

Accounting of infrastructure assets of state institutions as an element of sustainable development goals

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Abstract

The purpose of this study was to evaluate these principles with a special focus on their interaction with the achievement of sustainable development goals. The main research methods used in this study were modelling and forecasting. The study showed that the valuation of infrastructure facilities is one of the main components for ensuring the efficient functioning of the economy. The paper describes a significant number of problems observed in the country in the management of such assets, which indicates the need to create a more efficient system of accounting and auditing. It was also concluded that the life cycle approach is important, as it is more focused on achieving the principles of sustainable development than others. This is due, in particular, to the fact that this approach makes it possible to estimate the total cost of an asset over its lifetime, including a significant number of its various components. This allows for a better assessment of the true value of the asset. In addition, the study briefly assessed the state of infrastructure losses as a result of Russia's full-scale invasion of Ukraine, which once again confirmed the existing relevance of developing more effective standards for accounting for such assets in public institutions. The conclusions drawn in this study can be applied both to the management of public institutions and to the creation of policies in the field of accounting principles development.

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1. Introduction

Non-financial assets of state-owned institutions are one of the largest components of the structure of assets of state-owned institutions. In Ukraine and around the world, one of the challenges is to study and implement the latest methods of managing non-financial assets, namely infrastructure assets, in order to support sustainable development goals (Dovgal *et al.*, 2024). Infrastructure asset management is an important element of governance in public institutions, as the preference for new, modern assets results in a decrease in the quality of management of reliable infrastructure assets that provide basic public services (Molland and Clift, 2008). Such public policies on infrastructure asset management can be very costly. Effective management of infrastructure assets becomes especially important in times of crisis, including military operations. It would be appropriate to distinguish within non-financial assets those assets that are under the operational management of public institutions, but whose utility potential is consumed by citizens and society. Such identification of assets has become relevant and necessary as a result of Russia's terrorist actions against Ukraine, namely, the attacks on specific objects of state institutions.

A considerable number of scholars have studied the peculiarities of accounting for fixed assets in Ukraine. For example, Gatsenko and Nazarenko (2022) showed in their study what elements such a policy should have and what stages it should consist of. However, their work was rather theoretical, without an empirical element. Koliesnichenko (2021), in turn, studied the budgeting component of public sector budgeting, paying attention to how accounting affects this component. However, little attention was paid to the accounting for fixed assets. Yaremenko and Strahnitskyi (2022) emphasized the importance of critical infrastructure as an integral part of the national security and well-being of the country, stressing its key role in the functioning of society, the economy and sustainable development of the state. In their work, they also asserted the existence of a priority triad in building the content of the definition of "critical infrastructure "man-society-state", which reflects the exceptionally important national infrastructure facilities for ensuring civil, social and state security. The specifics of the state of sustainable

development in Ukraine were assessed by Buryak *et al.* (2022). The scientists pointed out the importance of achieving its goals for the future development of the country and success in the processes of European integration in particular. Matseliukh and Korzh (2021), in turn, also studied the role of sustainable development in Ukraine and provided some advice on how to achieve the country's sustainable development goals at the local level.

Thus, the purpose of this study was to assess the main principles and approaches to accounting for public sector infrastructure assets in Ukraine.

2. Materials and methods

The data from the official website of the State Statistics Service of Ukraine (2023) were used to draw some conclusions about infrastructure assets in the country, namely, estimates of the length of roads in different years. To assess the impact of the beginning of Russia's full-scale invasion of Ukraine on the state of infrastructure facilities, data from the Kyiv School of Economics (2023) was used. Information from certain documents was also used, in particular, International Public Sector Accounting Standards (IP-SAS), namely International Public Sector Accounting Standards 17 "Property, Plant, and Equipment" (2001).

One of the main methods used in the study was modelling. A model of the main elements of accounting for infrastructure assets was built, where these components were grouped and depicted within the framework of accounting conditions (Christiaens *et al.*, 2012; Pallot, 1997). A model of methods, processes, and tools for managing infrastructure assets in the public sector was also developed. A model of methods of collecting information on infrastructure assets for generalization and display in the state register of non-financial assets was also developed. All models were depicted using the graphical method and Microsoft Office software.

