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ENSURING ADAPTABILITY OF THE LOGISTICS SYSTEM OF THE AGROINDUSTRIAL ENTERPRISE TO ENVIRONMENTAL INSTABILITY

ЗАБЕЗПЕЧЕННЯ АДАПТИВНОСТІ ЛОГІСТИЧНОЇ СИСТЕМИ АГРОПРОМИСЛОВОГО ПІДПРИЄМСТВА ДО НЕСТАБІЛЬНОСТІ СЕРЕДОВИЩА

The article is concerned with studying the adaptability of the agro-industrial enterprises logistics system in an unstable environment. The article analyses specific features of logistics systems of agro-industrial enterprises and the external environment factors. On the case of Ukrprominvest-Agro, the aspects of ensuring the adaptability of the logistics system to economic conditions, political and legal changes, socio-demographic changes and technological innovations are considered. Ways to increase the logistics system adaptability are proposed. The methods of induction, deduction, analysis, synthesis and systematisation were used to analyse the enterprise logistics system and the environmental factors that affect its functioning; as well as observation methods and the graphical method.

Keywords: *logistics system, agro-industrial enterprise, adaptability, environmental instability, agro-logistics, management of logistics flows.*

У статті досліджено проблему адаптивності логістичної системи агропромислового підприємства до нестабільності зовнішнього середовища на прикладі ТОВ «Укрпромінвест-Агро». Актуальність дослідження зумовлена необхідністю швидкого пристосування логістичних систем до нових умов функціонування, особливо в умовах воєнного стану в Україні, що призвів до руйнування логістичної інфраструктури, зміни ринків збуту та інших кризових явищ. Визначено основні фактори зовнішнього середовища, що впливають на функціонування логістичної системи агропромислового підприємства. На основі проведеного дослідження запропоновано стратегічні напрямки адаптації логістичної системи ТОВ «Укрпромінвест-Агро»: вдосконалення планування, прогнозування та оперативного реагування на зміни умов функціонування; забезпечення персоналу необхідними навичками та гнучкістю; технологічна модернізація та цифровізація логістичних процесів. Визначено конкретні заходи в межах зазначених напрямів, зокрема: фіксація та формалізація успішних логістичних процесів, організація ефективного навчання логістів і диспетчерів, систематичний моніторинг змін та автоматизація вагового контролю на заводі. У процесі написання статті для аналізу логістичної системи підприємства та факторів зовнішнього середовища, які впливають на її функціонування, використовувалися загальнонаукові методи наукового пізнання, індукції, дедукції, аналізу, синтезу та систематизації; а також методи спостереження; графічний метод – для представлення результатів дослідження.

Ключові слова: *логістична система, агропромислове підприємство, адаптивність, нестабільність середовища, агрологістика, управління логістичними потоками.*

Problem statement. In the context of intense competition and rapid changes in the market environment, effective management of flow processes at an enterprise is crucial. The logistics system of an enterprise becomes a key tool for ensuring the uninterrupted flow of material, information and financial flows. The problem of adaptability of the logistics system is particularly acute for agro- industrial enterprises, whose activities are characterized by seasonality, dependence on natural and climatic conditions, territorial dispersion of production facilities and special requirements for storage and transportation of products.

The relevance of the study is due to the fact that in the current conditions of instability of the economic, political, and social environment, agro-industrial enterprises face numerous challenges that require prompt adaptation of logistics systems to new conditions of functioning. This problem has become particularly acute for Ukrainian enterprises in the context of martial law, which has led to the destruction of logistics infrastructure, changes in sales markets, mass migration and other crisis phenomena.

Analysis of recent research and publications. The issue of adaptability of logistics systems has been studied by such well-known scientists in the field of logistics as

V. Ponomarenko [6], E. Krykavskyi [5], G. Osovska, and O. Osovskyi [4].

Formulating the purposes of the article. The purpose of the study is to identify ways to ensure the adaptability of the logistics system of an agro- industrial enterprise to the instability of the external environment on the example of Ukrprominvest-Agro.

Methodology. To analyse the adaptability of the logistics system of an agro-industrial enterprise to the instability of the external environment, a combination of system analysis - to consider the logistics system as an integral complex of interconnected elements that function in a dynamic environment and case study methodology - an in-depth study of the logistics system of a specific agro-industrial enterprise (Ukrprominvest-Agro) with the following elements: structured observation – to study the logistics processes at the enterprise in real life.

