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**LEVERAGING BUSINESS CONTROLLING FOR  
SUSTAINABILITY CRISIS MANAGEMENT IN  
DIGITAL TRANSFORMATION**

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**Introduction.** The deepening of economic instability and accelerated digitalisation of the business environment have provoked a review of traditional management models. The impact of crises and risks complicates the comprehensive implementation of ESG principles and, accordingly, hinders the achievement of sustainable development goals, thereby reducing sustainability. This highlights the need to implement management systems that can provide flexible responses, ensure information transparency, facilitate proactive threat diagnostics, and support long-term development.

**Aim and tasks.** This study aims to substantiate the conceptual and practical aspects of integrating control into the anti-crisis management of enterprises in the context of digital transformation and sustainable development.

**Results.** Intervals for different categories of enterprises (large 2.72–3.02, medium-sized 3.54–4.12, small 2.57–3.01) were determined, allowing assessment of the change in the share of social costs in production costs during the crisis. The ratio of the average deviation of the share of social costs of enterprises to its average value in the period 2010-2023 was compared. For large enterprises, this indicator has a value of 0.22; for small enterprises, it is 0.33; and for medium-sized enterprises, the maximum value is 0.36. This confirms the vulnerability of medium-sized enterprises to crisis conditions. A mathematical model was employed to evaluate the performance of Ukrnafta-Postach LLC and forecast its results for the years 2025-2026. The growth of social costs in total production costs is projected to be 9.3% by 2024, while the share of environmental costs is expected to be 5.2%, and the share of total income from net income is anticipated to be 12.5%.

**Conclusions.** This study reveals the evolution of controlling and outlines its strategic, preventive, and financial functions in the context of ensuring business sustainability. The impact of the crisis varied across different enterprise categories. A method for identifying changes in indicators of such magnitude that require operational anti-crisis management activities is proposed. A mathematical model was developed to ensure adherence to ESG principles, thereby enhancing the resilience of enterprises in crisis conditions and identifying priority tasks for crisis management. A scheme for integrating control into anti-crisis management is proposed, ensuring the construction of a holistic response system and the consistency of management actions with strategic guidelines for sustainable development.

**Keywords:** Controlling, Crisis Management, Digital Transformation, Strategic Stability, Sustainability.

## **1. Introduction.**

Considering the comprehensive impacts of crises, characterised by a high level of mutual reinforcement, integrating control into the anti-crisis management of economic entities seems crucial. Moreover, the tasks of controlling crisis conditions are increasing owing to the need to coordinate management activities across various areas in response to resource shortages. This can be explained by the fact that, in addition to direct economic challenges, control should be extended to achieve social and environmental objectives. Companies can succeed in the market, particularly in foreign markets, through the comprehensive implementation of ESG principles.

This highlights the importance of effective operational resource allocation, particularly of financial resources, in the face of constant working capital shortages in Ukrainian enterprises. The introduction of comprehensive control of enterprise performance indicators, their analysis, and the development of new areas of control usage have been made possible by the development of digital tools and the steady increase in the speed and volume of calculations in modern computer systems (Valaskova et al., 2025). However, technological updates of digital systems alone are insufficient to meet the requirements of anti-crisis control. Therefore, there is an increasing need to change the control methods. A promising direction for improving control in this regard is to rely on a comprehensive environmental, social, and governance (ESG) approach to the operational management of enterprise resources.

Thus, achieving this balance during a dynamic crisis requires mathematical formulas. This implementation must be carried out without compromising the integrity of the decision support system (DSS), which coordinates the achievement of the SDGs. DSSs provide functions such as planning, monitoring, analysis and control. In combination with the priorities of sustainable development, this creates a complex, multidimensional environment. The effectiveness of control depends not only on the accuracy of the calculations but also on the ability to integrate social, environmental, and digital factors into the management systems.

This requires the development of mathematical models for the qualitative and quantitative adjustment of specific areas of the company's activity in the context of resource constraints caused by the crisis. Moreover, it necessitates not only selecting factors that trigger changes in management decisions but also justifying the limits of the intervals during which these changes occur. Mathematical methods for formalising control have not yet been proposed, as the impact of a crisis can change significantly over short periods of time.

In dynamic crisis conditions, defining the problem of controlling operational tasks and ensuring the long-term adaptability, flexibility, and sustainability of enterprises requires more detailed research.

