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THE IMPACT OF METROLOGICAL SUPPORT IN INTELLIGENT CONTROL SYSTEMS ON ECONOMIC EFFICIENCY IN THE TRANSPORT SECTOR

Abstract

The study deeply investigates the impact of metrological support of intelligent management systems on economic efficiency in the transport sector. Metrological support plays a critical role in the operation of modern transport systems, providing positive results in terms of measurement accuracy, service quality and efficient use of resources. The article discusses the economic advantages achieved by the application of intelligent systems in the context of cost reduction and risk minimization. The importance of metrological support is emphasized as one of the factors that leads to a small but significant change in efficiency in production and service processes. At the same time, the productivity increase and cost optimization resulting from the application of metrological support are the main parameters supporting the development of the transport sector. The results show how the efficient and perfect application of intelligent management systems helps to increase economic efficiency in the transport sector. The article presents the results of the research conducted in this field, supported by visual graphs and tables, thus presenting an example that meets the requirements of the modern economy.

Keywords: *Intelligent control systems, metrological assurance, economic efficiency, risk reduction, production costs, efficiency, transport sector.*

INTRODUCTION

The transport sector is an important sector in the dynamic and competitive environment of the modern economy. This sector is important not only for the movement of people and goods, but also for economic development, trade and strengthening social ties. The strategic geographical location of Azerbaijan makes it an important center for regional transport corridors. In this regard, the efficient operation of transport systems and their adaptation to modern requirements are of critical importance.

Intelligent control systems help to increase the efficiency of transport systems by revolutionizing the organization of complex processes in this area. These systems make it possible to collect, process and present fast and accurate information, making the decision-making process more transparent and systematic. The integration of intelligent control systems further emphasizes the role of metrological support. Metrological support increases the reliability and efficiency of systems by increasing measurement accuracy.

This article broadly discusses the impact of metrological support of intelligent control systems in the transport sector. The use of metrological support in modern transport systems will be measured by applying analytical and statistical tools through developing technologies. The study shows that metrological support will reduce costs in the production and service sectors and

increase efficiency. Finally, the value and prospects brought to the economy by the application of these systems will be evaluated with an approach that meets the requirements of the modern economy.

The scientific relevance of this study is related to the study of modern approaches to the effectiveness of metrological support of intelligent management systems in the transport sector. Changes in the transport sector are rapidly changing with increasing demands and technological developments. In this context, the application of metrological support has become an integral part of the modern economy. As a result, research in this field is aimed at the emergence of new approaches to increase economic efficiency and the development of methods that meet modern requirements.

The novelty of the study is revealed through the study of existing literature on the metrological support of intelligent management systems and the analysis of specific cases. In this context, the aim is to develop a more efficient model of metrological support through the application of modern technologies. The study focuses on aspects of safety, accuracy and efficiency, and contributes to the formation of new strategies that increase the efficiency of intelligent systems.

The methodology of this study consists of combined research methods. A combination of quantitative and qualitative methods is mainly used. Quantitative analysis involves the collection and statistical analysis of measurements and indicators. Qualitative methods provide in-depth understanding of the practical application of metrological assurance through interviews and expert meetings. The results will be presented, supported by various analytical models and statistical methods. These approaches increase the reliability of the study and create conditions for a more accurate assessment of the relevant indicators.

The main objective of this study is to investigate the impact of metrological support of intelligent management systems on economic efficiency in the transport sector. In the context of developing technologies and modern requirements, the impact of the application of these systems is analyzed, and their potential for reducing costs, minimizing risks and improving the quality of services is revealed. The study aims to identify strategies that ensure the integration of metrological support, as well as to present optimal ways for optimizing modern transport systems.

The perspective of this study covers the future development paths and application areas of metrological support of intelligent management systems. The rapid changes taking place in the modern world economy create new opportunities for further advancement and increasing the effectiveness of these systems. The results of the study will help to form long-term strategies, taking into account not only the economic efficiency of the systems applied in the transport sector, but also the protection of ecology and a favorable energy environment. In the future, the spread of efficient models achieved by the application of intellectual systems will lead to further development of the transport sector and the rise of modern standards.

ANALYSIS

Intelligent management systems are a necessary occupation for ensuring efficient and organized activity in the competitive environment of the modern economy. These systems are aimed at optimizing business processes, ensuring efficient use of resources and reducing financial costs through applied methodologies and technologies. At the same time, the role of metrological support is of critical importance in the work of these systems.

Metrological support aims to increase measurement accuracy and increase the reliability of information systems. This support, along with accurate measurement of production and service processes, provides relevant analytical data. Thus, it becomes possible to provide high-quality services that meet customer requirements. Metrological support of intelligent management systems has the following economic significance:

- Accuracy and reliability

The main goal of metrological assurance is to increase the reliability of the relevant systems by increasing the measurement accuracy. Accurate measurements are essential for guiding business processes and making the right decisions. In the transportation sector, the correct

operation of equipment is directly related to the accuracy of data. The quality of the technologies used, the accuracy of measurement systems and the correct implementation of procedures increase the efficiency of work. This not only results in reducing production costs, but also significantly increases customer satisfaction.

