# DIGITAL TRANSFORMATION READINESS OF MOLDOVA'S FOOD INDUSTRY: DEVELOPMENT TRENDS AND EMERGING AI ADOPTION

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***Abstract.*** *This study examines recent development trends in the food industry of the Republic of Moldova and evaluates the preconditions for its digital transformation in the context of emerging AI adoption. The analysis is based on official statistics from the National Bureau of Statistics of the Republic of Moldova and combines sector-specific indicators for 2019–2024 with manufacturing-level ICT data for 2025 used as the closest available proxy for the technological environment of food-processing activities. The study applies comparative, structural, and dynamic economic-statistical analysis to industrial output, producer prices, wages, investments, enterprise structure, employment, financial performance, selected foreign trade flows, and indicators of digital readiness. The results show that the sector remains an important component of national manufacturing, but its recent development has been uneven. Wages, investment, and nominal financial results increased, whereas employment declined and trade asymmetries persisted across product groups. The digital evidence indicates that basic forms of digital integration are already present, while the diffusion of more advanced solutions, especially AI, remains limited. Overall, the sector demonstrates relevant but incomplete preconditions for deeper digital transformation.*

***Keywords****: food industry; digital transformation; artificial intelligence; manufacturing; technological readiness; external trade.*
***JEL Classification:*** *L66; O33; E22.*

## 1. Introduction

The food industry is operating in an increasingly complex environment shaped by volatile costs, changing consumer preferences, stricter food safety requirements, and growing pressure to ensure transparency across supply chains. In such conditions, digital transformation is no longer merely a technological trend; it is becoming a strategic response to structural challenges related to efficiency, coordination, adaptability, and long-term competitiveness (Gomez-Trujillo and Gonzalez-Perez, 2022; Klerkx et al., 2019). This shift is especially relevant for food-processing activities, where firms must simultaneously maintain process continuity, product quality, traceability, and timely logistics under unstable market conditions (Verdouw et al., 2016).

In contemporary literature, digitalization is interpreted not only as the introduction of new tools, but also as a broader transformation of organizational routines, value creation mechanisms, and business models (Gomez-Trujillo and Gonzalez-Perez, 2022; Turcan et al., 2023). In the agri-food context, digital transformation is increasingly associated with new forms of coordination, data exchange, and ecosystem-based innovation that can improve the responsiveness and sustainability of production and distribution systems (Klerkx et al., 2019; Wolfert et al., 2023). For food enterprises, this means that digital technologies may support

not only operational efficiency, but also stronger interaction among producers, processors, distributors, and consumers (Turcan, 2025; Verdouw et al., 2016).

Artificial intelligence occupies a particularly important place within this broader transformation. Unlike basic digital tools, AI enhances the analytical and predictive capacity of enterprises by supporting forecasting, anomaly detection, process optimization, and data-based decision-making (Pournader et al., 2021; Toorajipour et al., 2021). In the food industry, these capabilities are especially valuable because errors in quality control, process management, or demand planning may result in direct financial losses, higher waste, and weaker market performance. Recent studies therefore emphasize the growing relevance of machine learning and AI-based solutions for food quality control and production support (Liakos et al., 2025; Turcan, I2025)

At the same time, the literature shows that the digital transformation of food systems cannot be reduced to AI alone. Blockchain-based traceability systems, IoT-enabled data collection, and interoperable digital infrastructures are increasingly discussed as complementary elements of more transparent and accountable food supply chains (Kamilaris et al., 2019; Vasileiou et al., 2025; Verdouw et al., 2016). This is particularly important for food markets, where product origin, safety, and compliance are increasingly important for market transparency, traceability, and consumer confidence (Ellahi et al., 2023; Kamilaris et al., 2019). In this sense, digital transformation in food manufacturing is closely linked to sustainability goals, since better traceability, improved information flows, and smarter coordination mechanisms may contribute to lower losses, stronger process accountability, and more resilient business models.

A number of studies from the Republic of Moldova provide useful entry points for this discussion. Existing research has addressed digitalization as a factor in the development of circular economy business models (Turcan et al., 2023), the integration of emerging technologies into supply chains and their contribution to circular economy practices (Turcan, R., 2025), and the role of digital technologies in quality assurance within circular production systems (Turcan, 2025). Related studies also emphasize the growing importance of digital resources in the promotion of agri-food production (Litvin, 2025). At the same time, broader sectoral research has also examined transport development trends relevant to freight movement in the Republic of Moldova, including investment-related challenges (Gheorghita et al., 2024), as well as transport and logistics trends affecting product movement and market connectivity (Gheorghita and Sestenco-Diacek, 2025).