Presentation of the main research material. The logistics system of an enterprise plays a key role in ensuring the effective functioning of business in modern conditions. The scientific literature presents various approaches to the definition of the concept of "logistics system". In particular, Yurii Ponomariov defines a logistics system as a flexible adaptive system with feedback mechanisms, the purpose of which is to perform logistics functions and operations. It consists of interconnected subsystems that are closely integrated with each other and have extensive links with the external environment, such as suppliers, consumers, intermediaries and other participants in the logistics chain [1, p. 32]. Kalchenko A.G. interprets the logistics system as an economic and managerial mechanism for planning and organising the coordination of actions of all units involved in managing the movement of various types of flows [2, p. 33]. In the works of A.M. Oklander, the logistics system of the enterprise is considered as the only possible form of existence of logistics as an integrated function of material flow management [2, p. 33].

The main purpose of the logistics system is to ensure timely delivery of the required quantity of goods and products of the appropriate quality to the destination with maximum preparation for production use or consumption while maintaining the established level of costs.

The structure of the logistics system includes functional and supporting subsystems. The functional subsystems include supply, production and distribution, and the supporting subsystems include organisational, economic, legal, personnel and logistics information system [3].

The links of the enterprise's logistics system are usually divided into internal (structural units of the enterprise) and external (suppliers, trade intermediaries, transport companies, banks, insurance organisations, etc.) By functional purpose,there are links that generate, transform and absorb logistics flows, as well as mixed links [4].

The logistics system of an agro-industrial enterprise operates in a turbulent and unstable external environment, the elements of which are constantly changing, appearing and disappearing, evolving and modifying. These elements have a certain impact on the logistics processes of the enterprise: some have a negative impact on its functioning, while others create attractive conditions for the development and improvement of the enterprise's logistics system.

All logistics processes of an enterprise take place in the logistics environment and are influenced by it [4, p. 117]. Macro-environmental factors that do not directly affect logistics operations, but create a certain context for the functioning of the logistics system, and micro-environmental factors that directly affect the logistics activities of the enterprise, form the conditions for the functioning of the logistics system.

Logistics systems should operate stably within the limits of permissible deviations of parameters and environmental factors. If the fluctuations of stochastic environmental factors are significant, the logistics system should adapt to new conditions by changing the functioning programme, parameters and optimisation criteria [11, p. 12].

The most important environmental factors that affect the logistics system of an agro-industrial enterprise include the following:

1. Economic factors. Economic changes affect various aspects of an agricultural enterprise's logistics system, including demand, pricing and logistics costs. In particular, the COVID-19 pandemic has had a significant impact on global economic conditions, and companies have had to quickly adapt their logistics strategies to the economic uncertainty.

Increased inflation leads to higher costs for logistics operations, such as transportation, storage, handling, etc. Currency fluctuations may affect the cost of imported logistics services or components. The cost of energy also has a significant impact, as fuel prices determine the level of costs for the transport component of logistics.

2. Political and legal factors. For Ukrainian agro-industrial enterprises, the impact of political and legal factors is particularly critical and unpredictable under martial law. Military actions and related political and legal consequences have an extremely serious impact on the functionality of the logistics systems of enterprises. In particular, this is manifested through:

– Destruction of transport infrastructure (roads, bridges, railways, ports), which critically complicates or makes it impossible to transport goods;

– additional restrictions and requirements for the movement of goods within the country and across borders in wartime;

– delays and risks due to checkpoints, shelling, and the presence of dangerous areas;

– shortage of labour, fuel and electricity to support logistics processes;

– the need to evacuate or relocate production facilities and logistics facilities;

– changes in the state regulation of logistics activities, the introduction of martial law and curfews;

– risks of damage or loss of cargo, warehouses, and transport due to hostilities;

– Massive destruction of warehouses and production facilities.

3. Socio-demographic factors. The full-scale war had a devastating impact on the socio-demographic situation in Ukraine, which critically affected the logistics systems of agricultural enterprises. Massive internal migration of people from the regions affected by the hostilities has completely changed the distribution of logistics flows and consumer demand for goods and services across Ukraine's regions.

