

*Розроблено модель якості управління та метод її кількісного визначення для підприємств міського електротранспорту. Сутність запропонованого рішення полягає в методи визначення експертних оцінок операцій маршрутних ліній та коефіцієнта доданої цінності. З цією метою визначається загальний пасажиропотік і пасажиропотік досліджуваного маршруту. Ефективність управління та якість обслуговування клієнтів оцінюється з використанням єдиного оціночного критерію*

*Ключові слова: математична модель якості, управлінські рішення, ефективність перевезень, центри відповідальності*

*Разработана модель качества управления и метод ее количественного определения для предприятий городского электротранспорта. Сущность предложенного решения состоит в методе определения экспертных оценок операций маршрутных линий и коэффициента добавленной ценности. С этой целью определяется общий пассажиропоток и пассажиропоток исследуемого маршрута. Эффективность управления и качество обслуживания клиентов оценивается с использованием единого оценочного критерия*

*Ключевые слова: математическая модель качества, управленческие решения, эффективность перевозок, центры ответственности*

# ORGANIZATION OF RESPONSIBILITY ACCOUNTING OF CITY ELECTRIC TRANSPORT ENTERPRISES' ACTIVITY

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## 1. Introduction

The important role of the land city electric transport (CET) is confirmed by the experience of the functioning of advanced transport systems around the world. The need for its development in cities is justified by scientists and experts in the field of organization of city transport systems. The infrastructure nature of transport services lies in the accessibility, cost-effectiveness and environmental friendliness.

At present, enterprises of city electric transport in Ukraine are unprofitable, so the industry is declining. However, latest scientific studies indicate the need for the development of electric transport, which will allow achieving significant environmental and social effects [1].

The CET sector needs radical reform. It is necessary to increase the efficiency of the management system by directing efforts to overcome the unprofitability of tram and trolleybus enterprises. This is primarily related to improving the quality of service. Therefore, optimization of the formation of financial results of activity are the priorities of management of tram and trolleybus enterprises.

Effective management in modern conditions involves the use of qualitatively new information generated in the management accounting system. The most accurate and timely

information on service quality violations is generated under the condition of organization of responsibility accounting. In such circumstances, information about resources consumed and results achieved by separate units of the enterprise is generated. Reasonable grounds for motivating employees to achieve specific goals are also provided. However, the profit and cost center accounting in different industries is carried out depending on the production technology and organizational structure of the enterprise. The organization of responsibility accounting creates the opportunities of proper information support for making optimal management decisions.

## 2. Literature review and problem statement

The scientific problem of improving the system of management accounting of the enterprise activity is under review by many researchers. The main trend of management accounting is the statement about changing the current role of accountants towards active participation in decision-making on management of economic activity of the enterprise [2].

At the moment, management accounting acquires clear strategic features. The growing complexity of business in con-

ditions of uncertainty leads to the corresponding information requests. It is important for modern management to adapt in due time to a changing environment by applying creativity and forecasting. Therefore, management accounting combines the features of forecasting, planning, analysis and control [3].

A significant contribution to the provision of the theoretical proposals is made in fundamental scientific works [4]. However, the presence of modern scientific research indicates further development of management accounting, in particular, responsibility accounting. Current publications cover the role of responsibility accounting and general principles of its organization at the enterprise [5]. They also reveal the importance of organizing an effective system of internal control and reporting [6]. The influence of proper planning, accounting and control of the activity of responsibility centers on the formation of financial results at the enterprise has been proven [7].

For the adequate provision of information support of optimal solutions, accounting should be fully integrated into the structure of the enterprise and take into account the technological features of its activity as much as possible [8]. Such criteria are met by responsibility accounting.

There are now a number of scientific works dealing with the study of trends in the development of CET enterprises in Europe [9, 10]. In scientific researches, the analysis of system effectiveness of city electric transport in Ukraine has been carried out and the system of measures to improve the industry functioning has been proposed [11, 12].

However, there are practically no proposals on the formation of a complete system of management accounting in the CET industry. At the same time, the activity of tram and trolleybus enterprises has many industry specificities. Therefore, for the effective organization of the management accounting system, it is necessary to study in detail the influence of such features and to develop a system of responsibility accounting, which links qualitative criteria with the efficiency of utilization of available resources.

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### 3. The aim and objectives of the study

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The aim of the study is to develop a method for quality control of management, taking into account the strategy of priority implementation on the most efficient city transport routes.