The method of analogy made it possible to find commonalities between different approaches to accounting for fixed assets in the public sector and draw conclusions on this basis. The descriptive method was used to characterize the main phenomena and approaches. The historical method allowed for the evaluation of past data on public sector accounting approaches in Ukraine. The forecasting method allowed drawing conclusions about how accounting principles will develop in the future. The comparison method assessed some individual approaches used for the purposes of accounting for infrastructure assets in public institutions.

3. Results

Infrastructure assets are all physical assets that are necessary for the provision of basic public services. These assets include traditional infrastructure assets such as roads, water and sewerage systems, as well as the land on which the roads are located, buildings housing essential services, and the equipment and information technology systems required to operate and maintain them (Centobelli *et al.*, 2022; Onyango and Ondiek, 2021). It distinguishes such groups of infrastructure assets as roads and road signs, public lighting, water supply, public sewers, flood control structures such as dams and levees, energy supply systems, parks and recreation facilities, cultural facilities, telecommunication networks, ports, and port facilities, information technology and systems (Tzachor *et al.*, 2022). Management of infrastructure assets is based on an analysis of public needs, the peculiarities of saving the use of the relevant facilities and their useful life.

Today there is a problem with the identification and effective management of infrastructure assets, which is why it is advisable to separate and account for individual infrastructure assets for the purpose of their effective management (Siriwardhane and Taylor, 2017; Vaio *et al.*, 2021). The information support for such management should be the information identified in accounting subaccounts and summarized in the financial statements (Westerdahl, 2021). Due to the relatively long life cycle of an infrastructure asset, it is advisable to determine its useful life, which is increasingly becoming more important in making infrastructure investment decisions. A relevant feature of the modern operation of infrastructure assets is that design, procurement, and decision-making are focused on their useful lives. In particular, the life cycle cost is identified and accumulated as the total cost over the entire life of the asset, including planning, design, acquisition, installation, operation, maintenance, refurbishment, and disposal costs associated with the ownership or use of the asset (Australian/New Zealand..., 1999).

Infrastructure assets meet the definition of property, plant, and equipment and should be accounted for in accordance with the provisions of this Standard. Infrastructure assets include road networks, sewerage systems, water supply systems, heating and electricity systems, and communication systems (International Public Sector..., 2001). For the purpose of identification and reliable assessment, it is necessary to amend the National Regulations (Standards) of Public Sector Accounting (NR(S)PSAS) 121 “Fixed Assets” and supplement information on infrastructure assets as one of the components of fixed assets with a separate section and, when determining the classification of fixed assets by groups, it is advisable to supplement the asset

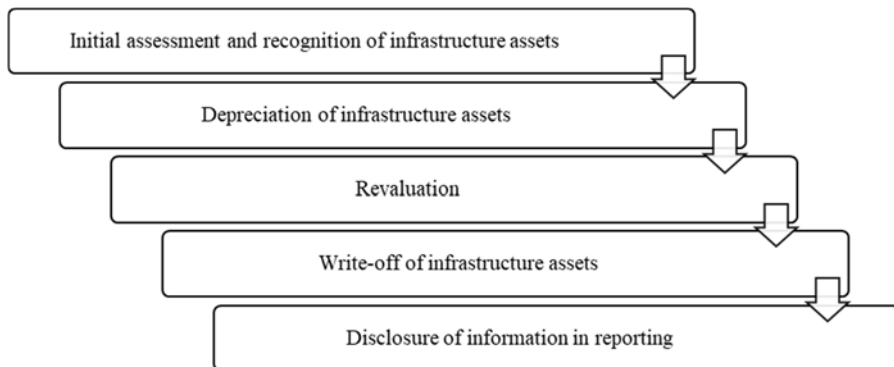
group “Infrastructure Assets”. In terms of infrastructure assets, according to the State Statistics Service of Ukraine (2023), the length of roads in Ukraine increased from 98 thousand km in 2013 to 104 thousand km in 2022; the length of railway tracks in Ukraine increased from 22 thousand km in 2013 to 25 thousand km in 2022. The number of airports in Ukraine increased from 72 in 2013 to 89 in 2022. The number of ports in Ukraine increased from 10 in 2013 to 14 in 2022. The number of bridges in Ukraine increased from 1900 in 2013 to 2400 in 2022. This proposal to amend the regulations is driven by the need to accurately assess the infrastructure assets held by public institutions. In particular, since the beginning of Russia’s military aggression, information on such assets has become extremely important and necessary for assessing the damage caused by military operations.