## **2. Literature Review.**

The concept of control in the academic literature is interpreted ambiguously, indicating its multifaceted nature and evolution within management paradigms. Čavlin et al. (2025) highlighted significant differences not only in the interpretation of the concept of control but also in its practical application. For instance, this concerns the expansion of the concept of control beyond the scope of accounting reporting and its implementation as a specific business function (Čavlin et al., 2025).

In discourse, several dominant approaches to understanding the essence of controlling have been formed, namely, from information support for management (Stojanović, 2024; Shakarchi & Nafzaoui, 2024) to a multilevel functional system (Barros et al., 2022; Pronoza et al., 2024), which confirms its gradual transformation into an independent management function. Attempts to use statistical analysis of the application of controlling tools in the practical activities of enterprises are not sufficiently convincing regarding the prospects of a particular approach (Martins et al., 2023; Bazaluk et al., 2024; Vranakova et al., 2024). Moreover, these differences in approaches create particular problems for the development of computerised control systems, as they narrow the possibilities of scaling sales. This is confirmed by Kuruppu et al. (2024), who found changes in the ERP system market due to the lack of analytical control functions.

Potkany et al. (2024) highlight the need to revise the principles for designing control blocks in modern digital systems that manage business processes within enterprises.

Yan (2022) outlines that the design of digital control tools is complicated by the dichotomy of interpreting their functions, either with an emphasis on achieving tactical tasks to optimise the financial results of the enterprise, or to form long-term prospects for its sustainable development.

Bieńkowska et al. (2022) proposed a model of controlling effectiveness based on qualitative analyses. Controlling is considered an information and analytical system focused on the future existence of the enterprise, providing support for informed management decisions. It is also emphasised that the primary function of control is to ensure organisational efficiency by increasing the efficiency of both management and all employees of the enterprise. Bieńkowska et al. (2022) overlooked the need to expand the controlling function to ensure the social responsibility of the enterprise, which reduces personnel motivation.

This approach overlooks the fundamental role of management in identifying the most effective tactics and strategies to mitigate the negative impact of these deviations on business operations. Kabachenko et al. (2023) emphasised the importance of digital control tools in enabling real-time management decisions to mitigate the impact of crises. This not only ensures the survival of companies under challenging conditions but also lays the groundwork for their sustainable development. However, Kabachenko et al. (2023) forecasts regarding the prospects for the use of digital control tools is diminished by their reliance on qualitative rather than quantitative analysis.

To design effective digital tools to support analytical activities in anti-crisis management, studies consider the use of various mathematical models.

Thus, Roška et al. (2022) used a factor model. Nevertheless, the crisis period is characterised by significant dynamic impacts on both the market and enterprise activities. This requires the introduction of mathematical approaches that consider the dynamics of changes in parameters subject to control.

The complexity of such a task requires the use of several complementary models for control systems based on data analysis. A case in point is the study by Silakova et al. (2022), where the application of a mathematical model of information entropy minimisation is supplemented by the use of the time series method, indicating the authors' uncertainty in the relevance of the results from the main model.

Special attention has been paid to the relationship between control and anti-crisis management (Stojanović, 2024; Gavkalova et al., 2023; Roška et al., 2022). In modern times, both concepts are considered complementary and dynamic (Čavlin et al., 2025). As Csikósová et al. (2022) demonstrate, controlling, which initially served as an auxiliary accounting function, now encompasses the strategic task of providing information and analytical support for the management of economic entities.

Investigating the activities of Slovak enterprises in the crisis conditions of the COVID-19 pandemic, Poláková et al. (2023) indicated that the relationship between sustainable socially responsible business and the anti-crisis financial controlling system, which includes subsystems of early warning, planning, monitoring, and communications, is capable of forming a holistic mechanism to prevent crises, restore financial stability, and prevent bankruptcy. The review of the selected topic confirmed the importance and timeliness of an in-depth study on the problem of integrating control into anti-crisis management. It also confirms the feasibility of developing a mathematical model to control the process, ensuring the implementation of the above tasks.

