



Analysis of the Experience of the EU Countries in the Field of Auditing the Effectiveness of Public Funds Aimed at Infrastructural Development

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Abstract

National audit systems play an important role in ensuring transparency and accountability in the use of public funds. European Union countries apply different approaches to the organisation and conduct of audits of public resources, which requires an analysis of their experience to identify best practices and possible areas for improvement. The purpose of this study is to identify the best practices in the field of auditing the effectiveness of the use of public funds aimed at infrastructure development, based on the experience of the European Union countries. The research methods include comparative analysis, classification by several criteria, study of the institutional structure, audit methodology, the degree of independence of audit bodies and the use of innovative technologies. The study highlights the importance of international cooperation to improve the quality of auditing and fight corruption. It is noted that despite the diversity of audit approaches in the European Union, there are common problems, such as professional development and the fight against corruption. Auditing plays a key role in ensuring the sustainability of infrastructure projects and improving public funds management. Evaluation of the effectiveness of the use of funds, in particular on the example of the Fehmarnbelt project, shows the possibility of significant budget savings and increased transparency. An important aspect of the study was also the identification of limitations and possible directions for further analysis, aiming to improve the effectiveness of audit practices and adapt them to changes in the financial and technological environment.

Keywords

Financial Control, Comparative Analysis, Cost Management, Project Management, Legislative Framework

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I. Introduction

The effective use of public funds for infrastructure development is one of the key tasks of Governments around the world. Infrastructure, including transport networks, energy systems, water supply, and other public facilities, plays a crucial role in ensuring sustainable economic growth and improving the quality of life of citizens. However, the process of allocating and using budgetary resources often faces problems of inefficiency and insufficient control, which makes it urgent to audit the effectiveness of public funds aimed at infrastructural development.

The relevance of this subject is due to several factors. Firstly, the substantial financial resources allocated to infrastructure projects require careful monitoring and evaluation of their use to ensure maximum return on investment. Secondly, in conditions of limited budgetary resources, the importance of effective use of funds increases, especially in conditions of economic instability and the need to solve many social problems. Thirdly, the experience of the European Union (EU) countries with diverse approaches to public finance management and auditing can provide valuable lessons and recommendations for other states.

The problems of auditing the effectiveness of public funds in the field of infrastructure development include several aspects: difficulties in defining performance criteria and indicators, which may vary depending on the specifics of a particular project or region; insufficient transparency and accountability in the management of public resources, which can lead to corruption and misuse of funds; and the limited human and technical resources of the audit bodies, which may affect the quality of the audits conducted (Musayeva et al., 2022).

There is a concept of efficiency audit, which involves evaluating the cost-effectiveness, efficiency, and productivity of using budget funds. Cost-effectiveness implies minimising costs when achieving set results, effectiveness is the degree to which goals are achieved, and productivity is the ratio between invested resources and the results obtained (Kerimkhulle et al., 2023). Theoretical approaches to public finance and project management include methods for planning, monitoring, and evaluating the implementation of budget programmes. The analysis of the experience of various countries allows identifying best practices and approaches that can be adapted to the specific conditions of other countries. Thus, the examination of the experience of EU countries in the field of auditing the effectiveness of public funds aimed at infrastructural development is an important step towards improving public financial management and achieving sustainable economic growth.

Studies by various authors provide valuable information on the analysis of methods and results of auditing the effectiveness of public funds aimed at infrastructural development. Castka et al. (2020) emphasise the importance of using modern information technologies and automated systems to improve the accuracy and transparency of audits. Volden (2019) analysed methods for assessing the cost-effectiveness of public projects and concluded that using comparative analysis with the private sector allows identifying inefficient costs and proposing measures to optimise them. Cordery and Hay (2019) focused on the need to involve the public and stakeholders in the audit process. In their opinion, this helps to increase the level of transparency and accountability of government agencies. Haapamäki

and Sihvonon (2019), in turn, investigated the practices of various countries and noted that successful auditing largely depends on the qualifications and training of personnel. Korytářová and Hromádka (2020) focused on risk analysis in infrastructure projects and proposed the implementation of risk management systems at the early stages of design and planning. Cohen et al. (2019) investigated the influence of political factors on the audit process and established that the political independence of audit bodies is a critical condition for conducting objective and unbiased audits.

Teo et al. (2019) proposed a model for integrating environmental and social criteria into evaluating the effectiveness of infrastructure projects. Their study showed that considering such criteria contributes to more sustainable development and an increase in the social value of projects. Furqan et al. (2020) highlighted the practice of regular public reporting on audit results, which contributes to increasing public confidence in government agencies and increasing transparency in the use of budgetary funds. Downey and Bedard (2019) emphasised the importance of international cooperation and the exchange of best practices between countries. The implementation of the best international standards and recommendations contributes to the improvement of audit efficiency. Alhababsah and Yekini (2021), in turn, examined the impact of the legal framework on the audit process and concluded that clear and strict regulations are an important element of successful control over the use of public funds.

