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ACCOUNTING IN A SMART CITY WITH THE COMBINED USE OF THE INTERNET OF THINGS AND GEOGRAPHIC INFORMATION SYSTEMS

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Abstract

Introduction.*The current stage of development of the smart city concept requires the development of effective digitalization techniques for accounting processes. To optimize the management of economic institutions and the smart city as a whole, multidimensional accounting information is required, generated by the Internet of Things (IoT) technology in combination with information about the territorial presence of residents. Zoning of the urban space forms an additional information resource for accounting and management purposes, which determines the importance and demand for scientific and applied developments in this area.*

The aim of the article *is to improve of the accounting in a smart city in the conditions of the combined use of Internet of Things technology (IoT) and geographic information systems (GIS) in various sectors of the economy.*

Methods. *Carrying out scientific research to achieve its goal involves the use of a systematic methodological approach in combination with innovative, functional methods and methodological tools of generalization, bibliographic, and comparative analysis.*

Results. *The feasibility of the combined use of the Internet of Things (IoT) technology and geographic information systems (GIS) in accounting in the conditions of a smart city has been substantiated. The methodology for processing accounting information using IoT and GIS technology has been improved in the economic sectors of the smart city, such as passenger transportation in terms of accounting for the expenses and revenues of carriers based on data on the number and duration of trips; parking - accounting for the expenses and revenues of parking operators depending on the number and duration of vehicle parking; fuel and energy sector and housing and communal services - accounting for the consumption of energy resources using automated meters in consumers and providers of municipal services; ecology and urban planning - calculation and accounting of rental rates of municipal property and local business taxation based on data on the ecological and urban attractiveness of the location; healthcare - accounting for the expenses and revenues of healthcare facilities taking into account the quantitative and time parameters of medical services to residents; other areas and administrative services - accounting taking into account the number of people who received the services, and so on. Common accounting dominants for different economic sectors in a smart city have been identified: automation, two-dimensional calculation units, spatial connectivity, analytical capability, integration, object-based identification, completeness of accounting, reduced periodicity, and so on. Adherence to these accounting dominants ensures transparency, reliability, completeness, timeliness, and fairness in processing accounting information for management purposes in a smart city.*

Prospects. *The methodology of using accounting information provided by IoT and GIS technologies for digitizing the management of smart city functioning is the subject of further scientific research.*

Keywords: *accounting, smart city, transport, communal services, administrative services, Internet of Things technology, geographic information systems.*

Formulas: 0, fig.: 2, tabl.: 3, bibl.: 12.

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Introduction. The latest evolutionary stage in the development of social formations is the emergence of a smart city. A smart city is a unique integrator of physical, human, and information systems around a common goal of optimizing the livelihoods of residents in different-sized territorial and community associations. The smart city creates a universal information environment that combines the city administration, municipal services, educational and healthcare institutions, and other private and communal institutions in the comprehensive servicing of the residents. The informational foundation of the smart city is a branched network of Internet of Things (IoT) devices combined through Internet communication into a single system. IoT technology ensures the collection of diverse data accumulated in a single database for further optimization of smart city management.

Using the smart city database, a feedback system is provided, through which residents can influence decision-making processes regarding the administration of socio-economic processes. Based on data from IoT devices, it is possible to take into account the behavioral characteristics of different groups of residents in the smart city, which affects the quality of municipal services. By studying the needs of residents, it is possible to quickly transform and adapt the smart city to new challenges facing municipal authorities. Managers at different levels of management receive an invaluable information resource for responding quickly to changes in the functioning of the smart city as a single economic system. However, the development of advanced methodologies for using large amounts of data provided by IoT technology is necessary for the most effective management of territorial and community associations, which determines the relevance of the research topic.

Analysis of research and publications. The development of information and communication technologies, among which IoT occupies a priority position, has led to the transition of modern large cities to smart city management principles. It is noteworthy that the most progressive in the formation of smart cities are the world centers of ICT implementation in various fields of financial and economic activity. In particular, a study conducted by the International Institute for Management Development on the global ranking of cities in terms of the successful implementation of smart city principles has made it possible to form a ranking table (Table 1).