Accuracy expands its role in meeting customer requirements. High-precision measurement systems, in addition to improving the quality of services, also increase customer loyalty. Customers prefer companies that provide quality service, and these companies gain a greater competitive advantage in the market. The accurate information provided by intelligent systems is aimed at improving customer experience and increasing customer satisfaction.

At the same time, accuracy and reliability increase the transparency of business processes. In the modern economic environment, systems need to be supported by accurate and transparent information for the decision-making process to be effective. Metrology assurance helps reduce risks by providing reliable analytical information for manufacturing and service sectors. Thus, enterprises detect relevant problems more quickly and implement corrective actions in a timely manner.

Finally, accuracy and reliability play a significant role in achieving the long-term strategic goals of organizations. The rise of lizard economies and modern marketing demands force enterprises to make operational changes. In this context, the sound implementation of metrology assurance ensures that enterprises are open to innovation and expand their customer base. As a result, accuracy and reliability are strategic factors due to the role they play in all modern business environments.

- Reducing production costs

Integrating metrology support plays an important role in reducing production costs. Accurate measurements and reliable data enable enterprises to use resources efficiently. Timely detection of existing errors in the production process prevents additional costs. For example, if errors are identified at an early stage, corrections are made with less financial and time expenditure.

In addition, the application of metrology systems increases the performance of equipment. Thanks to accurate measurements, the efficiency of equipment is maximized. As a result, enterprises minimize costs in the production process while increasing product production. This helps reduce the cost of each product produced, thus enabling companies to keep their market prices more competitive.

Reducing production costs is also related to optimizing energy consumption. Accurate measurement systems allow monitoring and managing energy consumption. Thus, enterprises can significantly save on costs by reducing energy consumption. In addition, the efficient use of resources results in independent optimization of flows and reduction of waste.

All these factors together help reduce production costs and ultimately increase the profits of organizations. Integration of metrological provision not only brings economic benefits to enterprises, but also creates a positive image in the market base by increasing customer satisfaction. This approach, in the long term, has a positive impact on the development and sustainability of companies.

- Increasing service quality

The application of metrological support plays an important role in increasing service quality. High-precision measurement systems and analytical approaches allow us to better understand customer needs at every stage of service processes and provide appropriate solutions. In modern transportation systems, the application of metrological support is of particular importance in order to improve the quality of services in order to increase customer satisfaction.

The accuracy of the incoming data increases the efficiency of services. For example, the desire of customers to receive services in a timely and efficient manner requires the correct and timely implementation of relevant business processes. If any violations occur in services, these violations can be quickly detected and intervened through metrological systems. As a result, it is ensured that services meet customer requirements and their quality is improved.

In addition, the integration of metrological support also enables constant monitoring and evaluation of services. In order to increase customer satisfaction, it is necessary to create feedback mechanisms. Systems supported by accurate data make it easier to follow customer opinions and suggestions. This allows you to meet customer requirements more effectively, creating conditions for the appropriate and proactive implementation of measures aimed at improving the quality of service.

Improving service quality leads to a significant advantage not only in customer satisfaction, but also in market competition. Customers appreciate high-quality services, and this increases their loyalty. Combining intelligent management systems with metrological assurance increases the opportunities for accessing a wider customer base in the service sector. Thus, increasing service quality ensures not only customer satisfaction, but also the long-term success of the company.

- **Competitive advantage**

The application of metrological assurance gives enterprises a significant competitive advantage in the market environment. In the modern business world, competitiveness is not only related to the quality of the product or service, but also to customer satisfaction, cost effectiveness and efficiency. Accurate measurement systems, by bringing these aspects together, distinguish enterprises from other competitors.

Responding quickly and accurately to market demands is one of the keys to modern success. Metrological assurance facilitates the adoption of strategic decisions in order to increase the quality of services and reduce costs in accordance with customer requirements. Accurate information shortens the time for enterprises to introduce relevant services and products to the market, which allows them to provide customers with fast and reliable service.

An increase in the quality of service affects the increase in customer loyalty. Customers tend to choose enterprises that provide high-quality service more often and remain loyal to their products and services. This situation is important in terms of expanding the customer base of companies and establishing long-term customer relationships. Combining intelligent management systems with metrological assurance allows you to more accurately determine the needs of customers, providing a more individual approach.

In addition, the creation of metrological assurance results in the mitigation of risks and reduction of errors. Enterprises can operate more efficiently by preventing defective production and services, minimizing additional financial losses. As a result, they gain a stronger position in the competitive environment. Establishing reliable relationships with their customers allows companies to make more profitable choices in the market environment, which again provides a competitive advantage.