The significant decline in population due to the migration of millions of Ukrainians abroad has narrowed the domestic market and the need for logistics

infrastructure. Many businesses have faced an acute shortage of logistics staff due to the mobilisation and departure of employees.

4. Technological factors. The development of digital technologies has a significant impact on the functioning of logistics systems of agricultural enterprises. The introduction of digital technologies in logistics has become a priority for large companies and a strategy in which developed countries are investing heavily to strengthen their market positions.

The spread of the concept of Industry 4.0 and intelligent logistics, based on the intelligent management of digital systems, has become the main driver of digital technologies in the logistics management of agricultural enterprises [12].

Ukrprominvest-Agro LLC (UPI-AGRO) is an agro-industrial company that is one of the industry leaders in Ukraine. It specialises in growing agricultural products, producing sugar and flour, and livestock [7].

The company operates in 4 business areas: sugar production, crop production, grain processing and livestock farming. The company's structure includes Kryzhopil and Haisyn sugar factories, Vinnytsia Bakery No. 2, Zorya Podillya Food Company and Podillya Food Company (Figure 1).

Ukrprominvest-Agro's logistics system includes the following key components: procurement of material resources, inventory management, warehouses, elevators, sugar mills (storage and processing systems), transport system, production maintenance, information communication and control, and human resources.

Efficient logistics at Ukrprominvest-Agro involves careful route planning, optimisation of traffic flows, and control and tracking of cargo movements. The company pays special attention to planning the need for vehicles in advance, as the seasonality of the business causes uneven demand for vehicle hire.

Based on the study, the following ways to ensure the adaptability of the logistics system of an agro-industrial enterprise to the instability of the environment can be proposed:

1) Ensuring adaptability to economic factors

– Implement flexible pricing systems for logistics services;

– Continuously monitor and analyse economic indicators and their impact on logistics costs;

– Build strategic stocks of material resources;

– Develop alternative options for transporting products.

2) Ensuring adaptability to political and legal factors

– Develop alternative routes for transporting products, taking into account safety risks;

– Create backup facilities for storing products in case of impossibility of their timely removal;

– Introduce systems for rapid response to changes in the security situation;

– Ensure the autonomy of critical links in the logistics system (e.g., autonomous power sources for warehouses);

– Develop plans to relocate logistics facilities to safe regions;

– Establish cooperation with international logistics companies to ensure exports of products through alternative routes.

3) Ensuring adaptability to socio-demographic factors

– Implement training and retraining programmes for logistics personnel;