Table 1

Leading smart cities in the global ranking

Smart City Rank 2021	City	Smart City Rating 2021	Structure 2021	Technology 2021	Smart City Rank 2020	Change	
1	Singapore	AAA	AAA	AAA	1	–	
2	Zurich	AA	AAA	A	3	↑	+1

continuation of table 1

3	Oslo	AA	AAA	A	5	↑	+2
4	Taipei City	A	A	A	8	↑	+4
5	Lausanne	A	AAA	A	NEW	–	
6	Helsinki	A	AA	A	2	↓	-4
7	Copenhagen	A	AA	A	6	↓	-1
8	Geneva	A	AA	A	7	↓	-1
9	Auckland	A	A	A	4	↓	-5
10	Bilbao	BBB	A	BBB	24	↑	+14

Evaluation scale: A - excellent, B - good, C - satisfactory. The more letters – the higher the grade.

Source: formed on the basis of [1].

Significant progress in the development of infrastructure and technologies, which are key elements in the formation of smart cities, has been achieved by the countries of Northern Europe and Asia. Eastern European cities lag far behind in the global ranking of smart city development: Warsaw (75th place), Prague (78th place), Krakow (80th place), Kyiv (82nd place) [1]. The emphasis on infrastructure transformations and the implementation of information and communication technologies in the formation of smart cities is based on global correspondence. In a survey of residents on the ranking of smart city development, priority areas for infrastructure and technological development were identified (Fig. 1).

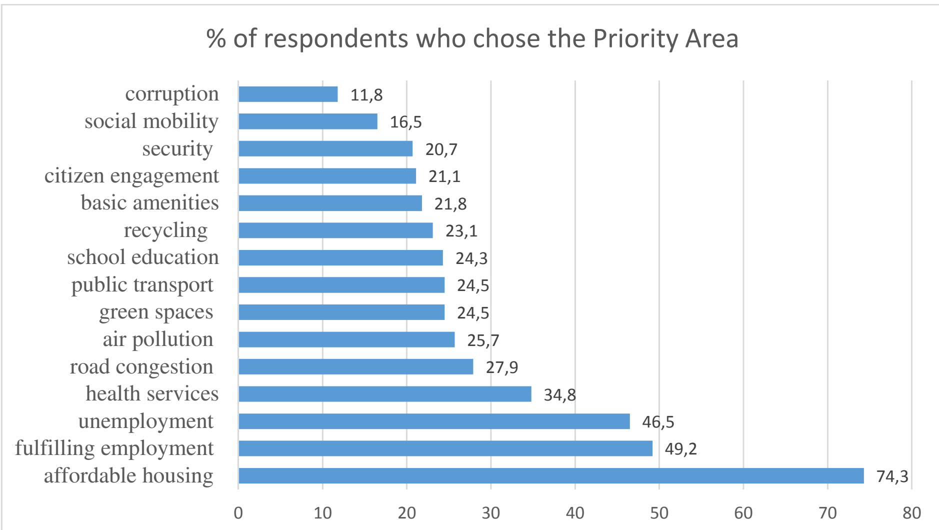

Fig. 1. Priority directions for the development of smart cities
(% of globally surveyed respondents).

Source: formed based on [2].

Among the respondents, the most important global directions for the development of a smart city are ensuring comfortable living, employment, public transportation, healthcare, ecology, and education [2]. However, economic development and effective management of financial and economic processes in smart cities are not of great interest to residents of large cities. Despite the importance of effective management of the economic development of smart cities, insufficient attention is paid to this issue in scientific research.

In the scientific space, there are isolated studies on the role of accounting in managing enterprises in a smart city. In particular, Alsaid Loai, Mutiganda Jean identified the informational, innovative, managerial, and, for the first time, government and political relationship between accounting and smart cities [3]. Karatzimas Sotirios points out the priority of acquiring accounting education for the staff of all economic entities (especially state-owned ones) in order to effectively interpret socio-economic processes that take place in the functioning of smart cities [4].