These contributions are important, yet they do not provide an integrated statistical assessment of the food industry of the Republic of Moldova that links sectoral economic dynamics with the current preconditions for digital transformation and the still limited diffusion of AI-related solutions. An important research gap therefore remains. The existing literature helps explain why digitalization, traceability, logistics, and emerging technologies matter for agri-food development, but it does not show whether the Moldovan food industry already possesses the economic, structural, and technological basis necessary for a deeper transition toward data-driven and AI-supported development.

Against this background, the present study aims to examine current development trends in the food industry of the Republic of Moldova and to assess the preconditions for its digital transformation in the context of emerging AI adoption. The article contributes by linking sector-specific evidence on production, prices, wages, investments, enterprise structure, employment, financial performance, and external trade with a proxy-based

assessment of digital readiness derived from manufacturing statistics. Such an approach makes it possible to evaluate not only the recent economic dynamics of the sector, but also the extent to which the conditions for further digital transformation are already emerging under existing statistical constraints.

## 2. Research methodology

This study employs a descriptive economic-statistical research design based on official data from the National Bureau of Statistics of the Republic of Moldova. The empirical analysis combines sector-specific indicators for the manufacture of food products with the most recent ICT indicators for manufacturing, which are used as the closest available statistical proxy for assessing the technological environment of food-processing activities.

The study applies comparative, dynamic, and structural analysis. Comparative analysis is used to identify differences between the food industry, industry as a whole, and the broader economic environment where relevant. Dynamic analysis is employed to trace changes in key indicators over time and to identify the main trends in sector development during 2019–2024. Structural analysis is used to interpret the position of the food industry within industry, the configuration of foreign trade across selected product groups, and the distribution of digital tools across manufacturing enterprises. Relative indicators are used to assess sector shares and intensity measures, while the trade balance for selected commodity groups is calculated as the difference between exports and imports.

The methodological logic of the study is exploratory rather than causal. Accordingly, the analysis does not attempt to estimate the direct effects of AI adoption on sector performance, but instead evaluates whether the economic, structural, and technological preconditions for further digital transformation are already emerging.

A methodological limitation should be noted. Published ICT statistics do not provide a stable and fully disaggregated set of indicators specifically for the food industry across all relevant dimensions of digitalization. For this reason, the digital component is interpreted through manufacturing as the closest available technological and organizational context for food-processing activities. Therefore, the study identifies the broader conditions for digital transformation rather than a fully isolated measure of digital maturity in the food industry itself.

## 3. Results and discussion

### 3.1. Production dynamics and producer price environment in the food industry

To assess the current position of the food industry and the economic background of its prospective digital transformation, it is first necessary to examine the dynamics of industrial output together with the producer price environment. Considered jointly, these indicators make it possible to distinguish between changes associated with real production performance and those driven primarily by price movements (Figure 1).

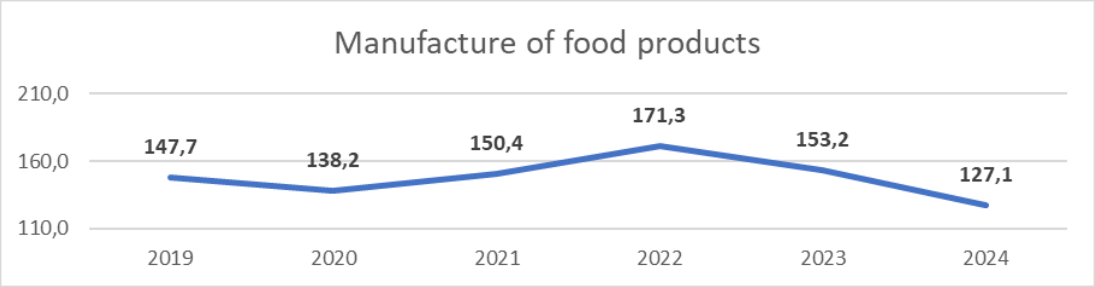


**Figure 1. Industrial production volume index for manufacture of food products, %**
*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.d).*

As shown in Figure 1, the manufacture of food products in the Republic of Moldova was characterized by uneven output dynamics over the period under review, indicating that the sector developed under changing production conditions rather than along a stable growth path. This pattern should be interpreted together with the producer price developments presented in Table 1.

**Table 1. Producer price indices for manufacture of food products by market, %**

| Indicators | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|
| Total | 102.6 | 105.5 | 112.4 | 123.3 | 107.4 | 99.9 |
| Internal | 101.5 | 104.5 | 114.4 | 128.4 | 106.9 | 98.5 |
| External | 106.4 | 109.1 | 105.6 | 105.1 | 109.1 | 105.5 |

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.g).*

The data indicate a pronounced acceleration of producer prices in 2021–2022, when the total producer price index increased from 112.4% to 123.3%, while the index for the domestic market reached 128.4%. In contrast, price dynamics on external markets were more moderate, fluctuating within a narrower range and amounting to 105.5% in 2024. By 2024, the total producer price index declined to 99.9%, and the domestic market index to 98.5%, pointing to a partial easing of internal price pressure.