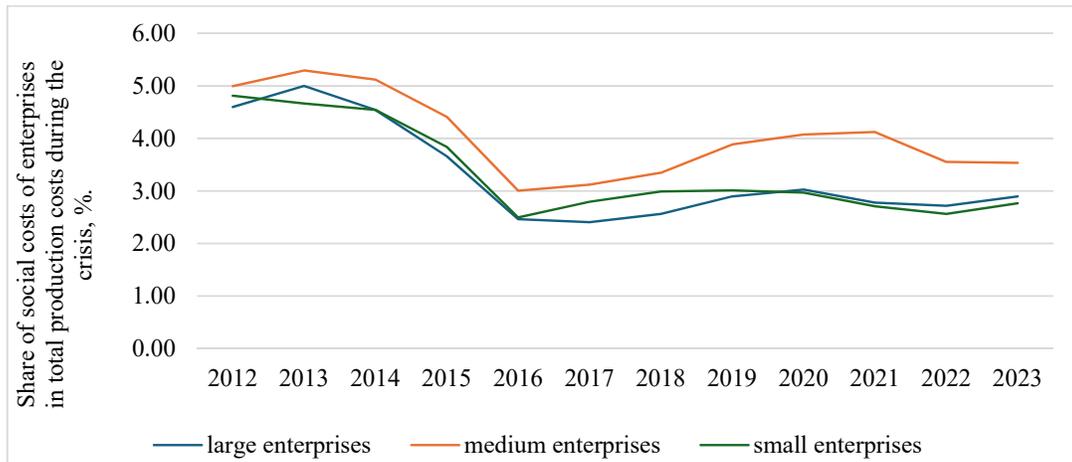
### **3. Methodology.**

The methodological basis of the study is a combination of systemic, process, and structural-functional approaches, which are grounded in mathematical analysis and enable a comprehensive examination of the integration of control into the system of anti-crisis management for enterprises. The empirical data were obtained from the State Statistics Service of Ukraine (2010–2023) and the Opendatobot platform (2020–2025), which provide official financial and environmental reports of enterprises.

A mathematical model was developed for the practical implementation of ESG principles (Aydoğmuş et al., 2022) based on the thesis of Delgado-Ceballos et al. (2023) on the relationship between achieving SDGs, the resilience of companies to crisis challenges, and ESG factors. According to Khan et al. (2022), the differences in applying ESG principles when forming a mathematical model are highlighted. This suggests that controlling the implementation of sustainable development principles.

Such control is especially important under conditions where the crisis impact changes significantly in a short period is proposed. In the first stage, this study examines the significance of changes in enterprise costs in relation to social and environmental goals, with a unified assessment of the crisis's impact on enterprise costs.

Figure 1 illustrates the changes in the share of social costs among large, medium-sized, and small enterprises in Ukraine's total production cost.



**Fig. 1. Share of Social Costs in Total Production Costs in the Crisis Period, %.**

*Source: based on State Statistics Service of Ukraine (2023).*

The data in Fig. 1 confirm that, first, the specified share for all categories of enterprises did not exceed 5.2% even in the absence of crisis impacts caused by military actions; second, this share is most significant for medium-sized enterprises; and third, the impact of the 2022 crisis caused by the start of large-scale hostilities was more significant for medium-sized enterprises.

This allows not only to establish the limits of the intervals of change in the share of social costs in total production costs during the crisis for different categories of enterprises (for large 2.72-3.02, for medium-sized 3.54-4.12, for small 2.57-3.01), but also, in accordance with the terminology of game theory, to determine the “strategy” of the crisis impacts on each category. This enables the formation of a forecast for the nearest period. A comparative analysis of the indicators for different categories of enterprises confirms this.

$$A = \left\{ \sum_1^n \frac{(x-\bar{x})}{n} \right\} / \bar{x} \quad (1)$$

where  $A$  is the ratio of the average deviation of the share of social costs of enterprises  $x$  to the average value of this factor  $\bar{x}$  in the period 2010-2023,  $n$  is the number of studied time periods.

For large enterprises, this indicator has a value of 0.22. At the same time, for small enterprises, it is 0.33, and for medium-sized enterprises, its maximum value is 0.36, indicating their greatest vulnerability in crisis conditions. Furthermore, these changes should be balanced to ensure the adaptability, flexibility, and sustainability of enterprises in both the short and long term. Environmental costs depend primarily on the type of activity of enterprises that leads to one or another type of environmental pollution, and are calculated based on data from environmental reporting forms.

