies intended to lead on brand. Consumers seek information and engage in word-of-mouth communication through online ratings and reviews (Reinartz et al., 2019). In turn, companies are increasingly sending personalized product recommendations via advertisements on social media (Goode and Main, 2019). Therefore, our results suggest that presenting the firm in an authentic manner and openly sharing information on social media is a key determinant of brand trust. Moreover, successful retailers are thinking beyond the advertising function of social media and evolving towards social selling (Sorecu et al., 2011).

Finally, a high proportion of those who were surveyed (45.4%) believed that highly technological flagship stores emphasize brand trust above all the rest of Kahn's basic strategies, while 40% said that these shops mainly contribute to a more exciting and enjoyable customer experience. Their advanced technological solutions not only can

provide exciting in-store experiences to shoppers, but they can also engage in-store associates and improve their job experience (Lewis and Loker, 2014).

Enhanced customer experience

The participating experts highlighted that augmented reality (AR), virtual reality (VR), 3D printing, personalized recommendations and voice and image search technologies primarily served to enhance the experiential and hedonic aspects of the shopping journey. Supporting prior research (Watson et al., 2020; Bonetti et al., 2019; Beck and Crié, 2018), in our study, 77.3% of participants said that AR/VR technology enabled retailers to provide a more experiential customer journey. Retailers across several industries have integrated these technologies into the in-store experience (e.g.: Nike, Adidas, Ikea, Gap, Sephora). Moreover, with the pandemic undermining many of the hedonic benefits of shopping, augmented stores powered by AR/VR provide an immersive and engaging shopping trip, with all the benefits of a touch-free shopping environment. However, AR/VR experiences are not limited to assessing products in-store. This technology also allows shoppers to access virtual endless aisles from home or on the go, as well as to virtually try on or view how a product looks in their home before they buy them (Castillo and Bigné, 2021). When asked about in-store 3D printing, the large majority (76%) of retail experts listed enhanced shopping experience as the top-of-mind strategy that this technology supports.

In our study, 51.08% of experts associated voice assistants with a fun shopping experience. Conversational platforms range from virtual voice assistants (Amazon Echo, Google Home) and software agents on smartphones or computers (Apple's Siri or Microsoft's Cortana) to AI-powered chatbots that use voice or email to interact with customers along their shopping journey. In the current social distancing scenario, retailers could also leverage conversational platforms to interact with customers along a contactless shopping journey, thereby enhancing the customer experience.

In addition, 38.3% of retail experts mentioned that solutions that enable retailers to personalize advertising, content and product recommendations based on shoppers' habits and preferences create relevant and meaningful experiences.

Frictionless shopping experience

The participating experts identified several technological solutions that fundamentally contribute to making the shopping journey easier. Our results support prior research by

Boudkouss and Djelassi (2021), Reintzart et al. (2019), Inman and Nikolova (2017) and others suggesting that click&collect, scan&go, self-checkout, automated pickup and return systems are solutions that eliminate pain points from the customer journey and improve convenience.

Additionally, most respondents (78.8%) highlighted those mobile payments are most relevant to enabling a frictionless shopping experience. New payment methods are increasingly replacing both cash and traditional credit cards. Biometric technology will most likely enable new, sophisticated touch-free payment and check-out methods in the future. For instance, Amazon recently launched Amazon One, which the firm claims is a convenient, contactless identity service that allows shoppers to enter stores like Amazon Style and pay by scanning their palms.

Chatbots have been widely discussed for the service industry, particularly to facilitate customer satisfaction in the e-retail environment (Chen et al., 2021). In this study, 55% of experts believed that chatbots help eliminate pain points and 57% associated voice assistants with a frictionless shopping experience. In addition, 34% of our experts agreed that the automation of marketing and communication processes—such as wish-list reminders, in-stock alerts, and price changes—increases convenience by offering customers relevant real-time information and responses.

Geolocation allows retailers to produce geo-fenced offers that reflect locational information, both inside and outside of the store (Grewal et al., 2020). Using GPS, Bluetooth or in-store beacons, retailers can identify shoppers' positioning and deliver personalized offers to them. Half of the experts we interviewed agreed that firms that want to create a frictionless strategy could benefit from these technologies.