Taken together, Figure 1 and Table 1 suggest that the recent performance of the food industry was shaped not only by changes in physical output, but also by a volatile pricing environment. This distinction is important for the subsequent analysis, since later changes in turnover and financial results should not be interpreted automatically as evidence of proportional real sector expansion.

Against the background of the volatile producer price environment discussed above, it is also important to consider labor cost dynamics in the food industry (Table 2).

**Table 2. Average gross monthly earnings in the manufacture of food products compared with industry and the total economy, lei**

| Indicators | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|
| Economic activities - total | 7233.7 | 7943.0 | 8979.8 | 10447.3 | 12209.2 | 13990.0 |
| Industry | 7151.0 | 7564.2 | 8242.0 | 9541.2 | 11106.2 | 12793.0 |
| Manufacture of food products | 6267.4 | 6704.2 | 7390.6 | 8843.2 | 10508.8 | 12144.8 |

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.f).*

As shown in Table 2, average gross monthly earnings in the manufacture of food products increased steadily from 6,267.4 lei in 2019 to 12,144.8 lei in 2024, indicating a

substantial rise in nominal labor remuneration. However, throughout the entire period, wage levels in the food industry remained below both the average for total economic activities and the industrial average. In 2024, for example, average monthly earnings in food manufacturing were 648.2 lei lower than the industrial average and 1,845.2 lei lower than the economy-wide average. This suggests that, despite evident wage growth, the sector continued to operate with comparatively lower labor remuneration, which may reflect both cost constraints and structural specificities of food-processing activities. At the same time, the upward wage trend may be interpreted as a necessary adjustment to inflationary pressures and labor market conditions rather than as an unambiguous sign of qualitative modernization. This observation is important for the subsequent analysis of investment activity, since sustained sectoral transformation depends not only on the ability to absorb rising labor costs, but also on the capacity to expand long-term capital investment (Table 3, Figure 2).

**Table 3. Investments in non-current assets in industry and in the manufacture of food products**

| Indicators | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|
| Industry – total, million lei | 5514.7 | 4356.3 | 5964.7 | 4924.9 | 5774.5 | 6917.3 |
| Manufacture of food products, million lei | 992.5 | 951.9 | 1406.9 | 1107.4 | 1427.8 | 1634.8 |
| Share of investments in the manufacture of food products in total industrial investments, % | 18.0 | 21.9 | 23.6 | 22.5 | 24.7 | 23.6 |

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.e).*

As shown in Table 3 and Figure 2, investments in non-current assets in the manufacture of food products increased overall from 992.5 million lei in 2019 to 1,634.8 million lei in 2024, despite noticeable year-to-year fluctuations. A similar uneven pattern was observed in industry as a whole, confirming that capital investment developed in a volatile macroeconomic environment rather than along a stable upward trajectory. At the same time, the share of the food industry in total industrial investments rose from 18.0% in 2019 to 23.6% in 2024, with a peak of 24.7% in 2023. This indicates that the food industry maintained a relatively strong investment position within the industrial sector and remained one of its major capital-absorbing segments.

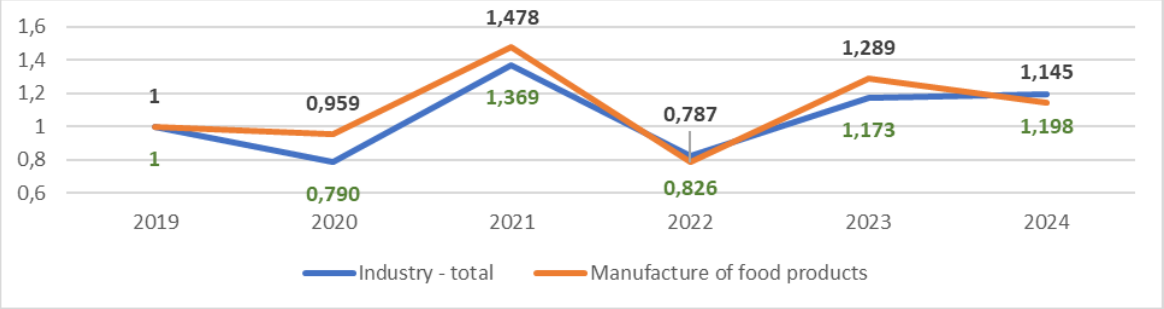


**Figure 2. Dynamics of investments in non-current assets in industry and in the manufacture of food products, %**

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.e).*

Nevertheless, the observed growth in investment should be interpreted primarily as evidence of strengthening material preconditions for modernization, rather than as proof of completed technological transformation. In this respect, the investment trend forms an important bridge to the subsequent analysis of enterprise structure and employment, since the real effect of capital expansion depends on how it is reflected in the organization and performance of firms operating in the sector (Table 4).