The cost volumes of Ukrainian enterprises in 2023 decreased by 4.5% compared to 2021, primarily due to a reduction in production volumes. This should be taken into account when conducting an ESG analysis of a specific company. To achieve the set objectives, the following mathematical model is proposed. Warning about the need for preventive measures to neutralise the effects of the crisis is the achievement of the response surface of the value of the first derivative in time ( $\tau$ ) of the controlled factor ( $y$ ) of the limit value ( $\varepsilon$ ), determined by management:

$$\frac{dy}{d\tau} \geq \varepsilon \quad (2)$$

Operational or strategic control objectives determine the time intervals for monitoring the first derivative.

Using a complex function, for example,  $y = \varphi(y_1)$  from several factors  $b_1, b_2, c_1, c_2, d_1, d_2$ , which are typical for the financial, environmental and social areas of enterprise activity, the following approach is implemented:

$$\left\{ \begin{array}{l} \frac{\partial y_1}{\partial y} = \frac{\partial y_1}{\partial \tau} \frac{\partial \tau}{\partial y} + \frac{\partial y_1}{\partial b_2} \frac{\partial b_2}{\partial y} + \\ \frac{\partial y_1}{\partial c_2} \frac{\partial c_2}{\partial y} + \frac{\partial y_1}{\partial d_2} \frac{\partial d_2}{\partial y} \geq \varepsilon_1 \\ \frac{\partial y}{\partial y_1} = \frac{\partial y}{\partial \tau} \frac{\partial \tau}{\partial y_1} + \frac{\partial y}{\partial b_1} \frac{\partial b_1}{\partial y_1} + \\ \frac{\partial y}{\partial c_1} \frac{\partial c_1}{\partial y_1} + \frac{\partial y}{\partial d_1} \frac{\partial d_1}{\partial y_1} \geq \varepsilon \end{array} \right. \quad (3)$$

where  $\varepsilon_1$  is an additional boundary value.

This leads to an increase in the dimensions of the response surface in the space of the mathematical model. The effects of the crisis on the activities of enterprises, which change significantly over short periods of time, confirm the need, if necessary, for an operational redistribution of operating resources between the main ESG areas, while, if possible, adhering to reasonable values of the average annual shares of the enterprise's social and environmental costs in total production costs. This will ensure the proper multiplicative effect of these factors on the sustainable development of the enterprise. This requires the use of the minimax approach to minimise the most significant value of operating costs.

This enables meeting social, financial, and environmental needs during times of crisis. Then, for a set of strategies  $S_i$  where  $i = 1, 2, 3$ , respectively, 1 is economic or financial direction, 2 is social direction, 3 is ecological direction. The result is defined as a vector function  $\bar{S} = f(S_1, S_2, S_3)$ , and the operating costs for each direction are  $A_i = f(S_1, S_2, S_3)$

$$A_i \in \left( \underset{A_i \in A}{\max} \underset{Q_j \in Q}{\min}; \underset{Q_j \in Q}{\min} \underset{A_i \in A}{\max} \right) \quad (4)$$

where  $Q$  is the general scenario of the impact of the crisis,  $Q_j$  is the scenario of the impact of the crisis in a certain direction  $j$  which may or may not coincide with the direction  $i$ .

Then the equilibrium point corresponds to the condition:

$$S_i > \bar{S} \Leftrightarrow \underset{\forall j}{A_{ij}} \geq 0; \exists j: A_{ij} > 0 \quad (5)$$

This approach, as mentioned above, provides the opportunity, using a step-by-step assessment, to forecast the nearest period, which assumes the invariability of the “crisis strategy” of the impact of the crisis at this time.

#### 4. Aim and Research Questions.

This study aims to provide a theoretical and methodological justification for integrating control into the system of anti-crisis management of enterprises, focusing on digital transformation and sustainable development, as well as to outline strategic guidelines for its implementation in modern management practices.

The research questions (RQ) were formulated as follows:

RQ1. To develop a mathematical model for implementing ESG principles in conditions where the impact of the crisis changes significantly over short periods of time.

RQ2. To assess the limits of change in the share of social and environmental costs of enterprises in total production costs during the crisis.

RQ3. The proposed mathematical model was used to study a specific entity of economic activity.

## 5. Results.

Controlling is considered not only as a concept of using specialised digital systems for the comprehensive analysis of accounting information, control, and planning of changes in indicators of economic entities to support management decisions in conditions of dynamic environmental influences that create significant threats, but also as a tool for managing operational resources. Roška et al. (2022) emphasise the crucial need to develop a comprehensive model in crisis conditions that meets management needs in terms of information and analytical support, and implements control of proposed management actions using digital tools to address identified problems (Vranakova et al., 2024).