Alsaid Loai justified the importance of multi-level management accounting in optimal resource planning for enterprises in the context of a sustainable relationship with other subjects of the smart city. Management accounting is positioned by the author as the information basis of any smart city, which is presented in the author's interpretation as the "city of accounting" [5]. The smart city is informationally saturated by the network of intelligent sensors on the principles of IoT, which, as explained by Li Xiaoguang, form arrays of data not only for management accounting but also for financial accounting in order to inform external stakeholders [6]. Francesca Loia and Gennaro Maione complement the research, which, in addition to the economic effects of the formation of smart cities, identifies the need for socially oriented accounting to inform the public about the social aspects of enterprise functioning [7].

Zadorozhny Z.-M. and Korniat I. position the modern smart city as a complex of infrastructure and transportation developments designed to optimize the living and mobility of residents, which is the task of automated accounting and management of economic institutions [8]. The scientific work additionally defines areas and sectors of economic activity with the possibility of automating the processing of accounting information, which can be information components of smart city management. In addition, Song Junkang and Liang Ji have developed a model for forming regional associations of smart cities, which include accounting-information systems for innovative agricultural enterprises [9]. Unlike classical areas of economic activity for smart cities that undergo digital transformations, agriculture, which makes the most complete use of the functional capabilities of IoT and GIS technology, is essential in the development of territorial-community associations [10]. However, the joint application of IoT and GIS creates conditions for the comprehensive digitization of accounting not only in the agricultural sector but also in other areas of economic activity in smart cities, which provides a basis for forming the goal and hypothesis of the article.

The purpose of the article is to improve of the accounting in a smart city in the conditions of the combined use of Internet of Things technology (IoT) and geographic information systems (GIS) in various sectors of the economy.

The hypothesis of the scientific research is the positioning of accounting as the information foundation for managing economic processes in the smart city, which requires data collection and processing using a combination of IoT and geographic information systems.

Results. The active implementation of GIS introduces a territorial-geographic component into the analytics of accounting in the context of its digitization. Based on the use of electronic cartographic services, it is possible to divide the city's territory into separate elements (zones) for the purposes of optimizing accounting and management in the smart city. Zoning the urban space promotes variability and reliability of accounting. Each separated territorial-spatial element can be characterized by unique properties that need to be taken into account in organizing and improving the methodology of accounting. Variables can include geographic, legal, economic, social, human, resource, and military-political conditions of entrepreneurial activity [11]. Adapting accounting to the variable conditions of urban space classification ensures the completeness and reliability of accounting information. A universal information scheme for data collection and processing using IoT and geographic information systems for accounting purposes is shown in Figure 2.