**Table 4. Structural and employment indicators of enterprises in the manufacture of food products**

| Indicators | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|
| Number of enterprises | 985 | 1004 | 977 | 980 | 997 | 1000 |
| Average number of employees | 26965 | 26608 | 25475 | 24816 | 24986 | 23890 |
| Average number of employees per enterprise | 28 | 27 | 27 | 26 | 26 | 24 |

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.a).*

As shown in Table 4, the number of enterprises operating in the manufacture of food products remained relatively stable over 2019–2024, fluctuating within a narrow range from 977 to 1,004 units and reaching 1,000 enterprises in 2024. In contrast, employment dynamics followed a downward trend: the average number of employees declined from 26,965 in 2019 to 23,890 in 2024, while the average number of employees per enterprise decreased from 28 to 24. This combination of relatively stable enterprise numbers and shrinking average employment suggests that the sector did not expand through extensive growth in labor input. Rather, it evolved toward a more compact organizational structure, which may reflect cost optimization, changing production practices, or gradual adaptation to technological and market pressures.

In analytical terms, this result is important because it indicates that the sector's resilience cannot be explained by workforce expansion. Instead, the key question shifts toward productivity and financial performance, making it necessary to examine whether the observed structural adjustment was accompanied by stronger turnover generation and improved profitability (Table 5).

**Table 5. Financial performance indicators of enterprises in the manufacture of food products**

| Indicators | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|
| Turnover, million lei | 19544.3 | 20154.6 | 23406.0 | 36419.0 | 35022.1 | 30792.8 |
| Turnover per employee, thousand lei | 724.8 | 757.5 | 918.8 | 1467.6 | 1401.7 | 1288.9 |
| Net profit or loss for the financial year, million lei | 557.6 | 417.3 | 977.6 | 2235.8 | 1386.2 | 1778.7 |
| Chain growth rate of net profit or loss, % | 120.4 | 74.8 | 234.3 | 228.7 | 62.0 | 128.3 |

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.b).*

As shown in Table 5, the manufacture of food products recorded a substantial increase in turnover, turnover per employee, and net financial results over the period under review, although the dynamics were not uniform. Turnover increased from 19,544.3 million lei in 2019 to 30,792.8 million lei in 2024, while turnover per employee rose from 724.8 thousand

lei to 1,288.9 thousand lei. Net profit also expanded markedly, from 557.6 million lei in 2019 to 1,778.7 million lei in 2024, despite strong fluctuations, including a peak in 2022 and a subsequent correction in 2023. These results suggest that the sector improved its nominal financial performance and generated higher output per worker even in the context of declining employment.

At the same time, such improvements should not be interpreted in a purely linear way, since they were formed under conditions of considerable producer price volatility, especially in 2021–2022. Therefore, the observed gains reflect not only internal efficiency adjustments, but also the influence of the broader price environment. This is particularly important for the next stage of the analysis, because the external trade profile makes it possible to assess whether the sector's improved financial position was accompanied by stronger competitive performance across food-related product groups (Table 6).

**Table 6. Foreign trade in selected food industry-related commodity chapters: exports, imports and trade balance, 2024, thousand USD**

| Commodity group | Export | Import | Trade balance |
|---|---|---|---|
| Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes | 122657.92 | 79759.74 | +42898.18 |
| Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates | 426.99 | 32382.97 | -31955.98 |
| Sugars and sugar confectionery | 7611.10 | 46896.70 | -39285.60 |
| Cocoa and cocoa preparations | 12879.40 | 49743.56 | -36864.16 |
| Preparations of cereals, flour, starch or milk; pastrycooks products | 25051.45 | 101130.65 | -76079.20 |
| Preparations of vegetables, fruit, nuts or other parts of plants | 133471.88 | 48146.08 | +85325.80 |
| Miscellaneous edible preparations | 23875.23 | 124560.37 | -100685.14 |
| Residues and waste from the food industry; prepared animal fodder | 28863.42 | 69313.78 | -40450.36 |

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.c).*

As shown in Table 6, the 2024 trade profile of selected food industry-related commodity chapters in the Republic of Moldova was markedly heterogeneous. Trade surpluses were observed only in a limited number of product groups, most notably in vegetable-based processed products and in animal or vegetable fats and oils, whereas most other selected categories showed trade deficits. The deficit pattern was especially pronounced in more processing-intensive segments and prepared food products, indicating that stronger external positions remain concentrated in a narrow set of commodity lines, while several higher-value-added segments continue to depend on imports.