This approach enables the timely detection of crisis signals and the implementation of preventive measures. This increases the timeliness of management actions for strategic decisions and reduces operational risk during crises. Control serves as an internal mechanism for the self-regulation, providing feedback and maintaining a balance between goals and the actual results of activity, even under turbulent conditions. Approaches to integrating the concepts of both strategic and operational control into the digital anti-crisis system, as well as considering the peculiarities of financial control in crisis conditions, are considered (Kuruppu et al., 2024; Pronoza et al., 2024). Strategic control in the crisis management system of an industrial enterprise is a set of external and internal influences on the enterprise's activities.

It ensures the restoration and stabilisation of operations or prevents a decline if the crisis is threatening. The dynamic nature of the crisis necessitates the implementation of preventive control utilities (Druhova, 2024) into the strategic control structure, which provides the opportunity not only to predict threats but also to offer flexible planning and options to neutralise the challenges of the crisis. Such utilities, as outlined by Druhova (2024), can be formed based on scenario analysis, sensitivity assessment, and stress testing. Considering the above, the proposed mathematical model ensures the implementation of the indicated approaches. This was confirmed by forecasting indicators for the next period and using the method of evaluating the derivative of influence factors as an implementation of the sensitivity analysis.

The importance of operational control over financial indicators for the effectiveness of implementing anti-crisis management activities lies in the fact that analysing these data allows for optimising cash flows and ensuring the fulfilment of short-term financial obligations in real-time (Kabachenko et al., 2023). The mathematical model enables the stability of financial indicators by promptly implementing the temporary redistribution of operating funds from other areas of the enterprise's activity, thereby integrating strategic, preventive, and financial controls to form a holistic anti-crisis management system. Ukrnafta-Postach LLC, a medium-sized enterprise, was selected for analysis, and its parameters are listed in Table 1.

**Table 1. Performance Indicators of Ukrnafta-Postach LLC.**

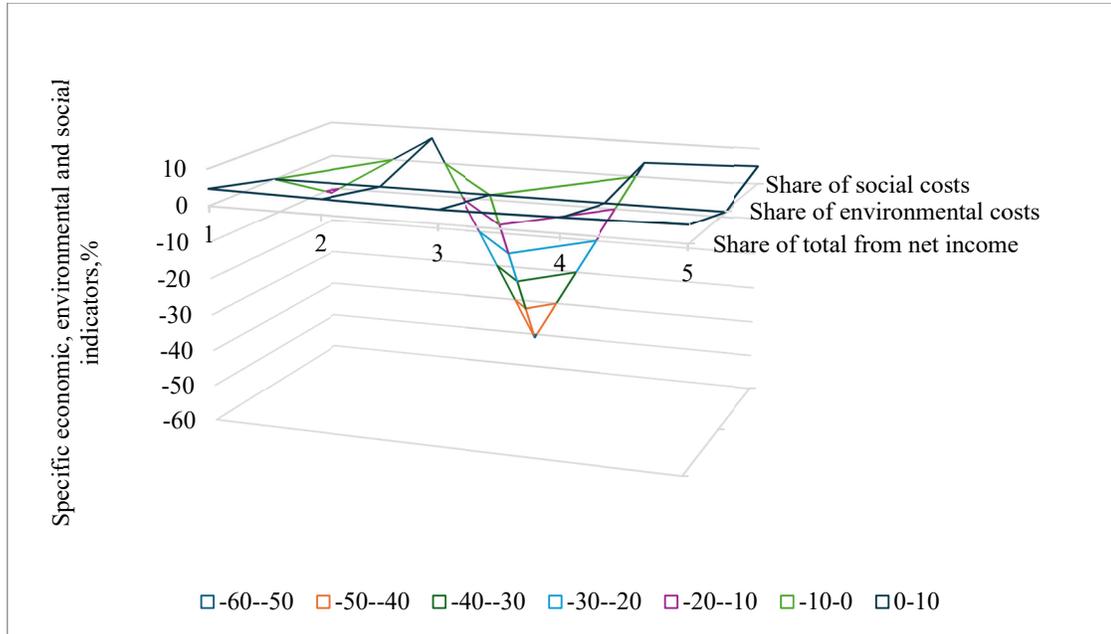
<b>Indicator</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>
Sales, thousand USD*	5.84	21.50	381.94	50543.35	204507.24
Net income from sales of products, thousand USD*	1276.25	11438.01	5853.32	69548.77	237252.04
Total income, thousand USD*	-139.64	382.07	-597.18	1109.01	3123.39
Assets, thousand USD*	1210.23	5305.24	1169.70	27010.99	62106.11
Liabilities, thousand USD*	1292.86	5006.85	1544.57	26261.56	60419.72
Share of social costs of total production costs, %	4.7	4.2	4.6	4.2	4.8
Share of environmental costs of total production costs, %	0.03	0.08	0.07	0.09	0.11

