Journal of Innovation & Knowledge 17 (2026) 101056

Contents lists available at ScienceDirect

Journal of Innovation & Knowledge

journal homepage: www.elsevier.com/locate/jik

# Retail innovation in Central-Eastern Europe: A mixed-methods exploration of executive and consumer perspectives

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ARTICLE INFO

*JEL classification:*
M10

*Keywords:*
Innovation
Retail management
Digitalization
Europe

ABSTRACT

Recent economic and political events and the rapid growth of digital technology have accelerated innovation in retail and made companies reconsider how they deliver front- and back-end solutions along the customer journey. Prior research deeply describes various retail technologies and their impact on customer experience; nevertheless, it rarely examines the perceptions of executives and consumers regarding retail innovation and its value in transition economies. Our mixed-methods study fills this gap by examining Hungarian retail as a representative market in Central and Eastern Europe. We combine 16 semi-structured interviews with senior retail executives and a survey of 291 consumers, analyzed through a two-level clustering methodology, to investigate the foundation, implementation, and impact of innovation. We identify six unique customer segments characterized by varying attitudes to back-end, front-end, and convenience innovations. Furthermore, we conclude that executives primarily perceive innovation as an organizational skill rather than a collection of individual technologies. Executives and consumers agree that omnichannel solutions and mobile app-based ecosystems are the minimum necessary, but they disagree on how important back-end transparency and sustainability information are. Many executives overlook these factors, but some consumer groups respond positively to information about product journeys and supply-chain practices. Theoretically, this study enhances sensemaking and strategic-framing frameworks for retail innovation by correlating executive perceptions with diverse customer adoption trends within an underexplored transition-economy setting. The results indicate that managers need to change how they approach innovation, view some technological solutions as basic features instead of unique ones, and be more proactive about telling customer groups that value them about improvements in back-end and sustainability.

## Introduction

In the last few years, retail markets around the world have changed a lot. Due to the COVID-19 pandemic and changing customer expectations, retailers are now more likely to operate in an environment where online shopping, home delivery, and seamless interactions across all channels are standard (Ernst & Young, 2022; Faulds et al., 2018). As customers use both physical and digital channels, retailers are putting more and more emphasis on improving customer experience and satisfaction. Satisfaction is often defined as the difference between what customers expect and what they actually get (Wirtz and Lovelock, 2016, as cited in Marín-García et al., 2022). Alexander & Kent (2021) highlight that between 2014 and 2019, the number of fashion retail stores without in-store customer-facing technologies halved, showing the proliferation of front-end technology in this retail segment. Researchers have also observed that futuristic technologies are gaining a foothold in the retail space. Abumalloh et al. (2024) note the potential positive impact of metaverse technology and its contribution to sustainable competitive advantage. These changes highlight the strategic necessity of innovation for retailers.

This study conceptualizes innovation not merely as a singular technology or process, but as a whole organizational and strategic

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[1] Research design, literature review, conducting and organising interviews, manuscript
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[3] Quantitative methodology, manuscript, finalising

https://doi.org/10.1016/j.jik.2026.101056
Received 31 August 2025; Accepted 3 May 2026
Available online 8 May 2026

framework influenced by managerial perceptions of what defines significant change. Previous research has regularly investigated technological solutions, consumer adoption trends, and companies operating in highly digitalized Western markets (Verhoef et al., 2022; Grewal & Roggeveen, 2020). Still, there is limited understanding of how retail executives see innovation, what they perceive as its primary drivers and challenges, and how these understandings vary across retail companies. This gap is especially noticeable in mid-sized, transition-economy settings, where the competitive pressures and tendencies toward digitalization are similar to those in other growing European markets but are not well covered in the literature. While competitive markets may eventually punish companies that do not meet customers' digital expectations, market selection does not indicate how companies should respond strategically when a digital transformation challenge arises.

It is crucial to understand how executives think about innovation, both in theory and in practice. Executives' perceptions affect how resources are allocated, which technological solutions are awarded priority, and when and how much money is spent on new ideas.

Despite the growing body of research on retail innovation, prior studies remain fragmented along two dominant lines of inquiry. One stream focuses primarily on specific technological solutions and their effects on customer experience, often examined in highly digitalized Western markets. A second stream concentrates on consumer adoption and behavioral responses to innovation, frequently without integrating managerial interpretations or strategic decision-making processes. As a result, limited attention has been paid to how retail executives conceptualize innovation as an organizational capability, how these perceptions shape innovation priorities, and how they align or misalign with heterogeneous consumer expectations. Addressing this gap is essential to advancing international retail innovation research, particularly in markets experiencing rapid structural transformation and increasing competitive pressure.

Hungary is employed in this study as an illustrative case of a Central and Eastern European transition economy. Retail markets in this region combine several characteristics that are increasingly observable across many mid-sized economies, including the strong presence of multinational retailers, the rapid digitalization of customer journeys, and persistent structural constraints such as labor shortages, cost sensitivity, and regulatory complexity (Otsuka et al., 2023; Kiss & Ónodi, 2023). These features make Hungary a suitable empirical setting for an examination of how executive sensemaking and consumer perceptions of innovation interact under conditions that are not unique to a single national context but are relevant to a broader set of international retail markets. Therefore, this research investigates the comprehension and prioritization of innovation among retail executives in Hungary through the following research question: How does innovation manifest in Hungarian retail, and how is it perceived by senior retail executives and consumers? In line with this, the study addresses three sub-questions: (1) which innovation solutions do senior executives in Hungary regard as most important; (2) how do consumers perceive retail innovations; and (3) in what ways do executive and consumer perspectives converge or diverge with respect to retail innovation? Semi-structured qualitative interviews with senior leaders are combined with a quantitative consumer survey and a two-step cluster analysis to enable triangulation and create a more generalizable picture of retail leaders and shoppers.

The results show that executives are more likely to see innovation as a general organizational skill than as specific technological advances. While multinational and domestic firms face similar environmental pressures, they differ in their framing of innovation, expectations regarding consumer behavior, and perceived constraints related to costs, skills, and regulatory demands. These insights expand the theoretical awareness of innovation readiness and strategic alignment within retail contexts across economies in transition.

This study contributes by (a) presenting an organizational-level perspective on the interpretation of innovation within a highly complex retail market, (b) addressing an empirical gap regarding managerial perspectives in underexplored Central-Eastern Europe (CEE) contexts, and (c) offering practical guidance for retailers aiming to align innovation strategies with shifting consumer expectations and regulatory demands. The following section (Section 2) outlines the theoretical background that frames and defines our research on innovation in the retail sector. This is followed by the literature review (Section 3), a description of the methodology (Section 4), the presentation of results (Section 5), the discussion (Section 6), and the conclusion (Section 7).

## Theoretical background

Understanding how retail executives perceive and prioritize innovation requires a theoretical perspective that extends beyond the adoption of individual technologies. Innovation-related decisions are shaped by how managers interpret environmental signals, frame strategic challenges, and mobilize organizational resources in response. Accordingly, this study draws on three complementary theoretical perspectives, namely managerial sensemaking, strategic framing, and organizational capabilities and integrates them with insights from consumer behavior research. Together, these perspectives provide a coherent framework for analyzing how innovation is understood, enacted, and evaluated within retail organizations and how these managerial interpretations relate to consumer perceptions.

### *Managerial sensemaking*

Sensemaking theory claims that managers use cognitive models and organizational routines to evaluate environmental cues under uncertainty (Maitlis & Christianson, 2014). Retail executives receive ambiguous signals due to unpredictable consumer behavior, regulatory shifts, and rapid technological change. Sensemaking determines which signals are prioritized, which challenges are considered important, and which innovation paths are viable. Managers' interpretations affect organizational responses to technological disruption (Nambisan, Wright & Feldman, 2019). This provides a solid theoretical platform for studying how executives view innovation in a fast-changing retail environment.

While sensemaking explains how managers interpret uncertainty and construct meaning from complex environmental cues, it does not fully account for how these interpretations are translated into strategic priorities. To understand how managerial interpretations shape organizational action, it is necessary to consider how executives frame innovation-related challenges and opportunities within their organizations. Strategic framing, therefore, represents a critical link between sensemaking processes and concrete strategic decision-making.

### *Strategic framing*

Strategic framing explains how leaders label environmental changes, influencing organizational attention and resource allocation (Cornelissen & Werner, 2014). Framing determines whether technologies are perceived as opportunities, threats, or gradual advances, guiding strategic choices. Framing affects how retail innovators evaluate digital tools, omnichannel capabilities, front-end vs. back-end investments, and organizational shifts (Grewal et al., 2017). Such different framing can explain innovation objectives even when organizations face similar competitive forces.

Strategic framing influences not only how innovation is discussed internally, but also how organizational resources are allocated and coordinated. However, framing alone does not determine whether firms are able to implement innovation successfully. The translation of strategic intent into practice depends on the development and deployment of organizational capabilities that enable firms to sense opportunities, seize them, and reconfigure existing processes accordingly.

*Organizational capabilities*

In digitally transformed marketplaces, perceiving, seizing, and reconfiguring are crucial (Teece, 2018). Managerial cognition directly affects capability development (Helfat & Peteraf, 2015), linking executive interpretations to capability formation. Retail innovation readiness depends on organizational culture, resource availability, technology competence, and front- and back-end integration (Verhoef et al., 2021). Innovation is a structurally and cognitively established process, as the related literature shows.

*Consumer perceptions*

While the preceding perspectives focus on managerial cognition and organizational processes, innovation outcomes in retail cannot be fully understood without considering the consumer side. Retail innovation ultimately materializes at the customer interface, where perceived value, satisfaction, and acceptance determine adoption and continued use. Integrating consumer perception frameworks, therefore, allows for an assessment of whether managerial interpretations of innovation align with consumer expectations and behavioral responses.

Analyzing the consumer adoption of retail innovations requires integrating established behavioral frameworks. Consumers have an initial set of expectations, and after being served, they compare the performance with what they had anticipated. Expectation-confirmation theory emphasizes that consumer satisfaction depends on whether innovations meet or exceed prior expectations, shaping repeat usage and loyalty (Lin et al., 2009). Recent research underscores that consumers evaluate innovations not only for their functional benefits but also for their alignment with personal values such as sustainability and convenience, which increasingly influence purchase decisions (Gil-Saura et al., 2023). This may reflect profound differences in perceived value and complexity, reinforcing the need for tailored innovation strategies (Karlsson et al., 2023; Wang & Chen, 2024). These insights highlight that managerial assumptions about innovation success must account for consumer-side drivers, as misalignment can undermine strategic outcomes.

Taken together, these theoretical perspectives form an integrated framework for analyzing retail innovation. Managerial sensemaking shapes how executives interpret environmental complexity, strategic framing determines how innovation is defined and prioritized, and organizational capabilities influence the firm's ability to act on these interpretations. Consumer perception frameworks provide a complementary lens by capturing how these innovation efforts are experienced and evaluated by customers. By combining these approaches, the study enables a holistic examination of the alignment and potential misalignment between executive perceptions and consumer responses to retail innovation.

## Literature review

The literature on retail innovation spans multiple disciplinary perspectives and addresses a wide range of technological, organizational, and consumer-related phenomena. To provide a coherent foundation for the present study, this section synthesizes prior research into interconnected thematic areas that collectively explain how innovation emerges, diffuses, and creates value in retail settings. Rather than treating individual innovation domains, the review highlights how market dynamics, technological transformation, and consumer-facing solutions jointly shape contemporary retail innovation strategies.

*Innovation foundations*

Today, innovation is the primary engine of national prosperity, closely intertwined with technological change and expressed in multiple forms (Mladenović & Vukojević, 2019). As highlighted by Fisher & Raman (2022), research linking retail innovation to broader markets and the global economy has increased, with retail increasingly viewed as a strategic component of national economies. The innovation process has also shifted away from a linear model toward a more complex, system-oriented dynamic that unfolds with the involvement of numerous internal and external stakeholders (Castro et al., 2018). To innovate effectively, firms require reliable and diverse knowledge sources; outcomes hinge on how efficiently they can absorb external information, know-how, and technologies (i.e., their absorptive capacity) (Odei & Stejskal, 2018). Stakeholders such as suppliers, customers, research institutes, and universities all serve as potential knowledge contributors. To harness these inputs, firms in many industries form networks whose ties can offset resource constraints, serving as a decisive factor even for large companies, but especially for small and medium-sized ones (Rideg et al., 2023).