From an analytical perspective, this indicates that the food industry's overall resilience is accompanied by structural trade asymmetries, which reinforce the importance of modernization, value-chain upgrading, and more advanced digital coordination tools in production, logistics, and market management. The static trade structure presented in Table 6

therefore creates a necessary basis for the subsequent dynamic analysis of exports and imports by product group (Figure 3, Figure 4).

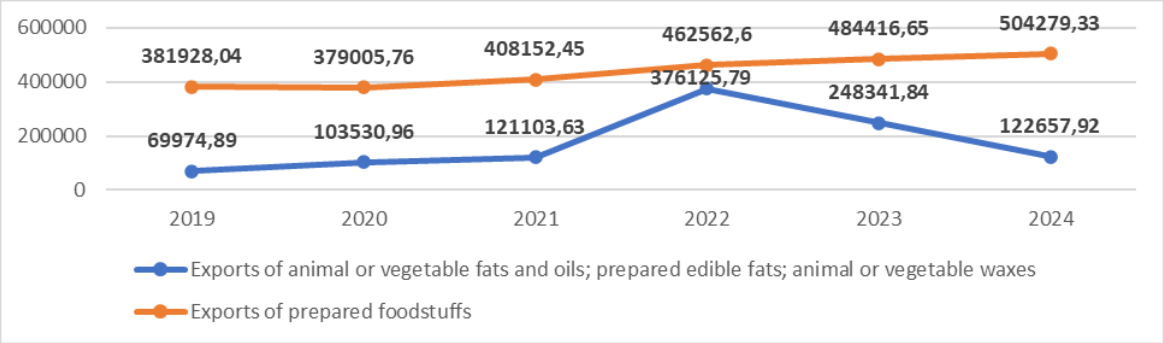


**Figure 3. Dynamics of exports of selected product groups related to the food industry, thousand USD**

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.c).*

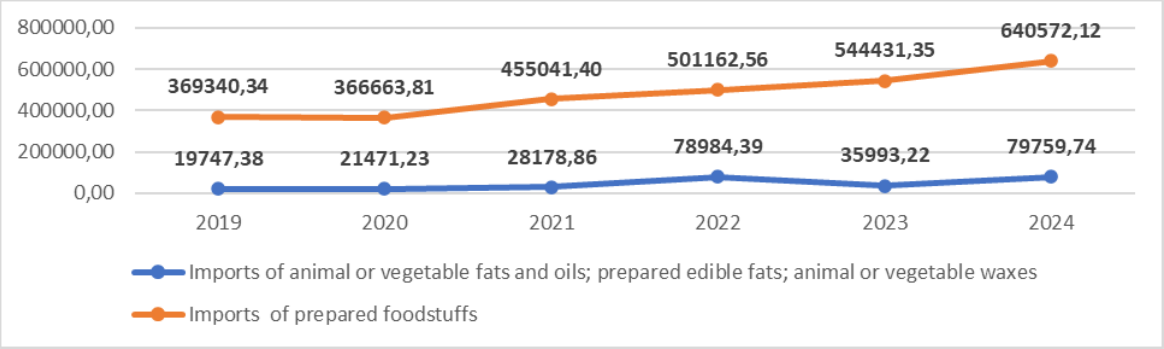


**Figure 4. Dynamics of imports of selected product groups related to the food industry, thousand USD**

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (n.d.c).*

The static trade configuration presented in Table 6 is further reinforced by the longer-term dynamics of export and import flows shown in Figures 3 and 4. Taken together, these figures indicate that external trade performance across selected food industry-related product groups evolved unevenly over time, with no uniform pattern of strengthening across all categories. Export growth appears to have been more concentrated in a limited number of product lines, whereas import flows remained comparatively strong across a broader range of processed food categories. This dynamic confirms that the external position of the sector is characterized not only by product differentiation, but also by persistent asymmetry between stronger export-oriented segments and more import-dependent ones.

From a structural perspective, such a pattern suggests that the food industry's participation in external markets remains unevenly distributed across value chains, which increases the relevance of technological upgrading, better supply-chain coordination, and more advanced digital instruments to support competitiveness in higher-value-added activities.

### 3.2. Digital readiness of manufacturing as a framework for assessing the food industry's transformation potential

While the previous subsection examined the economic, structural, and trade-related characteristics of the food industry, the next step is to assess whether the broader technological environment provides sufficient preconditions for digital transformation. In this respect, the analysis moves from sector-specific performance indicators to the digital readiness of manufacturing as the closest available statistical framework for interpreting the food industry's technological position.

Since the ICT indicators are derived from a separate annual enterprise survey and are subject to changes in coverage snapshot and reference period, they are used in this study as the latest available digital of manufacturing rather than as a directly comparable continuation of the 2019–2024 sectoral time series.