\*Calculations in USD were conducted based on the official exchange rate of the National Bank of Ukraine (2025).

Source: based on Opendatobot (2025).

The proposed mathematical model was used to assess the performance indicators of Ukrnafta-Postach LLC from 2025 to 2026 (Fig. 2). Accordingly, the increase in the share of social costs from total production costs

compared to the previous year was 9.3%, the share of environmental costs was 5.2%, and the share of total income from net income compared to the previous year was 12.5%.



**Fig. 2. Dynamics of Ukrnafta-Postach LLC Performance Indicators under Crisis Conditions.**

Note: 1–5 represent actual values for 2020–2024 and forecasts for 2025–2026.

Source: based on Opendatabot (2025).

To confirm the level of mutual influence between indicators of individual ESG policy areas of Ukrnafta-Postach LLC, a correlation analysis was applied (Table 2). Correlation coefficients were calculated using performance indicators expressed in national currency to mitigate the impact of the exchange rate on the correlation level. The correlation analysis revealed a distinct differentiation in the levels of correlation among individual ESG policy

indicators, indicating their varying importance in ensuring the sustainability of an enterprise’s activities.

The introduction of the presented mathematical model demonstrates its practical applicability to the operational management of resources and, consequently, ensures the sustainability of the enterprise’s activities in the face of dynamically changing external challenges.

**Table 2. Correlation Coefficients between ESG Cost Indicators and Financial Performance Metrics of Ukrnafta-Postach LLC.**

Correlation coefficient with the indicator	Sales	Net Sales Income	Total income	Assets	Liabilities
Social costs	0.481659	0.461163	0.263772	0.373732	0.381596
Environmental costs	0.729311	0.756687	0.770368	0.787828	0.787158

However, the key result of its introduction, in our opinion, is the confirmation that the integration of digital tools and new mathematical models leads to the fact that even the established definition of “controlling”, semantically related to the control function, acquires a new meaning beyond the permanent receipt and analysis of information. It now includes operational management, which, if necessary, can be implemented in autonomous mode.

As confirmed by Yan (2022), the digital revolution, which provided strategic control with the ability to analyse vast amounts of data in a short period of time, opened up new prospects for anti-crisis management, which further contributed to the resilience of enterprises to threats, thus significantly affecting the practice of controlling. This opens new opportunities for anti-crisis management.

In the context of forming a new corporate culture based on digital management control, according to Druhova (2024), it should be grounded in the timeliness of the methodology for preventive measures, i.e., control. This means that control ensures the sustainability of companies’ activities in crisis conditions, not only by forming the prerequisites for an appropriate level of financial results but also by stimulating comprehensive activities to achieve the Sustainable Development Goals, as confirmed by Martins et al. (2023).

Thus, strategic control in the anti-crisis management system becomes a means of forming an appropriate level of enterprise resilience to crises through the real-time monitoring of performance indicators (and not only financial indicators), planning anti-crisis activities, and effective resource management.

The importance of control in the anti-crisis management system is also enhanced by the fact that it creates prerequisites for the effective reallocation of resources in real-time between different areas of activity, ensuring the density of integration among these areas and, as a result, mitigating the effects of the crisis.

This was also confirmed by Shakarchi and Nafzaoui (2024), who considered internal control systems that implement part of the controlling functions.

Shakarchi and Nafzaoui (2024) point out that the use of such systems reduces losses due to the effects of crises. This confirms that integrating control into anti-crisis management is a prerequisite for sustainable enterprise development. Controlling allows for the simultaneous avoidance of the impact of threats during crisis periods and the maintenance of progressive movement towards strategic goals, consistent with the concept of sustainability.

