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RESOURCE AUDIT–BASED OPTIMIZATION OF INDUSTRIAL ENTERPRISE PERFORMANCE THROUGH MANAGEMENT AND TECHNOLOGICAL INNOVATIONS

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Abstract

This study addresses the problem of improving the efficiency of industrial and construction enterprises under conditions of resource imbalance, regulatory limitations, and increasing

technological complexity. Despite the extensive body of research on resource management, existing approaches often remain fragmented, focusing separately on human, material–technical, and informational resources, while insufficient attention is given to their integrated management and the role of regulatory enforcement.

The paper proposes a decision-based conceptual model for enterprise optimization, in which resource audit is positioned as a central diagnostic and management tool. The model enables the identification of systemic imbalances, including competency gaps, technological mismatches, inefficient resource allocation, and deficiencies in regulatory compliance and enforcement. Based on this diagnosis, a structured set of corrective actions is introduced, including personnel tuning, technological modernization, digital monitoring systems, and governance improvements.

A key novelty of the research is the integration of institutional and regulatory dimensions into the resource management framework, emphasizing that enterprise efficiency depends not only on resource availability but also on the quality of legal frameworks and their effective implementation. The model incorporates a feedback-driven mechanism, ensuring continuous adaptation and long-term sustainability.

The results demonstrate that the proposed approach provides a comprehensive methodological basis for improving efficiency, reducing risks, enhancing compliance, and supporting sustainable development in industrial and construction enterprises.

Keywords: resource audit, industrial enterprise, construction sector, resource imbalance, regulatory framework, enforcement, digital transformation, optimization model.

Introduction

In recent decades, the improvement of industrial enterprise performance has increasingly been examined within the context of integrated resource management, digital transformation, and the implementation of advanced technological innovations.

Contemporary research demonstrates that traditional management approaches, which rely on the isolated evaluation of individual resource components (human, material, and financial), are no longer sufficient to ensure sustainable efficiency under conditions of rapid market dynamics and accelerating technological change.

The concept of an enterprise's resource potential encompasses the totality of all resource types that ensure its functioning, including human, material and technical, information, and financial resources.

Studies in enterprise management indicate that the key factor in improving efficiency lies not merely in the availability of resources, but in their coordinated and balanced utilization.

Strategic management research further emphasizes that imbalances among different resource categories lead to decreased productivity and increased operational costs.

A specific case of industrial activity is the mining and metallurgical sector, which is characterized by high capital intensity, complex technological processes, and significant environmental and operational risks [1, 2]. Unlike many other industries, mining and metallurgical production involves continuous interaction with natural systems, variable raw material quality, and geographically dispersed assets, which increases the complexity of resource management [3].

Furthermore, the sector is highly dependent on the coordinated functioning of infrastructure, equipment, and skilled personnel, making the balance between human and material–technical resources critically important [4]. These characteristics, combined with increasing environmental and regulatory pressures, require the implementation of integrated management approaches, including resource audit and innovation-driven optimization [5]. The study [6] demonstrates that industrial activities, including mining, represent one of the major drivers of impacts on water resources and biodiversity at the global scale. The authors show that localized contamination can propagate through hydrological systems, evolving into regional and even global environmental risks. The study [7] analyzes the socio-economic impacts of mining activities and demonstrates that such projects are associated with complex governance challenges, resource redistribution, and population displacement. The authors emphasize that effective management requires not only technical solutions but also comprehensive systemic and institutional approaches.

Resource audit has emerged as one of the most advanced and effective instruments for comprehensive enterprise assessment. In contrast to conventional audit approaches—primarily financial or technological in scope—resource audit provides a systemic evaluation of all interconnected components of an enterprise and enables the identification of structural imbalances across them. Extant research indicates that the systematic implementation of resource audit facilitates the detection of critical inefficiencies and management bottlenecks, reveals imbalances between resource availability and utilization, and supports the formulation of robust, data-driven strategic development pathways. In particular, Neely A. et al. [8] emphasize the importance of integrated performance measurement systems that align resources with strategic objectives, while Wamba SF et. al [9] highlight the role of data analytics in transforming organizational decision-making processes. Its significance is further amplified in the context of digital transformation, where the exponential growth of data availability necessitates integrated analytical frameworks capable of converting heterogeneous data streams into actionable managerial insights.