**Table 7. Indicators of digital readiness in manufacturing in the Republic of Moldova, 2025 (number of enterprises)**

| Indicator | Manufacturing |
|---|---|
| Enterprises with a website | 480 |
| Enterprises using social media | 544 |
| Enterprises using paid cloud computing services | 192 |
| Enterprises using cloud-based ERP applications | 43 |
| Enterprises using cloud-based CRM applications | 49 |
| Enterprises using e-invoicing | 1060 |
| Enterprises using AI technologies | 31 |

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (2025).*

As shown in Table 7, the 2025 digital profile of manufacturing in the Republic of Moldova reflects a mixed level of technological readiness. On the one hand, a relatively large number of enterprises had already adopted basic digital instruments, including websites, social media, and especially e-invoicing. On the other hand, the diffusion of more advanced digital solutions remained limited: the number of enterprises using paid cloud computing services was markedly lower, while cloud-based ERP and CRM applications were adopted only by a small minority of firms. Most notably, only 31 manufacturing enterprises reported the use of AI technologies. This pattern suggests that manufacturing has already entered a stage of basic digital integration, but has not yet achieved broad-based diffusion of more sophisticated managerial and analytical tools. For the food industry, this is an important result, as it indicates that the preconditions for digital transformation exist, yet the transition toward deeper data-driven and AI-enabled business models remains at an early stage.

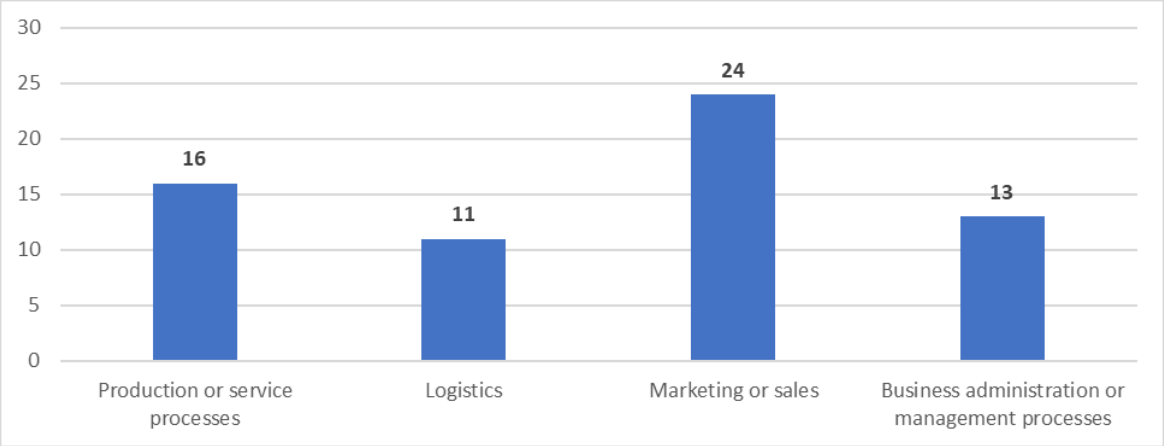


**Figure 5. Main areas of AI use in manufacturing in the Republic of Moldova, 2025 (number of enterprises)**

*Source: compiled by the authors based on National Bureau of Statistics of the Republic of Moldova (2025).*

Figure 5 provides a more detailed view of the functional distribution of AI use in manufacturing. The data show that AI applications were concentrated primarily in marketing or sales, followed by production or service processes and business administration, while logistics accounted for a comparatively smaller number of cases. This distribution is analytically significant because it indicates that AI adoption is currently oriented less toward fully integrated industrial transformation and more toward selected operational or commercial functions. In the context of the food industry, such a pattern implies that AI is more likely to be used initially in demand-related, process-support, and administrative tasks rather than in system-wide value-chain optimization. Consequently, the current stage of digital transformation should be interpreted as selective and uneven, with substantial room for expansion toward more integrated technological solutions capable of improving traceability, coordination, productivity, and strategic decision-making across the food value chain.

## 4. Conclusions

This study set out to examine the current development trends of the food industry of the Republic of Moldova and to assess the preconditions for its digital transformation in the context of emerging AI adoption. The analysis was based on official statistical data and combined sector-specific indicators of production, prices, wages, investment, enterprise structure, financial performance, and external trade with manufacturing-level ICT indicators used as the closest available statistical proxy for the technological environment of food-processing activities.

The findings indicate that the food industry remains a significant component of the national manufacturing base, but its recent evolution has been uneven and structurally differentiated. The sector operated under unstable output dynamics and a volatile producer price environment, particularly in 2021–2022, which means that recent changes in financial indicators cannot be interpreted solely as evidence of real expansion or productivity improvement. At the same time, the growth of wages and investments in non-current assets suggests that the sector has been strengthening some of the material conditions necessary for modernization.