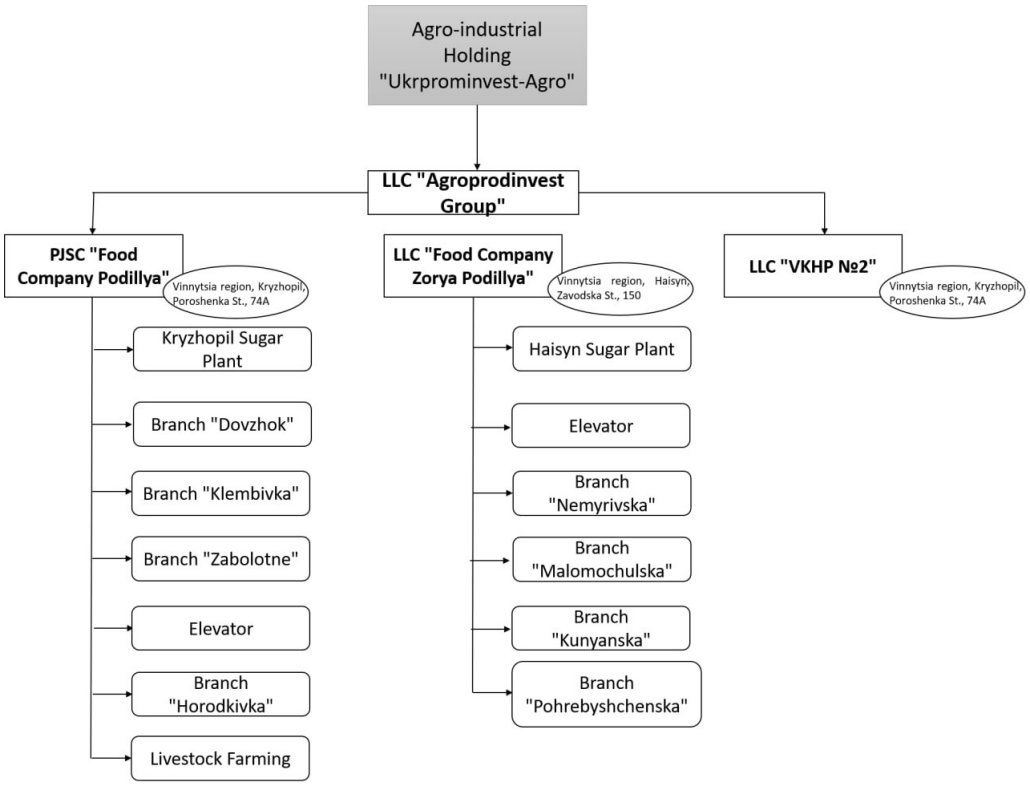

Figure 1. The structure of Ukrprominvest-Agro

Source: developed by the authors

– Develop incentive systems to retain qualified personnel;

– Automate logistics processes to reduce dependence on the human factor;

– Create backup logistics management teams;

– Monitor changes in the structure of consumer demand and adapt logistics flows accordingly.

Ensuring technological adaptability of the logistics system of an agricultural enterprise:

– Implement modern information systems for managing logistics processes (WMS, TMS, ERP);

– Use real-time cargo tracking technologies (GPS trackers, RFID tags);

– Develop digital twins of the logistics system to model different scenarios of its operation;

– Implement demand forecasting and route optimisation technologies;

– Ensure the integration of information systems with partners in the supply chain to increase transparency and efficiency of information exchange.

The state of the infrastructure, in particular the quality of roads and field tracks, is also a determining factor for the efficiency of sugar beet transportation. Every year, different crops can be grown in different fields, which requires changes in logistics routes and ways of transporting the crop. As a result, Ukrprominvest-Agro has to build new access roads and field tracks to ensure unimpeded access of specialised machinery to different areas and to optimise the transportation process.

Technology is also an important factor in adaptability. Innovative solutions for harvesting, transporting and processing beetroot can significantly improve logistics efficiency.

In the 2023/24 sugaring season, Kryzhopil and Haisyn sugar factories operated on wheels, meaning that they did not store root crops in the sheds, but dug up the beets, loaded them onto trucks and transported them to production.

"The existing system for weighing beet trucks at Ukrprominvest-Agro's plant is a bottleneck, as it is somewhat outdated and does not meet modern efficiency requirements. The lack of implementation of the latest technology leads to low productivity and creates opportunities for abuse. This outdated system is not sufficiently flexible and adaptive to changing environmental conditions, especially in the context of technological progress.

Currently, weighing beet trucks relies on weighers manually filling in paperwork and stamping it. This is a long and outdated procedure that slows down the entire weighing process. The involvement of a large number of weighers increases the risk of human error or intentional fraud when entering cargo weight data. Human resources are used inefficiently, and the company incurs significant labour costs for a large staff of weighers.

The use of paper documents and manual data entry make it difficult to integrate with modern logistics and accounting systems at the plant and across the company. Information can be distorted, partially lost, or entered into databases with a delay. In addition, such an outdated weighing system is not adaptive to changes in traffic volumes, the number of trucks, or other fluctuations in external conditions. Long transport queues, delays in data processing and slow operation reduce the overall productivity of the sugar plant.

In summary, ensuring the adaptability of the logistics system is a critical task for Ukrprominvest-Agro in the context of effective operation in the changing agricultural market. The key challenges include the impact of economic factors, seasonality and dependence on weather conditions, geographical dispersion of production facilities, and the complexity of planning and coordinating numerous logistics flows.

Only a comprehensive approach that combines technological modernisation, infrastructure development and employee training will allow Ukrprominvest-Agro to adapt to changing environmental challenges in a timely manner and ensure sustainable competitive advantages through high efficiency of the logistics system. Achieving such adaptability should be a strategic priority for the company's management.