An analysis of the work of various authors shows that many factors must be considered for an effective audit of public funds aimed at infrastructural development, including the use of modern technologies, public involvement, training, risk management, political independence of audit bodies, consideration of environmental and social criteria, international cooperation, and the existence of a strict legal framework. The analysis of the study identified several areas that require more in-depth research. In particular, insufficient attention was paid to integrating innovative technologies into the audit process at the level of government agencies and ensuring the long-term sustainability of infrastructure projects through audit mechanisms.

This study distinguishes itself from previous research by focusing on the integration of innovative technologies and the consideration of social and environmental criteria in auditing public funds for infrastructure development. While earlier studies, emphasize the use of modern information technologies and the inclusion of environmental and social factors, this study extends these ideas by specifically evaluating how these technologies are integrated into government auditing practices across EU countries. Additionally, the study develops a model aimed at ensuring the long-term sustainability of infrastructure projects, addressing a gap in prior research that largely overlooks the role of audits in ensuring not only cost-effectiveness but also enduring project success.

The purpose of the study was to analyse audit practices aimed at improving the efficiency of using public funds for infrastructure development, considering various features. The objectives of the study were to analyse and evaluate the current level of integration of innovative technologies into the audit process of public funds in the EU countries and develop a model to ensure the long-term sustainability of infrastructure projects through audit mechanisms.

II. Materials and Methods

This study is based on a comprehensive examination of national audit systems in EU countries to identify best practices and possible areas for improvement. The study covers several key aspects: the institutional structure of audit bodies, audit methodology, the degree of independence of audit bodies, and the use of innovative technologies. The main materials and methods used in the study include data collection, comparison, classification of national audit systems, qualitative and quantitative analysis, audit modelling, and evaluation of audit effectiveness.

The main sources of information included reports from the European Court of Auditors, international standards on auditing, which contain data from national audit bodies of countries such as Germany, France, Italy, Sweden, the Netherlands, Great Britain, Estonia, Finland, Romania, and Bulgaria. In addition, academic papers analysing the effectiveness of various audit approaches were used.

The main approach of the study was to compare national audit systems. For this purpose, several key criteria were identified: institutional structure, audit methodology, degree of independence, and use of technology. The comparative analysis allowed identifying differences and common features in audit approaches in different EU countries, and evaluate the effectiveness of various methods and practices.

Central and decentralised audit systems, including audit departments and systems in EU countries, were investigated. Various audit approaches were analysed, including financial, related, and production audits. Examples of the introduction of digital technologies and automated systems into audit practice were examined. Estonia and Finland, which actively use digital technologies to increase transparency and audit efficiency, were considered as examples.

In addition to comparing audit approaches, the study included both qualitative and quantitative analysis methods. The qualitative analysis included a detailed examination of examples of successful projects and audit methods in various countries. The quantitative analysis included an assessment of the economic effect of the application of various audit practices, such as budget savings, risk reduction, and increased efficiency of resource management.

The study examined the legislative part related to auditing and control of public finances, including a review of key laws and directives such as Directive 2014/56/EU of the European Parliament and of the Council amending Directive 2006/43/EC “On Statutory Audits of Annual Accounts and Consolidated Accounts” (2014). The analysis covered the legal and methodological framework establishing the powers of audit bodies, their responsibilities and audit procedures, as well as international standards developed by the International Federation of Accountants and the International Auditing Standards Council.

As part of the study, a model for auditing the effectiveness of the use of funds was formulated using the example of a specific infrastructure project Fehmarnbelt Fixed Link. The audit model included cost analysis, development of risk management strategies, verification of compliance with standards, and suggestions for optimising resource use.

III. Results

This project includes the construction of an underwater tunnel between Germany and Denmark, and its audit was divided into several key stages: budget planning and control, risk assessment and management, verification of compliance with project documentation standards, and control over the use of resources. Effective management of public finances is a key aspect of sustainable economic development. In this regard, national audit systems play an important role in ensuring transparency and accountability in the use of public funds. EU countries demonstrate a variety of approaches to the organisation and conduct of audits of public resources, which necessitates the analysis of their experience to identify best practices and possible areas for improvement. National audit systems in EU countries can be classified according to several criteria: the institutional structure, audit methodology, the degree of independence of audit bodies, and the use of innovative technologies. These aspects vary from country to country, reflecting their historical, cultural, and economic characteristics.

