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Scaling of a retail network in the meat processing business without loss of product quality control

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Abstract. The relevance of the study is determined by the intensification of retail network scaling processes in the meat processing industry, which is accompanied by increasing risks of losing controllability over product quality, growing complexity of logistics flows, and higher requirements for food safety and stability of consumer characteristics. Under such conditions, traditional approaches to quality control prove to be insufficient, which necessitates the search for integrated management solutions. **The purpose** of the study is to substantiate effective approaches to scaling retail networks in the meat processing industry while ensuring stable product quality control.

Methods. The study employs general scientific and special research methods, including analysis and synthesis to generalize approaches to quality management, systematization to structure the factors influencing scaling, comparative analysis to assess changes in the effectiveness of quality control, and logical generalization to develop practical recommendations.

Results. The impact of retail network scaling on the transformation of quality control systems and the stability of product characteristics is investigated. It is found that network expansion leads to increased control dispersion, information asymmetry, and logistical risks, resulting in variability of product quality. It is proven that the effectiveness of quality management is determined by the level of process integration, digitalization, and the system's ability to respond promptly to deviations. The feasibility of implementing multi-level models of quality control integration, combining centralized standards, local adaptation, and data-driven management, is substantiated.

Conclusions. It is established that improving the effectiveness of quality management under scaling conditions is achieved through the development of a unified digital traceability framework, the advancement of preventive control, optimization of logistics processes, and the integration of quality indicators into enterprise management systems.

Prospects for further research are associated with the development of methodological approaches to the quantitative assessment of the effectiveness of quality control systems, the improvement of deviation prediction models, and the study of the impact of digitalization on ensuring the stability of product characteristics in the context of retail network scaling.

Keywords: quality management, food safety, cold chain, product traceability, logistics processes, operational standardization, business process digitalization, deviation control, operational efficiency, risk-based approach.

Масштабування роздрібної мережі м'ясопереробного бізнесу без втрати контролю якості продукції

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Анотація. Актуальність дослідження зумовлена інтенсифікацією процесів масштабування роздрібних мереж у м'ясопереробному бізнесі, що супроводжується зростанням ризиків втрати керованості якістю продукції, ускладненням логістичних потоків та підвищенням вимог до безпечності й стабільності споживчих характеристик. За цих умов традиційні підходи до контролю якості виявляються недостатніми, що обумовлює необхідність пошуку інтегрованих управлінських рішень. **Метою дослідження** визначено обґрунтування ефективних підходів до масштабування роздрібної мережі м'ясопереробного бізнесу із забезпеченням стабільного контролю якості продукції. **Методи.** У процесі дослідження використано методи аналізу і синтезу – для узагальнення підходів до управління якістю, систематизації – для структурування факторів впливу масштабування, порівняльного аналізу – для оцінювання змін ефективності контролю якості, а також логічного узагальнення – для формування практичних рекомендацій. **Результати.** Досліджено вплив масштабування роздрібної мережі на трансформацію системи контролю якості та стабільність характеристик продукції. Виявлено, що розширення мережі зумовлює зростання дисперсії контролю, інформаційної асиметрії та логістичних ризиків, що призводить до варіативності якості продукції. Доведено, що ефективність управління якістю визначається рівнем інтеграції процесів, цифровізації та здатністю системи до оперативного реагування на відхилення. Обґрунтовано доцільність впровадження багаторівневих моделей інтеграції контролю якості, що поєднують централізовані стандарти, локальну адаптацію та управління на основі даних. **У висновках** встановлено, що підвищення ефективності управління якістю при масштабуванні досягається через формування єдиного цифрового контуру простежуваності, розвиток превентивного контролю, оптимізацію логістичних процесів та інтеграцію показників якості у систему управління діяльністю підприємства. Перспективи подальших досліджень пов'язані з розробленням методичних підходів до кількісного оцінювання

ефективності систем контролю якості, удосконаленням моделей прогнозування відхилень та дослідженням впливу цифровізації на забезпечення стабільності характеристик продукції в умовах масштабування роздрібних мереж.

Ключові слова: управління якістю, харчова безпечність, холодовий ланцюг, простежуваність продукції, логістичні процеси, стандартизація операцій, цифровізація бізнес-процесів, контроль відхилень, операційна ефективність, ризик-орієнтований підхід.