The rise of Industry 4.0 has catalyzed far-reaching changes in business practices in recent years (Ratchford et al., 2023). The spread of digital technologies and data-driven decision-making is observable across sectors; mastering these capabilities constitutes a source of competitive advantage and can reconfigure firms' market positions (Palmié et al., 2022). While technological progress and innovation are tightly linked, innovation is the broader construct, encompassing both technological and non-technological forms, as often analyzed in commercial and retail contexts (Marín-García et al., 2022).

A traditional typology distinguishes between incremental and radical innovation, a theme that has been widely examined in recent decades (Hristov & Reynolds, 2015, as cited in Mladenović & Vukojević, 2019). Although innovation inherently implies novelty, commonly associated with breakthrough solutions, incremental, step-by-step improvements have tended to dominate competitive markets due to their lower cost and staged implementation (Paredes et al., 2023).

The landscape has also been shaped by the COVID-19 pandemic. The pace of change accelerated during the crisis (Mostaghel et al., 2022). Research shows that innovation becomes especially critical in turbulent periods, enabling firms to renew activities to survive (Böttcher et al., 2022). Despite financial constraints associated with downturns, firms retain the scope to innovate, aided by sustained public support, usually at the national level and, in Europe, by the European Union, which acts as a key driver of innovative activity (Odei et al., 2020). In turn, companies may recognize that innovation underpins not only immediate market survival but also future crisis resilience.

These foundational perspectives underscore that innovation in retail does not occur in a vacuum but is embedded within broader competitive and institutional environments. Market dynamics, therefore, play a central role in shaping both the urgency and direction of innovation, influencing how retailers respond to intensified competition, changing consumer behavior, and technological diffusion.

*Market dynamics*

Saturated markets, intensifying competition, and rapid technological progress have revealed the need for firms to seek opportunities beyond traditional business models (Birkin et al., 2017, as cited in Heins, 2023). The breakneck diffusion of smartphones marked a critical milestone after the spread of the internet: in the mobile era, consumers and retailers can connect with one another anywhere, anytime (Faulds et al., 2018). The available technology and shifting consumer needs prompt retailers to respond, creating even more intense rivalry among firms. External pressures such as increased stakeholder expectations, consumer demand, and fast competitor reactions encourage even small retail businesses to use social media and related technologies (Kwon et al., 2021).

Retail technology investment reached USD 108.4 billion in 2021, up from only USD 46.7 billion in 2020 (Statista, 2022). The bulk of this spending targeted the build-out or enhancement of omnichannel capabilities (Ratchford et al., 2023).

Retail is a distinctive sector in that it sells products directly to consumers, making both product attributes and service quality central. Accordingly, retailers engage in both product and service innovation (Paredes et al., 2023). Nevertheless, customer satisfaction is shaped primarily by service innovation (Pilawa et al., 2022), which therefore becomes the principal avenue through which retailers differentiate and enhance their appeal (Lee et al., 2022, as cited in Pilawa et al., 2022). However, service innovation is typically more intangible and harder to measure than product innovation (Mladenović & Vukojević, 2019).

While market pressures foster the need for innovation, technological transformation determines how retailers operationalize their strategic responses. Advances in digital technologies affect not only customer-facing solutions but also back-end processes, making it necessary to consider innovation across the entire retail organization.

*Technological transformation*

Although consumers primarily encounter the front-end in retail, performance rests on the seamless operation of back-end processes. The customer-facing technologies in use today typically depend on substantial back-end integration. These include less visible components that support data collection and structuring, thereby playing a pivotal role in retail operations. Nevertheless, when examining front-end technologies, academic literature tends to understate the importance of back-end integration (Bonetti et al., 2023).

A wide range of innovation efforts is evident on the back-end, with emerging technologies such as augmented reality and service robots attracting particular interest (Riegger et al., 2021; Pistrui et al., 2023). These tools can also help bridge front- and back-end activities. Technology is relevant not only in warehouses and fulfillment centers but also in non-customer-facing areas of the store: sales associates spend up to 30% of their working time on back-end tasks that do not directly involve customer service (Pistrui et al., 2023). As many of these tasks are administrative or repetitive, they are prime candidates for automation.

Beyond in-store automation, service robots are increasingly used in inventory management and last-mile logistics, where their speed and precision enable end-to-end process optimization for retailers. While such solutions have not yet become the industry standard, they can deliver substantial cost reductions by substituting labor (Ratchford et al., 2023). The use of drones is attracting similar interest, though adoption remains more sporadic than that of service robots. Large retail platforms such as Amazon and eBay have reported early successes with drone-enabled fulfillment, operating with minimal human intervention (Sham et al., 2023).

Growing attention to sustainability is also pushing firms to pursue continuous optimization at the supply-chain level. Although consumers do not interact directly with suppliers, responsible conduct is an increasingly salient expectation for both retailers and their wider chains (Vadakkepatt et al., 2021). Supply-chain optimization is frequently implemented via licensed third-party software, which supports data capture and underpins data-driven strategy formulation (Mostaghel et al., 2022). Leveraging such data can enhance retailers' internal efficiency while increasing the personalization of value propositions, a benefit that ultimately registers most clearly on the front end.

Technological transformation ultimately becomes visible to consumers through customer-facing applications and services. Understanding how consumers interact with these solutions is therefore essential for evaluating the effectiveness of retail innovation efforts and explaining heterogeneous adoption patterns across customer segments.

*Consumer-facing technologies*

While research on retail innovation is extensive, front-end solutions receive markedly more scholarly coverage than back-end innovations. Retailers deploy in-store technologies not only to raise operational efficiency but also to elevate customer satisfaction (Bonetti et al., 2023). Today's stores commonly feature interactive screens, QR codes, service robots, and, particularly in apparel, virtual fitting rooms (Shankar et al., 2021; Bonetti et al., 2023). In the related literature, the umbrella term CFIT (consumer-facing in-store technologies) is frequently used (Bonetti et al., 2022). Such tools digitalize existing customer-journey touchpoints and can create new ones, thereby enhancing the shopping experience (Selter et al., 2023). Gamified elements at selected journey stages can deepen engagement by fostering a sense of experimentation that shoppers enjoy (Behl et al., 2024). Importantly, these solutions integrate the physical store with the digital realm and, through data collection, enable increasingly personalized experiences (Bonetti et al., 2023).

For consumers, the smartphone and its associated apps have become the pivotal shopping device. Implementing smartphone-based applications and related innovations typically requires modest investment from retailers (Tabeck & Ahuja, 2023), yet apps can incorporate a wide array of shopping aids: users can build shopping lists, collect loyalty coupons, and receive promotions designed to cultivate and sustain loyalty (Behl et al., 2024). Many apps now also support payment, enabling experiments with contactless "just-walk-out" purchasing and unstaffed stores (Szabó-Szentgróti et al., 2023). Although most retailers have not yet reached this level of automation, numerous good practices exist to streamline shopping; self-scanners, for example, are increasingly common and deliver efficient in-store experiences (Heins, 2023).

Alongside scanners, service robots also bolster front-end efficiency. Their adoption can improve not only productivity but also user experience and service quality (Pistrui et al., 2023). Robots can monitor shelf availability and detect when customers approach (Grewal & Roggeveen, 2020). Their efficiency gains stem from reduced human-resource requirements and the attendant cost savings.

The preceding literature highlights that retail innovation is shaped by the combined effects of market dynamics, technological transformation, and consumer-facing solutions. Competitive pressures and environmental change drive the need for innovation, digital technologies enable organizational responses, and consumer-facing tools mediate how innovation is experienced by customers. As these dimensions converge, researchers increasingly view retail innovation through an ecosystem perspective that captures the interconnected nature of technologies, organizational processes, and actors involved in value creation.

*Retail ecosystems*

The examples above underscore the inseparability of the front end and back end in retail. This tight coupling is reinforced by shifts in consumer behavior and the growing demand for convenience (Faulds et al., 2018; ConnectPOS, 2023). Contemporary retail business models have evolved accordingly. Rather than acting solely as intermediaries between wholesalers and end customers, many firms now operate as versatile platforms (Böttcher et al., 2022). The prominence of digital components in the literature has also foregrounded retail ecosystems and even the notion of the industry as a meta-ecosystem, an umbrella configuration that aggregates multiple, interlocking ecosystems (Palmié et al., 2022; Hänninen et al., 2018). The trajectory toward full digitalization is further illustrated by contactless, staff-free stores (Szabó-Szentgróti et al., 2023).

Despite this, numerous studies caution against neglecting the human factor: digital tools and spaces should amplify and enrich interpersonal interactions rather than replace them (Palmié et al., 2022). Nicolás-Agustín et al. (2024) observe that investing in human capital through ICT training positively impacts firm performance and leads to successful digital transformation. To ensure the success of this transformation and monitor changing consumer preferences catalyzed by the pandemic, major retailers such as Tesco and Carrefour established dedicated labs to design, test, and prepare retail innovations for market deployment (Berezvai et al., 2019), even before COVID-19. This signals the premium placed on preparedness and continuous experimentation at

the sectoral level.

Digitalization has opened new avenues for enhancing customer satisfaction (Palmié et al., 2022). As technology and preference shifts have raised the bar for omnichannel delivery, the joint management of digital and physical channels has become a strategic imperative. Yet many retailers remain unprepared to deliver a uniform experience across channels; achieving a consistent, harmonized customer experience is cited as the central challenge (Karmakar, 2021, as cited in Mostaghel et al., 2022).

In summary, prior research highlights that retail innovation is shaped by the interaction of market forces, technological capabilities, and consumer responses. However, studies often examine these elements separately, resulting in limited insight into how managerial interpretations of innovation align with consumer adoption across different retail contexts. By synthesizing these literature streams, the present study addresses this gap and provides an integrated foundation for examining executive and consumer perspectives on retail innovation.

## Methodology

This study investigates innovation in Hungarian retail through the dual lenses of senior executives and consumers, using a mixed-methods design. The aim is to map and contrast these viewpoints in order to enrich the retail literature, suggest avenues for further research, and generate actionable insights for managers.

As a mid-sized Central-Eastern European economy integrated into the EU single market and strongly shaped by foreign direct investment, Hungary combines several features that are typical of many transition and emerging markets: a highly concentrated retail structure dominated by multinational chains, the rapid growth of e-commerce, and an ongoing digital transformation of store formats and customer journeys (Machek, 2012; Nagy, 2016; Mohácsi et al., 2025).

### *The qualitative interview research*

Qualitative research adopts an investigative stance that allows for iteration and ongoing reframing during data collection and analysis (Galletta, 2013). In this context, qualitative inquiry strengthens the exploratory purpose and helps unpack relationships within the theoretical frame (Horváth & Mitev, 2015, as cited in Gáti & Bauer, 2017). Semi-structured interviewing was chosen because it balances a pre-defined guide with the flexibility to probe context-specific experiences and emergent themes (Lune & Berg, 2017; Gáti & Bauer, 2017; Molnár, 2010), thereby surfacing managerial perceptions and experiential knowledge (Maxwell, 2008, as cited in Gáti & Bauer, 2017). While this approach yields depth, its limitations must be acknowledged: respondent subjectivity and contextual dependence constrain reproducibility, and validity requires careful consideration (Golafshani, 2003). Even so, semi-structured interviews offer a nuanced view of leaders' constructions of reality that would be difficult to capture otherwise.

Data collection occurred during two distinct phases. In Phase #1, seven expert interviews were conducted online (Zoom/Teams) with senior representatives of key actors in the Hungarian retail market. Conversations followed a semi-structured protocol circulated in advance; with informed consent, all sessions were audio-recorded to facilitate later analysis. The interviews typically lasted between 45 and 60 minutes. To reflect market diversity, the sample included a retail start-up, a foreign-owned multinational, a domestic store network, and a management consultant specializing in retail. *Trademagazin's 2022* retail market leaders list was used to identify our initial top targets for interviews (Németh, 2023). We defined experts as managers with at least five years' work experience in retail so that interviews could be conducted with a homogenous sample. After completing the first phase, we contacted the startup and retail consultants interviewed in Phase 1 and developed a list of potential additional interviewees using the snowball sampling method. "Snowballing" is the technique by which *"researchers usually start with a small number of initial contacts (seeds), who fit the research criteria and are invited to become participants within the research. The agreeable participants are then asked to recommend other contacts who fit the research criteria and who potentially might also be willing participants, who then in turn recommend other potential participants, and so on" (Parker et al., 2019)*. We used our established list to facilitate data collection in Phase #2.

