TIME REALITIES SCIENTIFIC GROUP

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RISK MANAGEMENT OF SMART ACCOUNTING SYSTEM IMPLEMENTATION IN URBAN PASSENGER TRANSPORT BASED ON INTEGRATION OF SMART INNOVATIONS, INFORMATION TECHNOLOGIES AND MARKETING TOOLS

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The monograph provides an in-depth examination of the intricate process of implementing a smart accounting system in the realm of urban passenger transport. Through a comprehensive exploration of various facets, the monograph seeks to address the challenges and opportunities associated with incorporating innovative technological solutions in the transportation sector.

With a focus on the specific context of Ukraine, the monograph begins by analyzing the state of intra-urban passenger traffic within the country, drawing upon both domestic and international experiences. It also investigates the theoretical and methodological principles behind tariff policy formation in urban public transport and highlights the significance of smart accounting systems in ensuring secure data storage.

Furthermore, the monograph delves into risk management strategies associated with the implementation of these systems, examining both domestic and global methods for identifying and mitigating risks. It also investigates international experiences in passenger risk management and the implementation of automated fare payment systems. By drawing on research of global advancements in smart innovation, information technology, and marketing tools, the monograph offers valuable insights into how these technologies can be harnessed to enhance urban passenger transport. Finally, it proposes measures to strengthen stakeholder interactions within the smart accounting system, ultimately providing a comprehensive overview of the complex landscape of implementing smart innovations in urban passenger transport.

This monograph will be particularly valuable to a diverse audience. Transportation professionals and policymakers can gain insights to enhance the efficiency and security of urban passenger transport, while researchers can find a rich resource for academic studies in the fields of transportation management and technology integration. Government officials responsible for urban development and technology providers can use the knowledge to make informed policy decisions and develop relevant solutions. Additionally, consultants and educators can utilize this monograph for advising clients and educating students about the intersection of technology and transportation in urban environments, making it a versatile resource for enhancing the urban mobility landscape.

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CONTENT

INTRODUCTION

The transition to the investment and innovation stage of economic development, accession to the WTO, the acquisition of associate membership in the European Union requires the development of transport on a qualitatively new basis. Due to the fact that the modern transport system of urban passenger transport does not meet the requirements of society, mass motorization of the population is becoming an alternative to public transport, which creates a new lifestyle and ensures the mobility of the population. The number of privately owned cars in Ukraine is growing every year and in 2016 there were 202 cars per thousand Ukrainians. This leads to congestion in cities, increased environmental load and significant energy costs, as transport is the largest consumer of light petroleum products. In addition, low comfort in transport (no Wi-Fi, air conditioning, etc.); inability to plan a trip in advance due to the lack of a clear schedule and high level of possible injuries to passengers (due to distraction of the driver to carry out fare transactions with passengers; "competition" between taxi drivers - violation of traffic rules to increase passenger traffic, and thus revenue).

Most leading Ukrainian scientists insist on creating competition between carriers and reducing government regulation in this area. But now there is competition only between route carriers and due to the lack of routes and the number of public transport, passengers are more likely to get on minibuses, despite their technical condition or the fullness of transport because it is impossible to guess when the trolleybus or tram. On March 15, 2017, the Odessa City Council adopted a decision № 1780-VII On the introduction of an automated metering system in public passenger transport in Odessa, which provides for bringing the relationship between the city and the transport system to a completely different level, as close as possible to European practice: income carriers will be made dependent on the quality of their work and will create the

conditions for the elimination of traffic "minibus" and the transfer of all buses to normal traffic.

But due to a mistake in taking into account the possible risks, due to inefficient use of information technology and marketing tools, even this project may fail, which will lead to significant financial losses from the state and for many years again reject the introduction of quality, socially oriented, cost-effective urban passenger transport .

Public passenger transport is one of the priority infrastructure sectors, and its stable operation is a necessary condition for the development of all sectors of the economy and improving the social situation in the city. To begin with, it is necessary to understand the content of the concepts of tariff and compensation policy.