According to the Report on Direct Infrastructure Damage from the Destruction Caused by Russia’s Military Aggression against Ukraine as of 2 August 2023, conducted by the Kyiv School of Economics in cooperation with other government agencies, the total amount of direct documented damage to residential and non-residential real estate and other infrastructure was over \$150.5 billion (replacement cost). Residential buildings (37.14% or \$55.9 billion) and infrastructure (24.3% or \$36.6 billion) accounted for the largest share of total direct losses. The total direct losses from the destruction and damage to public sector facilities (social, educational, scientific and healthcare facilities, cultural facilities, sports facilities, and administrative buildings) amounted to approximately \$15.6 billion. The main targets of Russian aggression were infrastructure facilities, which suffered the greatest damage. In particular, there was massive shelling of aviation infrastructure, including airports, not only military but also civilian and dual (military-civilian) use. Later, the focus of active attacks shifted to railway infrastructure, including substations and road infrastructure. Since the beginning of the conflict in Ukraine, 19 airports and civilian airfields have been damaged; at least 110 railway stations and terminals have been affected. According to preliminary estimates, the total damage to infrastructure in Ukraine is \$35.3 billion (Kyiv School of Economics, 2023). Thus, the losses from Russian aggression continue, and there is a need for a clear analysis and assessment of the losses incurred and the available and usable property.

Despite the recent increase in public spending on infrastructure, much remains to be done to improve the quality of roads, railways, ports, and other transport networks. Investments in energy infrastructure, such as renewable energy sources and the modernization of existing power plants, are also important. Investments in telecommunication networks are also needed to keep pace with global trends in technology and communications. Infrastructure

assets are accounted for on the basis of the classical accounting model, which has been improved for infrastructure assets (Dorn *et al.*, 2019; Gambetta *et al.*, 2021). Figure 1 summarizes and groups the main elements of the classical model of infrastructure asset accounting.

Figure 1 – Basic elements of the classic accounting model of infrastructure assets



Source: compiled by the author.

As of today, one of the problems with the efficient and targeted use of budget funds is that institutions use significant amounts of budget funds to maintain existing assets that are not used properly and do not bring any economic benefit. In other words, such spending of budgetary funds will be defined as maintenance costs and, as a result, there will be no corresponding economic benefits (Furmanchuk, 2023). Thus, the study found that one of the most important tasks is the effective management of infrastructure assets by public institutions to ensure not only the efficient use of budget funds but also to promote the usefulness of the assets. That is why it is necessary to systematize and identify the main methods and tools for managing infrastructure assets, which are presented in Table 1.

Table 1 – Infrastructure asset management

Methods and processes	Toolkit
Inspection of infrastructure assets	Accounting system of infrastructure assets
Maintenance management	Infrastructure asset database software
Service availability and control	Software for investigating the condition of infrastructure assets
Capital expenditure planning for disposal and utilization of assets	Infrastructure asset maintenance software