In November 2025, nine additional interviews were conducted for Phase #2 to obtain a clear, up-to-date picture of the retail market. We analyzed the interviews from this phase and evaluated whether new codes and themes had emerged compared to the first phase of interviews. As consumers and retailers shifted back to pre-pandemic levels of activity but new habits emerged (Dabija et al., 2025), we observed a different market context from Phase #1, with codes that emerged in both phases disappearing and new ones emerging. Newly emergent codes were attributed to the time-sensitive development of retail linked to post-pandemic channel adjustments (Sheth, 2020). Consequently, following recommendations by Hennink et al. (2017) and Hennink & Kaiser (2022), saturation was assessed in a context-specific and phase-sensitive manner rather than by applying a pooled threshold across both phases. Accordingly, we claim phase-specific code saturation. In Phase #1, no new codes emerged after the seventh interview. In Phase #2, no additional sub-themes or analytically relevant codes emerged after the seventh interview within that phase. This pattern is consistent with the claims of Guest et al. (2020), who demonstrated that in homogenous interview samples, the majority of codes typically emerge within six to seven interviews. Similarly, as noted by Parker et al. (2019), snowball sampling usually concludes once the target group size or the point of saturation is reached.

All our interviews were conducted based on the same questionnaire protocol to ensure consistency. The questionnaire used in the qualitative research was developed by the authors based on their experience from three previous retail research projects (Mohácsi et al., 2025; Pistrui et al., 2023; Matyusz & Pistrui, 2020) (see Appendix A for the interview questions). For anonymity, interviewees are referred to by codes throughout the analysis. Appendix B summarizes the sample characteristics.

The selection criteria for interviewees included holding a current or former executive position or having management consulting experience in the retail sector and, for the purpose of data generalization, having international experience at least at the regional level. Interviews in both phases were transcribed and coded based on the framework proposed by Braun & Clarke (2006). As highlighted by Ahmed et al. (2025), the six-step framework of Braun & Clarke still remains the cornerstone of robust thematic analysis. After familiarization with the data, the coding process was conducted manually using sixteen interview transcripts. Themes and sub-themes were generated and are used as the structure for presenting the results of our qualitative data collection.

### *The quantitative consumer survey*

Our questionnaire consisted of several parts. First, we used age as a demographic element, then asked respondents about basic purchasing characteristics (e.g., credit card or cash payment, online or in-person shopping preferences). The second part involved asking respondents about the state of retail and more specific shopping habits. In the third part, we questioned respondents about the emergence and use of back-end solutions, front-end solutions, and front-end digital innovation solutions (see Appendix C for the exact questions).

The questionnaire was available between March 1 and 15, 2024. We received a total of 291 responses across online social media channels, which satisfies the large sample criterion. Ninety-three percent of the final sample completed the survey during the first week, with an additional 20 responses in the second week before the survey closed. This front-loaded distribution is typical of online surveys and indicates

consistent data collection without irregular late-response patterns. There was no missing data because all questions were mandatory. We also found no evidence of straight-lining or outlier respondents. To assess response quality, we also examined completion times for all 291 respondents. The average completion time was nine minutes, and no cases were removed based on this factor. As our survey was conducted online and on a voluntary basis, non-response bias was not applicable.

By examining the entire sample of 291 people, we can draw many conclusions regarding retail trends and innovation. The majority of consumers make their purchases with a bank card and are increasingly open to innovative solutions. It can be said that, with rising prices and the spread of sustainability initiatives, consumers' price and health awareness have also increased in recent years. Contrary to the results of the qualitative research, which indicated that customers prefer front-end solutions, consumers are also open to and interested in back-end process innovations, providing retailers with insights into their innovation strategy. Among the front-end innovation solutions, in-store solutions are less popular but have a positive impact on consumer purchases, while consumer convenience solutions are more popular and also have a positive impact.

Beyond the descriptive analysis, we derived further insights by segmenting the customers, a powerful tool for uncovering customer behavior (Shirole et al., 2021). This segmentation problem was handled by conducting cluster analysis, a standard and well-accepted technique in retail and innovation research with many possible approaches (e.g. Antunes-Pinheiro, 2020; Daraboina et al., 2024; Kraus et al., 2022; Kumar, 2025; Nguyen et al., 2024; Škare et al., 2024).

To conduct the segmentation, we performed a two-level cluster analysis. A visual overview of our methodology is provided in Fig. 1.

At Level 1, we examined five questions from the questionnaire, each containing several statements evaluated on a 1-5 Likert scale by respondents. The questions were about the following:

1) customer perceptions of the retail environment (see Question 8 in Appendix C)
2) customer perceptions about themselves (see Question 9 in Appendix C)
3) back-end innovations influencing purchasing decisions (see Question 10 in Appendix C)
4) front-end innovations influencing purchasing decisions (see Question 11 in Appendix C)
5) consumer convenience innovations influencing purchasing decisions (see Question 12 in Appendix C)

We conducted the cluster analyses on each question following the steps well established in the literature:

1) Hierarchical cluster analysis with the Ward method suggested the range of the optimal number of clusters. Ward's method minimizes the increase in total within-cluster variance at each agglomeration step, producing compact and internally coherent clusters (Hair et al., 2018). Although the method can be sensitive to outliers (Everitt et al., 2011), we used it to segment Likert-scale 1-5 data, which mitigates this issue.
2) After identifying the plausible range of cluster solutions using Ward's method (typically between three and seven clusters), we applied k-means clustering to refine the segment structures. K-means is a widely used clustering algorithm that iteratively assigns observations to the nearest centroid based on Euclidean distance (Everitt et al., 2011; Hair et al., 2018). Its advantage lies in its ability to optimize cluster membership once an initial cluster structure has been suggested. Combining Ward's hierarchical results with k-means refinement leverages the strengths of both approaches: Ward's method provides a stable initial structure, while k-means offers enhanced precision and convergence to local optima.
3) We then compared the solutions of the two methods for every cluster number with crosstabs and the strength of association. Because cluster memberships are nominal categorical variables, measures such as correlations cannot be used to compare them; we had to select an appropriate association index for nominal-nominal comparisons based on cross-tabulations. For this, we used Cramer's V, a well-established measure of association between variables measured at the nominal level. Specifically, for tables with more than two columns and two rows, Cramer's V must be used (Healey, 2010). For each number of clusters, we constructed a contingency table of the two solutions and calculated Cramer's V to assess their overlap. Higher values indicate stronger agreement between the two methods and thus greater cluster stability. For each question, four or five

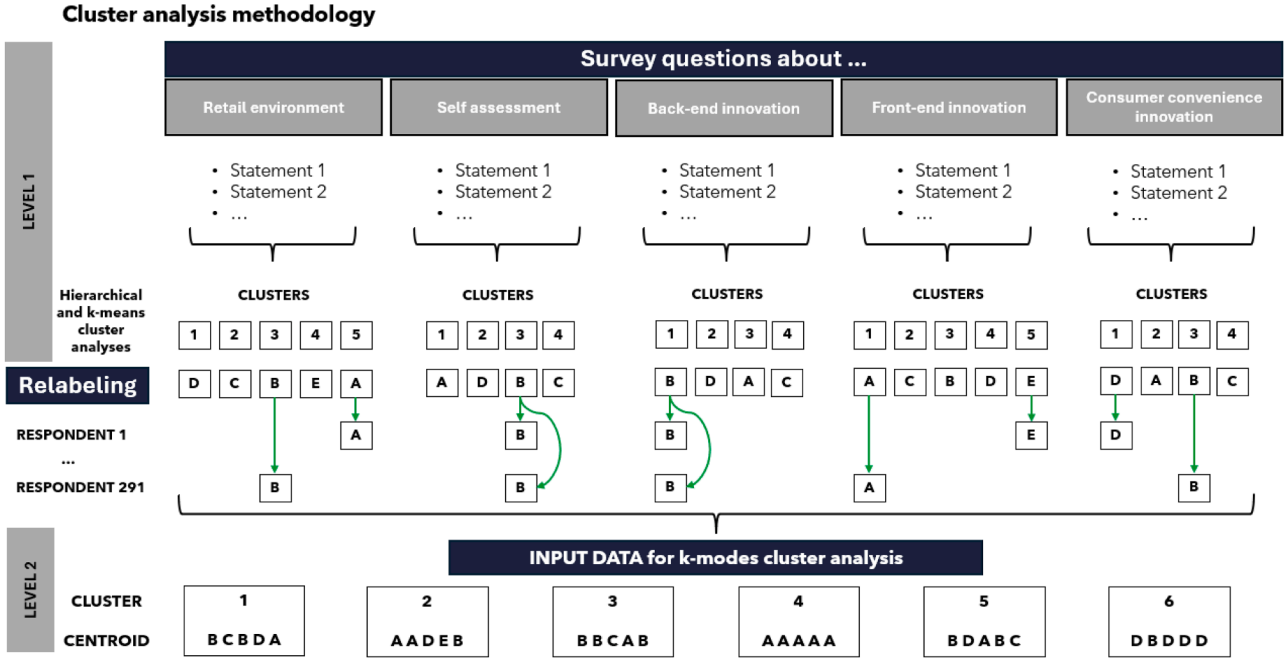



**Fig. 1.** Overview of methodology.

clusters emerged as the best solution. Accordingly, each customer had five cluster memberships based on their responses to the five questions.

For Level 2, we sought to use these customer cluster memberships as inputs to develop an overarching cluster membership that reflects customers' holistic views of the environment, themselves, and the effects of different back-end and front-end innovations. As cluster memberships are categorical variables, we could not use k-means or similar clustering methods at this level, thus we opted for k-modes clustering. The k-modes algorithm is an extension of the k-means algorithm that uses modes (the most frequent categories in each cluster) and measures dissimilarity by counting mismatches. This method effectively groups categorical data by minimizing dissimilarities between points and cluster modes (Huang, 1998).

Cluster membership numbers, as cluster labels, emerge randomly from k-means cluster analysis, so to bring more structure to our data and facilitate k-modes cluster analysis, we relabeled the clusters as follows for each question: we looked at the final cluster centers and summed them for each cluster. Then, we assigned the label 'A' to the cluster with the highest sum, 'B' to the second-highest sum, and so on. The emerging clusters for the different questions are shown in Appendix D (for more details on the clustering, please see Appendix E).

Ultimately, each respondent was assigned a set of cluster memberships such as AABCD, BCBAD, DDDAD, and so on. On Level 2, these relabeled sets of cluster memberships were used as input for k-modes clustering. We used the *kmodes* Python package, which supports clustering with k-modes and k-prototypes (for mixed data), to run our analysis. An important issue is the selection of the method for initializing cluster centroids. From the built-in options available in *kmodes,* we chose Cao initialization. Cao's initialization explicitly selects initial cluster centers by considering both the density of data points (favoring dense regions, which are more representative of clusters) and the distance between candidate centers (ensuring well-separated, diverse initial modes).

This contrasts with Huang's more heuristic, frequency-based initialization or purely random selection, making Cao's initialization more principled and better adapted to the dataset's structure. Cao's initialization also produces highly stable clusters, with repeated runs converging to nearly identical solutions. The deterministic or near-deterministic nature of Cao reduces the variability caused by random seeds and local optima. Because Cao's initialization carefully selects initial modes that reflect natural grouping tendencies, algorithms initialized this way typically achieve better clustering quality (lower total cost or distance to modes) than Huang or random initializations, which can become trapped in worse local minima. This means Cao often finds more meaningful clusters in categorical data (Cao et al., 2009; Bai et al., 2012; Jiang et al., 2016; Nguyen, 2017)

As we did not know the optimal number of clusters, we ran the algorithm over a range of cluster counts (2-9) and then used the Elbow method to examine the clustering cost and apply our domain knowledge to determine which number of clusters best fit our data. With the Elbow method we plotted the clustering cost (the sum of the dissimilarities between each data point and the mode of the cluster it belonged to) against the number of clusters in an analogous way to how k-means minimizes the sum of squared distances to cluster centroids (see Appendix F for the plot and cost values; see the next section for the results).

## Results

### *Interview results*

Data collection sheds light on key themes and sub-themes related to changes in the retail environment and how innovation shapes the sector's future. Table 1 summarizes the results of code generation for Phase #1 and Phase #2 of the interviews. Themes and sub-themes serve as the structural basis for the discussion of qualitative results.