The system of state financial support of public passenger transport, the purpose of which is the balanced development of transport systems with a high level and quality of passenger service in terms of partial performance of public transport assigned to it, exists in most developed countries. The basis of unprofitable urban passenger transport in developed countries is a single tariff for intermodal transport systems. An intermodal transport system is a system for ensuring the functioning of public transport in a given area, when several types of urban transport (bus, tram, trolleybus, metro) create a clear and simple system of interconnected routes, adhering to certain conditions and regularity of intervals between connections and relocation. passengers at a single fare, which contributes to the promotion of urban transport and encourage the population to it through the establishment of a relatively low fare.

The authors of this monograph are employees of Odessa National Polytechnic University, Department of Accounting, Analysis and Auditing, Department of Management and Department of Business Economics:

Bashynska Iryna, PhD, Associate Professor, (Introduction; Sections 1.1; 1.2; 1.3; 1.4; 1.5; 2.1; 2.2; 2.3; 2.4; 3.2; conclusions – 5,6 p.p);

Filippov Volodymyr, PhD, Associate Professor, (Introduction; Sections 1.2; 2.3; 3.2; conclusions – 5,0 p.p);

Chapter 3 was prepared by Doctor of Economics, Full Prof. Filyppova Svitlana (1,2 p.p.); Sections 1.3 and 3.1 – Ph.D., Assoc. Prof. Dyskina Anastasia (1,1 p.p); Section 4.2 – Ph.D., Assoc. Prof. Kovalova Olena (0,9 p.p); Sections 2.1 and 2.3 – Ph.D student Alnuaimi Hamed Rashed Sayed Abdullah (0,2 p.p); Sections 2.2-2.3 – Ph.D student Alhammadi Taleb Abdullah Mohammed Ali (0,2 p.p); Section 2.5 – Ph.D student Eisai Salah Abu Isbaykhah Almabruk (1,78 p.p) according to the results of research for a long period.

The monograph contains the results of research for the budget of the Ministry of Education and Science of Ukraine, provided for the development of research topic № 0017U003804 № 711-82 "Risk management of smart metering in urban passenger transport based on the integration of smart innovations, information technology and marketing tools".

CHAPTER 1.
ANALYSIS OF THE PASSENGER TRANSPORT INDUSTRY OF UKRAINE

1.1 Intra-urban passenger traffic in Ukraine

The transport sector is one of the most critical areas of social production and is designed to meet the needs of the population and production. This industry in the economy has a wide range of competitive players, but each of the modes of transport plays a role in the market of transport services.

Trams and trolleybuses operate in 53 cities of Ukraine; they provide a significant share of intercity passenger traffic. Therefore, it is necessary to analyze the dynamics of transport (Fig. 1.1).