In retail, the use of smart tags powered with RFID (radio-frequency identification) technology helps firms manage their inventory and optimize the store layout, reducing customer pain points. In addition, tags that include QR codes offer customers additional product information, which enables more informed purchase decisions (Tanner et al., 2019). Approximately 40% of respondents said that smart tags and smart devices for in-store sales assistants contributed to a frictionless shopping experience for customers.

Before the coronavirus outbreak, retailers who wanted to excel in offering a frictionless experience were already investing in touch-free solutions to eliminate pain points from the customer journey. In the fear-of-touch months that followed the COVID -19 outbreak,

retail employees, who suffered unprecedented levels of stress and uncertainty (Voorhees et al., 2020; Berry and Stuart; 2021), felt their physical and emotional safety threatened as they interacted with very close proximity to potentially infectious customers or with one another (Berry et al., 2020). Similarly, customers' service expectations included the need to stay safe and healthy during the shopping journey (Esper, 2020). As a result, retailers implemented technology-driven solutions that reduce in-store physical contact. For example, chatbot adoption increased to provide real-time customer assistance and promote safe interactions with customers (Pantano et al., 2020), while spatial sensors were redeployed to track in-store traffic and promote social distancing.

Operational excellence strategy

According to this study, 50% of retail executives believed that technology that supports unified commerce first helps deliver superior efficiencies, and then contributes to a frictionless experience (21%). In this vein, retailers have the power to turn data collected from IoT and sensors throughout the supply chain into meaningful insights with the help of advanced analytics and artificial intelligence. In addition, robotics is automating repetitive and physically demanding tasks, increasingly improving supply chain and store management functions. The COVID-19 crisis could engender the adoption of last-mile delivery solutions powered by robots, drones, and autonomous vehicles (Shankar et al., 2020).

Additionally, 65% of participants rated dynamic pricing as a technological application that supports operational excellence strategies. The success of leading retail players has made clear that AI-powered dynamic pricing is a critical capability for driving revenue and margin growth (McKinsey and Co., 2017).

5. Conclusions

This study offers exploratory insights into the role of technology as a strategic imperative for retailers striving to remain relevant and profitable. It maps twenty-one technological solutions that retail experts consider enablers of four key competitive strategies: product superiority, enhanced customer experience, frictionless shopping experience and operational excellence. The findings show that technologies that support the experiential components of the shopping journey include 3D printing, mixed reality and conversational platforms. Voice assistants, advanced payment methods, in-store self-service solutions and reliable geo-fenced offerings remove obstacles from the purchase

process. Finally, blockchain, AI-powered dynamic pricing and autonomous vehicles have the potential to deliver superior operational efficiencies. Thus, our research offers several theoretical contributions alongside managerial implications.

First, only a few academic articles compile research on a broad range of retailing technologies (Wolpert and Roth, 2020). Most existing research tends to focus on individual technologies. Therefore, this study sought to fill that gap by developing a new, encompassing classification of retail technologies which could guide retail practitioners when deciding in which technological solutions to invest.

Second, this study integrates twenty-one retailing technologies into the theoretical framework provided by Kahn's Retail Success Matrix. Our conceptual model expands on Gauri et al. (2021)'s by incorporating two additional routes for success into our theoretical proposal: branded performance superiority and operational excellence. In doing so, we develop the first known inventory of emerging technologies in terms of their impact on retailers' competitive strategy. Additionally, our categorization reveals that one technological solution could serve several retailing strategies. For example, voice assistants can add an experiential component to the shopping experience and increase convenience at the same time. Similarly, blockchain's immutable distributed ledger technology can be used to generate trust and increase operational efficiency.