**Table 1**
Coded themes and sub-themes.

| Themes | Sub-themes | Phase #1 | Phase #2 |
|---|---|---|---|
| Post-pandemic hardships and experienced changes in retail | Resurgence of retail after the pandemic | ✓ | |
| | Adaptability to changes in consumer behavior | ✓ | ✓ |
| | Environmental threats of inflation and geopolitical tension | ✓ | |
| | Channel rebalancing efforts after pandemic recovery | | ✓ |
| Innovation process challenges in retail companies | Coexistence of product and service innovation | ✓ | ✓ |
| | Diversity in innovation processes | ✓ | ✓ |
| | Financial and non-financial success metrics of innovation implementation | ✓ | |
| | Organizational readiness for innovation culture | | ✓ |
| | Workforce digital skills gap | | ✓ |
| Changes in the importance of smooth back-end operations | Efficiency and sustainability expectations in back-end operations | ✓ | ✓ |
| | Consumer interest in back-end processes | ✓ | |
| | Infrastructure modernization | | ✓ |
| Complex front-end expectations from consumers | Consumer satisfaction and usage expectations regarding in-store and digital technology | ✓ | ✓ |
| | Mobile application-centered ecosystems | ✓ | ✓ |
| | Sustainability and health-conscious consumption | ✓ | ✓ |
| | Polarized acceptance of self-service solutions | | ✓ |

#### *Post-pandemic hardships and experienced changes in retail*

*Resurgence of retail after the pandemic.* In Phase #1, despite representing seven companies across multiple retail segments, participants converged in their assessment of the sector's current condition. The COVID-19 outbreak was widely framed as an inflection point, like "a new calendar" that precipitated rapid operational reconfiguration. Several interviewees reported immediate shifts in shopping patterns ("we noticed smaller basket sizes with more frequent visits; we had to adapt," INT3), while government restrictions on opening hours further constrained store operations. At the same time, executives underscored a positive legacy: the forced acceleration of digitalization and the diffusion of omnichannel models ("our system ran at virtually 100% capacity throughout COVID, necessitating expansions to meet demand," INT3; "online [operations were] already in motion, but COVID gave it a push," INT4; "we saw our competitors struggling with overdemand so we accelerated our online delivery project," INT2). The speed of strategic adjustment was captured by a consultant's observation that "retailers had to switch strategy from Monday to Tuesday" (INT7). Participants also noted that the transition to digitally infused operations posed substantial challenges for smaller, local retailers, prompting calls for ecosystem support ("as a shopping service, we see it as our duty to help local businesses establish a robust online presence," INT1).

*Adaptability to changes in consumer behavior.* Although most pandemic-era restrictions have receded, firms continue to adapt to altered consumer expectations, with omnichannel operation now treated as a baseline. As one executive from Phase #1 noted, "there are no 'offline' and 'online' shoppers; there are paths. The winning retailer is present across many channels and remains accessible" (INT1). Pandemic-period preferences for health-conscious and pre-packaged goods have persisted

("we shifted to pre-packaging to prevent transmission and recorded extraordinary growth in these items," INT3). Similar patterns emerged during Phase #2. Store visit behavior turned upside down, as noted by a drugstore manager, "Now it is less beneficial for us to stay open on Sundays as footfall has decreased dramatically" (INT8). Some retailers took advantage of changes due to store closures and benefited from flexible procurement: "Unfortunately, smaller shops faced disrupted business in our proximity, but our ability to adjust supplier orders ensured that we have stayed agile and we attracted huge traffic as well" (INT9).

*Environmental threats of inflation and geopolitical tension.* Interviewees further highlighted exogenous shocks beyond the pandemic. Many, particularly those representing foreign-owned multinationals, emphasized spillovers from the Russia-Ukraine conflict and ensuing supply-chain disruptions, with knock-on effects on food prices and household budgets. More obvious behavioral responses included down-trading ("premium buyers moved to mid-range; mid-range to the cheapest options," INT6) and the expansion of a price-driven "deal-hunter" segment "with limited brand or chain loyalty" (INT3). Participants also referenced Red Sea/Suez disruptions, which delayed East-to-Europe shipments and acutely affected apparel ("goods are arriving weeks late; this affects us as well," INT5).

*Channel rebalancing efforts after pandemic recovery.* Managers in grocery retail have recognized the need to recalibrate how customers are served: "Consumers have now gone full circle after the pandemic recovery in search of cheaper offline deals; shoppers once again walk to local stores to browse the assortment" (INT13). Drugstore retailers experienced the same, as after the boom in webshop traffic, consumer behavior slowly shifted back to pre-pandemic levels: "Cosmetics and fragrance are typical products consumers preferred to purchase in brick-and-mortar stores. Resurgence took years, but we are seeing an increase in offline sales this year" (INT8). The ability to shift focus amongst channels was also accelerated by the pandemic: "If we observe slower turnover at one of our offline or online channels, we try to give discounts to strengthen the performance" (INT16). The usage of multiple channels also allows retailers to test product attractiveness: "We constantly monitor trending items; if a product performs well in one channel, we try to promote it in the other ones" (INT16).

### *Innovation process challenges in retail companies*

*Coexistence of product and service innovation.* Innovation among the observed retail firms takes multiple forms (product and service innovation, as well as technological and non-technological change), consistent with the literature on retailing (Paredes et al., 2023). Interviewees uniformly emphasized the necessity of continuous renewal on both the product and store-environment fronts (INT2), reflecting intense competitive pressure (INT6; INT2). Multinational subsidiaries reported parallel, ongoing efforts in product and service domains without explicit prioritization, while an external consultant framed innovation as a "strategic response to turbulence and abrupt market shifts requiring rapid organizational adaptation" (INT7). Interviewees highlighted that even though product innovation is considered a constant, app upgrades facilitate service innovation: "you just have to do both to compete" (INT8). Some foreign-ownership retailers do not consider product and service innovation as separate categories, instead branding their projects a *technological product way of thinking*: "we want our product lines and projects to look the same across the whole group, so for example, as part of the digital transformation we include services and new products that we can offer, among other things" (INT13). Intense competition is not the only factor retailers must consider. Consumers are demanding more sustainable products, and for retailers to cater to this, they need to innovate their products and services: "We lay emphasis on conscious water consumption on our part as a company; this includes selecting the right suppliers and upgrading technology related to production. Our group invests a significant amount of money [into increasing] sustainability" (INT10).

*Diversity in innovation processes.* Regarding the sources of innovation initiatives, practices varied among the businesses examined in Phase #1. Given that two-thirds of interviewees in this phase work in local subsidiaries of multinational corporations, headquarters-led innovation was common. In terms of apparel, the head office typically mandates centrally defined initiatives for subsidiaries. By contrast, food-retail subsidiaries described greater discretion to select and operationalize innovations locally. Headquarters-driven initiatives were generally accompanied by implementation support (guides, training). New application rollout is accompanied by meetings among franchise partners: "I recently attended a collective workshop where executives revealed the features of the app in development to us, the franchisees" (INT9). New product development for fragrances comes with mandatory training for store managers (INT8). Bottom-up channels complemented these top-down flows. One international supermarket chain operates digital "idea boxes," open to all staff and tied to recognition and prizes; management reports annually identify 15-20 previously unconsidered ideas that yield cost savings or value creation: "We always find at least two or three ideas that we just haven't thought of which manages to cut costs or increase our turnover, and these come from our employees" (INT3). A domestically owned drugstore chain convenes twice-yearly, two-day store-manager meetings attended by owners and functional leaders, where managers must present negative experiences and development proposals; traveling field managers subsequently brief stores on approved implementations (INT6). Firms routinely drew on multiple sources of ideas. Competitive monitoring, benchmarking, and scanning industry developments were pervasive; interviewees noted that the visibility of retail practices reduces secrecy and accelerates imitation, even as firms also develop original concepts (INT5). One start-up explicitly benchmarks a comparable U.S. provider when considering new features (INT1). External actors such as consultancies and market research firms are frequently engaged both to ground innovation in consumer insights and, at times, to co-develop and implement solutions (e.g., enterprise-wide software) (INT2, INT5; INT13). Governance and decision processes likewise diverged by ownership and size. In the domestic drugstore chain, owners decide on innovation and communicate via field managers (INT6). Several executives, however, stressed the openness to fully elaborated proposals and the expectation of a business case (INT2). In multinational subsidiaries, proposals typically undergo cross-functional review (e.g., IT, finance). The start-up from our sample operates with markedly greater agility: a small leadership team makes rapid "test-and-learn" decisions (INT1).

*Financial and non-financial success metrics of innovation implementation.* Implementation and evaluation criteria combine financial and non-financial metrics. As profit-oriented firms, interviewees highlighted return on investment and up-front capital needs as central to evaluation. Additional indicators included transaction growth (as a revenue proxy), customer satisfaction, cost savings, and operational efficiency gains. One international supermarket chain noted a willingness to relax strict financial thresholds if consumer well-being benefits are clearly demonstrable (INT3). Piloting was widespread: a discount chain typically trials innovations in two stores and scales only after positive results and high customer ratings (INT2). In e-commerce contexts, post-order surveys and digital analytics (e.g., heatmaps) inform decisions; for the start-up, growth in transactions is the principal early-stage KPI, contingent on sustained customer satisfaction (INT1).

Speed constituted a further point of differentiation. The start-up reported a short time-to-market enabled by flat hierarchy and an experienced development team. Larger organizations acknowledged

coordination frictions yet stressed the impossibility of slowing down amid intense rivalry; as one apparel executive remarked, rapid imitation compels continuous innovation to preserve advantage (INT5). Conversely, the domestic drugstore chain adopts a more deliberate pace due to capital constraints, which lengthen innovation and investment cycles (INT6).

*Organizational readiness for innovation culture.* Nine managers interviewed in Phase #2 emphasized the importance of organizational readiness: "On both the consumer side and employee side, younger generations are more open to technology and innovation, and that creates a challenge" (INT11); "The real cultural change happened right after the succession happened, and innovation became a strategic priority" (INT12). This factor is reflected in how managers view innovation at one of the clothing retailers: "We deem innovations successful when our colleagues can use a new system smoothly and without substantial negative feedback" (INT10).

*Workforce digital skills gap.* The intensifying digital transformation is inevitable; moreover, the move towards paperless operations is well underway. Managers from Phase #2 highlighted the growing importance of going digital: "Our stores are full of digital solutions, our employees use e-worksheets, and within five years we aim to become paperless" (INT15); "In both back-end and front-end operations, all our employees use Personal Digital Assistants (PDAs)" (INT14). Interviewees shed light on the importance of education and training as the workforce is diverse in terms of digital literacy: "Even with our own system, we have to teach employees how to use the new functions after upgrades" (INT14); "Ideally a system is as intuitive as a smartphone, but for many even that would be a struggle" (INT13); "The upcoming generations are talking with chatbots and active online, naturally they are well-versed in technology" (INT11).

### *Changes in the importance of smooth back-end operations*

*Efficiency and sustainability expectations in back-end operations.* In line with the literature, respondents conceptualized back-end innovation as improvements to less customer-visible processes (e.g., logistics design, warehouse operations, and wider organizational systems) while emphasizing the practical inseparability of front- and back-end functions, since front-end shortcomings often precipitate back-end investment and neither domain performs effectively in isolation.

Logistics emerged as the most important area because its effects are readily perceived by customers. One grocery-delivery start-up is finalizing a machine-learning time-window system to forecast shopper capacity, shifting from manual control to a data-driven, predictive model (INT1). In contrast, a discount chain outsources delivery, making innovation contingent on partners who themselves upgrade under competitive pressure. A domestically owned drugstore also relies on the owner's wholesale logistics yet retains greater influence, as the wholesaler is directly invested in retail performance.

Proprietary systems appear to confer a persistent advantage. A multinational supermarket exploits substantial in-house IT capacity (country-level developer entities; a group-wide team of roughly 300 developers, about 50 in Hungary) to expand a two-decade-old demand-forecasting inventory system supporting procurement and stocking (INT3). An apparel firm operates a largely robotized mega-warehouse introduced around seven years ago, achieving notable time savings globally; it has also deployed real-time, enterprise-wide sales monitoring down to product level, equipped stores with tablets and PDAs, and is scaling Radio Frequency Identification (RFID) – approximately 50% tag coverage locally versus about 90% in the home country; INT5). RFID is observed to be impactful at other clothing retailers as well: "We use RFID, and it significantly increases the speed of our back-end processes" (INT16).