In many EU countries, such as Germany, France, and Italy, auditing functions are performed by central government agencies, which have a high degree of independence from the executive branch. For example, the German Federal Accounting Chamber (Bundesrechnungshof) is an independent body that monitors the effectiveness of the use of budget funds. Its work is based on strict standards and covers a wide range of government programmes and projects. The independence of the Chamber is enshrined in the Basic Law (Constitution) of Germany, which underlines the importance of an independent audit for a democratic society. The Federal Accounting Chamber conducts comprehensive audits of all federal ministries and agencies and enterprises in which the state has a substantial stake (Aden, 2015).

Therewith, in countries such as Sweden and the Netherlands, audit systems include elements of decentralisation. In Sweden, for example, the National Audit Office (Riksrevisionen) works in conjunction with regional audit authorities, which allows for more detailed monitoring of the use of funds on the ground. This approach helps to increase the effectiveness of the audit by considering regional peculiarities and the specifics of local projects. The audit methodology also differs depending on the country. In the UK, the National Audit Office (NAO) uses a comprehensive approach that includes financial, compliance, and performance audits. This approach allows not only to assess the legality and reasonableness of expenses but also to identify opportunities to improve the efficiency of using budget funds. The NAO has a high degree of independence and is accountable to Parliament, not the Government. The head of the NAO, the Controller, and the Chief Auditor are appointed by the monarch on the recommendation of the Prime Minister, but only after consultation with the parliamentary committee (Hnydiuk et al., 2021). This structure ensures that the NAO can conduct its audits without any interference from the executive branch, ensuring the objectivity and impartiality of the audit.

The use of innovative technologies in auditing is becoming an increasingly important aspect of the national audit systems of the EU countries (Ciula et al., 2024). The integration of digital solutions and automated systems can substantially improve the transparency, accuracy and efficiency of audit processes while providing more reliable control over the use

of public funds. Estonia is one of the leaders in the implementation of digital technologies in public administration, including auditing. The Estonian e-Government system includes key elements such as e-Residency, electronic elections, and electronic taxation (e-Tax). One example is the use of X-Road, a government information system that allows various agencies to exchange data in a secure and standardised format (Robles et al., 2019). This allows auditors to quickly obtain the necessary information about government expenditures, reducing the time for requests and data processing. As a result, the accuracy and efficiency of audits are improved.

In Finland, the National Audit Office actively uses Big Data and analytical tools to improve audit efficiency. For example, the office uses data analysis to identify anomalies and risks in financial transactions. This allows directing efforts to check the most problematic areas and optimise the allocation of resources. In the Netherlands, the Accounting Chamber (Algemene Rekenkamer) has implemented a digital project monitoring system that allows tracking the progress of government programmes and projects in real time. This system includes data visualisation tools and dashboards that provide auditors and the public with up-to-date information on the progress and financing of projects. The Danish National Audit Office (Rigsrevisionen) is also actively using modern technologies to improve audit quality. One of the innovative approaches is the use of blockchain technologies to create immutable records of financial transactions (Otia and Bracci, 2022).

Despite the diversity of audit approaches in the EU countries, there are a number of common challenges that need to be taken into account to improve the effectiveness of audit systems. These challenges include the need for professional development and training, the fight against corruption and ensuring transparency in the use of public funds. A high-quality audit requires highly qualified specialists with in-depth knowledge in the field of finance, economics, and law (Musayeva et al., 2024). However, in a number of EU countries there are deficits in the field of professional training and certification of auditors. This can affect the quality of inspections and exacerbate problems with detecting and preventing violations. In some countries, such as Greece and Portugal, there is a shortage of highly qualified audit personnel, which limits the ability of national audit authorities to effectively handle large amounts of data and complex financial transactions.

Corruption and inefficient use of public funds remain acute problems for a number of EU countries (Yevseiev et al., 2020). Countries with high corruption levels, such as Romania and Bulgaria, face significant challenges in conducting effective audits of public funds. These nations struggle with systemic corruption, which hampers the transparency and accountability of financial transactions. Issues like document forgery, manipulation of accounting records, and misuse of budgetary funds remain prevalent, complicating the ability to perform honest audits. Romania and Bulgaria have implemented various measures to address these issues. Romania, for instance, has adopted a series of anti-corruption reforms, including the establishment of the National Anti-Corruption Directorate, aimed at prosecuting high-level corruption. Despite these efforts, challenges persist, with reports of political interference in anti-corruption actions and limited public trust in the effectiveness of these measures. Similarly, Bulgaria has introduced reforms like the establishment of the Commission for Prevention and Ascertainment of Conflict of Interests, but corruption

remains deeply ingrained in public administration and judiciary sectors, limiting the success of these initiatives. Both countries continue to work on improving judicial independence, increasing access to financial information, and enhancing the transparency of public procurement processes, but these efforts face setbacks due to political instability and resistance from vested interests.