The structural and financial evidence reveals a dual pattern. On the one hand, the number of enterprises remained broadly stable, while turnover, turnover per employee, and net financial results increased in nominal terms. On the other hand, employment and average enterprise size declined, pointing to a more compact organizational structure rather than extensive growth. This suggests that the sector's resilience has been associated less with expansion in labor input and more with internal adjustment under changing market and cost conditions.

The external trade analysis further demonstrates that the sector's competitive position is uneven across product groups. Trade surpluses were concentrated in a limited number of categories, whereas several more processing-intensive and higher-value-added segments remained import-dependent. This pattern indicates persistent structural asymmetries in the food industry's integration into external markets and underscores the importance of upgrading production capacity, strengthening inter-firm coordination, and improving the technological basis of value creation.

The digital evidence shows that manufacturing in the Republic of Moldova has already developed elements of basic digital integration, particularly in relation to e-invoicing, websites, and social media use. However, the diffusion of more advanced digital solutions remains limited, especially in the case of cloud-based ERP and CRM systems and, most notably, AI technologies. In addition, the observed use of AI is concentrated primarily in selected functional areas rather than in integrated value-chain transformation. In the context of the food industry, this means that digital transformation should currently be understood not as a completed structural shift, but as an emerging and still uneven process supported by partial technological preconditions.

Overall, the study supports the conclusion that the food industry of the Republic of Moldova possesses a relevant but incomplete foundation for digital transformation. The sector demonstrates economic significance, investment activity, and a manufacturing environment in which basic digital tools are already present. At the same time, limited diffusion of advanced digital systems, early-stage AI adoption, and persistent structural trade imbalances indicate that the transition toward more intelligent, data-driven, and coordinated business models remains at an initial stage.

The study also has an important methodological limitation. The digital block relies on manufacturing-level ICT statistics rather than consistently disaggregated food-industry indicators, which means that the analysis captures the broader technological context surrounding the sector rather than a fully isolated measurement of its digital maturity. Future research should therefore incorporate more detailed firm-level and sector-specific evidence in order to assess the actual drivers, depth, and performance effects of digital and AI-based transformation in food-processing activities.

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**References**

1. Ellahi, R.M., Wood, L.C. and Bekhit, A.E.-D.A., 2023. Blockchain-Based Frameworks for Food Traceability: A Systematic Review. *Foods*, 12(16), 3026.

2. Gheorghita, M. and Sestenco-Diacek, N., 2025. Development trends in road freight transport in the Republic of Moldova. *Journal of Social Sciences*, 8(2), pp. 46–56.
3. Gheorghita, M., Stratila, A. and Gumeniuc, I., 2024. Transformation of Moldova's agricultural sector: new challenges and investment opportunities. In: *Competitiveness and Sustainable Development: Conference Proceedings*, Chișinău, 7–8 November 2024, pp. 229–236.
4. Gomez-Trujillo, A.M. and Gonzalez-Perez, M.A., 2022. Digital transformation as a strategy to reach sustainability. *Smart and Sustainable Built Environment*, 11(4), pp. 1137–1162.
5. Kamilaris, A., Fonts, A. and Prenafeta-Boldú, F.X., 2019. The rise of blockchain technology in agriculture and food supply chains. *Trends in Food Science & Technology*, 91, pp. 640–652.
6. Klerkx, L., Jakku, E. and Labarthe, P., 2019. A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS - Wageningen Journal of Life Sciences*, 90–91, 100315.
7. Liakos, K.G., Athanasiadis, V., Bozinou, E. and Lalas, S.I., 2025. Machine Learning for Quality Control in the Food Industry: A Review. *Foods*, 14(19), 3424.
8. Litvin, A., 2025. Utilizarea resurselor digitale în promovarea producției agroalimentare [Use of digital resources in promoting agri-food production]. In: *Marketingul și logistica în era digitală*, Chișinău, 23 May 2025, pp. 159–163.
9. National Bureau of Statistics of the Republic of Moldova, n.d.a. *Statistical databank "Statbank"*. Activity and financial position of economic units by Economic activities, Indicators, Size of enterprise and Years. Available at: <https://statbank.statistica.md:443/PxWeb/sq/f73ac05d-5503-47f7-98a5-f6b4eb2e634b> [Accessed 03 April 2026].
10. National Bureau of Statistics of the Republic of Moldova, n.d.b. *Statistical databank "Statbank"*. Activity and financial position of economic units by Economic activities, Indicators, Size of enterprise and Years. Available at: <https://statbank.statistica.md:443/PxWeb/sq/ffefe9ab-8b87-4dd9-8bfe-68715b25059a> [Accessed 09 April 2026].
11. National Bureau of Statistics of the Republic of Moldova, n.d.c. *Statistical databank "Statbank"*. External trade of the Republic of Moldova, structured by sections and chapters, according Combined Nomenclature of Goods (CNG) and groups of countries, 2001–2024. Available at: <https://statbank.statistica.md:443/PxWeb/sq/36c101b0-bcca-49b1-a754-506c4bcede21> [Accessed 14 April 2026].
12. National Bureau of Statistics of the Republic of Moldova, n.d.d. *Statistical databank "Statbank"*. Industrial production volume index for manufacture of food products, %. Available at: <https://statbank.statistica.md:443/PxWeb/sq/82cd7e33-7027-4f33-9c61-adb99097bac9> [Accessed 12 March 2026].
13. National Bureau of Statistics of the Republic of Moldova, n.d.e. *Statistical databank "Statbank"*. Investments in non-current assets in industry by Industrial activities, unit variable and Years. Available at: <https://statbank.statistica.md:443/PxWeb/sq/55e6251b-9514-4c67-bcf9-a77245516603> [Accessed 29 March 2026].