Sustainability initiatives complement these technical upgrades. The e-commerce start-up has built dedicated interfaces and apps for delivery "shoppers," embedding core business logic in the back end (INT1). The discount chain has launched a paperless program to eliminate paper for efficiency and environmental reasons (INT2), while the automotive retailer also aims to become fully digital in five years (INT15). One of the supermarkets whose representative we interviewed operates a supplier development academy and a comprehensive food waste treatment system (donations and biogas), reducing landfill volumes to a minimal level (INT3). The interviewed franchisee reflected on the recent infrastructure development, in which water reuse is supported by a new cleaning system available to customers adjacent to the storefront: "There is a clear drive toward sustainable developments for consumers" (INT9). Multiple retailers operating in the clothing and apparel segment report greater investment into sustainability efforts (INT10; INT4; INT5).

*Consumer interest in back-end processes.* Despite growing transparency, managers approached in Phase #1 reported limited consumer interest in understanding back-end processes: "We don't see real interest coming from consumers on back-end operations" (INT2). However, a different viewpoint and several best practices were shared by managers approached in Phase #2: "We have a new reverse logistics system which does not require signing a printed receipt; customers initiate the process with a digital signature, warehouse process redesigns have also led to better customer feedback" (INT10). Innovation in keeping track of inventory has also led to positive changes at the clothing retailer: "With RFID, we are seeing our inventory in real time and consumers can also track available sizes in all our stores" (INT10). When clothing fulfillment is not frictionless, consumers may voice their concerns: "If someone orders eight products, it might happen that we should obtain them from three different stores, which obviously takes two days, and it impacts consumer satisfaction" (INT14).

*Major infrastructure modernization.* Notably, while Phase #1 interviews touched upon incremental adjustments in innovation, an emergent subtheme in Phase #2 was that various retailers have since then started major infrastructure developments: "There is no such area which is currently not undergoing major redevelopment" (INT14); "Our new large-scale warehouse complex near the capital is our recent investment" (INT15). Other managers mentioned planned overhauls: "The biggest development on our back-end is the complete overhaul of our machinery, the capabilities of new-generation compact devices are amazing" (INT10). The reason why such large-scale developments are being implemented now is the change in the retail environment: "The current rising wages and inflation make the business case for automation overhaul look better…there is better ROI compared to what we saw two years ago" (INT13). Managers underlined the organizational shift towards a culture that welcomes innovation (INT12; INT13).

### *Complex front-end expectations from consumers*

*Consumer satisfaction and usage expectations regarding in-store and digital technology.* Front-end domains in retail comprise the consumer-facing touchpoints encountered in stores, often grouped under the umbrella of consumer-facing in-store technologies (CFIT). Their primary purpose is to enhance the shopping experience and, in turn, to build competitive advantage (Bonetti, 2022). Consequently, the success of front-end innovation depends on consumer satisfaction, which is difficult to attribute directly to single interventions and therefore often assessed through staged pilots. A discount chain measures satisfaction uplift in test stores before network-wide deployment (INT2), while a grocery-delivery start-up iteratively tests website and app features, using heat map analytics to monitor dwell times and feature usage, and conducts post-purchase surveys with response rates exceeding 50% (INT1). Managers agreed that digitalization is expected to deliver

consistency and reliability to consumers: "Digitalization reduces room for error and yields better results, hence consumers see consistency in our services" (INT13). Customers expect unified channels and a frictionless customer journey: "Now the consumer can do anything digitally from purchase to delivery pickup" (INT10). The measurement of customer satisfaction varies among retailers: "We rely on first-hand employee feedback on whether customers are open to the small innovative solutions we implement" (INT10); "We measure in-store satisfaction with quick surveys and reward customers with small gifts" (INT14).

*Mobile application-centered ecosystems.* In front-end innovation, common elements include the ubiquity of loyalty-enabled mobile apps, widespread in-store digital displays, and the growing role of omnichannel mechanisms such as Click Shopping; emergent payment and checkout paradigms (e.g., just-walk-out) suggest additional, still-latent potential. Typical functions of smartphone apps include embedded loyalty cards, shopping lists, payment options, and personalized offers via coupons linked to shopper profiles (INT2). Simply, the unified experience is ensured through mobile applications, which are the central point of innovation: "As an e-commerce startup, the primary touchpoint with customers is the app" (INT1). These apps have largely shifted from differentiators to hygiene factors. A domestic drugstore's pared-down app, which is essentially a digital loyalty card with points and store lists, illustrates this standardization (INT6). In apparel, intense rivalry has prompted the integration of loyalty programs within apps to retain customers in a contracting market (INT4). Another drugstore manager stated that "without an application nowadays you cannot even compete with other retailers" (INT8), while a franchisee managing director noted: "We are about to introduce the first mobile application, and now we see that it is missed by customers" (INT9). Concerning customer loyalty, managers identified mobile apps as the key anchor: "We eliminated paper leaflets years ago, and now all coupons and discounts are app-based" (INT13). If substantial digital infrastructure is present, apps serve as shopping facilitators: "Through the app we have made available personalized offers, customers can use the app and loyalty card at the cashier desk or even if they choose the self-checkout" (INT3).

*Sustainability and health-conscious consumption.* Heightened post-pandemic attention to health and environmental externalities has likewise shaped front-end choices. One supermarket chain reports prioritizing consumer well-being in adoption decisions and coupling rollouts with shopper education. For example, introducing reusable options and converting formerly free plastic bags to paid, biodegradable alternatives, which was an initially contentious move that competitors later emulated (INT3). To sustain a health-conscious and quality assortment, back-end operations monitor product conditions: "We have sensors and cameras with which we monitor product quality" (INT11). Discount grocery retailers are in close cooperation to ensure food waste treatment and have sustainability-related offerings: "We send food waste to biogas companies and landfills" (INT3); "Our collaboration with a food waste startup was piloted and became a huge success among customers [so] we decided to scale it to countrywide rollout" (INT2). In the clothing segment, consumers are turning toward longer-lasting products: "Good quality products are sought after, consumers seek longer use products" (INT10). On the other hand, some customers still have low interest in green initiatives: "In our stores, I haven't really met anyone who cares for what we do for sustainability" (INT16).

*Polarized acceptance of self-service solutions.* Within the store, digital displays, self-service scanners and checkouts, and QR codes have diffused, with the pandemic acting as a catalyst. Digital displays are used mainly for information and education (e.g., concerning healthy eating) rather than high interactivity (INT6). On the other hand, the use of self-checkouts has expanded rapidly but remains polarizing; roughly half of shoppers prefer and use them, while the remainder avoid them, prompting retailers to offer both assisted and self-service options (INT3). Retailers have started piloting "just-walk-out" solutions, signaling the further convergence of payment and automation (INT2). One manager from the drugstore segment observed substantial resistance to self-checkout solutions: "Others retailers have tried it, but customers don't like self-checkout, they are not comfortable with them yet, so we don't have them" (INT8).

To conclude our findings from the two-phase qualitative data collection, Table 2 is included below, with illustrative quotes linked to the themes and sub-themes that were developed.

*Quantitative results*

Based on the *k-modes* clustering, we accepted the 6-cluster solution. Each emerging cluster centroid serves as a final cluster center containing a set of five cluster memberships, such as BCBDA or AADEB, with each respondent is assigned to one of the six final clusters (see Table 3).

Looking at the cluster memberships and additional data from the questionnaire (see Questions 1-7, 13 in Appendix C), we can describe the emerging clusters as follows:

*Cluster 1: Selective explorers*

Cluster 1 represents a group of respondents who are moderately engaged with retail trends and digital innovations but remain somewhat cautious, especially when it comes to sustainability. They spend more per purchase than before, prefer card payments, and are open to trying new and innovative retail solutions. However, their openness is less pronounced than in the more innovation-driven clusters. They are not strongly motivated by brands, choosing products more for convenience than for prestige.

Their shopping behavior reflects flexibility in how they shop (online or in-person), depending on what is easiest in the moment. At the same time, they are less comfortable combining online and offline elements within a single purchase, which may explain why they feel they have fewer payment and delivery options. Interestingly, they are willing to explore digital tools and solutions, but this openness does not extend to sustainability or health-conscious products, which they buy less frequently than the average shopper. When they do make such purchases, they are prepared to endure minor inconveniences, indicating a conditional acceptance of these values. Overall, members of Cluster 1 combine a pragmatic approach to shopping with selective curiosity, embracing digital changes but not strongly invested in broader retail or sustainability trends.

*Cluster 2: Selective traditionalists*

Cluster 2 is made up of respondents who are strongly aligned with general retail trends and display high awareness of their own shopping behavior. These are self-conscious consumers who are careful spenders, typically spending less per purchase compared to others. They are very open to healthier product options and innovative solutions and place a lot of importance on price, payment methods, and the physical environment of the store, including staff behavior. They have strong values concerning health and price sensitivity, which shape much of their decision-making.

Despite their alignment with general industry trends, this group is completely unaffected by back-end and front-end retail innovations. They also make limited use of advanced digital convenience services, such as scheduled or same-day delivery, although they show a moderate interest in other digital shopping solutions. They are strongly card-oriented in their purchasing behavior and, compared to others, place relatively stronger emphasis on brands when making product choices. In many ways, Cluster 2 members resemble the average shopper, but with distinct preferences for card payments, price awareness, and a slightly higher degree of brand loyalty. Their approach combines practicality with cautious openness, grounded in a strong sense of awareness about

**Table 2**
Main topics and illustrative quotes.

| Themes | Sub-themes | Illustrative quote |
|---|---|---|
| Post-pandemic hardships and changes experienced in retail | Resurgence of retail after the pandemic | "Our system ran at virtually 100% capacity throughout COVID, necessitating expansions to meet demand" (INT3) |
| | Adaptability to changes in consumer behavior | "Unfortunately, smaller shops faced disrupted business in our proximity, but our ability to adjust supplier orders ensured that we stayed agile and we attracted huge traffic as well" (INT9) |
| | Environmental threats of inflation and geopolitical tensions | "Premium buyers moved to mid-range, mid-range to the cheapest options" (INT6) |
| | Channel rebalancing efforts after pandemic recovery | "Consumers have now gone full circle after pandemic recovery in search of cheaper offline deals; shoppers once again walk to local stores to browse the assortment" (INT13) |
| Innovation process challenges in retail companies | Coexistence of product and service innovation | "You just have to do both to compete" (INT8) |
| | Diversity in innovation processes | "I recently attended a collective workshop where executives revealed the features of the app in development to us, the franchisees" (INT9); "We always find at least two or three ideas that we just haven't thought of that manage to cut costs or increase our turnover, and they come from our employees" (INT3) |
| | Financial and non-financial success metrics of innovation implementation | "There is willingness to relax strict financial thresholds where consumer well-being benefits are clearly demonstrable" (INT3) |
| | Organizational readiness for innovation culture | "The real cultural change happened right after the succession happened, and innovation became a strategic priority" (INT12) |
| | Workforce digital skills gap | "Ideally, a system is as intuitive as a smartphone, but for many, even that would be a struggle" (INT13) |
| Changes in the importance of smooth back-end operations | Efficiency and sustainability expectations in back-end operations | "We use RFID, and it significantly increases the speed of our back-end processes" (INT16); "There is a clear drive toward sustainable developments for consumers" (INT9) |
| | Consumer interest in back-end processes | "We have a new reverse logistics system which does not require signing a printed receipt; customers initiate the process with a digital signature, and warehouse process redesigns have also led to better customer feedback" (INT10) |
| | Infrastructure modernization | "The current rising wages and inflation make the business case for automation overhaul look better... there is better ROI compared to what we saw two years ago" (INT13). |
| Complex front-end expectations of consumers | Consumer satisfaction and usage expectations about in-store and digital technology | "We rely on first-hand employee feedback on whether customers are open to the small innovative solutions we implement" (INT10); "We measure in-store satisfaction with quick surveys and reward customers with small gifts" (INT14) |
| | Mobile application-centered ecosystems | "We are about to introduce the first mobile application, and now we see that it is missed by customers" (INT9) |
| | Sustainability and health-conscious consumption | "Our collaboration with a food waste startup was piloted and became a huge success among customers, so we decided to scale it to a countrywide rollout" (INT2) |
| | Polarized acceptance of self-service solutions | "Other retailers have tried it, but customers don't like self-checkout; they are not comfortable with [them] yet, so we don't have them" (INT8). |

the products they buy and how they shop.