To achieve this aim, the following objectives were set:

- to determine the influence of industry specifics of the activity of tram and trolleybus enterprises on the organization of management accounting;
- to develop a mathematical model and a method for determining the quality of management, which connects the quality of service with the efficiency of city transport routes.

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### 4. Materials and methods of the study

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The information base for the study were official reporting data, factual information and results of the questionnaire of managers of CET enterprises of Ukraine.

Methods of studying the specified problem are based on dialectic and system approaches to studying the current state of activity accounting of CET enterprises, management quality and efficiency models. Methods of analysis and synthesis were used to determine the industry specifics of

the activity of tram and trolleybus enterprises and to study the influence of such features on the construction of the accounting system. The development of the organizational model of responsibility accounting is based on the application of modeling methods.

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### 5. The results of studies of the organization of the system of responsibility accounting of CET enterprises

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Within the ordinary course of business, operating, financial and investment activities are distinguished. Of these, the operating activity of the enterprise is always connected with the main purpose of the enterprise and its industry specifics. The main differences of such activity are constant repeatability and regularity of economic operations.

The operating activity is, first of all, characterized by typical operations for the operating conditions of the enterprise. Such operations directly affect the stability of formation of financial results due to the high probability of costs and profit.

A thorough approach to this problem indicates the need to allocate a number of features that would characterize the type of enterprise activity. These include the purpose and the nature of activity, the need for invested capital or significant volumes of resources, dependence on the enterprise life cycle, the presence of operational risk and focus on a specific consumer market [13].

But such an approach will be effective only if transport services are provided with a certain quality.

Thus, the main objective of the operating activity of tram and trolleybus enterprises is to provide transport services to large segments of the urban population with the most favorable results. Such activity can be characterized as follows:

- priority of transport quality in the coordination of operations with the investment activity;
- use of the prevailing volume of the involved material, labor and financial resources of the enterprise;
- provision of the main share of profit.

The organization of enterprise management is associated with certain stages of the operational cycle of its activity, that is, the interval between the acquisition of resources for carrying out passenger transport and making profit from the provision of transport services to passengers. The process of interaction of the enterprise with suppliers and consumers of services includes the conversion of the initial capital into resources necessary for the provision of high-quality transport services. The process of interaction with consumers involves a reverse conversion – obtaining the result of transport services provided into the capital in monetary terms. The cycle of capital turnover of city electric transport enterprises is presented in Fig. 1.

The main feature of the operating activity is the regularity of economic operations and the resulting profit, costs and financial results. Thus, the basis for the operating activity of tram and trolleybus enterprises are operations for the preparation and implementation of city passenger transport in accordance with schedules and routes. However, enterprises of city electric transport incur costs not only in the course of organization and implementation of transport. Much of the costs arise during storage, maintenance and repair of the rolling stock. Also, enterprises carry out AC transformation and uninterrupted power supply, maintenance and repair of the contact network and tramways.

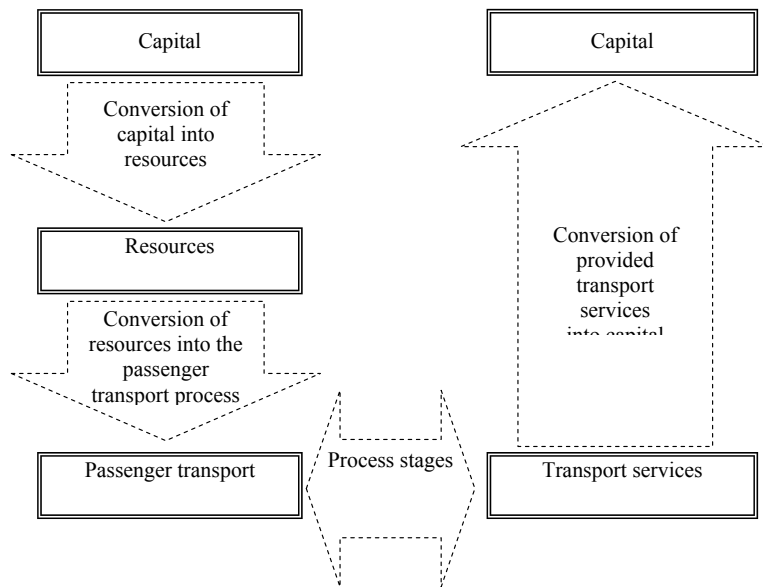


Fig. 1. Processes of the operating activity of city electric transport enterprises