Third, this empirical study contributes to current calls for collaboration between academic researchers and retail experts to address challenges experienced by key stakeholders. Our work enhances previous research by adopting the retailer perspective. In so doing, it offers a counterpoint to extant studies based on the more broadly exploited customer viewpoint. It has been previously acknowledged that data on shopper adoption of technologies are more commonly available than data on retailer technology adoption because firms tend to be reluctant to share information with academic researchers (Shankar et al., 2021). Moreover, while prior research focusing on classifying retail technologies has been limited by the preponderance of secondary data, our research uses qualitative and quantitative methods to co-create knowledge with practitioners.

Finally, as Grewal et al. (2018) state, it is important for retailing education to evolve at the same time as retailers change and, therefore, retail courses should reflect on technological advances. In this sense, our matrix provides a graphing tool that could be used in the classroom to engage students in active learning.

From a managerial point of view, the study offers several implications. First, it depicts the actual extent of retailing technologies. The input from the retailers who participated in the study suggests that only a small number of retail firms utilise technology at scale. The categorization of technological solutions that we provide offers practitioners an additional framework to support their evaluations of technologies. The matrix we developed allows for measurement on the underlying axes, therefore changes can be tracked over time. Firms could also use the matrix to plot users' expectations regarding each technology and gain greater insights into their customers and their evolution.

Second, our research provides valuable insight into how retail companies can capitalize on technology to create or reinforce their competitive positioning. Given that technology can help fuel omnichannel customer experience, smart offerings and lean operations, the adoption of retail technology is key to staying competitive and increasing profitability, especially for small retailers (Aithal et al., 2023). Retail managers should anchor on the firm's purpose and pursue the deployment of technologies in a manner that supports their competitive strategy.

Third, by providing examples of retail firms that leveraged technology as a competitive differentiator during the COVID-19 health crisis, the study contributes to deepening the understanding of how retailers can harness existing technology to protect consumers' health and mental well-being throughout a touch-free and highly automated shopping journey. Some of the solutions deployed during the toughest months of the pandemic may not be as needed now that the health crisis is mostly over (e.g.: spatial sensors and virtual queuing apps that controlled in-store traffic to ensure social distancing). Nevertheless, the technologies that continue to improve retailing operations sufficiently are likely to remain relevant and become an integral aspect of customers' shopping routines (Berry et al., 2020).

Finally, the present study revealed that retailers need to systematically assess their technology capabilities relative to emerging forms of service delivery. A strong technological foundation can extend retail business models beyond the traditional core business. With recent technological advances facilitating novel business models, some of these capabilities will need to be acquired or reinforced through mergers, acquisitions, and partnerships.

Limitations of the study and future research lines

Future research could address the limitations of this study. First, regarding the methodology, we adopted a non-random sampling method that merits some caution in interpreting the obtained results. Second, we did not claim to capture every retail technology but focused on the most relevant applications. As technology continues to pave the way for a more immersive online experience (modern retailers are already exploring the metaverse), forthcoming studies should incorporate new technologies and explore how they help retailers' differentiation. Additionally, with technology becoming a new actor that can co-create value on its own, future research should investigate how value is created when the exchange process takes place between a client and a smart technology rather than a human.

Moreover, given our focus on retailers, it would be advisable to replicate this study from the customer viewpoint. Future research should focus on customers' perceptions about the positioning of retailers who invest in technological solutions, as well as the potential gap between their expectations and those of retailers. Similarly, with the deployment of retail technology increasingly changing the traditional role of frontline employees in customer-service provider interactions, future research should analyze how retail workers perceive and cope with technology adoption in their workplace. Knowing if the frontline-employee perspective aligns with the opinion of retail managers on the value that technology can unlock could contribute to making better-informed technology investments.

In addition, the shopping motivations, preferences, and behaviours of consumers are known to vary among countries with different levels of economic development (Mishra et al., 2020). Also, retail structures are different in markets with deep cultural, demographic, and economic differences compared to the West. Therefore, a forthcoming study could explore how a technology's competitive advantage shifts across a broader spectrum of social and cultural contexts.