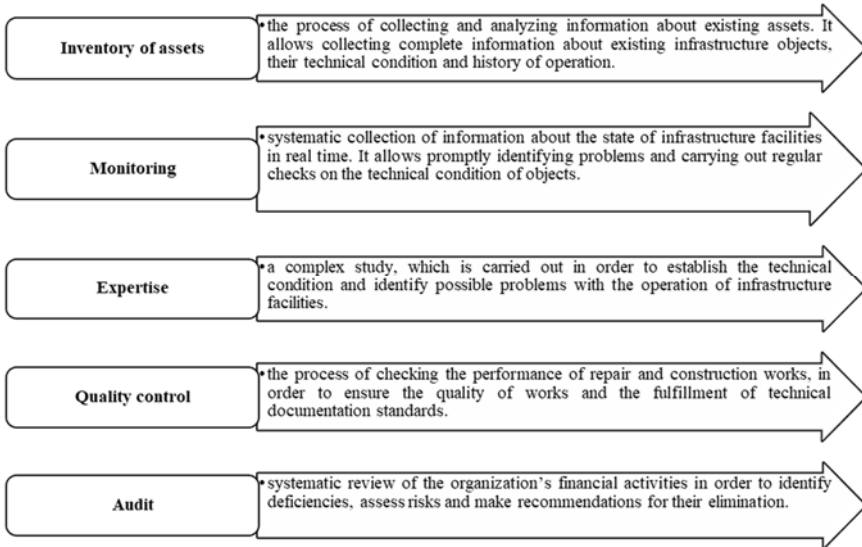
Source: compiled by the author.

To collect technical information on the condition of infrastructure assets, it is possible to use special hardware and software products that allow collecting data on the condition of the facilities and their operation. It is also possible to use maintenance and repair schedules to help plan and control maintenance and repair activities. In turn, the results of technical inspections and analyses of the condition of the facilities can be used to plan repairs and modernization of infrastructure assets. It is also worth considering the needs and priorities of facility users, which will allow them to focus on the most important work. In addition, for effective management of infrastructure assets, budgetary institutions should have an electronic database containing information on all objects, their characteristics, technical condition, date, and scope of repairs and modernization (Poyda-Nosyk and Markus, 2023; Vata-manyuk-Zelinska and Zakorko, 2023). Such a database will allow storing and analysing information on all non-financial assets to summarize it and group it for effective management decisions at different levels of management. That is why the consolidation of information on infrastructure assets in the State Register of Non-Financial Assets of Public Institutions will facilitate the collection, systematization, grouping, generalization of information on all non-financial assets. An approach based on an inventory of infrastructure assets could be used. To do this, it is worth using a database of each institution separately, which contains information about each asset, its technical condition, date of the last repair, and service life.

Using the approach based on visual inspection to assess the condition of assets, potential problems and deficiencies will be identified. A holistic approach to infrastructure asset audits will identify gaps in asset management processes and establish effective management practices (Kryvenko, 2022; Trusova *et al.*, 2021). The audit may include a review of the condition of the equipment, identification of potential risks, and assessment of the performance of work. In turn, the cost-tracking approach is aimed at controlling the costs of repairing and upgrading assets, which can be done using budgeting and cost accounting software. These programmes allow for controlling the costs of repairs and upgrades, as well as analysing performance and developing plans for the future. Certain methods can be used to generate and collect information (Figure 2). When using an inventory of infrastructure assets, it is necessary to compile a list of all infrastructure assets owned by public institutions, determine the technical condition of the assets, their value, planned service life and other characteristics. Maintaining information in a single database, namely the state register of non-financial assets. This database will contain all data on infrastructure assets, including information on their technical condition, service life, cost, planned repairs and upgrades.

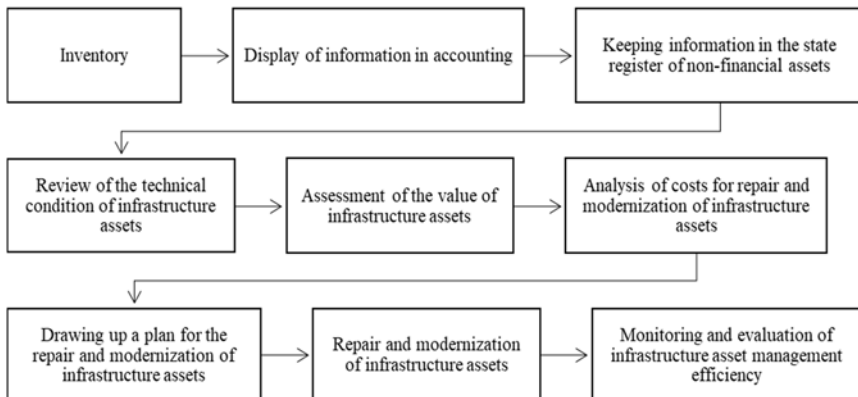
For this purpose, it is possible to use specialized software or create one's own database in electronic form (Figure 3).