Human capital represents one of the key determinants of industrial enterprise performance. Contemporary research indicates that insufficient workforce qualification levels or a mismatch between employee competencies and production requirements leads to decreased labor productivity, inefficient utilization of equipment, and increased technological risks. In particular, [10] highlights the role of human capital as a fundamental driver of productivity, while [11] demonstrate that alignment between human resources and organizational strategy significantly influences firm performance. In this context, the concept of adaptive competency development has gained increasing attention, emphasizing flexible systems of education, training, and continuous professional upskilling aligned with evolving industrial demands.

The material and technical base of an enterprise comprises production equipment, technologies, and infrastructure. Recent studies indicate that investments in equipment modernization, without corresponding improvements in workforce capabilities, do not result in significant efficiency gains. In particular, [12] demonstrate that technological advancement must be complemented by human skill development, while [13] highlight the importance of integrating human and technological systems within Industry 4.0 environments. Thus, achieving sustainable performance improvements requires the synchronized development of both human capital and material–technical resources.

In contemporary conditions, digital technologies play a central role in enterprise management, encompassing monitoring systems, analytical platforms, and integrated information management systems. These technologies enhance process transparency, improve the quality of managerial decision-making, and contribute to cost reduction through increased operational efficiency. In particular, [14] demonstrate that digital and analytics-driven systems enable real-time monitoring and adaptive decision-making, while [15] highlight the transformative impact of Industry 4.0 technologies on organizational performance and competitiveness. The implementation of managerial and technological innovations is therefore widely recognized as a key driver of enterprise competitiveness in the context of digital transformation.

The construction sector represents a distinct domain within industrial activity, characterized by project-based operations, high uncertainty, multi-stakeholder coordination, and a strong dependence on regulatory frameworks. Unlike continuous production industries, construction projects are inherently non-repetitive, geographically dispersed, and highly sensitive to contractual conditions, permitting procedures, and compliance requirements.

In the context of the Republic of Armenia, one of the most critical constraints affecting the efficiency of construction activities is the incompleteness and fragmentation of the legislative and regulatory framework governing the sector [16]. This limitation is particularly evident in the domain of design and cost estimation, where the absence of comprehensive and consistently enforced regulations creates significant challenges for project planning and execution. Empirical evidence indicates that compressed project timelines, insufficient funding, and weak enforcement of regulatory requirements often result in incomplete or technically inadequate design–estimate documentation, increasing the likelihood of errors, cost overruns, and safety risks [16]. Furthermore, the lack of clear accountability between clients and design organizations leads to systemic imbalances that reduce transparency and overall project efficiency.

These challenges are consistent with international findings, which indicate that regulatory uncertainty and weak institutional environments significantly increase transaction costs and reduce investment efficiency [17]. In large-scale construction and infrastructure projects, inadequate planning and insufficient governance mechanisms are among the primary causes of systematic cost overruns and project delays [18]. From a theoretical perspective, the effectiveness of construction systems is strongly conditioned by the quality of institutional frameworks. Technological improvements alone are insufficient without supportive regulatory structures and governance mechanisms [19]. Moreover, efficient resource allocation requires a well-defined legal environment and minimized transaction costs, as established in the theory of economic organization [20].

Therefore, the construction sector requires not only regulatory improvements but also the implementation of integrated management approaches. In this context, resource audit emerges as a critical tool for identifying mismatches between planned and actual resource utilization, improving cost control, and enhancing accountability across all stages of project implementation.

Conflict Setting

Despite the substantial body of research in this field, several critical challenges remain unresolved, including the lack of an integrated approach to resource management, the fragmented consideration of human and material–technical potential, the insufficient application of resource audit in managerial practice, the limited integration of digital technologies into resource analysis

processes, as well as deficiencies in the development and enforcement of regulatory and legal frameworks governing industrial and construction activities [21, 22].

These gaps highlight the need for a unified methodological framework capable of integrating diverse resource components into a coherent management system, while also ensuring the effective implementation and enforcement of existing legal and regulatory provisions.

In response to these limitations, the present study proposes an integrated approach to industrial enterprise optimization based on resource audit principles, combining human capital development, modernization of material–technical infrastructure, the application of digital and innovation-driven management tools, and the improvement of regulatory mechanisms with a focus on compliance and accountability.

