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MERCHANDISING TRANSFORMATION UNDER THE INFLUENCE OF TECHNOLOGICAL, COMPETITIVE AND CONSUMER FACTORS: A COMPREHENSIVE CONCEPT FOR RETAIL

Viktor Sibruk, Iryna Suvorova, Oleksii Yarmoliuk. "Merchandising transformation under the influence of technological, competitive and consumer factors: a comprehensive concept for retail". *The article examines the transformation of merchandising in the context of retail digitalization and intensifying competition. Based on an analysis of classical theories of retail format evolution, the necessity of rethinking traditional approaches to retail space organization with consideration of modern technological innovations is substantiated. Four groups of factors that comprehensively influence merchandising effectiveness are identified: technological, consumer, competitive, and economic. An integrated multi-factor model for evaluating merchandising effectiveness is proposed, which is intended to enable quantitative assessment of*

each factor group's contribution to overall retail performance. Practical tools for improving merchandising effectiveness are examined: basket analytics for identifying complementary products, including the use of large language models; checkout automation integrated with loyalty programs; and dynamic customer flow management across various functional zones of the retail space. Recommendations are developed for phased implementation of innovative solutions in retail enterprises, considering the specifics of various formats – from supermarkets to specialized hardware stores.

***Keywords**:* modern merchandising, retail trade, influencing factors, innovations, integrated multi-factor model

Віктор Сібрук, Ірина Суворова, Олексій Ярмолюк. "Трансформація мерчандайзингу під впливом технологічних, конкурентних та споживчих факторів: комплексна концепція для ритейлу". *У статті досліджується трансформація мерчандайзингу в умовах цифровізації роздрібної торгівлі та посилення конкуренції. На основі аналізу класичних теорій еволюції форм роздрібної торгівлі обґрунтовано необхідність перегляду традиційних підходів до організації торговельного простору з урахуванням сучасних технологічних інновацій. Визначено чотири групи факторів, що комплексно впливають на ефективність мерчандайзингу: технологічні , споживчі , конкурентні та економічні. Запропоновано інтегральну багатофакторну модель оцінки ефективності мерчандайзингу, яка має дозволити кількісно визначити внесок кожної групи факторів у загальну результативність торговельної діяльності. Розглянуто практичні інструменти підвищення ефективності мерчандайзингу: аналітику споживчого кошика для виявлення товарів-компліментів, зокрема з використанням великих мовних моделей; автоматизацію касових розрахунків та інтеграцію з програмами лояльності; динамічне управління потоком покупців у різних функціональних зонах торговельного закладу. Вироблені рекомендації щодо поетапного впровадження інноваційних рішень у діяльність підприємств роздрібної торгівлі з урахуванням специфіки різних форматів — від супермаркетів до спеціалізованих будівельних центрів.*

Ключові слова: сучасний мерчандайзинг, роздрібна торгівля, фактори впливу, інновації, інтегральна багатофакторна модель оцінки ефективності

Introduction. The current state of retail trade is characterized by a profound transformation driven not only by shifts in consumer behavior but also by the rapid advancement of technology. Retail is an industry that responds both to the slightest fluctuations in global processes and to changes in consumer preferences, under the influence of which modern retail is undergoing significant structural and institutional changes. According to forecasts by Wellbrock W. and Traumann Ch. [23], the coming decade can confidently be expected to bring changes unseen over the past fifty years. This dynamic necessitates a rethinking of established approaches to organizing retail space and customer interaction.

Despite considerable progress in the theoretical understanding of the evolution of retail formats, there is a substantial gap between established concepts (cyclical and environmental theories, conflict theory, and the Big Middle concept) and the contemporary challenges that retailers face in the field of merchandising. Classical theories, as rightly noted by Brown S. [3], offer a division into three groups: cyclical theories, related to economic cycles; environmental theories, pertaining to the operating environment; and conflict theory, which is based on the idea that institutional changes result from competitive behavior among retail organizations. It should be noted that classical theories, as emphasized by Fernie J., Fernie S. and Moore C. [6], reflect only the

general picture of the development of certain retail formats, without accounting for the influence of many environmental factors, particularly technological innovations, which are today reshaping the very nature of merchandising.

With regard to the integration of analytical tools for identifying complementary products and developing effective cross-category solutions, according to McArthur E., Weaven S., and Dant R.P. [12], existing theories remain disconnected from one another due to an overly narrow approach to the topic, and the overall understanding of retail functioning is composed of a multitude of heterogeneous variables.