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Appendix

(Insert Figure A1 here)

(Insert Table AI here)

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(Insert Table AIV here)

Figure 1. The Kahn Retailing Success Matrix



Source: <http://knowledge.wharton.upenn.edu/article/barbara-kahn-the-shopping-revolution/>

Figure 2. Matrix for technological solutions and retail strategies

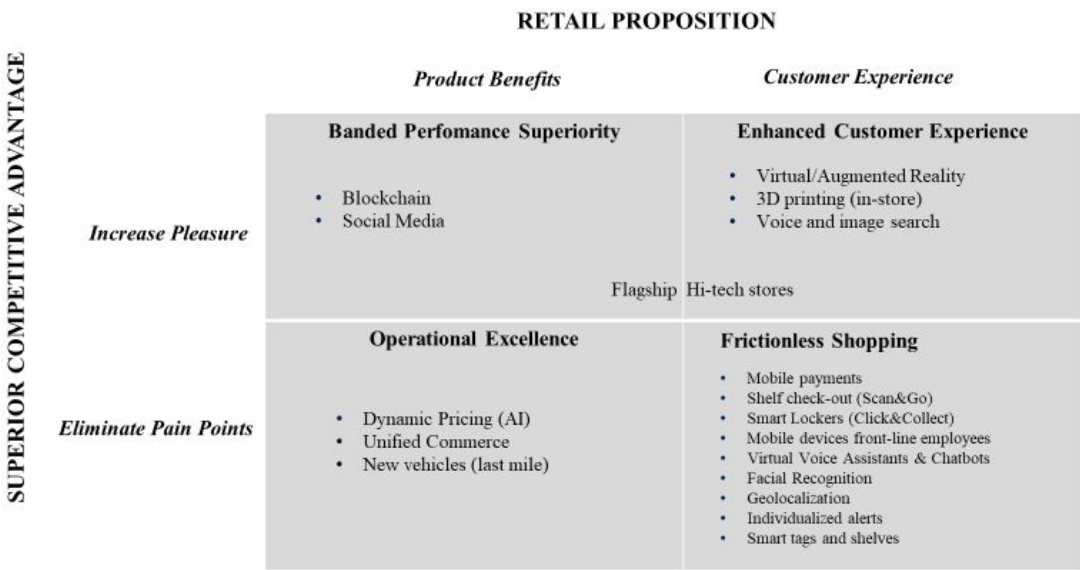


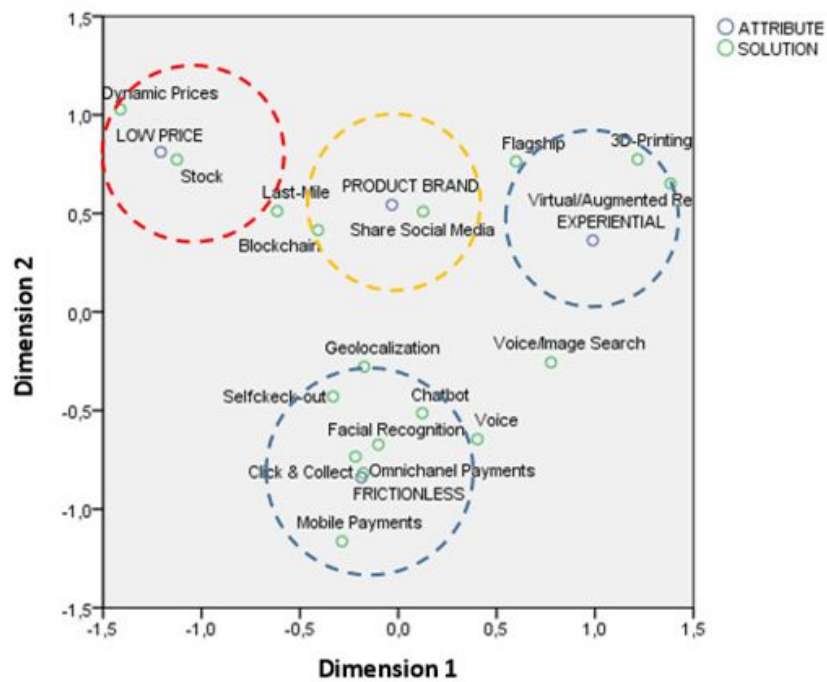
Figure A1: Column and Rows Points (AFC Output)