The legislative and regulatory framework for auditing plays a vital role in ensuring the effectiveness and transparency of control over financial statements and the use of public funds (Galikhanov et al., 2024). These frameworks form the legal and methodological framework for conducting audits, promoting trust in reporting results and ensuring accountability (Free et al., 2020).

The legislation governing auditing includes several key components. The basic laws and regulations establish the legal framework for auditing activities (Karimli et al., 2024). For example, in EU countries, there are directives such as Directive 2014/56/EU of the European Parliament and of the Council amending Directive 2006/43/EC “On Statutory Audits of Annual Accounts and Consolidated Accounts” (2014). The legislation provides for the creation of specialised bodies to control and regulate the activities of audit firms. These bodies, such as national audit chambers or associations, develop rules and standards for the professional activities of auditors. The laws also define the powers of auditors, their responsibilities to government agencies and the public and establish procedures for conducting audits and interacting with audited organisations.

Regulations and standards complement legislation, ensuring the practical implementation of audit functions and techniques. The International Standards on Auditing, developed by the International Federation of Accountants and the International Council on Auditing and Assurance Standards, serve as the basis for auditing at the international level. These standards cover all aspects of auditing, from planning and execution to reporting and evaluation of results. In addition to international standards, each country can develop and implement its own national auditing standards that consider the specifics of the national economy and legislation. It is also important to observe ethical and professional standards such as independence, objectivity, and confidentiality, which are usually enshrined in professional codes, for example, in the Code of Ethics of the International Federation of Accountants.

Legislative and regulatory frameworks have a substantial impact on audit practice by providing standard procedures that auditors are required to follow. This contributes to the uniformity and quality of audit services, strengthening public confidence in financial reporting and public administration. The effectiveness of an audit also depends on how well the legislative and regulatory framework is adapted to changes in the economic environment and financial markets (Thomas and Purcell, 2019). The flexibility and relevance of the standards allow the audit to respond to new challenges and risks, ensuring the protection of the interests of society and the state.

Auditing plays a key role in ensuring the sustainability of infrastructure projects, performing several important functions that contribute to their successful implementation and durability (Mohammadi et al., 2025). The main aspects of the audit include checking the compliance of project documentation with established standards and requirements, monitoring the use

of resources, evaluating the achievement of targets and increasing transparency. Firstly, the audit ensures that the project documentation meets the established standards and requirements. This includes an assessment of how well the project complies with regulations, building standards, and environmental requirements (Willar et al., 2021; Tsvyetkov, 2024). Such control helps to prevent deviations from approved plans and standards, which in turn reduces the risk of problems in the future. For example, in the railway infrastructure modernisation project in Amsterdam, independent auditors conducted regular inspections, which allowed identifying inconsistencies and errors in the early stages of implementation. This included checking the compliance of materials and technologies with established standards, and monitoring compliance with schedules and budgets. Timely identification and elimination of deficiencies contributed to the successful completion of the project and ensuring its long-term sustainability.

Monitoring the use of resources is an important audit function, as it allows assessing how effectively and expediently financial resources, materials and human resources are being used. Auditors analyse costs, evaluate budget execution and identify possible overspending or misuse of funds (Kerimkhulle et al., 2023). If problems are identified, auditors provide recommendations for optimising processes and improving resource management (Eulerich et al., 2019). For example, in a road infrastructure reconstruction project in London, auditors identified several cases of inefficient spending at the procurement and contracting stages. Due to these findings, it was possible to review contracts and implement more efficient procedures, which reduced costs by 15% and improved overall project results, saving about 5 million pounds (Update on the . . . , 2022).

Evaluating the achievement of targets is another important aspect of the audit. Auditors analyse how well the project achieves pre-set goals and indicators, such as improving security and functionality and meeting user needs. This includes checking the implementation of project plans and evaluating the results based on key indicators (Xiao et al., 2020; Franchuk et al., 2024). For example, in the Green Bridge construction project in Copenhagen, auditors assessed how well the project meets the goals of environmental sustainability and efficiency. Indicators such as pollution reduction and improved water management were thoroughly tested. The auditors identified that the introduction of environmentally friendly technologies and innovative materials allowed reducing the cost of bridge maintenance by 20% and reduce pollution by 30%. Within the framework of the project, water management systems were implemented, which allowed minimising the negative impact on the environment and increasing the durability of the bridge (Copenhagen Climate Projects, 2016).