Contemporary trends in the development of multichannel, cross-channel, and omnichannel strategies, alongside the persistence of traditional store-based and non-store retail formats, are creating a new reality to which existing theoretical frameworks must be adapted. Issues such as the automation of checkout processes, personalization of loyalty programs, and dynamic management of customer flow within the sales floor are gaining relevance [22]. Modern retail establishments typically seek to develop several formats and brands simultaneously, covering different segments of the consumer market, which complicates the application of traditional practices and calls for more flexible, adaptive approaches to retail space management. There is a growing need to systematize innovative merchandising approaches that take into account the specifics of various retail formats – from supermarkets to specialized outlets.

Analysis of recent studies and publications. In the field of basket analytics, Pan Y., Russell G., Gruca T. S., and Li C. recently developed the MVL (Multivariate logistic model) -Poisson model to account for the impact of marketing activities on visit frequency and cross-category dependencies between product categories [14]. Kumar et al. introduced an innovative approach to cross-category recommendations that combines traditional basket analysis with LLM (Large language model)-generated associations, enabling the proposal of novel, contextually relevant product combinations [8]. In the work of Basu S., the concept of "agentic commerce" is proposed – autonomous AI systems that go beyond generating recommendations and actively manage end-to-end retail processes, including dynamic pricing, assortment management, and operational orchestration in an omnichannel environment [2].

Contemporary research, particularly Kwak confirms the high effectiveness of implementing self-checkout systems, although they also reveal certain peculiarities in their usage, including longer transaction times with fewer items per basket compared to traditional checkout counters [9;20]. Current trends in POS (Point-of-sale) system development include integration with mobile applications, biometric authentication, and smart basket scanning [13]. According to an analytical report, loyalty programs are evolving into a key element of data-driven business models, where retail media function as a continuous optimization cycle. These capabilities enable higher basket efficiency, better retention, and increased revenue from Retail Media. [16].

Customer flow management has gained new momentum through RFID (Radio-frequency identification) technologies: Dey S., Lahon J., Boruah S. and Deka P. used RFID tags to visualize customer movement trajectories and identify the most and least visited zones within a store [5]. Sharma P., drawing on empirical A/B testing, confirmed the effectiveness of the "decompression zone" concept, demonstrating that customers need time to adapt to the store environment upon entry [19].

Identification of previously unresolved parts of the overall problem. Despite a considerable number of scholarly studies devoted to the evolution of retail formats, the practical aspects of implementing modern

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merchandising technologies remain insufficiently explored. Above all, further investigation is needed into how exactly technological innovations – electronic shelf labels, dynamic pricing systems based on demand elasticity, basket analytics tools for identifying complementary products, automated checkout integrated with loyalty programs, as well as RFID technologies for monitoring customer movement – affect the evolution of retail formats. This is particularly relevant across different formats, ranging from supermarkets to specialized hardware stores, where merchandising strategies differ substantially.

Furthermore, the issue of customer flow management across various functional zones of a retail establishment remains open. The concept of the "decompression zone" at the entrance, route optimization within the main sales floor, and the organization of the checkout area with its high impulse-purchase potential, while having practical applications, require theoretical generalization and empirical validation. The challenge of dynamic queue management during peak activity periods also remains unresolved. In addition, the differentiated effectiveness of loyalty programs depending on the retail format and consumer type has been insufficiently studied.

Formulation of the article's objectives. The purpose of this study is to develop theoretically grounded and practically oriented recommendations for improving merchandising in retail trade through the integration of modern technological innovations across various retail formats. The research is intended to bridge the gap between classic theoretical approaches to the evolution of retail formats and the contemporary challenges facing retailers in the context of digitalization, intensifying competition, and shifting consumer behavior.

Presentation of the main research material. The methods and forms of retail management are evolving rapidly within various conceptual frameworks, each with its own distinctive features, advantages, and limitations. For the purposes of this study, the most relevant approach appears to be the integration of environmental theory by Davies K., which emphasizes the adaptation of retail enterprises to changes in the macroenvironment, and the Big Middle concept described in the work of Levy M., Grewal D., Peterson R.A., Connolly B. [4;10]. The Big Middle concept structures the market into four segments, with the optimal one being precisely the middle segment – where retailers offer innovative products in a wide assortment at reasonable prices, and where innovative merchandising becomes particularly critical as one of the most significant factors in competitiveness. The influence of various factors on the formation of modern merchandising is presented in Figure 1.

The contemporary competitive environment of retail trade is characterized by unprecedented dynamism, compelling retailers to rethink traditional approaches to merchandising. Competition in retail can lead to paradoxical effects: instead of the expected price reductions, it stimulates assortment expansion and price increases, since a broader assortment becomes a strategy for attracting customers away from competitors and also allows for better segmentation of consumers with heterogeneous preferences. This creates new challenges for merchandising, which must ensure not only an attractive price but also a unique value proposition.