Figure 2 – Basic methods of collecting information about infrastructure assets for generalization and display in the state register of non-financial assets



Source: compiled by the author.

Figure 3 – Structural and logical diagram of the main elements of effective management of infrastructure assets in state institutions



Source: compiled by the author.

Since non-financial assets are inherently quite diverse both in terms of useful life and cost criteria, clear criteria and requirements for their recognition and valuation upon receipt are established for all these objects of non-financial assets.

4. Discussion

Buildings and structures may be owned by budgetary entities or provided for use by other government agencies. Roads, bridges, tunnels, and other infrastructure may be owned by the state or local authorities, and budgetary entities may obtain the right to use them under operational management, lease or other agreements. Infrastructure assets in public sector entities have a significant impact on the financial position of the public sector. The cost of buildings and structures, their repair and maintenance, as well as the reconstruction of roads and other infrastructure-related facilities, are significant items of expenditure in the budgets of the state and local authorities. Managing infrastructure assets in public institutions requires a responsible approach to their maintenance and efficient use. To do this, it is necessary to have high-quality information on the condition of the assets, their technical readiness, as well as to plan repairs and modernization, which allows for more efficient use of infrastructure and reduced maintenance costs. The real public sector currently lacks information on infrastructure assets, namely information on their value, technical condition, and planned expenditures for their repair and modernization. This is one of the reasons for their inefficient use by public sector institutions. Information on the condition of infrastructure assets can be generated and collected by conducting a technical inspection, which will determine the technical condition of the facilities and identify faults that require attention. The technical inspection can be carried out by the budgetary institution's own staff or by engaging external experts with relevant qualifications and experience in carrying out such work.

In addition, it is necessary to review the technical condition of infrastructure facilities to identify problems and needs for repair and modernization. This can be done with the help of special commissions that have the appropriate qualifications and equipment. In order to plan for the repair and modernization of infrastructure assets, it is necessary to assess the value of infrastructure assets. This can be done by engaging appraisers who have the appropriate qualifications and experience. In addition, in order to plan repairs and modernization of assets, it is necessary to conduct a cost analysis and develop a repair and modernization plan. A cost analysis allows for deter-

mining the need for and justifying the necessary costs of repair and modernization of assets. And based on the information obtained about the condition of the assets and their technical readiness, as well as the cost analysis, a repair, and modernization plan can be developed. The plan should include a list of assets that need to be repaired and modernized, a justification for the need to carry out the work, and a cost estimate. A maintenance and modernization planning system is a systematic programme for planning and controlling the maintenance and modernization of infrastructure. It helps ensure the rational and targeted use of budget funds. After repairs and upgrades are carried out, it is necessary to monitor and evaluate their effectiveness, summarize information on infrastructure assets and the effectiveness of decisions made in relation to non-financial assets.

Methods for improving the assessment of the sustainable development of districts by taking into account the sustainable development goals were found by Subramanian *et al.* (2021). In the study, they showed a new approach to assessing regional sustainability based on Chinese data using the “five capitals” model. They noted that the chosen approach made it possible to accurately assess the existing problems in certain regions and propose methods to solve urgent problems in them. The researchers also drew attention to the importance of sustainable development goals and the attention paid to them to ensure the region’s continuous development. The current study did not pay such significant attention to the development of regions but described a significant number of methods and approaches on how to assess the condition of infrastructure facilities, which is one of the important parts of assessing the company’s activities in terms of its impact on sustainable development. Paying more attention to this component can provide a clearer assessment of the level of sustainable development of the country, and thus allow for more efficient operations of enterprises and government agencies in the long term.