Problem statement. The intensification of scaling retail networks in the meat processing business is accompanied by an increased risk of losing quality control due to the growing complexity of logistics flows, the expansion of sales geography, and the variability of operational practices at the level of individual retail outlets. Under such conditions, traditional quality control approaches oriented toward centralized supervision and periodic audits prove insufficient to ensure the stability of product characteristics, which directly affects food safety, corporate reputational risks, and consumer trust. The problem acquires an interdisciplinary nature, combining aspects of food production technology, logistics, quality management, and business process digitalization, thereby necessitating the substantiation of new organizational and economic mechanisms for ensuring quality under scaling conditions. The scientific interest lies in identifying the patterns of interrelation between the pace of network expansion and the ability of the quality control system to maintain the integrity and reproducibility of standards, while the practical significance is associated with the need to develop tools for integrated monitoring, standardization of operating procedures, and implementation of digital traceability solutions that minimize quality deviations at all stages of the value chain.

Analysis of recent research and publications. A review of contemporary studies indicates that the issue of scaling retail networks in the meat processing business without loss of product quality control is formed at the intersection of

approaches to competitiveness, production efficiency, supply chain management, and quality assurance systems. Yu. A. Perehuda substantiates methodological approaches to assessing the competitiveness of livestock products, emphasizing the decisive role of quality as an integral factor of market resilience under economic challenges [1], while in further studies the author reveals the relationship between technological efficiency and economic performance, which is critical in scaling business activities [2]. Yu. A. Perehuda also highlights the influence of agricultural policy on product competitiveness, determining external constraints for maintaining stable quality characteristics during market expansion [3].

B. Symonik and co-authors demonstrate the effectiveness of applying mathematical models to optimize production processes in meat processing, which allows reducing variability in product quality with increasing production volumes [4]. Z. Yurynets and co-authors consider business scaling as a systemic factor of economic growth, emphasizing the need to align organizational structures with expansion rates, which directly affects the controllability of product quality parameters [5]. M. V. Ruda and co-authors detail international expansion strategies, focusing on the risks of losing control due to geographic expansion and the necessity of process standardization [6].

Among foreign studies, particular attention is given to research on the functioning of meat supply chains and ensuring their resilience. M. Syukron and Y. Su analyze the specifics of small-scale meat processing enterprises, demonstrating that limited scale contributes to better quality control but complicates integration into broader retail networks [7]. J. E. Hobbs examines the impact of the COVID-19 pandemic on meat supply chains, emphasizing the vulnerability of centralized models and the need to enhance their adaptability [8], which correlates with the findings of D. Whitehead and Y. H. B. Kim, who substantiate the importance of supply diversification to ensure continuity of product quality [13].

S. B. Jeffer and co-authors investigate food safety management systems in meat supply chains, demonstrating that integrated approaches to quality control are

crucial in scaling distribution networks [9]. P. R. Sarkar develops the concept of data-driven quality assurance systems that enable real-time monitoring of deviations and minimization of quality loss risks in large distribution centers [10]. J. K. Kuwornu and co-authors emphasize the role of sustainable supply chain management practices, which ensure synergy between efficiency and product quality [11].

C. O. R. Okpala and M. Korzeniowska substantiate that modern quality management systems in the agri-food sector should be based on the integration of ethical, sanitary, and technological standards, which complicates their maintenance under rapid business scaling [12]. J. Pinto and co-authors demonstrate the importance of effective management of losses and by-products in the retail sector as a component of ensuring both quality and economic efficiency [14]. M. Ben-Daya and co-authors highlight the transformative potential of the Internet of Things (IoT) in ensuring transparency and quality control in supply chains, which is critically important for scalable retail networks [15].

Identification of the unresolved part of the problem. Despite the development of scientific approaches to quality management and the functioning of retail networks, the issue of ensuring the stability of product characteristics under scaling conditions remains unresolved, particularly in terms of harmonizing control procedures within spatially distributed structures. Existing studies predominantly address individual aspects – technological, logistical, or organizational – which does not allow for forming a holistic understanding of mechanisms for maintaining quality during network growth, due to the complexity of process integration and the limitations of the empirical base.

This uncertainty is of fundamental importance, as it determines the ability of enterprises to maintain a balance between scaling and quality controllability. This necessitates further research into integrative control mechanisms, the role of digitalization, and the conditions for reproducibility of standards, forming the

scientific basis for refining approaches to quality assurance in expanded retail networks.

Purpose of the article. The purpose of the article is to substantiate effective approaches to scaling retail networks in the meat processing business while ensuring stable product quality control.

Objectives of the article:

1. To generalize approaches to product quality management and analyze the impact of retail network scaling on the effectiveness of quality control and the stability of product characteristics.