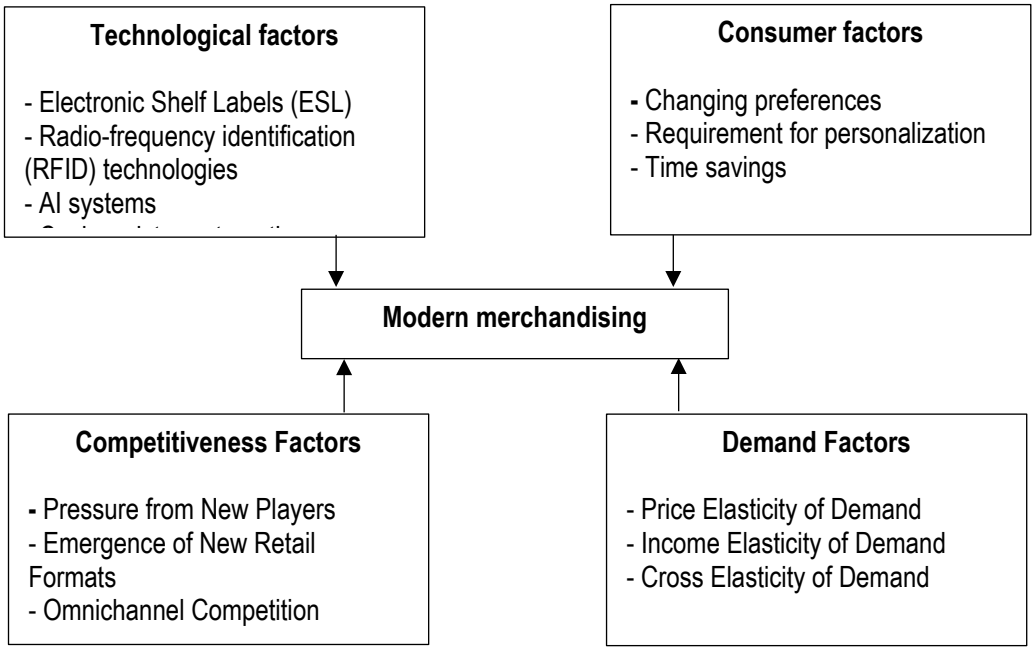

Figure 1- Integration model of factors influencing modern merchandising
Source: Developed by the authors based on [10; 6]

Pressure from new players significantly transforms merchandising strategies. The emergence of new competitors, especially discount formats, makes it critically important for incumbent retailers to develop unique service portfolios that protect against customer switching. Traditional retailers are forced to invest in additional services – from culinary studios to yoga studios – in order to create barriers to entry for new players. At the same time, unique services that are not duplicated by competitors demonstrate particular effectiveness: they foster customer loyalty to a specific store, reducing the likelihood of switching to a new player.

The emergence of new retail formats is changing the very logic of merchandising. For example, the showroom format, which is being actively implemented by online retailers, involves a fundamentally different organization of retail space: here, the customer does not purchase the product directly but gains an experience of interacting with the product, after which they place an order online. This necessitates a rethinking of the role of sales staff, product display, and navigation. In turn, traditional department stores are transforming from multi-category retail outlets into multi-brand, experience-oriented spaces where success is measured not only by sales per square meter but also by social media activity and the share of e-commerce.

Omnichannel competition is becoming a defining factor in modern merchandising. The blurring of boundaries between sales channels means that customers expect a seamless experience regardless of whether they are in a store, on a website, or in a mobile app [25]. This requires retailers to integrate online and offline merchandising—for example, through in-store recommendations of products that are available exclusively online, which creates synergy between channels and increases overall profitability. At the same time, competition from platforms such as Temu and TikTok is changing young shoppers' expectations regarding speed, price, and novelty of offerings, forcing traditional retailers to accelerate assortment updates and incorporate elements of "treasure hunting" into merchandising.

Competitive pressure also stimulates the adoption of technological innovations in merchandising. Research shows that retailers facing intense competition are more likely to

invest in digital tools for display and price management, as this enables more rapid responses to competitors' actions. This is particularly relevant for categories with high purchase frequency, where even small changes in price or assortment can significantly impact market shares.

Understanding the nature of demand and its sensitivity to various factors is a fundamental basis for making effective merchandising decisions. Modern retailers use elasticity analysis to optimize pricing policies, manage assortment, and improve overall sales efficiency [7].