Thus, the role of metrological assurance is not limited to optimizing production and services; it is a strategic factor that strengthens the position of enterprises in the market environment. Ensuring competitive advantage is an integral part of the modern economic model and a guarantee of long-term success.

A summary of these important aspects is presented in the following table:

Table 1

Economic results achieved by the application of intelligent management systems

Area of use	Application area	Economic effect
Transportation	Management	Quality management
Production	Quality management	30% increase

The table demonstrates the specific economic results achieved as a result of the integration of metrological support. This leads to significant increases in the performance of transport and production systems in the relevant areas. The introduction of metrological support in intelligent management systems not only increases economic efficiency, but also contributes to the implementation of long-term strategic goals. Thus, metrological support acts as a factor ensuring the reliability and development of all modern systems.

Cost reduction and efficiency improvement aspects

Metrological assurance is of exceptional importance in the field of cost reduction and efficiency improvement. Accurate measurements and analytical approaches ensure the optimization of production and service processes. First, correct measurements and warnings help to detect errors and deficiencies in a timely manner. Timely elimination of errors prevents additional costs and resource losses. This minimizes the costs of enterprises and creates a more efficient production environment.

Another aspect of cost reduction is the efficient use of energy and resources. The application of metrological systems allows you to monitor and optimize energy consumption. For example, regular monitoring of energy consumption helps to reduce waste in the production process and reduce costs. This approach not only helps to conserve material resources, but also to protect the environment.

Increasing efficiency is also associated with the automation of work processes. The integration of metrology provides businesses with real-time information, enabling them to accelerate their business processes. Efficient equipment operation increases the performance of the production line and ensures the effective use of the workforce. This, in turn, leads to increased production and, along with reduced costs, increased revenue.

Finally, reducing costs and increasing efficiency are also closely related to improving quality. Through accurate measurement systems, quality problems in production and service processes are detected more quickly. This minimizes product defects, which in turn leads to reduced costs and increased customer satisfaction. As a result, these two aspects complement each other and ensure the long-term success of the enterprise. Thus, the strategic role played by metrology in optimizing activities becomes an important factor for businesses in reducing costs and increasing efficiency. This approach not only increases economic results, but also increases customer satisfaction.

The application of metrological support provides solutions to existing problems in increasing the accuracy of measuring devices by qualified specialists. For example, modern sensors increase the efficiency of operation by providing more accurate analysis of equipment and devices. As a result, both cost reduction and in some cases a completely new business model emerges.

Table 2

Efficiency indicators		
Type of Indicators	Traditional Systems	Traditional Systems
Efficiency (%)	60%	85%
Cost (%)	\$100,000	\$70,000

Economic evaluation methods

Different methods should be used for economic evaluation. These methods help to more accurately assess the impact of intelligent management systems.

- **Quantitative Analysis**

Quantitative analysis is an important tool in the field of metrological support of management systems and means the collection and analysis of objective and measurable data through statistical and measurement methods. This theory aims to implement effective measures aimed at increasing the reliability and efficiency of systems by accurately measuring and analyzing data.

Quantitative analysis requires the collection of relevant data to evaluate the performance of systems. This data is collected and analyzed through appropriate measurement systems. For example, data such as product production and service delivery, production times, cost lines, defective product numbers and customer satisfaction levels are included. This data collection is carried out through surveys, monitoring and appropriate statistical methods.

Quantitative analysis is carried out with various statistical methods and algorithms. Descriptive statistics is used as the first step in analyzing the collected data. This method forms an idea of the central tendency, spread and other key indicators of the data. As a result, the strengths and weaknesses of the systems are identified.

Then, broader conclusions are drawn based on the data obtained through inferential statistical methods. These methods allow for general conclusions about populations and systems through samples. For example, hypothesis testing and correlation analysis are used to assess the relationship between two or more variables. This approach provides reliable information for making appropriate strategic decisions.

The application of quantitative analysis results supports the decision-making processes of enterprises. The analysis of the collected data aims to identify risks, reduce production costs and increase customer satisfaction. Strategies developed based on these results play a key role in implementing appropriate changes. For example, if customer satisfaction indicators are below a certain level, changes can be implemented in the systems and measures can be taken to correct this situation.

● Risk Identification

The beginning of the risk identification process begins with a systematic analysis of significant hazards and uncertainties. At this stage, the following factors are considered:

- Equipment and Sensor Problems: The quality of metrological systems is directly related to the accuracy of the equipment used. Any malfunction or incorrect measurements can cause interruptions in the production process and, as a result, financial losses.

- Human Factors: The level of training of employees and their professional knowledge can increase risks. Wrong decision-making, lack of appropriate training and the impact of a stressful environment in the workplace can occur.