2. To substantiate approaches to integrating quality control systems into the multi-level structure of retail networks and to determine the features of their functioning under scaling conditions.

3. To identify key scientific and practical problems of ensuring product quality control and to develop practical recommendations for improving the effectiveness of quality management in the process of retail network expansion.

Main material. The generalization of approaches to product quality management in the meat processing business under retail network scaling conditions is associated with the transition from local production control to integrated quality management across the entire value chain – from raw material supply to final retail. The increase in the number of retail outlets raises requirements for the standardization of procedures, synchronization of logistics, and ensuring traceability, which necessitates a systemic combination of various management approaches (table 1).

Table 1

Systematization of approaches to product quality management in the meat processing business

Approach	Substantive characteristics	Key tools	Practical significance
Technological	Focus on controlling production process parameters and product safety	Temperature control, sanitary regulations, laboratory testing	Ensuring a baseline level of safety and compliance with standards
Process-based	Quality management through regulation and standardization of business processes	Standard Operating Procedures (SOP), audits, certification	Reducing quality variability across production and retail units
Risk-oriented	Focus on identifying and minimizing critical risks in the supply chain	HACCP, critical control point analysis	Preventing defects and reducing the likelihood of hazardous deviations
Logistical	Ensuring quality through control of transportation and storage conditions	Cold chain management, shelf-life control, inventory tracking	Preserving product quality during distribution and retail
Digitally integrated	Use of information systems for monitoring and traceability	ERP systems, RFID tags, digital control logs	Enhancing process transparency and decision-making responsiveness

Source: developed by the author based on [1, p. 10; 3, p. 138; 4, p. 210; 9; 12, p. 1885; 15, p. 22].

In the practice of retail networks of meat processing enterprises, these approaches are implemented as interrelated elements of a unified quality management system, where each performs a specific function – from ensuring basic safety to operational control of deviations. The technological approach ensures the stability of product characteristics at the production stage; however, without proper logistical support, its effectiveness decreases – a typical situation occurs when compliance with temperature regimes at the enterprise does not guarantee their preservation during transportation, leading to reduced product shelf life in retail

networks. The process-based approach gains critical importance under scaling conditions – Standard Operating Procedures (SOP) ensure the reproducibility of storage, display, and sales conditions across different retail outlets. For example, in chain meat stores, the frequency of product rotation and display temperature regimes are strictly regulated, minimizing spoilage losses and ensuring consistent quality for consumers.

The risk-oriented approach, implemented through the Hazard Analysis and Critical Control Points (HACCP) system, ensures a preventive nature of quality management – enterprises identify key risks at the stages of transportation and retail and establish control parameters [15, p. 22]. In practice, this is reflected in temperature monitoring during transportation and tracking the time products remain in open display units, which helps prevent critical deviations. The logistical approach determines the enterprise's ability to maintain product quality during geographic expansion – the effectiveness of the cold chain directly affects the preservation of organoleptic properties and product safety. For instance, the use of specialized vehicles with automated temperature control reduces spoilage risks when delivering to remote retail outlets.

The digitally integrated approach acts as a system-forming element – the application of Enterprise Resource Planning (ERP) systems and Radio Frequency Identification (RFID) technologies ensures full traceability of product movement [12, p. 1885]. In practice, this enables rapid localization of problematic batches – for example, in the event of a temperature breach, the system identifies specific retail points where the affected products are located, minimizing risks for consumers and reducing economic losses. Thus, the integration of these approaches forms the foundation for effective scaling of retail networks without loss of quality control (table 2).

Table 2

Impact of retail network scaling on the effectiveness of quality control and product stability

Impact parameter	Nature of changes under scaling	Impact on quality control	Impact on product stability
Geographical expansion	Increased distance between production and retail points	Complicates monitoring of transportation conditions – increases need for remote control	Higher risk of temperature deviations and reduced shelf life
Number of retail outlets	Expansion of the network with varying levels of organizational discipline	Reduced control responsiveness – increased dependence on personnel	Variability in storage and sales conditions
Product turnover rate	Increased sales volumes and logistics operations	Need for faster decision-making – automation of control	Potential for both improved freshness and increased operational deviations
Centralization of management	Concentration of managerial functions	Standard alignment – limited local adaptation	Stabilization of characteristics under effective coordination
Process digitalization	Implementation of monitoring and analytics systems	Increased transparency – reduced human factor	Reduced quality variability due to rapid response

Source: developed by the author based on [1, p. 12; 5; 6, p. 138; 8; 10, p. 160; 13].