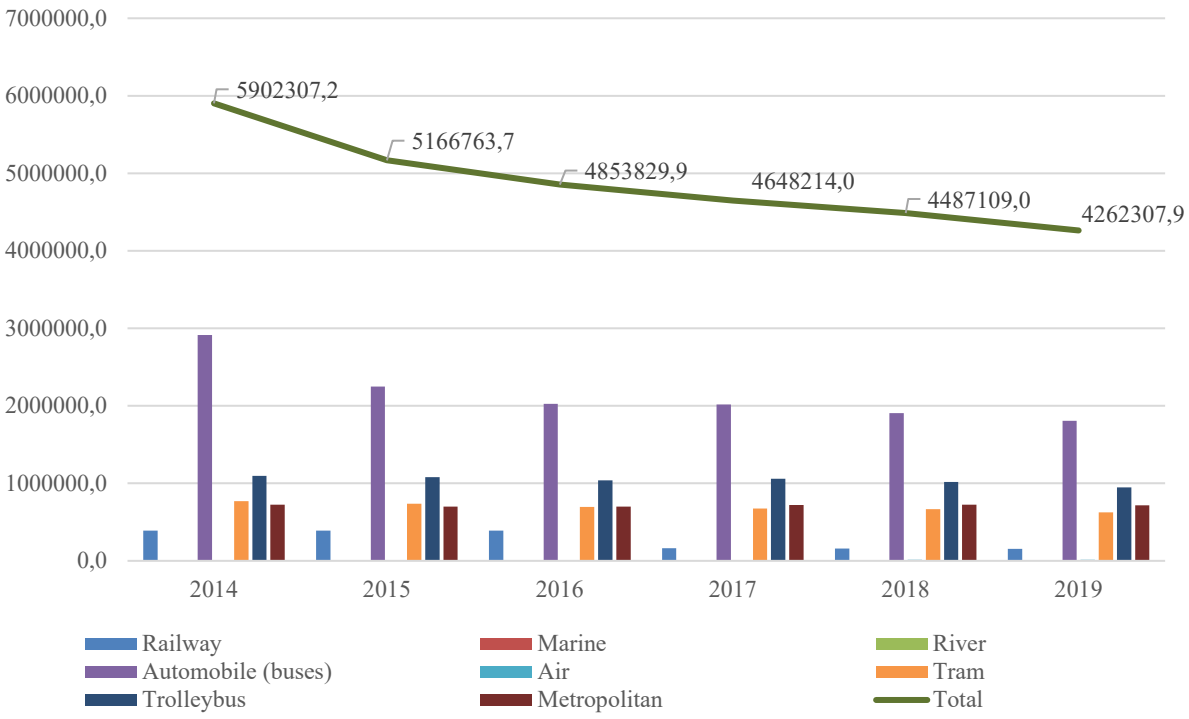

Figure 1.1. Transportation of passengers in 2014-2019, million passengers (source: developed by authors based on official statistics [The State Statistics Service of Ukraine])

The figure shows that passenger traffic is decreasing every year – in 2015 the decline in passenger traffic was 12.5% (compared to the previous year), in 2016 – 6.1%, in 2017 – 4.2%, in 2018 – 3, 5%, in 2019 - 5.0% (compared to the previous year) and 27.8% (compared to 2014), i.e. the average decline will be 6.26% per year. The most significant positive changes occurred in maritime transport (average annual growth of 32.4%), negative – in rail (the average yearly decline of 12.8%) (Fig. 1.2).