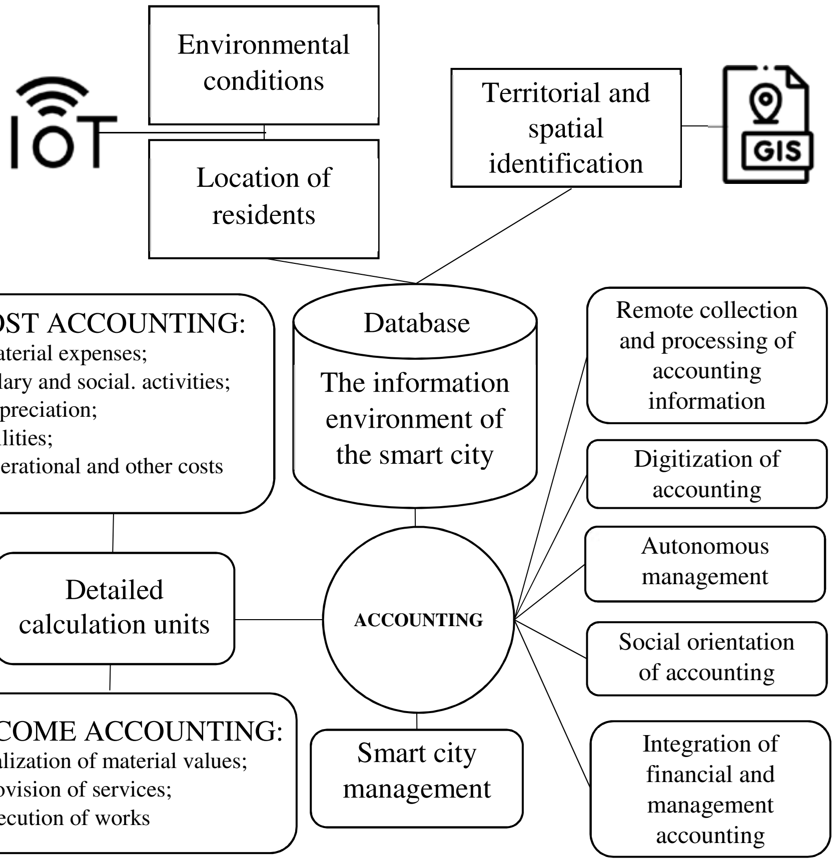

Fig. 2. Universal information scheme for accounting in a smart city with complex use of IoT and GIS.

Source: developed by the authors.

Collection and primary processing of accounting data in a smart city are carried out using the Internet of Things (IoT) technology. Technological sensors connected to the

Internet are placed in functional zones, public spaces, or utility rooms within the city or public organizations. The spatial placement of IoT devices is conveniently carried out with reference to the electronic maps of the smart city. Each IoT sensor additionally informs about the location and time of accounting data collection. As a result, a combination of geographic information systems for electronic mapping of urban space and data collection and processing technology using IoT is formed. This functional cooperation forms a significant detailed information resource for digital accounting and management purposes in various areas of smart city economic activity (Table 2).

Table 2

Areas of complex use of IoT and GIS technologies in a smart city for accounting purposes

№	Area of economic activity	Accounting objects in Smart City	Impact on organization and accounting methodology
1.	Passenger transportation	Cost of passenger transportation, revenues of carriers, revenue from providing transportation services	Based on identification of passenger location and movement within urban space, automation allows for accounting of revenues and expenses of passenger carriers.
2.	Parking of vehicles	Expenses and revenues of parking operators for providing vehicle parking services	By determining the number of vehicles and parking time in different zones of urban space, expenses and revenues of parking operators can be reflected.
3.	Fuel and energy sector and housing and communal services	Costs and revenues from providing services for the supply of electricity, water, natural gas, etc.	Automated fuel and energy resource meters provide complete, accurate, and timely accounting and control for consumers and providers of communal services.
4.	Ecology and urbanism	Rental of municipal space and taxation of businesses	Variation in the cost of rental of municipal space and the size of business taxation depending on location and the influence of ecological and urban factors.
5.	Healthcare	Expenses and revenues of medical institutions providing services to the population	Automation of accounting for expenses and revenues based on identification of population requests using an electronic patient record.
6.	Other sectors and administrative services	Efficiency results of municipal institutions	Accounting for activity depending on the location of institutions and the number of users of municipal services, etc.

Source: developed by the authors.

The combined use of GIS and IoT contributes to the optimization of accounting and management of transportation flows in a smart city. The functioning of passenger transport in a smart city is aimed at minimizing the time and costs involved in the spatial movement of residents [12]. IoT technology is used to identify passengers in places of their stay, such as public stops, various types of transport, waiting or rest halls of transport infrastructure, and so on. Information about the number of passengers, time spent, and routes travelled is used for autonomous management of transportation flows in a smart city. However, this data is also a valuable information resource for digitizing accounting and managing the activities of passenger carriers. Transport companies are also interested in the data provided by IoT and GIS technologies for optimizing their financial and economic activity at the micro level.

In particular, depending on the number of passengers transported or the duration of the travel, it is advisable to calculate the cost of transportation services provided, taking into account a smart city zoning. Transport costs and revenues of carriers may vary depending on the route in the transportation network. The routes that connect densely populated residential areas of the city, industrial or commercial establishments, city centre or historical landmarks, are usually more profitable. The popularity of transport routes involves the use of a larger number of vehicles with a significant number of seats. This leads not only to an increase in expenses for the depreciation of transport, fuel and energy resources but also to an increase in expenses for labour compensation, social insurance, and other operational measures.