Thus, the impact of scaling manifests as a complex dynamic interaction of organizational and technological factors, where the key issue is not the expansion itself but the system's ability to adapt to increasing complexity. Geographical expansion significantly increases the sensitivity of product quality to logistical disruptions – even short-term violations of temperature regimes during transportation may not be immediately evident but lead to accelerated microbiological spoilage at the retail stage. In large networks, this is compensated by the use of vehicles equipped with built-in temperature sensors and remote

monitoring systems, enabling real-time detection of deviations and operational adjustments to routes or product withdrawal [6, p. 138].

An increase in the number of retail outlets creates an additional layer of uncertainty associated with the human factor – from compliance with display rules to timely product rotation. In practice, even with unified standards, differences in staff qualifications can lead to significant quality deviations. Therefore, networks actively implement indirect control mechanisms – video analytics, electronic checklists, and automated reminders for critical operations.

The product turnover rate acts as an ambivalent factor – high turnover contributes to the sale of fresher products, but simultaneously increases staff workload and the likelihood of errors in labeling or inventory accounting. In practice, this is addressed through the integration of POS systems with inventory management systems, where each sales operation automatically updates stock levels and shelf-life data [8]. Centralization of management in large networks ensures uniformity of standards; however, its effectiveness depends on the quality of feedback – in its absence, there is a risk of formal compliance without actual quality control.

At the same time, digitalization acts as a key compensatory mechanism – the implementation of analytical platforms enables the identification of deviations not only ex post but also based on trends, for example, through analysis of sales velocity of specific batches or frequency of write-offs [10]. Therefore, under modern conditions, scaling is not inherently detrimental to quality – it creates new challenges but also opens opportunities for transitioning to more mature, technologically supported control models, where the stability of product characteristics is ensured not only by regulations but also by continuous analytical support of managerial decision-making.

The integration of quality control systems in multi-level retail networks of the meat processing business reflects the transition from rigid hierarchical supervision to a coordinated interaction of organizational levels, where the synchronization of

decisions and data becomes a key determinant of effectiveness. Under such conditions, quality control is no longer concentrated at a single managerial level but is distributed across the network while maintaining overall consistency and controllability. This necessitates the identification and systematization of integration models that define how control functions, coordination mechanisms, and managerial responsibilities are structured within expanded retail systems (table 3).

Table 3

Models of quality control integration in multi-level retail networks

Model of integration	Organizational logic	Coordination mechanism	Practical effect
Centralized	Concentration of control functions at the head office level	Unified standards and managerial decisions	Ensuring quality uniformity across the network
Decentralized	Delegation of control functions to retail outlets	Local decision-making within established regulations	Increased responsiveness
Hybrid	Combination of centralized standards and local implementation	The center defines parameters – outlets adapt them	Balance between stability and flexibility
Platform-based	Integration through a unified digital environment	Data-driven management and digital indicators	Increased transparency and controllability of processes
Adaptive	Dynamic adjustment of control actions depending on the situation	Analytics and scenario-based management	Flexible maintenance of quality stability

Source: developed by the author based on [5; 6, p. 140; 9; 10, p. 170; 11; 15, p. 30].

These models rarely exist in a “pure” form – real retail networks combine them depending on scale, level of digitalization, and organizational maturity. For example, the centralized model is effective at the standardization stage – the head office establishes unified quality requirements and control indicators that form the basis for the entire network. However, as the number of retail outlets increases, this becomes insufficient, and in practice a decentralized component is introduced – store

managers receive the authority to respond promptly to deviations, including independent decisions on product write-offs or adjustments to sales conditions.

The hybrid model is dominant under contemporary conditions, as it allows stability and adaptability to be combined – the center defines critical quality parameters, while the local level ensures their practical implementation, taking into account actual workload, demand intensity, and the technical condition of equipment. For example, in large grocery networks such as Silpo, cold chain standards and quality control indicators are set centrally, while stores are able to promptly adjust product display and rotation depending on sales velocity and actual stock levels [4, p. 208]. This makes it possible to maintain unified standards while minimizing quality losses under the specific operating conditions of each retail outlet.

The adaptive model, which is gradually being introduced in more technologically advanced networks, enables a transition to proactive quality management – for instance, if the system detects an increase in workload at a particular retail outlet, it can automatically initiate enhanced control or adjust product storage parameters. As a result, the integration of quality control systems takes the form of a dynamic multi-level system, in which the stability of product characteristics is ensured not only by compliance with standards but also by the network's ability to adapt rapidly to changes in its operation [9].