*Cluster 3: Practical loyalists*

Cluster 3 includes respondents who are moderately aligned with retail trends, showing some awareness of industry shifts but with a weaker emphasis on sustainability. They have shopping attitudes similar to those of the more self-conscious Cluster 2, but are more inclined to favor cash payments, especially for online purchases. Their shopping patterns reveal an interesting split: they prefer to make smaller, everyday purchases in person, while reserving larger ones for online platforms. This makes them relatively heavy online shoppers, especially for categories like food, beverages, electronics, and entertainment products, while they are less likely than others to buy clothing or apparel online.

They rely more heavily on home delivery than on in-store pickup, further indicating their preference for convenience when shopping online. Compared to other clusters, they show stronger brand orientation: 25% of members choose products based on brand, while fewer rely primarily on price or discounts, making them the least price-driven group overall. While they are not eager to put up with inconveniences when trying out new types of products, they do make exceptions for health-conscious or sustainable items, for which they are willing to be more flexible. Their relationship with innovation is balanced, as they have a positive but not overly enthusiastic view of front-end retail solutions, are lukewarm about back-end systems, and moderately accepting of convenience tools. This makes Cluster 3 a group of pragmatic online-oriented consumers who prioritize convenience and brands, with conditional openness to sustainability.

*Cluster 4: Digital enthusiasts*

Cluster 4 stands out as the most innovation-driven and forward-looking group. These shoppers strongly support all major retail trends, from sustainability and health to digital and operational innovations. They are highly self-conscious in their shopping habits, spend less per transaction, and actively seek out healthier products and innovative solutions. Every aspect of the retail experience matters to them, including pricing, payment, the physical shopping environment, and staff interactions. They are influenced by back-end innovations (even

**Table 3**
Final clusters.

| CLUSTER | CLUSTER SIZE | CLUSTER CENTROID | | | | |
|---|---|---|---|---|---|---|
| | | ENV | SELF | BACK | FRONT | CONVENIENCE |
| 1 | 43 | B | C | B | D | A |
| 2 | 98 | A | A | D | E | B |
| 3 | 20 | B | B | C | A | B |
| 4 | 49 | A | A | A | A | A |
| 5 | 23 | B | D | A | B | C |
| 6 | 58 | D | B | D | D | D |

warehouse automation), front-end solutions like self-service checkouts and digital displays, and convenience innovations such as same-day delivery or digital coupons.

They prefer online shopping more than average, regardless of basket size, and show broad openness to purchasing a wide range of product categories online, from food and beverage products to furniture. Their preferred payment method is card, and they are heavily price- and discount-driven, with very few showing brand loyalty. They are also the most willing to experiment with new digital retail solutions and are comfortable blending online and offline elements in a single shopping journey. They receive more personalized offers than other clusters and are more likely to use them repeatedly, demonstrating a strong integration with retailer marketing. Additionally, they are highly engaged with sustainable and health-conscious products, not only facing a wider selection of such items but also embracing them more readily.

*Cluster 5: Traditional loyalists*

Cluster 5 represents a more traditional and older-leaning group of shoppers. They moderately recognize general retail trends but show weaker alignment in sustainability. They are characterized by their strong preference for cash payments, infrequent store visits, and relatively high spending per purchase compared to earlier habits. They are not particularly open to healthy products, innovative solutions, or price-conscious shopping. Instead, they show stronger preferences for brands and, interestingly, sustainability, though they are reluctant to adopt new digital innovations or mix online and offline shopping methods.

This cluster contains the largest proportion of older consumers, with nearly a third of members aged 65 and older and none in the youngest age group (16-24). While they do buy online, a significant portion refuse to shop online altogether. They are less likely to buy clothing and personal care products online but more willing to purchase books and related categories of items. When they do shop, they are less inclined to use card payments than average, reinforcing their attachment to traditional payment methods. Although they are less exposed to personalized offers and less likely to use them, they are the most willing of all clusters to put up with inconveniences in order to purchase healthy or sustainable products. In many ways, Cluster 5 reflects a group of traditional, brand-loyal shoppers who are hesitant about retail innovation but remain strongly committed to sustainability values when it matters most.

*Cluster 6: Minimal engagers*

Cluster 6 is the most skeptical group regarding members' attitudes toward innovation and sustainability in retail. They are not convinced by industry trends related to health or sustainability, and they show little enthusiasm for new back-end or front-end innovations, apart from a slight preference for self-service solutions. They are also largely uninterested in convenience innovations and make very limited use of them, representing the least digitally engaged cluster overall. Despite this, they are not opposed to online shopping itself, which they sometimes use for convenience, though they avoid mixing online and offline channels within the same transaction.

They lean more toward card payments than cash when shopping in person, but their overall payment preferences are not particularly innovative. They buy less in certain categories, such as the drugstore, and are less likely to take advantage of personalized offers, which they also tend to ignore when they receive them. They are also less willing to endure inconveniences for sustainability or health-conscious purchases, indicating low engagement with these values. Overall, Cluster 6 can be described as a group of pragmatic, convenience-driven consumers who resist most forms of retail innovation and sustainability messaging, preferring to keep their shopping simple and straightforward without adopting the latest industry trends.

*Comparison*

Both the interviews and the cluster analysis point to the same baseline: digitalization and omnichannel have become hygiene factors, while innovation must operate on multiple fronts, like back-end (logistics, IT, data-driven systems), front-end (self-service, digital displays, mobile apps), and convenience (delivery, digital coupons). The executive perspective emphasizes rapid strategic adaptation to external shocks (e.g., COVID, supply chain disruptions, inflation), HQ-subsidiary governance, piloting, strict ROI discipline, and the need for ecosystem support for smaller retailers. The consumer view, in turn, reveals sharply heterogeneous adoption: "Digital Enthusiasts" try everything and are price-driven; "Practical Loyalists" prize convenience and brands; "Selective Traditionalists" and "Selective Explorers" are cautiously open; "Traditional Loyalists" lean towards cash/in-store purchases, yet will endure friction for sustainability; and "Minimal Engagers" prefer simplicity and mostly reject new solutions. Both perspectives support the claim that sustainability and health matter, but they call for education, incentives, and solutions that fit naturally into the shopper journey unevenly. The key takeaway is this: sustained performance hinges on continuous, coordinated front- and back-end innovation, fast organizational responsiveness, and fine-grained segmentation that layers the same omnichannel foundation with differentiated value propositions, communication, and service levels by segment while measuring success not only with ROI but also with satisfaction and operational metrics (see Table 4 for more details).

## Discussion

This study examines retail innovation through the combined perspectives of senior executives and consumers, providing a holistic view of how innovation is interpreted, implemented, and experienced in retail contexts. By integrating qualitative insights from executive interviews with quantitative consumer segmentation, the findings extend existing research on retail innovation and reveal how managerial sensemaking and organizational framing interact with heterogeneous consumer expectations. The discussion that follows interprets the results in relation to prior literature and outlines their theoretical and managerial implications.

*Interpretation of key findings*

First, while prior research emphasizes the growing importance of technological development and omnichannel capabilities in retail

**Table 4**
Comparison of innovation perceptions of executives and consumers.

| Theme | Interviews (Executives) | Cluster Analysis (Consumers) | Similarities | Differences |
|---|---|---|---|---|
| **Retail Environment** | COVID as digital acceleration; ongoing supply shocks & inflation. | Consumers split: C4 embraces digital; C6 resists; others are in-between. | Agreement that digitalization is central. | Executives emphasize external shocks; clusters show consumer heterogeneity. |
| **Innovation Processes** | HQ- vs local-led, pilots, ROI-driven, mix of back-end & front-end. | Consumer openness varies: C4 embraces all; C5–C6 resist; C1–C3 selective. | Both confirm multiple innovation domains (front, back, convenience). | Firms focus on processes; clusters on adoption behavior. |
| **Sustainability & Health** | Persistent demand for pre-packaged, sustainable solutions; supply-side adaptation. | C4 & C5 strongly engaged; C6 disengaged; C1 indifferent; C2–C3 moderate. | Both highlight the importance of sustainability and health. | Firms emphasize operational rollouts; clusters reveal consumer polarization. |
| **Consumer Convenience** | Omnichannel baseline: apps, loyalty, just-walk-out pilots; convenience key to satisfaction. | C3 & C4 adopt convenience tools; C2 limited use; C5–C6 reluctant or reject. | Agreement that convenience is central to competition. | Executives: convenience is expected; consumers: uneven adoption. |

transformation (Verhoef et al., 2022; Grewal & Roggeveen, 2020), this study shows that executives view innovation as an organizational rather than a technological investment. This reinforces earlier claims that innovation reflects both technology uptake and managerial interpretations of meaningful change in the respective organizational settings (Palmié et al., 2022).

Second, international and local retailers differ in their innovation priorities, restrictions, and expectations concerning consumer behavior. Previous studies suggest that multinational retailers are better positioned to incorporate innovative technologies due to resource advantages (Alexander & Kent, 2021), but this study shows that strategic framing also differs. Domestic enterprises focus on cost and labor shortages, whereas multinationals establish long-term competencies. This shows that ownership structure affects innovation strategy, cognitive foundations, and implementation capacity.

Although customer behavior is typically cited as a main driver of retail transformation (Claudia de Graf et al., 2021; Marín-García et al., 2022), our study suggests that executives view consumer expectations as just one of multiple forces. Internal organizational competencies, competitive dynamics, and regulatory changes all matter. This suggests a more complex relationship than consumer-centric research shows. Building on the interpretation of the findings, this section outlines the study's theoretical contributions to retail innovation research.

### *Theoretical implications*

The research presented here strengthens theoretical understanding in three ways. First, it presents empirical evidence that executives perceive innovation in retail not merely as discrete technological enhancements but as an ingrained organizational competence. This expands current paradigms of retail innovation, which have primarily focused on technical or consumer-driven approaches.

The findings indicate that managerial perceptions of innovation vary according to ownership structures and retail models. This suggests that cognitive frameworks influence adaptation through the concepts of innovation readiness and strategic alignment, even under similar environmental conditions.

The study advances research on transition-economy retail marketplaces by illustrating how executives conceptualize innovation amid structural limitations, including labor shortages, regulatory changes, and foreign ownership trends. Understanding these contextual dynamics will improve theories concerning the collaborative impact of organizational and environmental elements on innovation trends.

Beyond the theoretical contributions, the findings have several implications for retail managers operating in digitally transforming and highly competitive environments.

### *Managerial implications*

Beyond its value to scholars, our research presents retail executives with tangible insights. The study emphasizes the importance of managers clearly defining their views on innovation within their organizations. When everyone in the company agrees on the priorities for innovation, it can lead to better resource allocation, less confusion about consumer trends, and greater strategic coherence across innovation projects.

The results indicate that local companies need to invest in expanding their capabilities rather than just seeking inexpensive, small-scale solutions. Organizations must tailor global innovation frameworks to local limitations and customer behavior to guarantee effective adoption.

These results are important not only for businesses but also for legislators and regulators. Executives see regulatory complexity and legal limitations as obstacles to innovation. Clearer policy horizons and incentives for innovation could help with deploying innovative retail solutions more quickly. Companies need to solve the problem of a lack of trained workers. Collaborative programs that improve digital and management skills could greatly increase the sector's ability to innovate.

These findings show that being ready for innovation is not only about technology; it also requires the cooperation of many different organizations.

We observed a significant difference in attitude between consumers and retail managers. Retailers must place greater emphasis on educating consumers on back-end innovation, such as the product journey and the sustainability of the supply chain that brings the product to the shopper. Consumers responded positively to receiving information about products, as was especially evident in Clusters 1, 4, and 5, as shown in Table 4. Actions may include creating digital touchpoints with informative content, as all the clusters mentioned above respond well to digital front-end solutions. Connected to digital solutions, retailers should treat loyalty apps as hygiene factors. Based on the results of the semi-structured interviews, consumer loyalty apps cannot generate a competitive advantage on their own. Instead, managers should layer additional features by building on such apps, which, although shifting from having an innovation function to a baseline one, can still serve as the backbone of an omnichannel innovation strategy for retailers. Additionally, retail executives should segment innovation into the final six clusters rather than focus efforts solely on one type of innovation. Instead of deploying “one-size-fits-all” approaches, managers should tailor innovation rollouts – for example, push advanced omnichannel and sustainability features for Cluster 4, while retaining simpler, traditional options for Clusters 5 and 6. This will avoid alienating less tech-driven customers while capitalizing on early adopters.