Table I: Summary of previous classifications of retail technologies

Perspective	Authors	Retail -Technology Classification Criteria
Demand (consumers)	Willems et al. (2017)	<ul style="list-style-type: none">• Shopping value• Impact on stage of the customer journey
	Grewal et al. (2020)	<ul style="list-style-type: none">• Level of convenience• Social presence
	Roggeveen & Sethuraman (2020)	<ul style="list-style-type: none">• Influence on the customer’s purchase journey
Supply (retailers)	Sethuraman & Parasuraman (2005)	<ul style="list-style-type: none">• Cost-saving technologies• Service-enhancing technologies
	Varadarajan (2010)	<ul style="list-style-type: none">• Infrastructure technologies• Broadcast communication technologies• Interactive technologies
	WEF (2017)	<ul style="list-style-type: none">• Value chain applications
	Linzbach et al. (2019)	<ul style="list-style-type: none">• Technology as a process automation tool vs. technology as a marketing tool
	Reinartz et al. (2019)	<ul style="list-style-type: none">• Source of value creation: automation, individualization, ambient embeddedness, interaction, and transparency and control
	Hoyer et al. (2020)	<ul style="list-style-type: none">• Task type: repetitive vs. non-repetitive• Activity type: behavioural vs. cognitive
	Pantano & Vannucci (2019) Alexander & Kent (2021)	<ul style="list-style-type: none">• Application and function: product display; shopping experience; information search; payment and other uses.
Integrative: Demand + supply perspectives	Wolpert & Roth (2020)	<ul style="list-style-type: none">• Participant issues• Technology issues• Information issues• Intended purposes
	Shankar et al. (2020)	<ul style="list-style-type: none">• Stakeholder: shopper-facing, employee-facing, supplier-facing.• IT Relatedness• Source of origin: internal vs. external, outside-in vs. inside out span• Newness: incremental vs. radical• Nature of change: facilitating vs. disruptive• Outcome: commoditizing vs. value adding

Table II. Key insights from the qualitative study


























Theme	Key insights	Participant Voices
Stage of the digitalization of the retail sector	<p>In many instances, customers are more digital savvy than retailers themselves.</p> <p>The competitive environment is changing dramatically.</p> <p>Transformation is taking place at two different levels: internal (operational processes) and external (supply chain and customer interactions). The pace of digital adoption varies by industry.</p> <p>Digital transformation requires putting just as much emphasis on people as on systems and processes.</p>	<p><i>"Consumer digitalization causes a tsunami in organizations." "Companies need to speedup to catch up with customer needs and deliver the digitally enhanced products that customers demand."</i></p> <p><i>"The technological advancements lower the entry barriers." "New 'pure-player' entrants are obsessed with the customer and data. They set very high customer experience standards which traditional retailers who want to remain competitive can only meet in the short term by incurring in negative profitability."</i></p> <p><i>"Technology adoption and digital transformation are taking place at two levels: 'back office' and 'front office'. The pace is faster when it comes to investing in back office because the impact on the bottom line is more obvious."</i></p> <p><i>"Digitalization can't succeed without culture change." "Technology adoption must come hand-in-hand with continuous education, upskilling and empowerment of people so they can make the right decisions in this new environment."</i></p>
Emerging Technologies	<p>Participants recognize technology's importance as a strategic component of their business, not only a source of cost.</p> <p>Trying to capitalize on technological trends without the appropriate business model evolution is a pitfall for many businesses. Winning in the new retail landscape requires reimagining how to work and how to create a long-term competitive advantage.</p> <p>In the coming years, Internet of Things, Augmented, Virtual and Mixed Reality, virtual assistants, chatbots and robots will radically transform the retail landscape.</p>	<p><i>"Technology is a lever to create value, differentiation and improve our competitive advantage."</i></p> <p><i>"Technology is a tool which needs to be put to use in the best possible manner but above all, it has to be an integral part of the business."</i></p> <p><i>"Our job is to be ready to adopt the right technology, which is not always easy because it is hard to anticipate which solutions and methods will end up crystallizing."</i></p> <p><i>"Millions of euros are being invested in technologies that companies do not know how to optimize fully and/or become obsolete in the very short term."</i></p> <p><i>"Back offer digital initiatives are linked to investing in automation, robots, machine learning, IOT and blockchain. As far as 'front office' or customer interaction is concerned, then obviously, mobile payment methods, chatbots, augmented reality, mobile devices for shop assistants and geofencing."</i></p> <p><i>"Voice assistants will be a new shopping channel. We will be forced to serve customers who won't use keyboards to search and buy our products but will use voice instead."</i></p> <p><i>"3D printing might be a relevant technology for manufacturers, for us it is a solution to enhance customers' experience and make shopping a bit more fun."</i></p>