The proposed framework contributes to the existing body of knowledge by bridging the gap between theoretical resource management concepts and their practical implementation, offering a systematic mechanism for improving efficiency, enhancing decision-making, strengthening regulatory compliance, and ensuring the sustainable development of industrial enterprises.

Research Results

Modern industrial enterprises operate under conditions of high uncertainty, rapid technological change, and increasing requirements for resource efficiency. In this context, there is a growing need to transition from fragmented management of individual resource types toward an integrated system of resource potential management. The proposed conceptual model is based on the premise that enterprise performance is determined not by the absolute level of resources, but by the degree of their coordination and balance.

Within the framework of the model, the resource potential of an enterprise is considered as a system comprising the following interrelated components: human capital; material and technical resources; information resources; managerial capacity Each of these components evolves dynamically; however, their isolated development leads to a reduction in overall system efficiency.
A central issue addressed in the model is the imbalance between components of the resource potential. In practice, this manifests as:

- advanced equipment combined with insufficiently qualified personnel;
- highly skilled workforce operating with outdated technological infrastructure;
- availability of data without adequate analytical capabilities;
- existence of regulatory frameworks without effective enforcement mechanisms.

The latter is particularly relevant for the construction sector, where discrepancies between adopted legal provisions and their practical implementation lead to reduced project efficiency and increased operational risks.

Within the proposed model, resource audit is positioned as a key diagnostic and managerial tool. It performs the following functions:

- identification of imbalances between system components;
- evaluation of resource utilization efficiency;
- detection of critical constraints;
- formulation of optimization pathways.

Resource audit enables the transition from intuitive management to evidence-based and structured decision-making.