The operating activity consists of a number of successive stages: supply, preparation for transport, provision and implementation of transport services. At the enterprises of city electric transport, the processes of production, sale and consumption of products are combined, while in the production sphere the specified processes are separated from each other in space and time. Transport does not generate wealth that can be accumulated or reserved. CET companies provide passenger transport services. Services cannot be separated from the transport process, resulting in an inextricable link between the provision and consumption of transport services. This puts transport companies in direct dependence on fluctuations in demand for transport and leads to uneven production.

In addition, CET companies have significant peculiarities in relations with customers. In accordance with the law, tram and trolleybus enterprises are obliged to provide transport services to certain categories of passengers at a reduced cost [14]. According to the report of the CET Corporation, the number of passengers entitled to reduced transport fares in 2017 reached 65.84% [15]. The procedure of forming transport fares is also legally established, focusing primarily on the criterion of real solvency of the population [16]. Therefore, part of the costs of the main activity are covered at the expense of budgetary financing. The amount of such financing should correspond to the amount of profit lost due to the transport of those categories of passengers who enjoy reduced public transport fares. In addition, the funds of CET enterprises should be recognized as a form of profit, the amount of which depends on the quantity and quality of transport services provided to those categories of the population paying reduced fares.

Based on the above peculiarities of management of city electric transport enterprises, the following definition of the operating activity can be proposed. It is a set of operations related to the preparation and direct implementation of passenger transport by the rolling stock in accordance with established routes and schedules.

To ensure the proper management of the operating activity of CET enterprises, it is necessary to possess suffi-

cient information about quality and efficiency. The information behavior of managers should combine control, adaptation, forecasting and creativity based on the diversity of information resources [17]. In this regard, the main objects of management are profit, costs and financial results. At present, information on these objects is formed within the integrated accounting system at the enterprises of city electric transport. However, such information is not enough to ensure the high-quality implementation of management functions. The process of effective accounting of activity should be organized so that on its basis, it would be possible to take timely and scientifically sound management decisions. "One of the major principles when choosing an option of the organization of activity accounting and management is obvious the compliance of the accounting system with the objectives of management" [18].

In each case, the management decision must be, above all, targeted. That is, the management influence should be directed to the definition of financial result and efficiency of activity not only of the enterprise as a whole, but of each structural unit separately. This situation leads to the growth of the information role of responsibility accounting, which will allow determining general and individual results. Possibilities of effective management depend on "the extent of perception and interpretation of information formed in the accounting system by the management staff" [19].

Responsibility accounting provides direct and feedback communication at different levels of management. The purpose of such accounting, above all, is the formation of a new vision of production responsibilities of employees and the organization of conscious self-control. Employees will feel responsible for the quality of the work performed and have confidence that the final achievements will not remain unnoticed by the management. After all, the skillful use of psychological and economic leverage will motivate employees to achieve the best results.

Therefore, responsibility accounting is a key element of organization of management accounting, which combines control, analytical and motivational functions. Such accounting system is not new, it is described in detail in the works of both foreign and domestic scholars. Thus, "responsibility accounting is a system that allows you to evaluate plans and actions of each responsibility center" [4]. The organizational structure of the enterprise resembles a pyramid, in which each manager is assigned to the responsibility center [18]. This principle of accounting allows determining levels of profit and costs by the primary places of origin in structural units. There are different approaches regarding the structure and classification methods of responsibility centers. Cost, profit and investment centers are commonly distinguished [20].

However, it is necessary to distinguish between the concepts of "profit or cost center" and "responsibility center". It is well-known that the profit or cost center is a type of responsibility centers. Often, scientists define both the profit or cost center, and the responsibility center as a segment of the enterprise activity. But responsibility centers must have personal responsibility of the head for activity indicators, which can be influenced and controlled.

At the same time, there are differences regarding the specificity of distribution of profit and costs among responsibility centers. Thus, there is a statement that cost centers and responsibility centers should be considered as two independent objects of accounting and control of production costs, which are determined by the place in the enterprise structure, economic characteristics and social content [21]. That is, responsibility centers, first of all, are associated with cost management, while cost centers – only with the calculation of production costs.