Price elasticity of demand is one of the most important indicators determining consumer response to price changes. It can vary significantly across sales channels: specifically, own-price elasticity of demand in offline stores is higher in absolute value (on average –1.74) compared to the online channel (on average –0.87) [24]. This means that consumers in traditional stores are more sensitive to price changes, which is explained by higher search costs and a lesser ability to compare offers in real time. For modern merchandising, this implies the need for a differentiated approach to pricing depending on the sales channel, as well as the importance of using analytical tools to determine precise elasticity values at the level of individual products and stores [17].

Particular attention in merchandising practice is paid to KVIs (Key Value Items), which account for less than 10% of the assortment but determine consumers' perception of the overall price level of the entire store. As experts note, it is precisely these products that shape the retailer's price image: if prices on them are competitive, the customer extrapolates this impression to the entire store offering. Products belonging to this category typically have high price elasticity, as consumers are well aware of their market value and react sensitively to any changes. Price optimization for KVIs requires continuous monitoring of the competitive environment, seasonal fluctuations, and changes in consumer behavior, making them a critical element of strategic pricing.

Income elasticity of demand reflects the sensitivity of sales volume to changes in consumer income levels. Research empirically confirms that income elasticity varies depending on the type of product and retail format. In particular, an analysis of the Seoul market showed that a 1% increase in income leads to a 1.083% increase in supermarket sales, a 1.5% increase in restaurant sales, and a 2.184% increase in mobile phone store sales [18]. The lowest income elasticity is observed for essential goods, which form the core of the supermarket assortment, making this channel more resilient to economic fluctuations.

Cross-elasticity is critical for understanding the interrelationships between products in the assortment and for effective cross-merchandising planning. Research shows that cross-elasticity is higher in offline channels (on average 0.17) compared to online channels (0.04), indicating that consumers in physical stores are more inclined to search for substitute products in response to price changes [24]. This is explained by the fact that in a traditional store, the customer has invested time and effort in the visit, making them more inclined to purchase an alternative product in the same store rather than abandoning the purchase altogether.

Understanding cross-elasticity is the foundation of many merchandising strategies, in particular the use of loss leaders to drive traffic. As economists explain, selling certain products below cost or with minimal margin can be profitable because it increases cross-price elasticity of demand for other, higher-margin products. This strategy demonstrates the importance of considering interrelationships between products when formulating pricing policies and merchandising decisions.

For practical implementation of demand analysis, modern retailers use structural vector autoregressions (SVAR) and multiple price elasticity identification methods, which

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allow combining data with managerial insights about market functioning. This approach helps overcome endogeneity problems arising from the correlation between price and unobserved demand shocks, yielding more reliable estimates. In particular, studies on large samples of nearly 2,000 stores demonstrate that traditional methods often yield paradoxical positive price elasticity estimates that contradict the behavioral foundations of demand, whereas modern multiple identification approaches provide sufficient accuracy for practical use in pricing [17]. Merchandisers, faced with high uncertainty in elasticity identification, must continuously monitor the effectiveness of pricing strategies and be prepared to frequently adjust the marketing mix in response to the dynamics of market characteristics.

The comprehensive impact on modern merchandising can be viewed as a combination of four groups of factors, each of which must be taken into account when planning and developing product displays, pricing, and customer flow management. Technological factors provide the instrumental foundation for change, consumer factors determine the direction of these changes, competitive factors compel the acceleration of innovation adoption, and demand factors either constrain or stimulate particular solutions.

One of the effective tools of modern merchandising is Market Basket Analysis, which allows for the identification of stable pairs and groups of products that are purchased together (complementary goods) (Table 1). In contrast to the traditional intuitive approach, where sellers have a rough idea or assumption about which products "go well together," modern methods employ association rule mining algorithms, particularly the Apriori algorithm [1], which enables the quantitative assessment of three key metrics: support – the frequency with which an itemset appears in all transactions; confidence – the probability of purchasing item B given the purchase of item A; and lift – a measure of how much more often two items are purchased together than would be expected by chance.

Table 1. Application of complementary product analytics across retail formats

Retail Format	Typical Complementary Pairs	Placement Strategy	Expected Effect
Supermarket (FMCG)	Pasta + sauce; chips + beer; coffee + cream	Placement nearby or on separate "Dinner Idea" shelves	Increase in average transaction value by 15–25%
DIY (do-it-yourself) outlet	Tiles + adhesive + grout; paint + brush + masking tape	Problem-oriented grouping ("For the bathroom," "For walls")	Reduction of cognitive load; increase in sales of related products by 30%
Electronics Store	Laptop + case + mouse; phone + screen protector + case	Cross-merchandising on a single display stand	Higher margins through accessory sales
Pharmacy	Shampoo + conditioner; vitamins + probiotics	Placement nearby; "Buy two, get a discount" promotion	Increase in repeat purchases