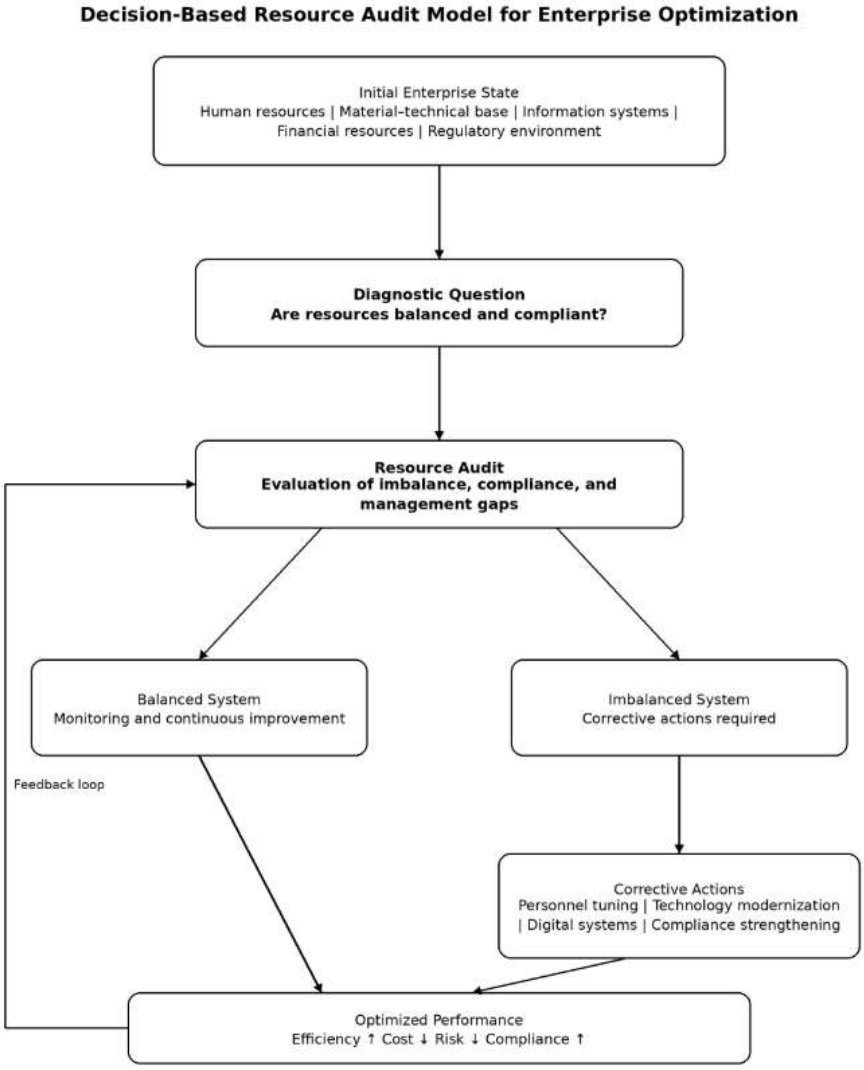

Fig. Decision-based conceptual model for industrial enterprise optimization integrating resource audit, system imbalance diagnosis, regulatory and enforcement factors, and feedback-driven corrective actions

The model introduces the concept of adaptive competency development ("personnel tuning"), which includes:

- targeted development of critical competencies;
- flexible systems of training and reskilling;
- alignment of workforce capabilities with technological advancement.

This approach allows reducing the gap between production requirements and actual workforce capacity.

Digital technologies act as an integrating element within the model, enabling:

- data acquisition and processing
- real-time monitoring of resource conditions
- support for managerial decision-making.

The integration of digital tools enhances the effectiveness of resource audit and increases system adaptability.

Unlike many existing models, the proposed framework explicitly incorporates the institutional environment.

The effectiveness of resource management depends on:

- the quality of regulatory and legal frameworks;
- the mechanisms of their enforcement;
- the level of compliance across stakeholders

Thus, optimization cannot be achieved without the simultaneous improvement of both managerial and regulatory systems.

The proposed model represents an integrated system in which, resources:

- are assessed through resource audit;
- imbalances are identified;
- managerial and technological interventions are applied;
- an optimal system state is achieved.

Conclusions

This study demonstrates that improving the efficiency of industrial enterprises requires a transition from fragmented resource management toward an integrated, system-based approach. The findings confirm that enterprise performance is determined not by the absolute availability of resources, but by the degree of their coordination, balance, and alignment with operational and regulatory requirements.

A key contribution of the research is the development of a decision-based conceptual model in which resource audit functions as a central mechanism for diagnosing system imbalances, including human, material–technical, informational, and managerial inconsistencies. The model extends existing approaches by explicitly incorporating regulatory and institutional factors, particularly the role of legal frameworks and the effectiveness of their enforcement, which are often overlooked in traditional resource management studies.

The analysis highlights that one of the most critical constraints in the construction and industrial sectors, particularly in the context of developing economies, is not only the incompleteness of the regulatory framework but also the insufficient implementation and enforcement of existing legal provisions. This results in systemic inefficiencies, increased operational risks, and reduced investment effectiveness.

The proposed model introduces a structured decision-making process that links resource audit, imbalance identification, and corrective actions, including personnel tuning, technological modernization, digital monitoring, and governance improvements. The inclusion of a feedback loop ensures continuous system adaptation and supports sustainable enterprise development.

Overall, the research contributes to bridging the gap between theoretical resource management concepts and their practical application. It provides a methodological foundation for enhancing efficiency, strengthening regulatory compliance, and improving decision-making processes in industrial and construction enterprises.

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ԱՐԴՅՈՒՆԱԲԵՐԱԿԱՆ ՁԵՌՆԱՐԿՈՒԹՅՈՒՆՆԵՐԻ ԱՐԴՅՈՒՆԱՎԵՏՈՒԹՅԱՆ ՕՊՏԻՄԱԼԱՑՈՒՄ՝ ՌԵՍՈՒՐՍԱՅԻՆ ԱՈՒԴԻՏԻ ՀԻՄԱՆ ՎՐԱ՝ ԿԱՌԱՎԱՐՄԱՆ և ՏԵԽՆՈԼՈԳԻԱԿԱՆ ՆՈՐԱՐԱՐՈՒԹՅՈՒՆՆԵՐԻ ԿԻՐԱՌՄԱՄԲ