Given the diversity and dynamism of the challenges faced by the logistics system of an agricultural enterprise, it is obvious that there is a need to identify areas that can be improved. Defining clear strategic directions will help to systematise measures to increase the flexibility and adaptability of logistics, ensure coordinated interaction between different functional units of the company and rationally allocate resources to achieve the set goals.

Therefore, it is worth identifying the key strategic areas of adaptation of the logistics system of Ukrprominvest-Agro LLC, namely:

• Improvement of planning, forecasting and prompt response to changes in operating conditions;

• Ensure that staff have the necessary skills and flexibility to effectively implement adaptive solutions;

• Technological modernisation and digitalisation of logistics processes to improve the efficiency and effectiveness of flow management.

Now let's look at more specific measures that a company should take within the above areas.

Firstly, it is worth paying attention to the recording and formalisation of successful logistics processes at the enterprise. In times of war, logistics chains often need to be urgently adapted to new challenges and circumstances. Having documented processes in place makes it easier to analyse and optimise them in line with new realities.

Secondly, in the context of military realities and high staff turnover, the issue of organising effective training for logisticians and dispatchers at an agricultural enterprise is becoming critical. Given the possibility of attracting people who have never worked in logistics before, thorough training programmes are needed to build basic competencies from scratch. The traditional practice of having experienced employees the company train newcomers on the job is no longer viable. Training should include both theoretical knowledge and practical skills, taking into account the specifics of the company's operations. Given the martial law, it can be conducted both in person and remotely

It is also worth considering such a tool as systematic monitoring of changes:

– analysis of competitors' logistics operations, which involves collecting and studying open data on the organisation of logistics processes (supply, transport, warehousing) in competing companies, for example: "Astarta-Kyiv, Radekhivskyi Sugar, Kernel, UkrLandFarming and others. This will help identify their potential advantages and practices that can be adopted;

– studying the offers of logistics service providers (transport, forwarding, warehousing companies), their tariffs, conditions, reputation to optimise logistics costs and build new partnerships;

– analysis of infrastructure projects - monitoring plans for the development of transport, warehouse and terminal infrastructure in the regions where Ukrprominvest-Agro operates to adjust and optimise logistics strategies.

In our opinion, given that sugar production is one of the key activities of UPI-AGRO, it is worth paying special attention to the adaptation of sugar beet logistics.

The transportation of raw materials has its own peculiarities, which affects the construction of routes and related logistics procedures. That is, from the moment the beet is loaded into the truck, the optimal route for its delivery to the sugar factory must be determined. Vehicles should not stand idle while waiting to be loaded or unloaded, otherwise this affects the efficiency of logistics and the operation of processing facilities. Therefore, it is extremely important to calculate the required number of vehicles, drivers' work schedules, and coordinate the schedule of harvested raw materials to sugar factories (taking into account the available capacity). Therefore, it is advisable to consider the automation of weight control at the plant.

When using an automated weighing system, all the responsibilities of the weigher are transferred to the automated system. The system independently monitors the placement of the vehicle on the scales, determines the weighing conditions (gross or tare), links the weighing result to the appropriate vehicle, transmits commands to the driver to enter and exit the weighbridge, and regulates traffic flows on the territory of the enterprise. In addition, the automated system generates all the necessary data for creating consignment notes, completely eliminating the need for manual data entry. Thus, the integrated solution takes over all the functions previously performed by the weighbridge operator.

Conclusions. Ensuring the adaptability of the logistics system of an agro-industrial enterprise to the instability of the external environment is a critical factor in its competitiveness and sustainability in modern conditions. An analysis of the logistics system of the agro-industrial company Ukrprominvest-Agro has shown that it is a complex multicomponent system that operates under the influence of numerous external factors.

In order to ensure the adaptability of the logistics system of an agro- industrial enterprise to environmental instability, it is necessary to implement a set of measures aimed at adapting to economic, political and legal, socio-demographic and technological factors. These measures should take into account the specifics of agro-industrial production, in particular its seasonality, dependence on natural and climatic conditions, and territorial dispersion of production facilities.

A promising direction for further research is the development of a methodology for assessing the adaptability of the logistics system of an agro-industrial enterprise to the instability of the external environment, as well as the formation of a mechanism for forecasting and preventing logistics risks associated with changes in the environment.

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