In addition, auditing contributes to increased transparency and accountability. The publication of audit reports and management improvement recommendations helps to increase public and stakeholder confidence. This creates the basis for a more open and honest project implementation process (Montero and Le Blanc, 2019). At Helsinki International Airport in Finland, auditors monitored the use of advanced technologies to manage energy consumption and ensure comfortable passenger service. The audit reports published following the inspections included recommendations for improving energy management systems and passenger comfort. These measures have reduced operating costs by 10% and provided a high level of comfort for passengers. The use of smart energy management

technologies and environmental solutions has become a model for other airports (Fintraffic Air Navigation..., 2023).

Various audit approaches have been developed and applied in different EU countries, reflecting their unique economic, social, and political conditions. It is important to conduct a comparative analysis of audit practices in different countries to identify the best examples and understand which methods and technologies can be used to improve national audit systems. Table 1 provides a comparative analysis of audit practices in different countries.

Table 1: Comparative analysis of audit practices in the EU countries

Country	Main audit practices	Innovations and technologies in auditing	Anti-corruption and transparency	Examples of successful projects
Estonia	Automated audit systems	Digital technologies, e-government	High level of transparency, minimal corruption	Development of digital structures
Finland	Regular and independent inspections	Advanced data management technologies	Low level of corruption, high transparency	Helsinki International Airport
Romania	Traditional auditing methods	Slow implementation of innovations	High level of corruption, the need to strengthen measures	Transport modernisation projects
Bulgaria	Traditional auditing methods	Limited use of innovation	High level of corruption, the need to strengthen measures	Water supply infrastructure projects
Denmark	Regular checks and controls	Environmentally friendly technologies, water resources management	High level of transparency	The Green Bridge
United Kingdom	Regular and independent inspections	The use of innovative financial instruments	Moderate level of corruption, high transparency	Reconstruction of the road infrastructure
Netherlands	Regular and independent inspections	Advanced data analysis techniques	Low level of corruption, high transparency	Modernisation of the railway infrastructure
Germany	Regular and independent inspections	Eco-friendly technologies, integrated planning	Low level of corruption, high transparency	New transport hub
Sweden	Regular and independent inspections	Smart grids, adaptive materials	Low level of corruption, high transparency	A “smart” residential area
Spain	Regular checks and controls	Risk management strategies	Low level of corruption, high transparency	Construction of a new bridge

Source: compiled by the authors

In Estonia, the active use of digital technologies and automated systems in auditing substantially increases the transparency and accuracy of audits, reflecting the country's success in the field of e-government. In Finland, the constitutional independence of the National Audit Office allows for objective and reliable audits without government intervention, which underscores the importance of independence for a quality audit. Romania and Bulgaria face serious corruption problems, which indicates the need to strengthen anti-corruption measures and increase transparency. While innovation in these countries is slow, examples from countries such as Denmark and the Netherlands show how the use of environmentally friendly technologies and advanced data analysis techniques can contribute to the successful implementation of infrastructure projects.

A specific infrastructure project, Fehmarnbelt Fixed Link, was considered to understand the impact of the audit on the efficiency of the use of funds. The Fehmarnbelt Fixed Link project is an infrastructure initiative aimed at building an underwater tunnel connecting Germany and Denmark through the Fehmarn Strait. This 19-kilometre-long tunnel will become an important part of the transport network in Northern Europe and one of the largest underwater tunnels in the world. The tunnel will function for both rail and road transport, substantially reducing travel time between the two countries. Currently, travel between Germany and Denmark via Fehmarn can take up to several hours, including ferry crossings and car trips. After the completion of the project, the travel time will be reduced to 10–15 minutes, which will substantially improve transport links and increase the economic integration of the region. The project provides for the creation of not only the tunnel itself but also the associated infrastructure, including new transport interchanges, stations, and checkpoints. These additions will ensure efficient distribution of traffic flows and improve accessibility for passengers and freight carriers. The construction is scheduled to be completed by 2029, and the total project budget is about 8 billion euros. These funds will be used for the construction of the tunnel, modernisation and construction of the necessary infrastructure, conducting the necessary research, and obtaining permits. The budget includes costs for the design, construction, and implementation of safety and management technologies, as well as for the maintenance and operation of the tunnel in the future (State aid: Commission..., 2020).

Based on previous successful practices, an audit of the effectiveness of the use of funds within the framework of this project was modelled. The audit will include several key stages: budget planning and control, risk assessment and management, verification of compliance of project documentation with standards, control over the use of resources (Table 2).