Source: Developed by the authors based on [8]

Contemporary research, particularly the work of Kumar A., Pathak N., Agrawal A., Gupta R., and Gupta C, proposes the use of large language models (LLM) to identify new, non-obvious categories of complementary products. In contrast to classical basket

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analysis, which relies exclusively on historical purchase data, LLMs enable the generation of contextually relevant associations that extend beyond observed patterns [8]. An LLM can analyze textual product descriptions, customer reviews, and repair forums to suggest less obvious combinations – for example, a specialized joint sealant that is not purchased together with tiles but is logically related to them in the context of solving a specific task. This approach allows for going beyond observed data and creating new consumer value, opening up new opportunities for cross-category merchandising, particularly in specialized formats where consumers often come to solve a specific problem rather than to buy a single product.

The checkout area is a critical point of customer interaction that can either strengthen loyalty or ruin the positive impression of the entire store visit. Traditional queues at checkout counters, especially during peak hours, are one of the main reasons for purchase abandonment and reduced customer satisfaction. The solution to this problem lies in comprehensive automation, which includes several interrelated components. The first approach involves the implementation of self-checkout systems (SCO), which allow customers to scan and pay for goods independently. As evidenced by Decathlon's experience in transitioning to 100% self-service, this not only reduces queues but also enables the reallocation of cashiers to the role of sales floor consultants, thereby improving service quality. According to Decathlon Turkey, the introduction of self-checkout reduced waiting time in queues by 50% [11]. The effectiveness of self-checkout systems increases significantly when combined with smart basket scanners, where customers scan items directly while selecting them from the shelf and only pay for the already compiled receipt at the checkout.

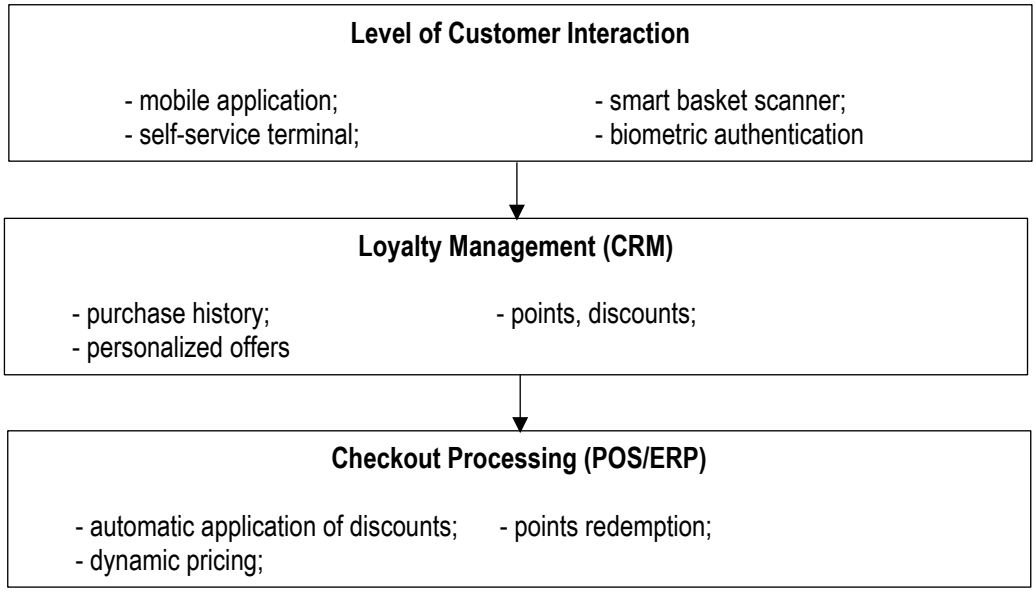

Figure 2 – Architecture of an integrated automation system for checkout and loyalty
Source: Developed by the authors

The second approach to optimizing service processes is the deep integration of point-of-sale (POS) systems with loyalty programs. Modern architecture enables automatic customer recognition (via mobile app, biometrics, or smart card), retrieval of their personalized offers, and automatic application of discounts without requiring

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any additional action on the part of the customer or the cashier (Fig. 2). This approach, known as "background loyalty," not only speeds up checkout but also creates a sense of care and a personalized approach.

Thirdly, automation enables the implementation of dynamic pricing directly at the checkout. This is particularly relevant for products with a short shelf life, where the system can automatically offer a discount on a product expiring today, or for stimulating sales during "dead hours." Electronic shelf labels (ESL) play a key role here, as they allow real-time synchronization of the price on the shelf and at the checkout, avoiding conflicts and confusion [21].