## Conclusion

This study contributes to the retail innovation literature by demonstrating that innovation is shaped not only by technological advancement but also by managerial sensemaking, strategic framing, and organizational readiness. By combining executive and consumer perspectives, the research highlights the conditions under which innovation initiatives align with customer expectations and where misalignments may arise. These insights are particularly relevant to retail markets

undergoing structural transformation and growing competitive complexity.

We acknowledge that this study is not without its limitations. First, the sample of 291 consumers was primarily drawn from social media channels, which might not fully represent the broader population, particularly older or less tech-savvy consumers who may not be active on such platforms. As a result, the study may underrepresent traditional shoppers or those less engaged with digital innovation, potentially skewing the findings toward more digitally engaged consumers. As preferences evolve rapidly, particularly with ongoing digitalization and sustainability trends, the static snapshot provided by the survey may miss temporal shifts or short-term fluctuations in consumer attitudes. Cluster analysis results can be sensitive to the choice of initial cluster center selection. On Level 1, we mitigated this by using both hierarchical and k-means clustering to find more robust clusters. On Level 2, we chose Cao's initialization to favor the creation of clusters in dense regions. For this research, we constrained ourselves to the built-in Python k-modes initialization selection, but in the future, the use of other algorithms can also be considered. Results might also be made more sophisticated by changing categorical survey questions into Likert-scale questions for the next edition of the survey.

Semi-structured interviews with retail experts rely on participants' subjective perceptions of innovation and their company's practices. This entails potential response bias – where executives overstate the success of their innovation efforts or their company's commitment to sustainability, affecting the objective interpretability of the interview results. Additionally, the insights are influenced by individual experience and organizational context, limiting the ability to apply findings uniformly across all retail companies. As some sub-themes appear to reflect short-term post-pandemic rebalancing rather than stable behavioral change, future research would benefit from tracking these in the retail context. Lastly, adopting a broader regional context may reveal further patterns, supporting generalization and providing better results for researchers and managers alike. Also, as retailers typically do not operate in a single country, executives would benefit more from results across a wider array of markets.

Building on these limitations, future research may extend the present findings in several directions. When analyzing the current landscape, recent research considers the combined prevalence of innovation and sustainability to be the main condition for establishing a durable competitive advantage. Innovative services can increase the attractiveness of retailers, while sustainability solutions improve the consumer experience (Gil-Saura et al., 2023). In the latter's research, the authors emphasize that, despite the evident synergistic relationship between the two factors, the combined presence of innovation and sustainability remains under-researched by scholars. Since sustainability solutions are a new territory for companies in the retail sector, it is also unclear how consumers will react to such innovations. Although the success of companies in the retail sector lies in enhancing the consumer experience and thus consumer satisfaction (Pistrui et al., 2023; Marín-García et al., 2022), several articles have highlighted the lack of research coverage of both the relationship between innovation and consumer satisfaction and the connections between sustainability and consumer satisfaction (Gil-Saura et al., 2023). Moreover, the literature on service innovation is more extensive than that on product innovation in retail (Marín-García et al., 2022), making research in this area equally interesting. Furthermore, based on recent studies (Karlsson et al., 2023; Wang & Chen, 2024), promising avenues for future research include examining how specific innovations affect the channel-selection preferences of the identified clusters and, in the case of returns, which solutions consumers within each cluster prefer. These observations point toward further significant research potential in the retail sector.

In this study, we have deliberately focused on segmentation and on mapping how innovation-related perceptions differ across consumer profiles and between consumers and senior managers. Future work could extend our findings by specifying and testing structural models that link innovation perceptions, sustainability attitudes, and behavioral outcomes such as channel choice, loyalty, and willingness to adopt new solutions. For example, researchers could employ structural equation modeling (SEM) to treat constructs such as "perceived value of back-end innovation," "trust in digital touchpoints," or "sustainability orientation" as latent variables and examine their direct and indirect effects on purchase behavior within and across the clusters identified here. This would complement our segmentation-based analysis by unpacking the causal mechanisms underlying the cluster patterns we have observed.

## Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) used ChatGPT and Quillbot to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

## CRediT authorship contribution statement

**Daniel Stephen Kostyal:** Writing – original draft, Formal analysis, Data curation, Conceptualization. **Bence Pistrui:** Writing – original draft, Validation, Supervision, Methodology, Formal analysis, Conceptualization. **Zsolt Matyusz:** Writing – original draft, Visualization, Software, Resources, Methodology.

## Appendix A. Interview questions

**1. General introductory questions**

Please introduce yourself!

Please introduce the company in a few sentences!

What do you think about the situation of domestic retail? (general insights, trends, and challenges)?

What do you think about the importance of innovation in the Hungarian economy and domestic retail?

**2. Research-related questions**

How does innovation appear in your company? (e.g., product innovation, process innovation, service innovation, technological or non-technological innovation)

What internal and external stakeholders can you list who participate in the innovation processes? (e.g., IT manager, project managers, Chief Technology/Data Officer, external stakeholders such as universities, research centers, joint innovation with suppliers, other corporate partners, open innovation with the involvement of consumers)

Is there a formal expectation concerning the introduction of innovative solutions? How would you describe the innovation process at your company?

What kind of expectations do you have regarding innovation projects?

What measurement framework do you use to measure the success of innovation solutions?

Consumer habits have changed radically due to the coronavirus pandemic. What key innovation processes and results have made/could make your company crisis-resistant and innovative?

What can be considered a front-end area and activity in your operations that your customers directly encounter?

What are the most important innovation solutions in front-end areas at your company? What tools and solutions do you plan to implement in the short and/or medium term?

Have you experienced a difference between senior management expectations and consumers' perspectives? (e.g., a long-awaited innovation project that top management hoped would be successful, but consumers did not appreciate as much; perhaps the introduction was unsuccessful, or vice versa, an unexpected innovation solution brought a breakthrough to customers)

How do you think consumers' behavior and their receptivity to innovation have changed as a result of the coronavirus pandemic and technological developments? (Is it easier or more difficult to introduce new projects? / is the shorter time enough for consumers to get used to innovation?)

How can you determine that a front-end innovation was successful?

What are the most important activities and areas of the back-end? (e.g., infrastructure, logistics processes, organizational aspects)

What are the most important innovation solutions in your back-end areas?

How do you think back-end innovation is reflected from the consumers' perspective? How can you determine that a back-end innovation was successful?

What are the general experiences (success factors, failures) related to innovation? What are the obstacles, both organizational and technological?

How do you think innovation and sustainability are related? Can the two support each other?

Do you think there are any issues we have not covered regarding innovation?

## Appendix B. Data about expert interviewees

| Research Phase | Interviewee code | Job position | Retail segment | Represented company type |
|---|---|---|---|---|
| Phase #1 Interviews conducted in February 2024 | INT1 | Managing Director | E-Commerce | Startup |
| | INT2 | E-commerce Director | Food & Beverages | Foreign-ownership Discount Multinational Retailer |
| | INT3 | Head of Communications | Food & Beverages | Foreign-ownership Supermarket Chain |
| | INT4 | Regional Sales Manager | Clothing & Apparel | International Holding Subsidiary (Company A) |
| | INT5 | HR Business Partner | Clothing & Apparel | International Holding Subsidiary (Company B) |
| | INT6 | Store Manager | Drugstore | Domestic-ownership Drugstore Chain |
| | INT7 | Consultant | External Retail Management Consultant | Retail Consulting |
| Phase #2 Interviews conducted in November 2025 | INT8 | Store Manager | Drugstore | Foreign-ownership Retail Chain |
| | INT9 | Managing Director | Food & Beverages, Gasoline | Franchisee of Foreign Ownership Retailer |
| | INT10 | Sales Manager | Clothing & Apparel | International Holding Subsidiary (Company C) |
| | INT11 | Owner, Managing Director | Food & Beverages | Foreign-ownership Supermarket Chain |
| | INT12 | Digital Technology Manager | Consumer Electronics | Foreign Ownership Retailer |
| | INT13 | Regional Technology and Online Director / Former CEO for a multinational company's regional subsidiary | Food & Beverages | Foreign-ownership Supermarket Chain |
| | INT14 | Marketing Manager | Clothing & Apparel | Domestic-ownership Retailer |
| | INT15 | Director of Strategy and Operations | Automotive Retail | Domestic-ownership Retailer |
| | INT16 | District Manager | Clothing & Apparel | International Holding Subsidiary (Company D) |

## Appendix C. Questionnaire

**1. Age:** 16-24 / 25-34 / 34-45 / 45-64 / over 65

**2. Please indicate which of the following statements describes your shopping habits!**

I do small purchases online and larger purchases in person in the store. / I do small purchases in the store, and larger purchases online. / I mostly shop online, regardless of the size of the purchase. /

I mostly shop in person in the store, regardless of the size of the purchase. / Regardless of the item, I shop both online and in person, as is convenient.

**3. For which product groups would you consider online shopping? (you can choose more than one)**

Food and beverage products / Clothing and apparel products / Drugstore products / Electronics / Furniture / Other (e.g., books, toys, etc.) / I do not consider online shopping.

**4. What is the typical payment method for your personal purchases?**

Payment by credit card / Cash, cash on delivery

**5. What is the typical payment method for your online purchases?**

Payment by credit card / Cash, cash on delivery (e.g., online order with personal collection, parcel point collection) / I do not buy online.

**6. What is the typical delivery method for your online purchases?**

Home delivery by courier or by the retailer / Personal collection at a parcel point, parcel machine, or in a store / I do not buy online.

**7. What is most characteristic of you when choosing products?**

I choose primarily based on price or promotions. / I choose primarily based on the brand. / I choose primarily based on the novelty value of the products (e.g., recently released or limited edition products). / I choose primarily based on the health or environmentally friendly properties of the products)

**8. Please indicate how typical the following statements are of retail! (1 - Not at all typical; 5 - Extremely typical)**

a) Prices are rising.
b) More and more innovative solutions and new products are being observed.
c) Online ordering and service are gaining ground.
d) Sustainability solutions are coming to the fore (environmentally friendly packaged products, biodegradable paper bags and packaging materials, etc.).
e) A variety of payment methods and delivery methods are available.
f) Health-conscious products are coming to the fore. (e.g., organic products, vegan/vegetarian products)
g) More sustainable products are coming to the fore. (e.g., products from domestic producers, recycled products

**9. Please indicate how typical the following statements are of your current shopping habits! (1 - Not at all typical; 5 - Extremely typical)**

a) I have been shopping for a smaller basket value in the last 2-3 years than before. (The basket value is the amount spent during a single purchase.)
b) I have been visiting stores more often in the last 2-3 years than before.
c) I have been more open to health-conscious products in the last 2-3 years than before.
d) I have been using new and innovative solutions offered by stores more often in the last 2-3 years than before. (e.g., self-service checkout, app coupon solutions)
e) I have been paying more attention to prices and taking advantage of retail promotions more often in the last 2-3 years than before.
f) I have been paying much more often with a credit card than with cash in the last 2-3 years than before.
g) My purchases are influenced by the store environment and the behavior of the staff.