Firstly, it is necessary to carefully check the compliance of expenses with the approved budget at all stages of the project. This includes an analysis of the costs of materials, labour, and equipment, as well as an assessment of any deviations from the planned costs. For example, if it is planned to use a certain type of concrete for the construction of a tunnel, auditors will check whether the purchase price corresponds to the average market value and whether there are opportunities to purchase similar materials at a lower price without loss of quality. Similarly, auditors will analyse labour costs to ensure that pay is in line with standards and that there is no overspending on overtime or unnecessary contractor costs. As for the equipment, the auditors will check that the purchased equipment and tools

are optimal in terms of price-quality ratio and that there are no surpluses or shortages of equipment. Regular audits will help identify and prevent cost overruns, which will save 10–15% of the budget, or about 800 million euros. Auditors can suggest cost-optimisation measures, such as using cheaper but better materials or introducing new technologies that can reduce costs. Alternative building materials, such as recycled concrete, which may be cheaper and more environmentally friendly, may be considered.

Table 2: The audit model of the effectiveness of the use of funds in the Fehmarnbelt Fixed Link project

Audit stage	Auditors' actions	Expected results	Examples and optimisation measures
Budget planning and control	Cost analysis of materials, labour, and equipment	Reduction of overspending by 10–15% or savings of about 800 million euros	Use of alternative materials (recycled concrete)
	Estimation of deviations from planned expenses		Negotiations with suppliers to reduce prices
Risk assessment and management	Identification of technical, financial, and environmental risks	Reducing the cost of eliminating risks by 5–10% or saving about 400 million euros	Conducting additional examinations of the bottom of the strait
	Developing risk management strategies		Hedging currency risks
	Creating backup plans and monitoring situations		Environmental monitoring
Verification of compliance with standards	Verification of compliance of project documentation with national and international standards	Reduction of time for improvements and corrections by 10–15%	Verification of welding technologies for compliance with safety standards
	Confirming that the work is conducted in accordance with the established standards	Speeding up the completion of the project	Regular quality inspections
Resource management	Assessment of current processes and proposals for optimising resource use	Saving 5–10% of the project budget	The use of modular structures
	Implementation of more efficient construction methods and technological solutions	Improving productivity and efficiency	Automated management of construction processes

Source: compiled by the authors

It is necessary to assess the possible risks associated with the implementation of the project, including technical, financial, and environmental risks. They can develop strategies to manage these risks to minimise their impact on the project. For example, potential technical risks associated with the geological features of the strait floor can be identified and measures can be proposed to minimise them, such as additional research or the use of more sustainable construction technologies (Kopan and Melnyk, 2024; Farah, et al., 2024). Financial risks may include fluctuations in the cost of materials or currency risks associated with international purchases. Auditors may recommend hedging strategies or the conclusion of long-term contracts with fixed prices. Environmental risks may include the impact of construction on the marine ecosystem, and auditors may propose measures to mitigate these risks, such as monitoring environmental conditions and the use of environmentally friendly technologies. Effective risk management involves the creation of backup plans and constant monitoring of situations, which will reduce the potential cost of eliminating unforeseen circumstances by 5–10%, or 400 million euros (Prasada et al., 2024).

Regular checks of compliance of project documentation with national and international standards will help prevent possible errors and violations that may lead to delays or increased costs. It is necessary to carefully ensure that all work is conducted in accordance with established standards, which will ensure high-quality construction and durability of the tunnel. If, for example, the project involves the use of certain welding technologies, the auditors will verify that the methods used comply with international safety and quality standards (Botnarenko and Kryzhna, 2023). This can reduce the time for improvements and corrections by 10–15%, speeding up the completion of the project and reducing costs. Effective management of resources, including materials, labour, and equipment, is a key aspect of auditing. Auditors can evaluate current processes and suggest methods to optimise the use of resources. For example, it is possible to recommend the use of more efficient construction methods or technological solutions, which will lead to savings of 5–10% of the project budget. This will not only reduce costs, but also increase the overall productivity and efficiency of construction. An example is the use of modular structures, which can substantially reduce construction time and reduce labour costs. It is also necessary to propose the introduction of automated control systems for construction processes, which allow better control over the use of materials and equipment, minimising losses and increasing the overall efficiency of the project.

An audit of the effectiveness of the use of funds can substantially affect the success of the Fehmarnbelt Fixed Link project. The benefits of conducting an audit include cost savings, improved quality, reduced risks, and increased transparency and accountability. The cost savings due to the audit may amount to approximately 1.2 billion euros, which will be the result of budget optimisation and cost reduction. Regular inspections will ensure high quality of construction and compliance with established standards, which will increase the service life of the tunnel and reduce maintenance costs. Effective risk management will help to prevent potential problems and reduce the cost of their elimination, and open and regular audit reports will increase the transparency of the project and public confidence.