Transporting each passenger increases the carrier’s costs. However, the distance travelled by each passenger using public transport is also necessary for calculating the cost of transportation services. Organizing short transport routes that connect several public stops requires minimal transportation costs, while it works differently with long distance routes between different residential areas or city zones. Accordingly, the “passenger-kilometer” can be used as a calculation unit in accounting for the cost of passenger transportation services. A two-component metric takes into account the number of residents transported in the smart city, information about which is provided by IoT technology, and the spatial distance travelled by each passenger, according to the GIS system. All costs related to the transport operation (fuel and energy resources, depreciation, and driver salaries) and servicing residents (cabin maintenance, passenger insurance, conductor and inspector salaries) should be calculated based on the number of passenger kilometers of passenger carriers.

Based on the identification of facts of passenger boarding (alighting) from public transport in the smart city’s route network, the cost of transporting one person can be automatically calculated. Taking into account the required level of profitability after providing transportation services, each passenger can be informed about the variable cost of moving within the smart city. In the case of electronic ticketing systems, the cost of transportation services can be automatically debited from the passenger’s account with corresponding reflection of revenues and cash receipts in accounting.

It works differently with electronic travel documents with a predetermined number of trips regardless of the zoning of transport routes. The revenue from the sale of electronic tickets is fixed and reflected in the future income. Writing off future period income in current financial results can occur after the passenger’s trip or at the end of the reporting period. At the same time, the costs of providing transportation are reflected in the cost of services provided by carriers in proportion to the number of passenger-kilometers within the service package according to the terms of the travel document.

A similar methodology of digitizing accounting in the transport sector can be applied to calculate the costs and revenues of parking operators in municipal areas. Zoning of urban space affects the cost of parking vehicles. In the central zones of territorial public entities, the payment for rental parking spaces is relatively high. However, in geographically remote areas of the city, the cost of parking may be lower. In the conditions of a smart city, it is possible to identify the spatial location of cars based on a complex combination of IoT and GIS technology capabilities. In this case, it is appropriate to automatically calculate the cost of parking for each vehicle depending on the parking locations during the day.

Depending on the location of parking zones in urban areas, smart city operators' expenses may vary. Variable operating costs for parking operators include the cost of renting private or public space; taxes and fees to the city budget for providing municipal services; servicing, cleaning, or security services; electric vehicle charging capabilities; additional passenger amenities; payment for the work of inspectors, cashiers, municipal police; the use of evacuation tools, etc.

It is advisable to use a universal metric to fully account for the expenses of parking operators - the "car-hour" of parking. Operating with a two-dimensional calculation unit makes it possible to calculate the time that vehicles spend in parking lots in accounting. Taking into account the number of car-hours of parking zone operation, it is possible to establish a correspondence between the operating costs of operators on the one hand, and revenues from providing parking services that take into account the duration of vehicle parking on the other.

Based on the cost of "car-hour" of servicing transportation for each parking space, the final cost of parking services can be automatically determined. The final cost of services for each driver during the reporting period depends on the zoning of the transportation in parking spaces with different costs, including free parking. The final cost of parking services is either communicated or automatically collected from the owner of the vehicle. The revenue from the sale of monthly parking subscriptions in urban zones is the income of future periods for parking operators. Accumulated future period revenues are proportionally written off together with the occurrence of operating expenses for the operation and maintenance of smart city parking zones.

One of the important cost items in the cost of services in the transport sector is fuel and energy resources and municipal services. Active development of electric transport and the transition of production to "green energy" leads to the significant increase of electricity bills. To ensure effective accounting and control of expenses for municipal services in smart cities, it is advisable to use automated metering devices that operate on the principles of IoT technology. However, the location of automated meters for municipal services such as electricity, water, natural gas, etc., is also important for accounting and management purposes. Therefore, the combination of functional capabilities of geographic information systems and IoT technology is important in smart cities. The use of GIS provides the smart city management system with information both about the territorial location of automated metering devices and but accounting of the internal spatial use of energy resources.