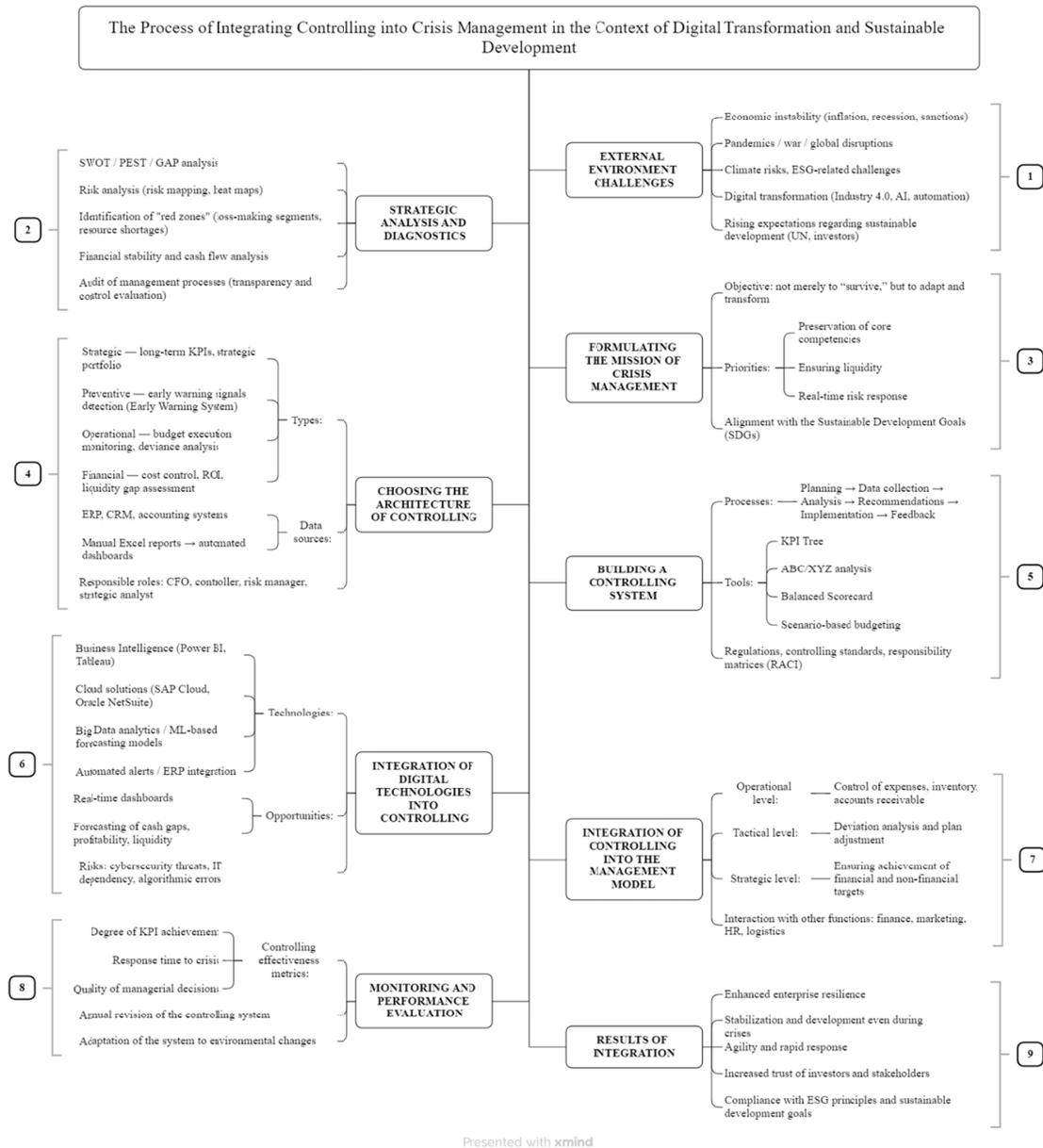
This confirms the conclusion that integrating control into anti-crisis management is a prerequisite for the sustainable development of an enterprise. To formalise the process of integrating control into crisis management for the implementation of ESG principles using digital tools, a schematic representation was developed.

This schematic representation illustrates not only the interrelationship of various functional components of control, but also its systemic nature and the phasing of the process of integrating control into crisis management.

The scheme presented in Fig. 3 demonstrates the consistent logic of implementing control into the anti-crisis management system, which is based on a gradual transition from analysing external challenges to assessing the effectiveness of an integrated model.