Effective management of customer movement within the store is one of the most underestimated reserves for increasing sales. Different zones of the retail space have different functional purposes and generate different revenue volumes, which requires a differentiated approach to their organization (Table 2).

Table 2. Characteristics of functional zones in a retail establishment

Zone	Share of Total Area	Share of Turnover	Primary Function	Key Products
Entrance Zone (Decompression)	2–5%	up to 10%	Forming the first impression, capturing attention	Seasonal items, new arrivals, emotional products
Main Zone (Sales Floor)	70–85%	75–85%	Core sales, navigation, selection	Planned purchase products (groceries, tiles, etc.)
Checkout Zone (Impulse)	<1%	up to 5%	Impulse purchasing	Small cheap items (batteries, gum, chocolate)

Source: Developed by the authors based on [19;5]

The entrance zone, referred to in academic sources as the "decompression zone," is the space where customers adapt to the store environment, shifting their attention from external stimuli to internal tasks. Research shows that shoppers often overlook the first display upon entry, as they need time to orient themselves within the space; therefore, placing key POS materials directly at the entrance may prove ineffective [19]. It is considered optimal to position the first display at a distance of 2–3 meters from the entrance door, after the customer has already oriented themselves toward the main sales floor. In the entrance zone, it is advisable to place seasonal items, new arrivals, and products that create an emotional atmosphere (flowers, fresh baked goods).

The main sales floor area should be organized to provide a logical traffic flow that covers the maximum number of product categories. The use of RFID technologies and CCTV (closed-circuit television) cameras with video analytics capabilities makes it possible to visualize actual customer movement trajectories, determine dwell time in various sections, and identify "cold zones" that customers tend to bypass [15]. The data obtained serves as the basis for store replanning, navigation optimization, and POS material placement. Of particular importance is the identification of so-called "dead

corners" – areas with low foot traffic due to planning errors – and their correction through route adjustments or the placement of targeted-demand products in these zones.

Despite its small area, the checkout zone generates a significant volume of impulse purchases, which are based on different merchandising methods than those used in the main area. A customer standing in the checkout queue has already made their purchasing decision, calculated their budget, and did not plan any additional expenditures. Therefore, products in the checkout zone must meet several criteria: low price, small packaging, emotional appeal, and no need for lengthy selection.

For a comprehensive consideration of the factors influencing merchandising effectiveness, an integrated multi-factor model can be proposed that allows for the quantitative assessment of the contribution of each group and the calculation of a single integral indicator – the Merchandising Effectiveness Index (MEI). Similar approaches to constructing integral indices in the field of trade and services are used to assess the impact of various sales channels on customer satisfaction and business model efficiency.

The model is based on the assumption that each group of factors has a different weight depending on market specifics, store format, and current operating conditions. Weighting coefficients can be determined either through expert assessment or on the basis of empirical data – for example, through regression analysis of the relationship between factors and actual sales performance. For each group of factors, an aggregate indicator is calculated that combines several measurable indicators characterizing individual aspects of influence.

The calculation of the integral index can be performed as the sum of the products of weighting coefficients and the aggregate indicators of the corresponding factor groups. In turn, each group of factors is determined by functions for the respective factors.

The technological factors group may include: the electronic shelf label adoption index, defined as the share of product items equipped with electronic shelf labels in the total number of items; the RFID coverage index, which reflects the share of products identified using radio-frequency tags, enabling automated inventory management and product movement monitoring. The artificial intelligence usage index assesses the extent to which machine learning algorithms are applied for demand forecasting, dynamic pricing, and personalized recommendations. The checkout automation index is defined as the ratio of the number of self-checkout terminals to the total number of checkout terminals.

For consumer factors, the aggregate indicator may include the Customer Satisfaction Index, measured on the basis of surveys, review analysis, and return data. The Loyalty Program Penetration Index, calculated as the share of purchases made by loyalty program members in total turnover. The Service Time Index reflects the average time a customer spends at checkout, normalized relative to a target value.

Competitive factors may include: the Competitive Pressure Index, which assesses the number of new players in the market and their market share; the New Formats Emergence Index, which reflects the degree of penetration of alternative retail forms (discounters, showrooms, DTC channels); and the Omnichannel Index, which measures the integration of online and offline sales channels. The demand factors group may include elasticity coefficients calculated on the basis of statistical analysis of sales and price data, with subsequent normalization to a scale from 0 to 1 to ensure compatibility with other indicators.

Validation of the model should involve data collection for a group of stores that differ significantly in their level of technological equipment, calculation of the integral MEI indicator for each of them, and comparison with actual performance metrics (growth in

average transaction value, increase in impulse purchases, reduction in queue waiting time). The correlation coefficient between the MEI and the selected performance indicators allows for an assessment of the model's adequacy. At correlation coefficient values >0.7, the model can be considered suitable for practical use.