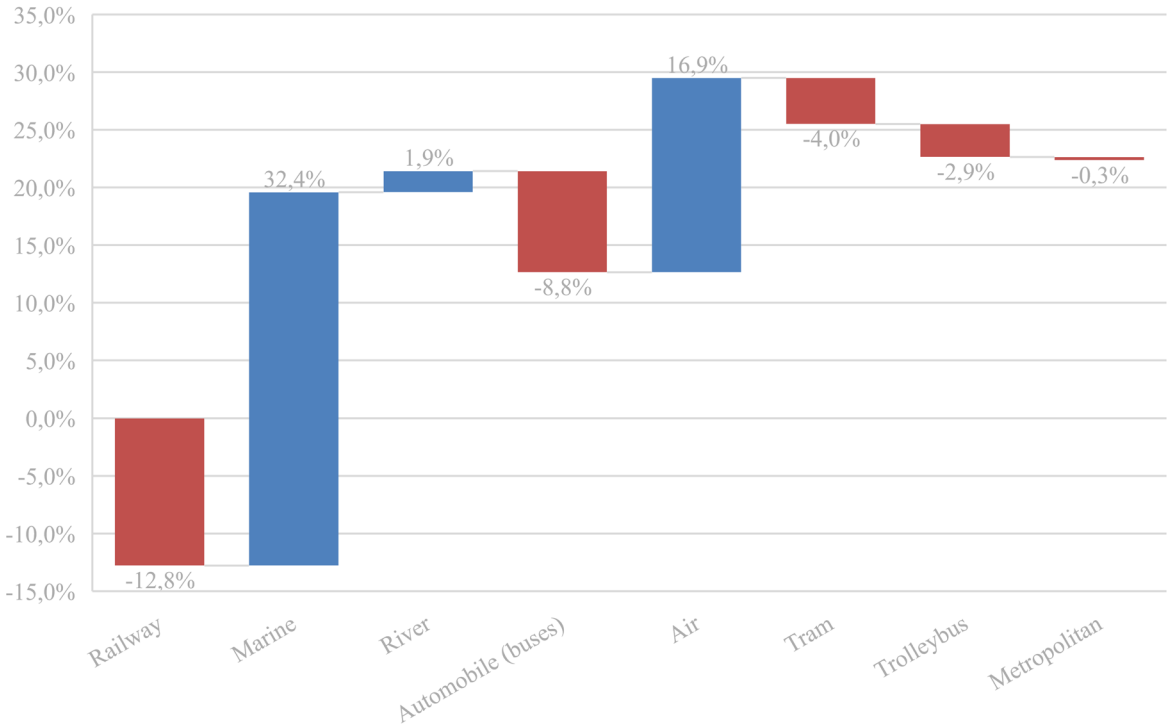

Figure 1.2. Average annual change in passenger traffic in 2014-2019, % (source: developed by authors based on official statistics [The State Statistics Service of Ukraine])

As for urban transport, there is a drop in demand everywhere. This is due to the growing number of personal cars, primarily due to the mass import to Ukraine of supported cars from the EU. It is this category of consumers, not having the financial ability to buy a new car, to a greater extent, used public transport.

In Ukraine, with the support of the Ministry of Infrastructure of Ukraine, within the framework of the Draft Framework Loan Agreement for Urban Public Transport of Ukraine, there is the "Urban Public Transport Ukraine Project". Technical documentation for MIU funding applications. However, not all cities submit applications.

Table 1.1 – Infrastructure improvements. Cities that have applied (source: developed by authors based on official data [The Ministry of Infrastructure of Ukraine])

Name of the city	Infrastructure improvement	New ticket system
Chernihiv	Overhaul of existing trolleybus lines	No
Lviv	New trolleybus lines. Overhaul of existing trolleybus lines. New trolleybus depot. Bus station. Bus repair centre. Overhaul of existing tram lines. Tram depot.	No
Ivano-Frankivsk	New catenary and substation	No
Kharkiv	No	No
Kyiv	Capital reconstruction of the tram track 2 x 9.2 km	No
Lutsk	New trolleybus lines. Overhaul of existing trolleybus lines. New contact network.	Yes
Mykolayiv	Comprehensive system of traffic organization and safety	Yes
Odessa	Overhaul of the existing tram route, 2 x 32 km	No
Sumy	No	No
Ternopil	No	No
Zaporizhzhia	No	No

Typical stages of the cycle of city public transport project development is shown in Fig. 1.3.

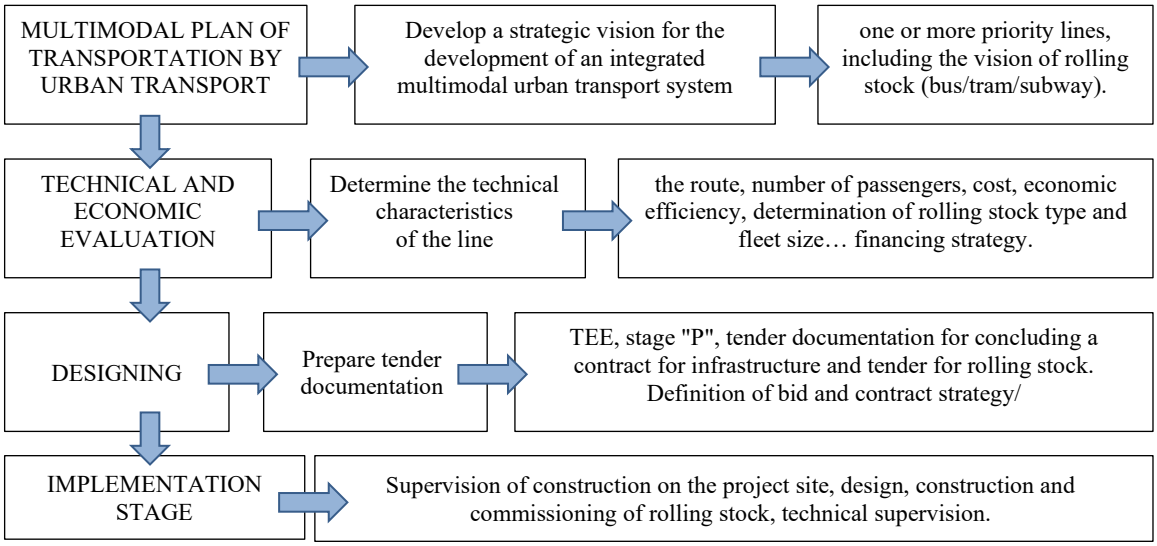

Figure 1.3. Typical stages of the cycle of city public transport project development