Alliances and coopetition	<p>The way to deliver relevant value propositions comes from working with an ecosystem of players.</p> <p>Retailers need to systematically assess their technology requirements and capabilities relative to emerging forms of service delivery. Some of these capabilities will need to be acquired or reinforced through mergers, acquisitions, and partnerships.</p>	<p><i>“There have been many alliances between retailers in the past and they will continue to take place. However, nowadays, it is a must for traditional retailers to have a technological partner, in order to be able to survive and thrive.”</i></p> <p><i>“We are opening many new doors to collaboration. In the recent past, I believe these were seen as a threat. Now it is about finding ways in which all players can add to build the capabilities that are needed.”</i></p>
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Table III. Association between technological solutions and the quadrants in Khan's Matrix

Item	Branded product superiority	Enhanced customer experience	Frictionless shopping experience	Operational excellence
Voice Assistants	6.34%	34.51%	57.04%	2.11%
Unified Commerce Technology	19.86%	7.80%	21.99%	50.35%
Personalised products recommendations and advertising	29.79%	38.30%	27.66%	4.26%
In-store 3D printing	9.42%	76.09%	5.07%	9.42%
Chatbots	12.23%	25.90%	54.68%	7.19%
Automated alerts (price changes, product availability)	26.24%	10.64%	34.04%	29.08%
High-tech flag ship stores	45.39%	40.43%	9.22%	4.96%
Virtual/Augmented/ Mixed Reality	12.06%	77.30%	7.80%	2.84%
Voice and image search	5.04%	51.08%	41.73%	2.16%
Facial Recognition Payments	14.29%	16.43%	61.43%	7.86%
Information and recommendation on social media	54.29%	19.29%	20.71%	5.71%
Autonomous vehicles for last-mile delivery	19.85%	17.56%	26.72%	35.88%
Geolocalization	11.36%	21.97%	49.24%	17.42%
Mobile Payments	9.09%	6.82%	78.79%	5.30%
Blockchain Applications	41.86%	10.08%	27.91%	20.16%
Employee-facing in-store mobile devices	12.88%	18.94%	40.91%	27.27%
Click and collect solutions	7.58%	15.91%	64.39%	12.12%
Customer-facing smart labels	22.56%	26.32%	39.10%	12.03%
Dynamic pricing	9.92%	9.16%	16.03%	64.89%
Autonomous check-out	9.09%	16.67%	55.30%	18.94%
Omnichannel payment systems	13.95%	12.40%	66.67%	6.98%

Table AI: Examples of retail companies that deployed technology to protect the health and safety of their internal and external customers during the pandemic