**10. Please indicate to what extent the following new solutions would positively influence your purchases and purchasing decisions! (1 - Not at all affected; 5 - Extremely positively affected)**

a) Information about suppliers (e.g., active information about procurement, local producers, domestic suppliers)
b) Information about the product path (e.g., production in own factory, own delivery system, information about storage, warehousing, and inventory)
c) Automation in warehouses (e.g., use of robots)
d) Sustainability efforts (e.g., extent of environmental impact, energy efficiency, reduction of greenhouse gas emissions)

**11. Please indicate how the following new solutions influence your shopping and how often you use these solutions! (1 - Not at all relevant and I do not use them; 5 - Positively relevant and I use them with pleasure)**

a) Digital displays (e.g., for advertising or information purposes)
b) QR codes in the store (e.g., for redeeming a discount with a smartphone, opening the brand's website)
c) Self-service checkouts
d) Self-service price scanners
e) Paper-based discount coupons

**12. Please indicate how the following new solutions affect your shopping, and how often you use these solutions! (1 - I do not choose or use it at all; 5 - I perceive a positive impact and use it with pleasure)**

a) A variety of delivery solutions (e.g., home delivery, personal collection in the store, parcel point collection, etc.)
b) Time slot, customer-selected delivery, or same-day delivery
c) Mobile application with loyalty card, coupons
d) Personalized digital offers, discount coupons (e.g., name day and birthday discounts)

**13. Mark the statements below that are true for you!**

a) I try out many more new digital, innovative solutions during my shopping than in the past 2-3 years. (e.g., mobile application, self-service scanners, self-service checkout)
b) I combine personal shopping with online shopping much more often (e.g., I order a product selected in a store online and request home delivery, or I pick up/select a product found online in the store)
c) I receive many more personal offers and use them repeatedly (e.g., a coupon received based on a previous purchase, a name day or birthday promotion that is just for me)
d) I have many more options for my purchases, both in terms of payment and delivery.
e) I am faced with a much larger selection of health-conscious and sustainable products, and I am more willing to buy these products.
f) I am willing to endure minor inconveniences (e.g., going to a store a few blocks away, paying a higher price) if I know I can buy a new type of product.

g) I am willing to endure minor inconveniences (e.g., going to a store a few blocks away, paying a higher price) if I know I can buy a health-conscious or sustainable product

## Appendix D. Level 1 cluster overview (Cluster size in brackets)

| | |
|---|---|
| **RETAIL ENVIRONMENT CLUSTERS (ENV)** | |
| **A (46)** | Cluster members agreed strongly with every statement |
| **B (41)** | Similar to Cluster 'A' in the sense that these cluster members also think these trends are all characteristic of the retail industry, but their level of agreement is weaker in general, especially for sustainability-related trends |
| **C (120)** | Cluster members seem more skeptical about innovation and online trends, but they think the others are typical of retail. |
| **D (8)** | Cluster members are very skeptical about innovation and sustainability trends in retail, but not about online trends. |
| **E (76)** | Cluster members seem to reject all the retail trends inquired about. |
| **SELF ASSESSMENT CLUSTERS (SELF)** | |
| **A (88)** | Cluster members are very self-conscious, they spend less per purchase, they are more open to healthy products and innovative solutions, they are more aware of prices and payment, and are also influenced more by the physical environment and staff behavior |
| **B (45)** | Cluster members have similar but weaker attitudes to Cluster 'A' respondents, with one exception; they still prefer cash payments more. |
| **C (65)** | Cluster members spend more per purchase than before, have a strong preference for card payments, and are also open to innovative solutions. They are also price-conscious, but to a smaller extent than Cluster 'A' or 'B' members. |
| **D (93)** | None of the statements is characteristic of the cluster members. They strongly prefer cash payment, spend more than they did earlier, but also visit stores much less frequently than other cluster respondents. Typically, they are not open to healthy products and innovative solutions, and they are also not price-conscious. |
| **BACK-END INNOVATION CLUSTERS (BACK)** | |
| **A (82)** | Every back-end innovation strongly positively influences cluster members' purchasing decisions, including warehouse automation. |
| **B (79)** | Cluster members are moderately influenced by back-end innovations, except for warehouse automation. |
| **C (69)** | Back-end innovations are not that interesting for the cluster members, with all values hovering around 3 points. |
| **D (61)** | Cluster members are completely unaffected by back-end innovations |
| **FRONT-END INNOVATION CLUSTERS (FRONT)** | |
| **A (66)** | Cluster members generally have a strong positive attitude towards front-end innovations, though they are more moderate about digital screens and QR codes. |
| **B (29)** | Cluster members really like self-service cashier solutions and have a moderately positive attitude towards other solutions, with the exception of paper-based coupons. |
| **C (53)** | Cluster members like price scanners and paper-based coupons, but not really attuned to other innovations |
| **D (74)** | Cluster members have a positive attitude towards self-service solutions, but an aversion towards the rest. |
| **E (69)** | Cluster members are completely unaffected by front-end solutions, and they do not use them. |
| **FRONT-END DIGITAL INNOVATION CLUSTERS (DIGITAL)** | |
| **A (57)** | Cluster members have a strong positive attitude towards every digital innovation. |
| **B (104)** | Cluster members do not use scheduled and same-day delivery options, but are moderately positive about other solutions. |
| **C (77)** | Cluster members like and use a variety of delivery solutions. Scheduled and same-day delivery solutions are somewhat neutral for them, and they are not keen on using digital coupon solutions. |
| **D (53)** | Cluster members are not affected by digital innovations and do not use them. |

## Appendix E. Level 1 Cluster details

### *D.1. RETAIL ENVIRONMENT CLUSTERS*

| | **FINAL CLUSTER CENTERS** | | | | |
|---|---|---|---|---|---|
| **Statements** | **1** | **2** | **3** | **4** | **5** |
| Prices are rising. | 4.52 | 4.07 | 4.58 | 2 | 4.59 |
| More and more innovative solutions and new products are being observed. | 2.52 | 2.15 | 3.53 | 1.75 | 3.82 |
| Online ordering and service are gaining ground. | 3.91 | 2.73 | 4.41 | 2.13 | 4.49 |
| Sustainability solutions are coming to the fore (environmentally friendly packaged products, biodegradable paper bags, and packaging materials, etc.). | 2.48 | 3.51 | 3.43 | 2.13 | 4.41 |
| A variety of payment methods and delivery methods are available. | 3.85 | 3.98 | 4.21 | 2.25 | 4.57 |
| Health-conscious products are coming to the fore. (e.g., organic products, vegan/vegetarian products) | 2.28 | 3.49 | 3.54 | 2.13 | 4.47 |
| More sustainable products are coming to the fore. (e.g., products from domestic producers, recycled products | 2.24 | 3.78 | 3.12 | 2.63 | 4.38 |
| **Sum of final cluster centers** | 21.8 | 23.71 | 26.82 | 15.02 | 30.73 |
| **Cluster size** | 46 | 41 | 120 | 8 | 76 |
| **Categorical relabeling (A – highest sum, E – lowest sum)** | D | C | B | E | A |

### *D.2. SELF ASSESSMENT CLUSTERS*

| | **FINAL CLUSTER CENTERS** | | | |
|---|---|---|---|---|
| **Statements** | **1** | **2** | **3** | **4** |
| I have been shopping for a smaller basket value in the last 2-3 years than before. (The basket value is the amount spent during a single purchase.) | 3.86 | 2.02 | 3.55 | 1.52 |
| I have been visiting stores more often in the last 2-3 years than before. | 2.7 | 1.56 | 2.58 | 2.52 |
| I have been more open to health-conscious products in the last 2-3 years than before. | 3.93 | 2.84 | 3.55 | 3.38 |
| I have been using new and innovative solutions offered by stores more often in the last 2-3 years than before. (e.g., self-service checkout, app coupon solutions) | 3.91 | 2.44 | 3.63 | 3.96 |

(*continued on next page*)

(*continued*)

| | FINAL CLUSTER CENTERS | | | |
|---|---|---|---|---|
| **Statements** | **1** | **2** | **3** | **4** |
| I have been paying more attention to prices and taking advantage of retail promotions more often in the last 2-3 years than before. | 4.52 | 2.73 | 4.34 | 3.76 |
| I have been paying much more often with a credit card than with cash in the last 2-3 years than before. | 4.73 | 1.8 | 2.23 | 4.62 |
| My purchases are influenced by the store environment and the behavior of the staff. | 3.83 | 2.49 | 3.66 | 3.03 |
| **Sum of final cluster centers** | 27.48 | 15.88 | 23.54 | 22.79 |
| **Cluster size** | 88 | 45 | 65 | 93 |
| **Categorical relabeling (A – highest sum, E – lowest sum)** | A | D | B | C |

### *D.3. BACK-END INNOVATION CLUSTERS*

| | FINAL CLUSTER CENTERS | | | |
|---|---|---|---|---|
| **Statements** | **1** | **2** | **3** | **4** |
| Information about suppliers (e.g., active information about procurement, local producers, domestic suppliers) | 4.01 | 1.97 | 4.57 | 2.9 |
| Information about the product path (e.g., production in own factory, own delivery system, information about storage, warehousing, and inventory) | 3.7 | 1.75 | 4.39 | 3.02 |
| Automation in warehouses (e.g., use of robots) | 1.28 | 1.19 | 3.33 | 2.92 |
| Sustainability efforts (e.g., extent of environmental impact, energy efficiency, reduction of greenhouse gas emissions) | 3.95 | 2.24 | 4.42 | 3.31 |
| **Sum of final cluster centers** | 12.94 | 7.15 | 16.71 | 12.15 |
| **Cluster size** | 82 | 79 | 69 | 61 |
| **Categorical relabeling (A – highest sum, E – lowest sum)** | B | D | A | C |

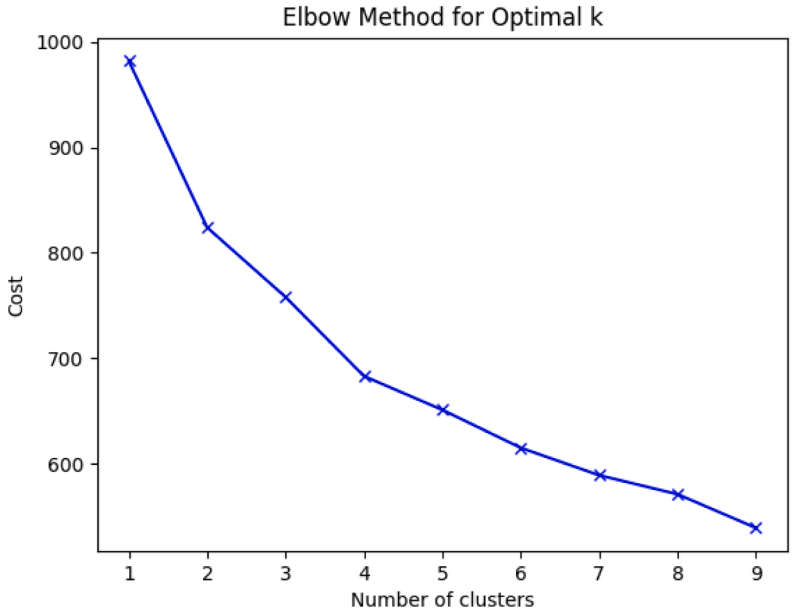
### *D.4. FRONT-END INNOVATION CLUSTERS*

| | FINAL CLUSTER CENTERS | | | | |
|---|---|---|---|---|---|
| **Statements** | **1** | **2** | **3** | **4** | **5** |
| Digital displays (e.g., for advertising or information purposes) | 3.42 | 2.1 | 3.4 | 1.65 | 1.65 |
| QR codes in the store (e.g., for redeeming a discount with a smartphone, opening the brand's website) | 3.68 | 2.31 | 3.91 | 1.51 | 1.51 |
| Self-service checkouts | 4.53 | 2.28 | 4.45 | 4.31 | 2.06 |
| Self-service price scanners | 4.27 | 3.79 | 3.81 | 3.5 | 1.58 |
| Paper-based discount coupons | 4.11 | 3.97 | 1.36 | 2.51 | 2.2 |
| **Sum of final cluster centers** | 20.01 | 14.45 | 16.93 | 13.48 | 9 |
| **Cluster size** | 66 | 29 | 53 | 74 | 69 |
| **Categorical relabeling (A – highest sum, E – lowest sum)** | A | C | B | D | E |

### *D.5. FRONT-END DIGITAL INNOVATION CLUSTERS*

| | FINAL CLUSTER CENTERS | | | |
|---|---|---|---|---|
| **Statements** | **1** | **2** | **3** | **4** |
| A variety of delivery solutions (e.g., home delivery, personal collection in the store, parcel point collection, etc.) | 2.09 | 4.69 | 3.66 | 4.3 |
| Time slot, customer-selected delivery or same-day delivery | 1.25 | 4.22 | 1.73 | 3.19 |
| Mobile application with loyalty card, coupons | 1.74 | 4.61 | 4.06 | 2.08 |
| Personalized digital offers, discount coupons (e.g., name day and birthday discounts) | 1.81 | 4.48 | 3.52 | 1.85 |
| **Sum of final cluster centers** | 6.89 | 18 | 12.97 | 11.42 |
| **Cluster size** | 57 | 104 | 77 | 53 |
| **Categorical relabeling (A – highest sum, E – lowest sum)** | D | A | B | C |

## Appendix F. K-modes cluster analysis elbow method




| Number of clusters | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Cost | 982 | 824 | 758 | 683 | 651 | 615 | 589 | 571 | 539 |

[redacted].

[redacted]

| Number of clusters | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Cost | 982 | 824 | 758 | 683 | 651 | 615 | 589 | 571 | 539 |

Source: authors' analysis using Python *kmodes* package

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