However, conducting an audit can also lead to a number of obstacles and challenges. Additional audit costs may amount to 1–2% of the total project budget, which must be considered when planning. The implementation of the auditors' recommendations may cause temporary delays, which will require careful planning and project management. In addition, the introduction of new methods and technologies proposed by the auditors will require adaptation and training of personnel, which may temporarily reduce productivity. Thus, an audit of the effectiveness of the use of funds in the Fehmarnbelt Fixed Link project can substantially increase its success, ensuring budget savings, quality improvement, and risk reduction. However, to achieve these benefits, it will be necessary to overcome a number of obstacles and challenges associated with additional costs and time delays.

IV. Discussion

As part of the study, the national audit systems of the EU countries were analysed to identify best practices and possible areas for improvement. Effective management of public finances plays a key role in sustainable economic development, and national audit systems promote transparency and accountability in the use of public funds. The differences in institutional structures and the degree of independence of auditors in the EU countries are substantial. In Germany, France, and Italy, audit functions are performed by central government agencies with a high degree of independence from the executive branch. For example, the German Federal Audit Chamber acts independently, which is enshrined in the Basic Law of Germany. This aspect of independence highlights the importance of an objective and impartial audit for a democratic society. Hasan et al. (2020) investigated the independence of audit bodies and its impact on audit quality. They highlighted that a high degree of independence allows auditors to work objectively and impartially. These results are consistent with the findings of the current study on the importance of independence to ensure high audit quality.

In some countries, such as Sweden and the Netherlands, auditing systems include elements of decentralisation. In Sweden, the National Audit Office works in conjunction with regional authorities, which allows for more detailed control over the use of funds at the local level. The decentralised approach helps to consider regional features and the specifics of local projects, which increases the effectiveness of the audit (Yuliia et al., 2025). This aspect shows that various organisational structures can be adapted to improve the accuracy and relevance of audits. Manes Rossi et al. (2021) investigated the impact of decentralised audit systems on the effectiveness of public finance management. They concluded that decentralisation helps to increase the transparency and accuracy of audits by considering regional features. However, Cao et al. (2022) emphasise that central authorities have more resources and capabilities for comprehensive audits, which raises questions about the absolute advantage of decentralisation. The authors' results coincide with the conclusions of this study on the benefits of decentralisation in countries. However, the authors also highlighted the potential risks of decentralisation, such as the complication of coordination between different levels of government, which was not considered in detail in the current study.

The audit methodology also varies. In the UK, the National Audit Office uses a comprehensive approach that includes financial, compliance, and performance audits. This method allows not only the assessment of the legality and reasonableness of expenses but also the identification of opportunities to improve the efficiency of budget funds. Such a methodology can serve as an example for other countries, demonstrating the importance of an integrated approach for a comprehensive assessment of the activities of public institutions. Salehi et al. (2019) also focused on the audit methodology and concluded that an integrated approach applied in various countries is the most effective for assessing the legality, validity, and effectiveness of expenses. This conclusion coincides with the current results. Notably, in some countries, the implementation of such a methodology is difficult due to a lack of qualified specialists, which was also mentioned in the context of the general need to improve the qualifications of auditors.

Innovative technologies are playing an increasingly important role in the auditing systems of the EU countries. Estonia is a leader in the field of digital technologies and automated systems in public administration, which substantially increases the transparency and accuracy of audits. For example, using the X-Road system allows for fast and secure data exchange between various government agencies. This highlights the importance of integrating digital solutions to improve audit quality and effectiveness. Frishammar et al. (2019) focused on the role of innovative technologies in auditing and concluded that the integration of digital solutions and automated systems substantially improves the quality of audits. Rykaczewski et al. (2022) also highlight Estonia as a leader in this field and note substantial improvements in the transparency and accuracy of audits due to digital technologies. The authors' findings align with these results on the importance of digital technologies for improving audit transparency and efficiency. However, not all countries are equally equipped to implement such technologies due to varying levels of economic development, differing priorities, and resource availability. While some nations face challenges due to limited resources, others may focus on gradual implementation of digital technologies or prioritize specific applications that align with their immediate needs and capabilities.

Despite the diversity of approaches, all national audit systems in the EU countries face common challenges. One of them is the need for professional development and training of specialists. High-quality auditing requires specialists with in-depth knowledge in finance, economics, and law. In some countries, such as Greece and Portugal, there is a shortage of qualified personnel, which limits the possibilities of effective auditing. This indicates the need for investments in the education and training of auditors. Kertarajasa et al. (2019) investigated the impact of auditor training on audit quality. They noted that countries with high standards of education and auditor certification demonstrate a higher quality of audits. Alberti et al. (2022), in turn, examined the influence of cultural and historical factors on the organisation of audit systems. They note that in countries with deep democratic traditions, auditors have a high degree of independence, which contributes to the objectivity of audits. The results obtained mirror those of this study on the need for investment in education and training and the necessity to consider cultural and historical factors. In countries with

less stable democratic traditions, the independence of auditors is often threatened, which requires additional measures to protect it.