14. National Bureau of Statistics of the Republic of Moldova, n.d.f. *Statistical databank "Statbank"*. Monthly gross and net average earnings by economic activities, sectors and sex, 2013–2024. Available at: <https://statbank.statistica.md:443/PxWeb/sq/45501d44-810f-40b2-b900-7f148aa440f3> [Accessed 24 March 2026].
15. National Bureau of Statistics of the Republic of Moldova, n.d.g. *Statistical databank "Statbank"*. Price indices for industrial production, by types of activities, market, previous year=100, 2012–2025. Available at: <https://statbank.statistica.md:443/PxWeb/sq/7af0f969-e67e-4507-904f-0e8f31839970> [Accessed 18 March 2026].
16. National Bureau of Statistics of the Republic of Moldova, 2025. *Information technology, post and communications. Excel tables*. Situation on computerization and Internet connection in 2025. Available at: <https://statistica.gov.md/files/files/serii_de_timp/tehnologii_posta_telecomunicatii/tehnologii_informationale/Situatia_conexiunea_internet_2025.xlsx> [Accessed 15 April 2026].
17. Pournader, M., Ghaderi, H., Hassanzadegan, A. and Fahimnia, B., 2021. Artificial intelligence applications in supply chain management. *International Journal of Production Economics*, 241, 108250. https://doi.org/10.1016/j.ijpe.2021.108250
18. Toorajipour, R., Sohrabpour, V., Nazarpour, A., Oghazi, P. and Fischl, M., 2021. Artificial intelligence in supply chain management: A systematic literature review. *Journal of Business Research*, 122, pp. 502–517. https://doi.org/10.1016/j.jbusres.2020.09.009
19. Turcan, I., 2025. Digital technologies for quality assurance in circular production systems. In: *Marketingul și logistica în era digitală*, Chișinău, 23 May 2025, pp. 169–175. https://doi.org/10.52326/mled2025.24
20. Turcan, I., Turcan, R. and Stratila, A., 2023. Digitalization and its role in the development of circular economy business models. In: *Competitiveness and Sustainable Development: Conference Proceedings*, Chișinău, 2–3 November 2023, pp. 103–109. https://doi.org/10.52326/csd2023.16
21. Turcan, R., 2025. Integration of emerging technologies into supply chains to promote the circular economy. In: *Marketingul și logistica în era digitală*, Chișinău, 23 May 2025, pp. 126–135. https://doi.org/10.52326/mled2025.17
22. Vasileiou, M., Kyrgiakos, L.S., Kleisiari, C., Lappas, P.Z., Tsinopoulos, C., Kleftodimos, G., Ntemou, A., Kateris, D., Moulogianni, C. and Vlontzos, G., 2025. Digital Transformation of Food Supply Chain Management Using Blockchain: A Systematic Literature Review Towards Food Safety and Traceability. *Business & Information Systems Engineering*. https://doi.org/10.1007/s12599-025-00948-0
23. Verdouw, C.N., Wolfert, J., Beulens, A.J.M. and Rialland, A., 2016. Virtualization of food supply chains with the Internet of Things. *Journal of Food Engineering*, 176, pp. 128–136. https://doi.org/10.1016/j.jfoodeng.2015.11.009
24. Wolfert, S., Verdouw, C., van Wassenaer, L., Dolfsma, W. and Klerkx, L., 2023. Digital innovation ecosystems in agri-food: design principles and organizational framework. *Agricultural Systems*, 204, 103558. https://doi.org/10.1016/j.agsy.2022.103558