Ensuring product quality control under the conditions of scaling a retail network in the meat processing business is accompanied by a set of interrelated scientific and practical problems caused by increasing organizational complexity and the spatial distribution of processes. First of all, the problem of control dispersion becomes evident – network expansion complicates the maintenance of unified standards due to differences in the operating conditions of retail outlets and dependence on the human factor, which leads to variability in actual product quality.

A significant issue is information asymmetry – data from retail outlets often arrive with delays or contain distortions, limiting the possibility of prompt response.

This is combined with the problem of fragmented information systems, where the absence of an integrated digital environment reduces the integrity of control [13]. At the same time, the problem of latent quality deviations becomes increasingly relevant – some changes in product characteristics appear with a time lag, which complicates their timely detection and requires the development of predictive approaches.

The logistical dimension forms the problem of instability in transportation and storage conditions – even short-term parameter deviations may accumulate and affect final quality, while full control of the supply chain remains limited. At the same time, the problem of scalability of control systems arises – as the network grows, the volume of data and the load on managerial mechanisms increase, reducing their effectiveness without appropriate digital support [15, p. 24].

The economic aspect is manifested in the contradiction between quality control costs and the need to maintain operational efficiency – excessive procedural detail increases costs, whereas oversimplification strengthens the risks of losses and reputational damage [11]. The personnel factor further reinforces this issue – a shortage of qualified staff and high turnover in the retail segment complicate stable compliance with standards even when they are formalized.

Improving the effectiveness of product quality management during the expansion of a retail network in the meat processing business should be ensured through a combination of organizational, technological, and analytical solutions aimed at minimizing process variability and reducing response time to deviations. A key direction is the construction of a unified digital quality management loop – it is advisable to implement integrated information systems that ensure continuous product traceability and data synchronization between the levels of “production – logistics – retail.” This enables a transition from fragmented control to data-driven management and ensures prompt localization of problematic batches.

From an organizational perspective, the introduction of a hybrid management model is justified, in which strategic quality parameters are centralized, while

operational decisions are delegated to retail outlets within clearly defined regulations. This approach reduces the burden on the central level while preserving system controllability. An important addition is the standardization of critical operations with a focus not on formal compliance with procedures but on their digital recording and performance control, which minimizes the influence of the human factor.

From a practical perspective, the implementation of preventive control systems based on data analysis is effective – the use of analytical models makes it possible to identify trends of quality deterioration before they become factually evident. For example, regular analysis of product sales velocity and write-off frequency allows the identification of retail outlets or logistics routes with an increased risk of deviations and timely adjustment of operational parameters.

The logistical component of the recommendations involves strengthening cold chain control through the use of sensor technologies and automated monitoring, ensuring continuous tracking of temperature regimes and reducing the likelihood of hidden deviations. It is also advisable to revise routes and delivery schedules based on actual operating conditions rather than only planned indicators.

The personnel aspect should be addressed through a combination of training and incentives – integrating quality indicators into the staff evaluation system is an effective practice that increases responsibility for compliance with standards. At the same time, control procedures should be simplified and digitalized, reducing their labor intensity and increasing the likelihood of their actual implementation.

The economic feasibility of quality management can be improved through differentiation of the control level – concentrating resources on critical sections of the value chain makes it possible to achieve a greater effect than the uniform distribution of control measures. As a result, the implementation of these recommendations ensures the formation of an adaptive quality management system capable of maintaining the stability of product characteristics under retail network scaling without a disproportionate increase in costs.

Conclusions. The study established that scaling a retail network in the meat processing business transforms quality management into a multi-level integrated system, where product stability is determined by the coordination of technological, logistical, and information processes. It was proven that the effectiveness of quality control depends on the level of digitalization, data integration, and the system's ability to respond promptly to deviations. The key problems were identified – control dispersion, information asymmetry, the latent nature of quality deviations, instability of logistics conditions, and the contradiction between control costs and operational efficiency, which together limit the reproducibility of quality standards during network expansion. The feasibility of implementing integrated quality management was substantiated – through a unified digital traceability loop, hybrid management models, analytically oriented preventive control, and strengthened cold chain management, which ensure a reduction in quality variability without excessive cost growth. Prospects for further research are related to the development of methods for quantitatively assessing quality control effectiveness, the advancement of deviation prediction models, and the study of the impact of digitalization on the reliability and controllability of product quality.

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