In addition to information about energy consumption, each automatic metering device reports on the location of any business entity and the entire smart city on an electronic map. In urban areas, automated meters can be integrated into municipal infrastructure objects, such as street lighting elements, electronic terminals, public information monitors, road control systems, and so on, making it practical to equip them with individual energy meters. Metering devices can automatically collect data on consumed services for any period and quickly transmit it for further accounting procedures. It is advisable to assign a personalized (individual number) for each metering device to account for the occurrence and settlement of debts for utilities.

When the functioning of infrastructure objects with built-in metering devices is part of the main activity of municipal institutions, energy consumption costs become production ones. It is the cost of the period of the business entity that owns the infrastructure equipment. The location of the business institution or its equipment in the smart city space is also vital. More advantageous spatial-territorial placement of economic institutions or their equipment can increase the cost per unit of energy consumed. That is, the cost of utilities may differ in certain areas of the smart city. It is necessary to consider that infrastructure equipment can be mobile and change location during the reporting period. The mobility of such objects requires determining their precise location based on data from geographic information systems to change the pricing of electricity, water, and natural gas consumption in different urban areas.

The cost of a unit of energy resources used may also vary depending on the time of day, season, consumption volume, etc. In the operation of automated energy resource meters, it is advisable to provide for the possibility of quick adaptation to tariffs changes. Therefore, energy consumption meters should be refined basing on the location of the consumer of communal services. In other words, automated meters can adapt the cost calculation algorithm for communal services for the reporting period based on variable factors. The consumer and the provider of communal services must transmit information on consumption volume and its cost simultaneously for further accounting of energy resources. If such information is the basis for operational revenue accounting for business entities providing relevant services, then for energy resource consumers, it is operational costs of various kinds.

Depending on the functional purpose of the premises with an installed automated meter is, it is advisable to separate accounts for the consumed energy resources. The cost of consumed energy resources should correlate with the structure of general production, administrative, sales, or other operational costs for each day or work shift. Impossible identification of the functional purpose of premises, territories, shared areas, etc. means that the bills for received communal services should be clustered and transferred to various expense accounts at the end of the reporting period. General production costs in terms of services should be automatically distributed proportionally to the amount of products manufactured, which ensures the determination of the full cost of finished products.

However, energy consumption as part of production costs is possible if production equipment with automated energy meters. Robotic equipment is capable of calculating the costs of utilities for the production of each unit of product, providing the basis for organizing identified cost accounting. In other words, using IoT technology in conjunction with GIS helps to calculate the share of electricity, water, natural gas, and other utilities in the cost of finished products, semi-finished products, In addition to the economic and ecological use of natural resources and electricity, the residents of the smart city are interested in protecting the environment. The information environment of the smart city integrates a branching IoT sensor network that parameterizes the conditions of the environment regarding the urban space. In the smart city, it is possible to identify the popularity of the urban objects among residents, the level of environmental pollution, the level of road congestion, access to municipal services, and so on. The parameters of the urban space determine its priority for physical and legal persons in terms of economic or residential location. Thus, certain spatial and territorial zones of the smart city are better for living or locating businesses. The municipality can impose different fees for renting municipal premises or land plots. Similarly, local taxes can be higher for objects in better spatial and territorial locations

Quick adaptation of the rental fees and taxation scheme to changes in data from the relevant IoT sensors, combined with GIS is advisable. When determining the current conditions of the urban environment, rental rates and local taxes can be reviewed periodically (once a month, quarter, or year). Based on established indicators, it is recommended to automatically generate records regarding the occurrence of arrears of individuals and legal entities to the local budget. In the future, payment of arrears is expected, and delay leads to automatic accrual of penalty sanctions and fines.

The association of household services and administrative services provided with the place of residence requires an even redistribution of resources in the smart city to ensure an edequate service. For comfortable living in the smart city, the territorial distribution of residents among service institutions matters. In particular, public health care is an institutional sphere, which, in conditions of using an electronic patient record, creates positive prerequisites for optimizing the accounting of medical services. Medical management can use data for medical services, the number of visitors to health care facilities, and information about their territorial distribution in the smart city.