There is also a definition of the cost center as cost grouping, which allows combining cost centers with the responsibility of managers who head certain departments in one accounting process. In this case, cost center means a separate object of analytical accounting for the purpose of monitoring, control and management.

Along with cost centers, most researchers distinguish profit (revenue) centers that have certain characteristics. This is a mandatory responsibility of the management of a separate structural unit of the enterprise for the formation of profit (revenue) and the lack of control over costs.

The starting point for constructing the responsibility accounting system is the organizational structure of the enterprise. First of all, it is proposed to take into account the technological structure of the enterprise and then allocate its horizontal and vertical sections.

So, in different industries, profit and cost center accounting should be carried out in different ways, because it depends on the technology and organizational structure of the enterprise. The main focus should be on the distribution of profit and costs precisely among responsibility centers, whose managers can directly influence the process of formation of indicators and bear personal responsibility.

The main operating activity is performed by the depot traffic service, which provides transport services to passengers. This service organizes passenger transport on routes and monitors compliance with the traffic regularity on the line according to the schedule. The services of the main unit can be characterized as follows:

- the cost of services is directly included in transport fares;
- direct consumers of services are passengers.

However, enterprises of city electric transport incur costs not only in the process of organization and implementation of transport according to the schedule. Auxiliary units do not directly serve passengers. The activity of such units is aimed at achieving the main objective. They should contribute to the functions of the main unit. To perform such technological functions, the following production and operating units are organized:

- rolling stock department of the depot (repair shops), which is intended for storage, maintenance and repair of the fleet, that is, responsible for putting technically sound vehicles on the line;
- energy management department (traction power stations and emergency dispatch service), which provides uninterrupted power supply to the line through AC transformation;
- railroad management department, which performs the functions of maintenance and current repair of tramways and railways.

The peculiarities of services provided by auxiliary units include:

- the cost of services is indirectly included in transport fares;
- passengers are indirect consumers of services.

However, the problem is the inconsistency of services, with respect to the priorities of service of technical facilities of different routes and the quality of their work with the quality of service of transport passengers.

At present, the role of city electric transport begins to grow. This trend is most noticeable in large cities, where the efficiency of using personal transport is constantly decreasing due to the growing shortage of parking places and frequent congestion.

Today, the main criterion for deciding on the type of vehicle is reliability and compliance with the declared schedule. In such a situation, a transport enterprise serving a passenger traffic of more than 2 thousand pass/h is guaranteed to become profitable [22].

As a result, the technology for improving the efficiency of city public transport should be based on the method that allows combining the interests of both service staff and passengers.

The proposed method relies on the use of the basic structure of the estimate [23, 24], which was tested for the possibility to be applied as a criterion of efficiency [25–27]

$$E = \frac{(P - R)^2}{R \cdot P \cdot T^2},$$

where  $R$  is the expert estimate of the input product of the operation;  $P$  is the expert estimate of the output product of the operation;  $T$  is the time of the operation.

The proposed method is based on the fact that the indicator of resource efficiency is transformed into a standard of passenger service quality.

For this, as the expert estimate of the input product of the operation, we take the volume of served passengers on the segment of the studied route –  $R=N$ .

Let us determine the coefficient of the added value of transport service as the ratio of the average number of passengers transported daily to the number of lines and the average number of passengers served by transport lines ( $k$ ).

Then the expert estimate of the output product of the transport operation can be determined from the expression  $P=N \cdot k$ .

Let us introduce the concept of a frame as an interval of time from the transport arrival to a stop until the arrival at the next stop.

Then out of frame at a fixed time interval will change the coefficient  $W$  of the penalty function  $F$

$$F = (k - 1) \sum W. \tag{1}$$

When out of one frame, the numerical value of the coefficient of the penalty function takes a unit value. This value is increased by one at the next out of frame within the route.

Then for the service quality indicator, we will get

$$Q = \frac{(N \cdot k - (k - 1) \cdot \sum W - N)^2}{N^2 \cdot k \cdot T^2}. \tag{2}$$

The value of the efficiency index with zero penalty function index is a standard for the transporter and the service staff of the line.

On the other hand, the maximum value of the estimate indicates the most profitable route for the transport enterprise.

For a route with a maximum reference  $Q$ , it is advisable to put the most experienced driver and the most up-to-date



rolling stock. And so on, as the reference values of the estimate decrease.