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Աշխատանքը նվիրված է արդյունաբերական և շինարարական ձեռնարկությունների արդյունավետության բարձրացման խնդրին՝ ռեսուրսների դիսբալանսի, օրենսդրական սահմանափակումների և տեխնոլոգիական բարդության աճի պայմաններում: Չնայած ռեսուրսների կառավարման ոլորտում առկա լայնածավալ հետազոտություններին, գործող մոտեցումները հիմնականում ունեն տարանջատված բնույթ՝ առանձին դիտարկելով կադրային, նյութատեխնիկական և տեղեկատվական ռեսուրսները՝ անտեսելով դրանց ինտեգրված կառավարումը և իրավական պահանջների կատարման կարևորությունը: Առաջարկվում է ձեռնարկության օպտիմալացման որոշումահեն կոնցեպտուալ մոդել, որտեղ ռեսուրսային աուդիտը հանդես է գալիս որպես հիմնական ախտորոշիչ և կառավարման գործիք:

Առաջարկվող մոդելը հնարավորություն է տալիս բացահայտել համակարգային անհամապատասխանություններ՝ ներառյալ կոմպետենցիաների պակասը, տեխնոլոգիական անհամապատասխանությունները, ռեսուրսների ոչ արդյունավետ բաշխումը, ինչպես նաև կարգավորող և իրավական պահանջների կատարման խնդիրները: Գիտական նորույթը կայանում է ռեսուրսների կառավարման համակարգում ինստիտուցիոնալ և իրավական գործոնների ներառման մեջ՝ ընդգծելով, որ արդյունավետությունը կախված է ոչ միայն ռեսուրսների առկայությունից, այլ նաև իրավական դաշտի որակից և դրա իրական կիրառությունից: Մոդելը ներառում է հետադարձ կապի մեխանիզմ, որը ապահովում է շարունակական հարմարվողականություն և կայուն զարգացում: Արդյունքները ձևավորում են մեթոդաբանական հիմք՝ արդյունավետության բարձրացման, ռիսկերի նվազեցման, իրավական պահանջների պահպանման և արդյունաբերական ու շինարարական ձեռնարկությունների կայուն զարգացման համար:

Բանալի բառեր՝ ռեսուրսային աուդիտ, արդյունաբերական ձեռնարկություն, շինարարության ոլորտ, ռեսուրսների դիսբալանս, օրենսդրական դաշտ, պահանջների կատարում, թվայնացում, օպտիմալացման մոդել:

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RESOURCE AUDIT–BASED OPTIMIZATION OF INDUSTRIAL ENTERPRISE PERFORMANCE THROUGH MANAGEMENT AND TECHNOLOGICAL INNOVATIONS

ОПТИМИЗАЦИЯ ЭФФЕКТИВНОСТИ ПРОМЫШЛЕННЫХ ПРЕДПРИЯТИЙ НА ОСНОВЕ РЕСУРСНОГО АУДИТА С ИСПОЛЬЗОВАНИЕМ УПРАВЛЕНЧЕСКИХ И ТЕХНОЛОГИЧЕСКИХ ИННОВАЦИЙ

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Рассматривается проблема повышения эффективности промышленных и строительных предприятий в условиях дисбаланса ресурсов, ограничений нормативно-правовой базы и роста технологической сложности. Несмотря на значительное количество исследований в области управления ресурсами, существующие подходы носят фрагментарный характер, рассматривая отдельно кадровый, материально-технический и информационный потенциал, при этом недостаточно учитывается их интеграция и роль исполнения нормативных требований.

Предлагается концептуальная модель оптимизации предприятия, основанная на принятии управленческих решений, в которой ресурсный аудит выступает ключевым инструментом диагностики и управления. Модель позволяет выявлять системные дисбалансы, включая дефицит компетенций, технологические несоответствия, неэффективное распределение ресурсов, а также проблемы нормативного регулирования и их исполнения.

Новизна исследования заключается во включении институционального и правового факторов в систему управления ресурсами, что позволяет учитывать влияние качества нормативной базы и эффективности ее реализации на результаты деятельности предприятия. Модель включает механизм обратной связи, обеспечивающий непрерывную адаптацию и устойчивое развитие.

Полученные результаты формируют методологическую основу для повышения эффективности, снижения рисков, улучшения соблюдения нормативных требований и обеспечения устойчивого развития промышленных и строительных предприятий.

Ключевые слова: ресурсный аудит, промышленное предприятие, строительная отрасль, дисбаланс ресурсов, нормативно-правовая база, исполнение требований цифровизация, оптимизационная модель.

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