Thus, the context of the project, tasks and definitions are evaluated; technical feasibility (demand and analysis of options) and environmental sustainability; a financial analysis is performed, which includes the calculation of investment costs, operating costs, operating income, an analysis of affordability, evaluates sources of funding, financial efficiency indicators and financial sustainability. The final stages are economic analysis and risk and sensitivity analysis. This is how the issue of urban rolling stock was assessed public transport (Table 1.2-1.6) (source: based on official data [The Ministry of Infrastructure of Ukraine]).

Table 1.2 – A general overview of needs in urban rolling stock

Cities	Trolleybus	Bus	Tram	Subway
Chernihiv	56			
Lviv	35	75	9	
Ivano-Frankivsk	30	9		
Kharkiv				35

Kyiv		35	10	
Lutsk	30			
Mykolayiv			10	
Odesa			56	
Sumy	22			
Ternopil		10		
Zaporizhzhia	30		20	
TOTAL:	203	129	95	35

Table 1.3 – Trolleybuses

Cities	Trolleybus	Specific price for consideration	TOTAL
Chernihiv	56 (41+15)	82 500 €	4 620 000 €
Lviv	35	200 000 €	11 200 000 €
Ivano-Frankivsk	30	200 000 €	6 000 000 €
Kharkiv	8	187 500 €	1 500 000 €
Kyiv	50	200 000 €	10 000 000 €
Lutsk	30	145 455 €	4 363 650 €
Sumy	22	181 000 €	3 982 000 €
Zaporizhzhia	30	141 000 €	4 230 000 €
TOTAL:	261		45 895 650 €

The unit price under consideration is low compared to the international market. Tenders will be of interest only to national suppliers. The significant size of orders. The price in Chernihiv looks low even for local prices.

Table 1.4 – Buses

Cities	Buses	Specific price for consideration	TOTAL
Lviv	75	120 000 €	9 000 000 €
Ivano-Frankivsk	9	200 000 €	1 800 000 €
Kyiv	35	143 000 €	5 005 000 €
Ternopil	10	80 000 €	800 000 €
TOTAL:	129		16 605 000 €

The unit price under consideration is low compared to the international market. The significant fluctuations in the price range. The tender will be attractive only for national suppliers. Regarding Ternopil, the price of buses 10-12 m long is low.

Table 1.5 – Trams

Cities	Trams	Specific price for consideration	TOTAL
Lviv	9	1 055 555 €	9 499 995 €
Kyiv	10	1 460 000 €	14 600 000 €
Odesa	56	500 000 €	28 000 000 €
Zaporizhzhia 1 (low-floor)	10	580 000 €	5 800 000 €
Zaporizhzhia 2 (standard)	10	516 000 €	5 160 000 €
TOTAL:	95		63 059 995 €

There is a considerable fluctuation in unit prices. Some cities are considering purchasing low-floor rolling stock according to European standards, while others are considering replacing existing T4 or KT4 conventional trams. For some cities, the number of transport units to order is small, which can lead to significant fixed prices. There is a difference in track width between cities (meter in Lviv).

Table 1.6 – A general overview of the subway

Cities	Subway	Specific price for consideration	TOTAL
Kharkiv	35	1 375 000 €	48 125 000 €
TOTAL:	35		48 125 000€

The specific price looks in line with the international market, even slightly higher. The purchase involves only seven trains, with five cars each, which is a very limited size, especially given the organization of maintenance, individual spare parts, training and more.

After this analysis, conclusions are drawn, and an open discussion is held. Thus, the first review of requests from cities gives grounds for the following findings:

- most rolling stock needs are justified by upgrading the existing fleet. In most cases, this applies to the products of national suppliers, reference data and prices;
- the required budgets are usually low and based on little unit prices. Only rolling stock provided by domestic suppliers can meet the budget (except for the metro). This can be a problem if Banks seek international competitive bidding.
- the justification of the benefits defined in the feasibility study should be checked for their confirmation by the appropriate values that must be taken into account in the analysis of costs and benefits. At what stage are the feasibility studies today?
- there is a certain synergy of projects between some Cities, which gives grounds for consolidation of orders and obtaining cheaper financial proposals from rolling stock suppliers.