In this case, the update rate of the entire fleet will be maximum, and the quality of service and the possibility of increasing salaries of the enterprise staff will increase.

Consider an example of using the method to assess the quality of passenger transport.

Let us assume that the total number of passengers transported daily by the entire fleet of rolling stock is 10,000 people. The total number of passengers transported daily on the studied route – 2,000 people. Route time – 1 h 30 min. The number of stops – 20 units.

Then,  $N=20$ ,  $k=2,000/10,000=0.2$ ,  $T=1.5$ .

By substituting the values in the expression (2), we get (Fig. 2).

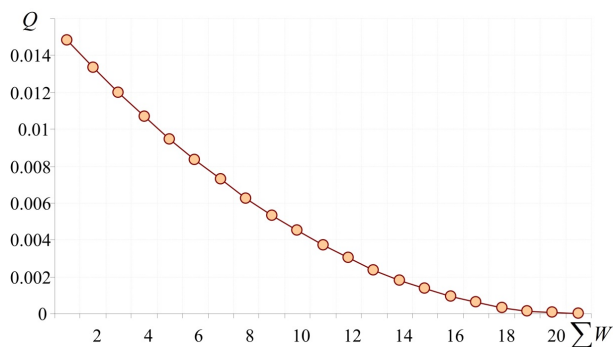


Fig. 2. The values of the passenger service quality index depending on the number of outs of the route frames

Calculations show that a complete deviation from the schedule or non-departure of the rolling stock on the line lead to a zero value of the quality index.

## 6. Discussion of the results of the study of the organization of the system of responsibility accounting of CET enterprises' activity

One of the biggest problems with transport service is the need to ensure maximum efficiency of each passenger. Moreover, as a result of such service, it is necessary to ensure the competitiveness of the transport enterprise.

This specificity necessitates the coordination of management efforts, which should be aimed at such a specific result as the accuracy of vehicle positioning in time.

The developed quality index allows linking various management aspects.

There is an opportunity to estimate the efficiency of various routes, and using this estimation to set priorities both for units that provide traffic of vehicles, and for the staff directly responsible for the quality and efficiency of passenger transport.

The connection between quality and efficiency in one indicator makes it possible to interest all structures of the transport enterprise in the high-quality service for passengers. At the same time, such high-quality service will satisfy customer needs as much as possible and significantly increase the passenger traffic.

This, in turn, will increase the efficiency of the transport enterprise with the use of accounting and management tools.

Of course, these new opportunities can be implemented only if the collection, storage and processing of new data will be organized. These are data on arrival and departure times of transport to the locations of passengers.

The collection of such data is already carried out in a number of cities of the world and Ukraine. At the same time, it is technically not difficult to implement such collection in the automatic mode. This requires additional information related to causes of deviation from the reference frame:

- low quality of road services in bad weather conditions;
- quality of repair and maintenance of the vehicle;
- low skills of the driver, etc.

The problem of practical provision of transport service quality in order to increase efficiency requires many steps and further scientific research. However, the development of the proposed quality formula and the method for determining the indicator, depending on the frame deviation from the standard, allows taking a step in the near future.

It should also be noted that at the governmental and departmental levels, provision of transport services will be subject to legal regulation solely in terms of detailing the procedural actions or administrative regulation of structural units and officials of some department to improve the organization of their service and public activity.

The process of standardizing the provision of transport services by public administration bodies should be based, certainly, on assessment of their quality. The quality of transport services will be determined by the appropriate criteria. The criterion is the basis for assessing the quality of transport services. The criteria should be suitable for the development of standards for the provision of transport services on their basis. Quality assessment of transport services should be carried out both by the state and by consumers of services through their comparison. The standard level will be determined as the appropriate quality level of transport services. Minimum requirements are a minimum quality limit. Failure to comply with the minimum standard is a reason for the negative quality assessment of provision of transport services and should provide for certain legal consequences.

## 7. Conclusions

1. To ensure the effective organization of management accounting of CET enterprises' activity, it is necessary to take into account sectoral features. These include state regulation of the industry, peculiarities in relations with customers, the specific nature of the services provided and technological features of structural units.

2. The mathematical model and the method for determining the management quality, which connects the quality of service with the efficiency of city transport routes, are developed. On the one hand, this allows rating of routes by the criterion of efficiency, on the other hand – determining the quality of service of the transport enterprise's customers regarding the accuracy of fulfillment of the transport schedule.

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