Shi (2021) studied the analysis of the structure of enterprise assets and profitability through the use of the latest technologies (on the example of SF Express). The scientist noted that a significant amount of “large” assets on the balance sheet can lead to an increase in profitability. He also noted that the structure of assets in the company’s portfolio is a key element in maintaining profitability and shaping the corporate strategy of the enterprise. This is due to the fact that assets, being the main resources for the production and provision of services, contribute significantly to the company’s competitive advantage and long-term success. In general, it can be said that the scientist paid considerable attention to the role of managing such assets in enterprises. The same idea was put forward in the current study, although it primarily concerns state-

owned institutions. Nevertheless, this may indicate that from both a public and private perspective, ensuring more effective accounting for such assets remains a very important component of management in these facilities.

Public sector accounting policies in the United States of America were studied by McDonough and Yan (2023). Their analysis of the relationship between accounting policies and capital investment showed that higher capitalization thresholds and longer expected useful lives may be associated with lower levels of capital investment. This relationship may be due to the distorted information content of financial information caused by these accounting policies. The study also found that a longer expected useful life is associated with better capital asset condition, indicating that the accounting treatment of assets may influence the perceived condition of assets. The findings of this study are important for the Governmental Accounting Standards Board (GASB) and its constituents: it offers insight into the impact of capital asset accounting policies on financial reporting and investment decisions in the public sector and suggests some changes to existing financial reporting standards practices. Thus, the current study did not pay much attention to the level of capitalization and the interaction of this indicator with the level of capital investment. Nevertheless, it should be acknowledged that the author's conclusions within the framework of the study are true, given the theoretical basis for the existence of a link between the indicators he studied. This also creates motives to constantly improve the existing practices of reflecting and maintaining such assets, which remains relevant for Ukraine (Subačienė *et al.*, 2023).

The assessment of American approaches to the accounting of infrastructure facilities was also carried out by Roje (2018). The researcher noted that the country is constantly experiencing significant changes in asset accounting policies across governments and over time, which could potentially affect the comparability of financial information. The study investigates the economic impact of these policies, in particular, in terms of capital investment decisions and capital asset performance as reported in government financial statements. The paper examines the classification of infrastructure and other tangible public sector assets, the recognition and measurement of infrastructure assets, assesses the management of infrastructure assets, and draws attention to the strategic importance of maintaining and improving public infrastructure to ensure the efficient delivery of public services. In general, the researchers concluded that in order to ensure the quality of financial information of enterprises and government agencies, changes in asset recognition policies should be introduced only if they are really necessary, but not too often in order not to interfere with the presentation of information on the activities of these companies (compared to other periods). Although the cur-

rent study of the impact of the policy change did not pay much attention, it is worth noting that these results are reasonable and suggest that the introduction of such a policy, including in Ukraine, should be timely. Given the situation in the country, discussions on any changes should only begin after the war is over. Until then, the authorities should focus on the problems at the frontline and ensuring economic stability.

5. Conclusions

The study shows that the management and valuation of infrastructure assets is a critical area in the broader context of urban and national development. These assets serve as the backbone of modern societies, facilitating economic activity, enhancing the quality of life and ensuring environmental sustainability. Nevertheless, the paper shows that Ukraine currently faces a significant number of challenges in ensuring the effective management of such assets, especially in the current environment of geopolitical tensions, environmental problems, and social complexity.

The paper mentions the life-cycle cost approach, the gradual adoption of which may indicate a gradual transition to more sustainable and high-quality asset management. By focusing on the total cost of an asset over its entire lifetime, including the costs of planning, design, acquisition, installation, operation, maintenance, refurbishment and disposal, a more holistic understanding of the value of an asset can be achieved, which is the main opportunity to ensure the social impact of assets. The study also concluded that regulatory frameworks and accounting standards, such as International Public Sector Accounting Standards, play a critical role in ensuring the accurate classification, valuation, and management of infrastructure assets. The paper also provides the latest statistics on infrastructure losses as a result of Russia's full-scale invasion of Ukraine.

Based on these losses, it can be concluded that in the future the country has significant potential to restore this infrastructure, as well as to improve the welfare of society and contribute to the country's economic sustainability. However, one of these components is the effective management of infrastructure assets, the application of the approaches described in this paper can significantly improve the situation in this regard. It is relevant for further research to assess other components of accounting in Ukraine to find methods to improve it (e.g., inventories, financial instruments).

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