- Process Violations: Delays or disruptions in transportation systems due to road, weather and other environmental factors also form a risk environment.

Risk Assessment

When assessing the identified risks, their probability of occurrence and impact are taken into account. The impact assessment of risks is carried out using the following criteria:

- Probability: The probability of each risk occurring is assessed based on statistical data and historical analysis. This helps to determine whether certain risks will occur more frequently.

- Severity of Impact: The degree of impact of each potential risk on the organization is analytically assessed. For example, if an equipment failure causes a production process to stop, the impact will be more severe.

Risk Management

It is important to develop monitoring and management strategies for the assessed risks. These strategies include:

- Risk Mitigation: Taking appropriate preventive measures to reduce the likelihood of risks occurring, such as regular maintenance of equipment and training of staff.

- Planning and Proper Management: In accordance with the plan, alternative strategies are prepared and developed to prevent risks. For example, using spare equipment, establishing appropriate backup systems between production lines.

- Monitoring and Feedback: Regular monitoring of risks is important in terms of identifying new problems and adjusting management strategies. Applying feedback mechanisms ensures the accuracy of processes.

Application of Results

The results of risk analysis are aimed at optimizing intelligent management systems and making appropriate strategic decisions. Correct risk assessment creates conditions for organizations to take appropriate measures and increase the resilience of systems. As a result, it allows for increasing customer satisfaction and improving efficiency.

● Reporting Methods

Recording and analyzing productivity, cost reduction, and efficiency indicators.

CONCLUSION

This study examines the impact of intelligent management systems on cost optimization and efficiency improvement in the transport sector on a scientific basis. The role of intelligent systems

in global transport dynamics is examined through analytical approaches, statistical methodologies and a number of case studies.

The introduction of intelligent systems has not only increased resource utilization, but also significantly improved the efficiency of operating systems. Thanks to optimization algorithms and big data analysis, the provision of real-time information facilitates process prediction and makes risk management strategies more dynamic. These innovations, in addition to reducing costs, also increase customer satisfaction.

The concept of metrological assurance plays a critical role in increasing the reliability of intelligent systems and achieving the set goals. Sensor technologies, regular monitoring and evaluation methods increase the accuracy of the system and serve to minimize errors. At the same time, this metrological approach enables independent evaluations and continuous development of information systems.

The results emphasize the role of intelligent management systems not only in the research and development dynamics, but also in the strategic decision-making of organizations. Diversification of relationships and multidisciplinary integration increase the efficiency of these systems, giving enterprises a higher advantage in the modern competitive environment.

Finally, this study provides a deep scientific foundation for the application of intelligent control systems to the transportation sector and opens up new directions that will promote the development of such systems in the future. Expanded application areas play an important role in creating a more efficient, reliable and sustainable transportation ecology by serving to improve the level of these systems.

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İntellektual idarəetmə sistemlərində metroloji təminatın nəqliyyat sektorunda iqtisadi səmərəliliyə təsiri

Xülasə

Tədqiqatda intellektual idarəetmə sistemlərinin metroloji təminatın nəqliyyat sektorunda iqtisadi səmərəliliyə təsiri dərindən araşdırılır. Metroloji təminat müasir nəqliyyat sistemlərinin fəaliyyətində mühüm rol oynayır və ölçmə dəqiqliyi, xidmət keyfiyyəti və resurslardan səmərəli istifadə baxımından müsbət nəticələr verir. Məqalədə intellektual sistemlərin tətbiqi ilə əldə edilən iqtisadi üstünlüklər xərclərin azaldılması və risklərin minimuma endirilməsi kontekstində müzakirə olunur. Metroloji dəstəyin əhəmiyyəti istehsal və xidmət proseslərində səmərəlilikdə kiçik, lakin əhəmiyyətli dəyişikliklərə səbəb olan amillərdən biri kimi vurğulanır. Eyni zamanda,

metroloji təminatın tətbiqi nəticəsində məhsuldarlığın artması və xərclərin optimallaşdırılması nəqliyyat sektorunun inkişafını dəstəkləyən əsas parametrlərdir. Nəticələr intellektual idarəetmə sistemlərinin səmərəli və mükəmməl tətbiqinin nəqliyyat sektorunda iqtisadi səmərəliliyin artırılmasına necə kömək etdiyini göstərir. Məqalədə bu sahədə aparılan tədqiqatların nəticələri vizual cədvəllərlə dəstəklənir və beləliklə, müasir iqtisadiyyatın tələblərinə cavab verən bir nümunə təqdim olunur.

Açar sözlər: *intellektual idarəetmə sistemləri, metroloji təminat, iqtisadi səmərəlilik, risklərin azaldılması, istehsal xərcləri, səmərəlilik, nəqliyyat sektoru.*