In addition to diagnosing the current state, the model should allow for simulation of various scenarios of changes in external conditions. For example, during a period of economic instability accompanied by a decline in household incomes, the weight of demand factors increases, which is reflected in the integral indicator and signals the need to reallocate resources in favor of flexible pricing tools and discounts for price-sensitive customer groups. Such modeling enables retail company managers to make informed management decisions under conditions of uncertainty.

From the practical recommendations for retail enterprises seeking to implement innovative approaches to merchandising, several strategies can be highlighted. First, the implementation of innovations can begin with the analysis of existing data. Most retailers already possess historical transaction data, which is an invaluable source for identifying complementary products. Even a simple basket analysis in Excel or Google Sheets can yield initial insights that allow for optimizing product displays and increasing cross-sales without additional investment in equipment. It is also worth considering a pilot implementation of electronic shelf labels in a specific category or in one of the network's stores. This would allow for assessing the real effect of dynamic pricing, testing customer response, and refining operational procedures before scaling up. It is advisable to start with categories with a short shelf life (fresh products) or seasonal items, where price sensitivity is highest.

Checkout automation can be combined with active communication with customers. Consumers often fear new technologies, so it is important to explain the benefits of self-service (speed, control over the process) and ensure the presence of support staff to assist with any issues. A positive experience with the technology is the best advertisement for attracting new users. Loyalty programs should be rethought as a data collection tool, not merely as a means of encouraging repeat purchases. Every transaction made by a loyal customer is information about their preferences, which can be used for personalizing offers, optimizing assortment, and managing inventory.

Conclusions.

The conducted research demonstrates that modern merchandising is undergoing a profound transformation driven by the integration of technological innovations, shifts in consumer behavior, and intensifying competition. Classical theories of retail format evolution, while conceptually significant, require supplementation with consideration of digital tools, without which they lose explanatory power in the contemporary retail environment. The analysis of four groups of factors – technological, consumer, competitive, and economic – confirms that their combined impact on merchandising is decisive for sales performance, and the proposed integrated MEI model enables quantitative assessment of each group's contribution and adaptation of management decisions to the specifics of various formats. The implementation of electronic shelf labels, self-checkout systems, and their integration with loyalty programs reduces service time, minimizes pricing errors, and creates a foundation for personalized offers. Customer flow management, including optimization of functional zones and dynamic queue regulation technologies, significantly improves operational efficiency and customer satisfaction. The use of large language models for identifying complementary products opens new opportunities for cross-category merchandising by generating associations based on semantic analysis of textual data. The practical value of the research lies in

recommendations for phased innovation implementation with continuous monitoring through the MEI model, enabling timely strategy adjustments in response to environmental changes. Future research should focus on calibrating the model's weighting coefficients based on empirical data from different markets and developing software tools for real-time monitoring.

References

1. Agrawal R., & Srikant R. (1994). Fast Algorithms for Mining Association Rules. In Proceedings of the 20th International Conference on Very Large Data Bases (VLDB '94) (pp. 487–499). Santiago, Chile. https://www.vldb.org/conf/1994/P487.PDF

2. Basu S. (2026). Agentic commerce applications: How autonomous AI is redefining the retail & e-commerce industry. International Journal of Computational and Experimental Science and Engineering, 12(1). https://doi.org/10.22399/ijcesen.5091

3. Brown S. (1987). Institutional Change in Retailing: A Review and Synthesis. European Journal of Marketing, 21(6), 5-36. https://www.emerald.com/ejm/article-abstract/21/6/5/33404/Institutional-Change-in-Retailing-A-Review-and?redirectedFrom=fulltext

4. Davies, K. (1998). Applying Evolutionary Models to the Retail Sector. The International Review of Retail, Distribution and Consumer Research, 8 (2), 165–181.

5. Dey S., Lahon J., Boruah S., & Deka P. (2024). Analyzing customer movement in retail stores using RFID and POS data for enhanced shopping experience. Journal of Theoretical and Applied Information Technology, 102(7), 3086-3095.

6. Fernie J., Fernie S., Moore C. (2015). Principles of Retailing. 2nd Edition. Abingdon, Oxon: Routledge. https://catalog.uttyler.edu/cgi-bin/koha/opac-detail.pl?biblionumber=914793&shelfbrowse_itemnumber=981095&__cf_chl_f_tk=nu3lm_4nN1dk4Fmj.YqCmDgHDnsSDkqXjz_UjVfdoK8-1782895795-1.0.1.1-cuDUQ0wor26sO9V9OuIn3rcd1ezRiZu.Tz7lQnbdv2g#shelfbrowser

7. Haschka, R. E., & Herwartz, H. (2025). Utilizing managerial beliefs for set identification of price elasticities of demand. Journal of Business Economics, 53, 1482–1505.