It illustrates the pattern: the effectiveness of control increases if its tools are consistently implemented at all levels of management, from the strategic definition of the mission to permanent monitoring of indicators. The key factor for success is multilevel coordination: at the strategic level, it guides the enterprise towards long-term sustainability; at the tactical level, it ensures the consistency of resources and plans; and at the operational level, it enables a quick response to deviations and crisis signals.

Controlling acts as an integrator that ensures consistency between the strategic guidelines of the enterprise, its resource base, and the dynamic challenges of the external environment. Digital technologies and the principles of sustainable development do not simply change the controlling toolkit but provide it with qualitatively new opportunities, including forecasting and modelling scenarios and forming proactive strategies.



**Fig. 3. Integration of Controlling into Anti-Crisis Management amid Digital Transformation and Sustainability.**

Source: compiled by the authors.

Digitalisation not only provides a new quality of enterprise management, but also serves as a real means of integrating the management of all business processes within the enterprise into a single system. It is the utilisation of all properties of system integrity, emergence, and other factors that qualitatively transform the management of enterprises. This is especially important in times of crisis, during rapid changes in external influences, when the

quality of management ensures not only the efficiency of the enterprise, but also, in especially critical conditions, provides the opportunity for the survival of economic entities. At the same time, providing not only control and accounting of information, but also forming forecasts and constructing scenarios of the consequences of specific management actions related to digitalisation directly affects their effectiveness.

The introduction and testing of the mathematical model indicated that to ensure the sustainability of enterprises, not only are specific financial indicators of the enterprise important, but also, first, the pace of their change and second, their management as a single holistic system. Thus, if earlier scientists highlighted the importance of diversifying management in crisis conditions to minimise risks (Csikósová et al., 2022), then the present study confirms the need for comprehensive management.

At the same time, there are certain differences in the interaction of the indicated indicators in crisis conditions, which is confirmed by the correlation analysis of the activities of Ukrnafta-Postach LLC. Correlation analysis revealed a closer connection between social expenses and net income from product sales, as well as total income, compared to assets and liabilities. In particular, this may mean that the social expenses of the specified enterprise have not yet had the desired impact on its reputation, which is crucial for inter-corporate relations and, accordingly, affects the enterprise's economic performance.

## **6. Conclusions.**

Integrating control functions into crisis management is strategically necessary for companies to withstand the negative consequences of crises. As accounting support functions evolve into management systems that focus not only on operational efficiency but also on strategic sustainability, control functions can proactively identify threats, analyse discrepancies in real time, and justify operational management actions.

A generalised scheme for integrating control into anti-crisis management is proposed, enabling the design of a digitalised management system with an emphasis on implementing ESG principles. Using the ratio of the average deviation of the share of social costs of enterprises to the average value of this factor for the period 2010-2023, a comparison was made among economic entities of various categories.

It was found that for large enterprises, this indicator has a value of 0.22; for small enterprises, it is 0.33; and for medium-sized enterprises, its maximum value is 0.36. This quantitatively confirms that in times of crisis, medium-sized Ukrainian enterprises are less resilient and use digital control systems less frequently than large enterprises do.

A method for assessing critical deviations of key indicators for indicative threat control is proposed. A mathematical model has been developed that provides an opportunity to implement ESG principles. This model was used to assess the performance of Ukrnafta-Postach LLC and forecast its results for 2025-2026. The share of social costs increased by 9.3%, the share of environmental costs by 5.2%, and the share of total income from net income by 12.5% compared to 2024.

Numerical methods of analysis substantiated the intervals of change in the share of social costs during the crisis for different categories of economic entities (for large 2.72-3.02, for medium-sized 3.54-4.12, for small 2.57-3.01). This authorises the formalisation of the strategy for assessing the impact of the crisis on individual categories of economic entities, which, using a step-by-step method, enables the formation of a forecast.

The formalisation of control in response to significant changes during a crisis ensures the coordination of management actions for the prompt redistribution of operating costs across the environmental, social, and financial spheres of the enterprise's activities. This approach enhances the adaptability, flexibility, and sustainability of the enterprise in the short and long term. The key result of the introduction of the presented mathematical model is the confirmation that the integration of digital tools and new mathematical models leads to the fact that even the established definition of "controlling", semantically related to the control function, acquires a new meaning beyond the permanent receipt and analysis of information, i.e. operational management, in particular, of operational resources, which, if necessary, can be implemented in an autonomous mode.

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