POSITIONING STRATEGY	TECHNOLOGY	RETAIL APPLICATIONS
Retailers who excel in customer experience work hard to add experiential components to the shopping tasks while ensuring a contactless experience.	AR/VR	<div><i>Amazon Room Decorator</i></div> <div><i>Ikea Place</i></div> <div><i>Starbucks Rewards app</i></div> <div><i>Sephora Virtual Artist</i></div>
Retailers who choose to lead on frictionless shopping experiences prioritize offering customers the easiest and most convenient way to shop.	VIRTUAL ASSISTANTS and CHAT BOTS	<div></div> <div></div>
	SMART TAGS	<div><i>Decathlon's RFDI powered self-checkout</i></div> <div><i>Zara's Click&Find</i></div>
	CONTACTLESS PAYMENT	<div><i>Amazon One</i></div> <div><i>Nestlé Market facial recognition</i></div> <div><i>MTG's Evering payment system</i></div>
	TECHNOLOGY TO ENSURE IN-STORE SOCIAL DISTANCE	<div><i>Zara Click&Try is booking system for dressing rooms.</i></div> <div><i>Ufirst queue management system</i></div>
	CONTACTLESS STORES	<div></div>
Leaders in operational excellence and low price have applied technological solutions to reduce costs along the value chain and increase safety	AUTOMATED DELIVERY AND RETURNS	<div></div>
	AUTONOMOUS VEHICLES and DRONES	<div><i>FedEx and Walgreens partnerships (Alphabet Wing)</i></div> <div></div>





POSITIONING STRATEGY	TECHNOLOGY	RETAIL APPLICATIONS
Retailers who lead on brand offer products/services that provide more differentiation and more confidence to customers.	BLOCKCHAIN	  <i>IBM Food Trust and WWF Open SC allow consumers to trace products from their origin to the store</i>
	VIRTUAL STORES	  <i>Virtual stores temporarily replaced closed flagship stores to stay connected with consumers who miss the hedonic aspect of the shopping experience.</i>

Table AII: Summary of the model

Dimension	Singular Value	Inertia	Chi square	Sig.	Proportion of inertia		SD	Correlation
					Accounted for	Acumulated		
1	.514	.265			.432	.432	.018	.209
2	.467	.218			.356	.788	.0180	
3	.361	.130			.212	1.000		
Total		.613	1414.736	.000	1.000	1.000		

Table AIII. General Row Points

SOLUTION	Mass	Score in Dimension		Inertia	Contribution				
		1	2		Point of Inertia in the Dimension		Dimension in the Inertia of the Point		
					1	2	1	2	Total
Voice	,061	,402	-,645	,018	,019	,055	,280	,654	,934
Stock	,061	-1,125	,773	,059	,150	,078	,679	,291	,970
3D Printing	,060	1,217	,774	,073	,172	,077	,622	,229	,851
Chatbot	,060	,122	-,513	,008	,002	,034	,059	,940	,998
Flagship	,061	,598	,764	,048	,042	,076	,233	,344	,577
RV/RA	,061	1,383	,651	,078	,227	,055	,768	,154	,922
Image/Voice Search	,060	,776	-,256	,025	,071	,008	,743	,073	,816
Facial recognition	,061	-,101	-,672	,014	,001	,059	,024	,946	,969
Share Social Media	,061	,127	,509	,056	,002	,034	,009	,131	,140
Last Mile	,057	-,615	,512	,018	,042	,032	,598	,376	,974
Geolocalization	,057	-,173	-,278	,004	,003	,009	,244	,571	,815
Mobile Payments	,057	-,286	-1,164	,039	,009	,166	,062	,931	,993
Blockchain	,056	-,408	,415	,027	,018	,021	,179	,169	,348
Click & Collect	,057	-,218	-,734	,016	,005	,066	,086	,884	,971
Dynamic prices	,057	-1,412	1,027	,102	,220	,128	,572	,275	,847
Selfckeck-out	,057	-,331	-,428	,009	,012	,022	,353	,535	,888
Omnichannel Pay	,056	-,177	-,817	,019	,003	,080	,047	,916	,964
Total	1,000			,613	1,000	1,000			

Table AIV. General Column Points

STRATEGY	Mass	Score in Dimension		Inertia	Contribution				
		1	2		Point of Inertia in the Dimension		Dimension in the Inertia of the Point		
					1	2	1	2	Total
PRODUCT BRAND	,178	-,033	,544	,117	,000	,113	,001	,210	,211
EXPERIENCE	,274	,989	,363	,171	,521	,077	,805	,099	,903
FRICTIONLESS	,388	-,187	-,838	,135	,026	,585	,052	,948	1,000
LOW PRICE	,159	-1,208	,812	,190	,452	,225	,630	,258	,888
Total	1,000			,613	1,000	1,000	1,000		