Quantitative accounting is carried out when creating an electronic request for medical services and the patient's arrival at a healthcare institution. Based on data on the number of serviced individuals, it is expedient to automatically calculate additional salaries for medical personnel, write off medical drugs according to electronic prescriptions, depreciate equipment, and reflect the proportion of consumed communal services in accounting. As a result, after confirming the receipt of medical services at a specific healthcare facility, it is appropriate to automatically display its operating expenses and revenues. Revenues may include the income from patients for medical services or fundings allocated by local or state budgets.

However, it is advisable to use the calculation unit for more accurate consideration of all healthcare facilities' expenses end the activation of telemedicine in smart cities - "man-hour" ("man-day") of providing medical services. Abandoning outdated measures such as "bed-places," "person-places," etc., is justified in conditions of transitioning to remote provision of medical services through electronic communications means, which effectively function in smart cities. In addition, taking into account the time parameters in medical services ensures a fair and accurate determination of operating expenses, which complicates machinations in the sphere of medical pricing. It also makes it impossible to use budget funds for unintended purposes, which were allocated to healthcare facilities to maintain one "bed-place." Patients' and the budget's funds are redistributed between healthcare facilities only according to the number of patients and the volume of medical services. Medical institutions offering better medical services at an optimal cost become more profitable. As a result, reliable pricing in medical services ensures the optimization of healthcare facilities' financial results and the population's medical protection level in smart cities by forming transparent competition.

Other types of services provided to the residents of the smart city can be based on similar principles of transparency, reliability, completeness, timeliness, and fairness in accounting for expenses and revenues. It is advisable to form the dominant aspects of accounting in the conditions of a smart city summarizing the features of the combined use of data from IoT and GIS technologies for accounting purposes (Table 3).

Table 3

Dominants of accounting in a smart city

№	Characteristic feature	Dominant features of accounting in a smart city.
1.	Automation	Accounting procedures for collecting primary data and their initial processing can be performed automatically.
2.	Two-dimensional calculation unit	Cost accounting and cost calculation in smart city enterprises take into account various quantitative and qualitative processes in operational activities simultaneously.
3.	Spatial correlation	The accounting data obtained have semantic links to the territorial-spatial locations of their acquisition or processing in the smart city.
4.	Analyticity	Accounting data have a significant level of analytics that makes it possible to characterize financial and economic events in the smart city from various angles.
5.	Integrability	All information services are integrated into a single information environment of the smart city, and the information from which is used for accounting purposes.
6.	Item-level identification	Each unit of manufactured products or each provision of services can be identified for separate object-oriented cost accounting.
7.	Completeness of inclusion	All expenses must be identified for full inclusion in the cost of production (services) in management accounting and management of the smart city.
8.	Reduced frequency	Data collection and accounting indicators formation can be performed within a significantly shorter period of time (minute, hour, day).

Source: developed by the authors.

Through the functional capabilities of IoT for identifying the number of residents receiving administrative services, and geographic information systems for identifying their spatial location, Smart City creates an information environment for effective autonomous management of economic processes. Therefore, the methodology of using accounting information from IoT technology and GIS for digitizing the management of Smart City's functioning is the subject of further scientific research.

Conclusions. The latest stage in the evolution of social formations is the emergence of a smart city. A smart city creates a unique information environment that combines physical, human, and information resources to optimize the lives of its residents. The technological and informational component of a smart city is the Internet of Things (IoT) technology, which provides a network of connected sensors to the internet. IoT devices parameterize the movements of smart city residents and the conditions of their living spaces. The most effective way to manage a smart city is through the combined use of IoT technology and geographic information systems (GIS) for urban planning.