Corruption and inefficient use of public funds remain an acute problem in a number of EU countries, such as Romania and Bulgaria. This highlights the need to strengthen anti-corruption measures and increase transparency. The introduction of strict regulations and the development of civil society institutions can help reduce corruption and improve the quality of public administration (Huseynov et al., 2023). Examples of countries with low levels of corruption, such as Finland and the Netherlands, demonstrate that transparent and independent audit systems can substantially contribute to reducing corruption risks. Al-Okaily (2023) analysed anti-corruption measures and their impact on audit effectiveness in various countries. The author concluded that countries with high levels of corruption face serious challenges in ensuring transparency and accountability. This matches with the current results on the need to strengthen anti-corruption measures. However, successful examples of the implementation of anti-corruption strategies in countries were also noted. Matkaluk et al. (2024) focused on the role of international cooperation and exchange of experience in improving the professional level of auditors. They emphasise that regular trainings and the exchange of best practices between countries contribute to improving the quality of auditing. The results of this study also highlight the importance of international cooperation to improve the skills of auditors. However, the authors note that in some countries, barriers to effective exchange of experience, such as linguistic and cultural differences, exist.

In general, the analysis shows that the national audit systems of the EU countries are diverse and reflect the historical, cultural, and economic characteristics of each country. A comparative analysis of audit practices allows identifying the best examples and understanding which methods and technologies can be used to improve national audit systems. It is important to continue international cooperation and exchange of experience to improve the professional level of auditors and strengthen anti-corruption measures, which will contribute to improving public financial management and sustainable economic development of countries.

V. Conclusion

The study analysed the role of national audit systems in ensuring transparency and accountability of the use of public funds in the EU countries. National audit systems in EU countries have substantial differences, which can be classified according to several criteria: the institutional structure, audit methodology, the degree of independence of audit bodies, and the use of innovative technologies. These aspects vary depending on the historical, cultural, and economic characteristics of each country.

In countries such as Germany, France, and Italy, audit functions are performed by central government bodies with a high degree of independence. For example, the German Federal Audit Office monitors the effectiveness of budget funds based on strict standards and covers a wide range of government programmes and projects. This structure ensures the objectivity and independence of the audit, which is critically important for democratic societies. On the other hand, in countries such as Sweden and the Netherlands, there is an element of

decentralisation in audit systems. The Swedish National Control Chamber and regional audit bodies allow for more detailed monitoring of the use of funds in the field. This helps to increase the effectiveness of the audit, considering regional features and the specifics of local projects.

The use of innovative technologies in auditing is becoming an increasingly important aspect. Estonia is a leader in the use of digital technologies and automated management systems, which substantially improves the transparency and accuracy of the audit. Finland is actively using big data and analytical tools to improve audit efficiency, and the Netherlands has implemented digital real-time project monitoring systems.

The audit of the Fehmarnbelt Fixed Link project was modelled to understand the impact of the audit on the effectiveness of the use of funds. The audit included an analysis of budget planning and control, risk assessment and management, verification of compliance of project documentation with standards, and control of resource use. The projected audit results included reducing cost overruns and risks and increasing overall transparency and accountability of the project. The audit involves saving 10–15% of the budget, which is about 800 million euros, by preventing overspending and optimising costs and reducing the potential cost of eliminating unforeseen circumstances by 5–10%, or about 400 million euros.

Based on the analysis, it can be concluded that, despite the diversity of approaches to auditing in the EU countries, there are a number of common challenges, such as professional development and the fight against corruption. It is necessary to consider the specific conditions of each country and apply the best practices identified during the study. Auditing plays a key role in ensuring the sustainability of infrastructure projects and improving the quality of public funds management, contributing to their successful implementation and longevity.

The limitation of the study lies in the insufficient availability of data on internal audit practices in some countries, which restricts the ability to conduct a comprehensive analysis across all relevant jurisdictions. In particular, the lack of detailed information on the specific methods, tools, and technologies employed by audit bodies in certain regions hindered the examination of diverse practices and their effectiveness. This limitation underscores the need for further research to explore the nuances of auditing systems in these countries. Future studies should focus on conducting more granular analyses of internal audit practices, especially in developing or lower-resource countries, where the implementation of innovative technologies may be in its early stages or more limited. Additionally, research could investigate the factors that influence the adoption of these technologies, such as political will, regulatory frameworks, and available infrastructure. Future research could explore the role of international collaboration in facilitating the transfer of knowledge and best practices, as well as the potential for harmonizing audit standards across countries with differing levels of development.

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