8. Kumar A., Pathak N., Agrawal A., Gupta R., & Gupta C. (2025). Beyond co-occurrence: LLM-based novel category discovery for e-commerce. arXiv, arXiv:2505.12718v2. https://arxiv.org/abs/2505.12718v2

9. Kwak J. K. (2020). Empirical Analysis on Comparison between Self-checkout and Regular Staffed-checkout lanes in a Poland Retail Store. International Journal of Advanced Culture Technology, 8(1), 56–61. https://koreascience.kr/article/JAKO202009759220175.pub

10. Levy M., Grewal D., Peterson R.A., Connolly B. (2005). The concept of the «Big Middle». Journal of Retailing, 81(2), 83-88.

11. Logo Software and Decathlon deliver a seamless customer experience in the cloud. (2023). https://perakende.org/logo-yazilim-ve-decathlondan-bulutta-kesintisiz-musteri-deneyimi/#content_skip_link_anchor

12. McArthur E.S., Weaven S., Dant R.P. (2016). The Evolution of Retailing. Journal of Macromarketing, 36(3), 272-286.

13. Miller C. (2025). Emerging Biometric Authentication at the Point of Sale Scorecard. https://javelinstrategy.com/research/2025-emerging-biometric-authentication-point-sale-scorecard

14. Pan Y., Russell G., Gruca T. S., & Li C. (2026). Multicategory purchase behavior: basket choice, shopping frequency, and promotional analysis. Journal of Retailing, 102(1), 44-62.

15. Pott J. (2024). Queue management for retailers: Customer convenience by respecting their time. EuroShop Magazine. https://origin-www.euroshop-tradefair.com/en/media-news/euroshopmag/retail-technology/queue-management-in-retail-for-greater-customer-convenience

16. Reeve J. (2026). Changing loyalty landscape: Here's what retail leaders need to know. https://www.retailbiz.com.au/contributor/changing-loyalty-landscape-heres-what-retail-leaders-need-to-know/

17. Rodrigues, A. (2025). Consumer Choice Over Shopping Baskets: A Linear Demand Approach. arXiv, arXiv:2511.11846. https://doi.org/10.48550/arXiv.2511.11846.

18. Seong E.Y., Chang G.C. (2017). A Study on the Impact of Income and Physical Location Characteristics on Retail Sales - Focusing on Restaurants, Supermarkets, and Mobile Phone Stores in Seoul. Real Estate Studies. vol.23, no.4, pp. 77-91. DOI : 10.19172/KREAA.23.4.6.

19. Sharma P. (2023). Decoding the Decompression Zone in Retail Stores. Indore Management Journal, 15(1), 35-48.

20. Sharma P, Ueno A., & Kingshott R. (2020). Self-service technology in supermarkets – Do frontline staff still matter? [Journal article]. Curtin University. https://curate.curtin.edu.au/articles/journal_contribution/31711852

21. Stamatopoulos I., Sanders R., & Bray R. (2025). Electronic Shelf Labels Have Not Led to Surge Pricing in US Grocery Retail, Despite Regulator Concerns. SSRN. https://doi.org/10.2139/ssrn.5271491

22. Verhoef P.C., Kannan P.K., Inman J.J. (2015). From Multi-Channel Retailing to Omni-Channel Retailing: Introduction to the Special Issue on Multi-Channel Retailing. Journal of Retailing, 91(2), 174-181. https://doi.org/10.1016/j.jretai.2015.02.005

23. Wellbrock W., Traumann Ch. (2012). Zukünftige Herausforderungen im Bereich des Handels. Chancen und Risiken ausgewählter Supply-Chain-Management-Konzepte. Discussion Papers on Logistics and Supply Chain Management. Philipps-Universität Marburg. Nr. 3. https://de.readkong.com/page/discussion-papers-on-logistics-and-supply-chain-management-6606075

24. Xingyue L. Zh., Haluk D. (2021). Between online and offline markets: A structural estimation of consumer demand. Information & Management. Volume 58, Issue 4. https://doi.org/10.1016/j.im.2021.103467

25. Yu J., Ren Y., & Zhou C. (2024). Strategic Interactions in Omnichannel Retailing: Analyzing Brand Competition and Optimal Strategy Selection. Journal of Theoretical and Applied Electronic Commerce Research, 19(4), 2557-2581.