Information on territorial zoning and the movement of residents can be effectively used for accounting purposes. Promising directions for the combined use of IoT and GIS technology in the context of identifying objects in urban spaces include: passenger transportation (accounting for transport costs and revenues based on data on the number and duration of trips); parking (accounting for parking costs and revenues depending on the number and duration of parked vehicles); fuel and energy sector and utilities (accounting for energy consumption using automated meters for consumers and providers of municipal services); ecology and urban planning (calculating and accounting for rates of municipal property rental and local business taxation based on data on the ecological and urban attractiveness of locations); healthcare (accounting for healthcare costs and revenues for healthcare institutions based on quantitative and time-based parameters of medical services for residents); and other spheres and administrative services (accounting for the number of people receiving services, etc.).

Based on the generalization of information processing methods from IoT and GIS technology, common features that form the dominant characteristics of accounting in smart cities can be identified. Specifically, automation, two-dimensional calculation units, spatial correlation, analytics, integration characterize accounting in smart cities, object identification, comprehensive consideration of factors, reduced periodicity, and more. Adhering to these dominant accounting features in smart cities ensures transparency, reliability, completeness, timeliness, and fairness in processing accounting information. However, the methodology of using quality accounting information from IoT and GIS technology for digitizing smart city management requires further scientific research.

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ОБЛІК У СМАРТМІСТІ З КОМБІНОВАНИМ ВИКОРИСТАННЯМ ТЕХНОЛОГІЇ ІНТЕРНЕТ РЕЧЕЙ ТА ГЕОІНФОРМАЦІЙНИХ СИСТЕМ

Анотація

Вступ. *Сучасний етап розвитку смартміст потребує розробки дієвих методик діджиталізації облікових процесів. Для оптимізації управління господарськими інституціями та смартмістом загалом необхідна різностороння облікова інформація, яка генерується технологією Інтернет Речей (IoT), у поєднанні з відомостями про територіально-просторове перебування жителів. Зонування міського простору формує додатковий інформаційний ресурс для цілей обліку та управління, що визначає важливість та затребуваність науково-прикладних розробок у цій сфері.*

Мета статті *полягає в удосконаленні обліку у смартмісті в умовах комбінованого використання технології Інтернету речей та геоінформаційних систем у різних галузях економіки.*

Методи. *Виконання наукового дослідження для реалізації його мети передбачає використання системного методичного підходу у поєднанні з інноваційним, функціональним методами та методичним інструментарієм узагальнення, бібліографічного і компаративного аналізу.*

Результати. *Обґрунтовано доцільність комбінованого застосування технології Інтернет речей (IoT) та геоінформаційних систем (GIS) у бухгалтерському обліку в умовах смартміста. Удосконалено методику обробки облікової інформації з використанням технології IoT та GIS у галузях економіки смартміста: пасажирських перевезеннях у частині обліку витрат і доходів перевізників на основі даних про кількість і тривалість поїздок; паркуванні транспорту – обліку витрат і доходів паркувальних операторів залежно від кількості і тривалості паркування транспортних засобів; паливо-енергетичному секторі та ЖКГ – обліку споживання енергоресурсів з використанням автоматизованих лічильників у споживачів і надавачів комунальних послуг; екології й урбаністиці – розрахунку та обліку ставок оренди комунальної власності та місцевого оподаткування бізнесу на основі даних про екологічну й урбаністичну привабливість місця розташування;*

охороні здоров'я – обліку витрат і доходів закладів охорони здоров'я з урахування кількісно-часових параметрів медичного обслуговування жителів; інших сферах та адміністративних послугах – обліку з урахуванням кількості осіб, яким надані послуги, тощо. Виокремлено спільні для різних галузей економіки домінанти обліку в смартмісті: автоматичність, двовимірні калькуляційні одиниці, просторова пов'язаність, аналітичність, інтегрованість, пооб'єктна ідентифікованість, повнота врахування, зменшена періодичність тощо. Дотримання наведених домінант обліку забезпечує прозорість, достовірність, повноту, оперативність та справедливість в опрацюванні облікової інформації для цілей управління у смартмісті.

Перспективи. *Методика використання облікової інформації, наданої технологіями IoT та GIS, для діджиталізації управління функціонуванням смартміста є предметом наступних наукових пошуків.*

Ключові слова: *облік, смартмісто, транспорт, комунальні послуги, адміністративні послуги, технологія Інтернет речей, геоінформаційні системи.*

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