1.2 World experience of smart accounting system implementation (e-ticket)

The world experience of passenger transport reforms shows that despite all their differences, there is one global common specificity: in almost all countries of the world, public transport as a whole remains unprofitable.

The problem of the optimal ratio between the public and private sectors, government regulation and market mechanisms in passenger transport has not yet found a universal satisfactory solution in the world. Different countries approach this problem differently.

Reforms with the privatization of passenger transport enterprises have been carried out mainly in developing countries. As a result of these reforms, a mixed system of public passenger transport has developed almost everywhere, in which transportation is carried out by both public and private enterprises. These reforms are reduced to the more or less widespread implementation of transport service contracts concluded on a competitive tender basis.

Government regulation is always too strict. Therefore, tariff regulation and admission to traffic can, over time, severely limit the ability of private carriers to increase or maintain the existing level of service.

In developing countries, privatization and deregulation of passenger road transport have rarely been accompanied by the retention of any significant direct budget subsidies. Moderate assistance is sometimes provided, for example, in the form of bus stop equipment or fuel tax exemptions. However, subsidies previously received by state-owned companies are usually completely abolished when these companies are transferred to the private sector (because the burden on the budget is an important argument in favor of privatization). If direct subsidies are maintained, they are provided only to a state-owned company, which does not disband, but works in competition with private carriers.

In urban public transport, smart card data consists of millions of observations of users who are part of vehicles over the network over several days.

Although the popularity of automated Smart Card payment collection systems is increasing in public transport, a large amount of data is collected daily in existing systems. Although they are mainly focused on revenue collection, smart systems can help planners better understand the behavior of public transport users, thus helping to improve service.

In fact, these systems contain data on each landing on the public transport network with accurate time and some accuracy on site. The data sets produced by these systems are growing rapidly and require both an effective data research tool and the ability to discriminate from planning experience. We are convinced

that data mining gathers useful data processing techniques to increase the analytical value of smart card data.

Thus, we present an analysis of the international experience of implementing a smart metering system in public urban passenger transport [17]:

Seoul (South Korea)

Seoul has recently become a testing ground for advanced digital technology. According to the International Telecommunications Institute, in June 2011, the city announced the launch of the Smart Seoul 2015 program. The measures envisaged by the program would allow the city to remain a world leader in the implementation of ICT solutions.

Here, digital technology is ubiquitous. Even people whose earnings are not enough to buy a smartphone, such a device will still appear. Citizens rent out-of-fashion smartphones in working order, and then receive a reward of 50 to 100 dollars. Poor citizens can eventually choose one smartphone to use. The city's free wireless internet network combines high-speed broadband optical wired and wireless networks using technologies such as Wi-Fi and NFC [18].

In 2009, land transport stops were installed in Seoul, the touch panels of which offer citizens to use various "smart" services: get information about routes, weather reports, build a route on online cards.

Poland

Public transport in Poland is automated - from the button to open the door and ending with the purchase of a ticket.

Ticket machines are installed in every tram and almost all buses in the first car. Its presence is indicated by the plate Automat biletowy. You can also buy tickets at some stops (depending on the city's passenger traffic: in Warsaw - almost all stops, in Krakow and Lublin - mainly in the city center, near the stations).

There is a special mobile application Sky Cash, with which you can also buy tickets by depositing money in a virtual account (with a commission) or with a bank card. Passengers often use payment from a bank card - it is very

convenient, in the case of control, you can present tickets on the phone screen (they indicate how long the ticket will be valid).

There are signs at the tram stops, where you can see how long it will take to get the right tram.

There are various sites to help passengers:

– at www.kkm.krakow.pl you can find more information about tickets.
– the website jakdojade.pl paves the routes of public transport in the cities of Poland, showing the travel time, the nearest time of arrival of the tram (bus) to the desired stop (Fig. 1.4). The site also shows on the map how much and where to go to the stop.

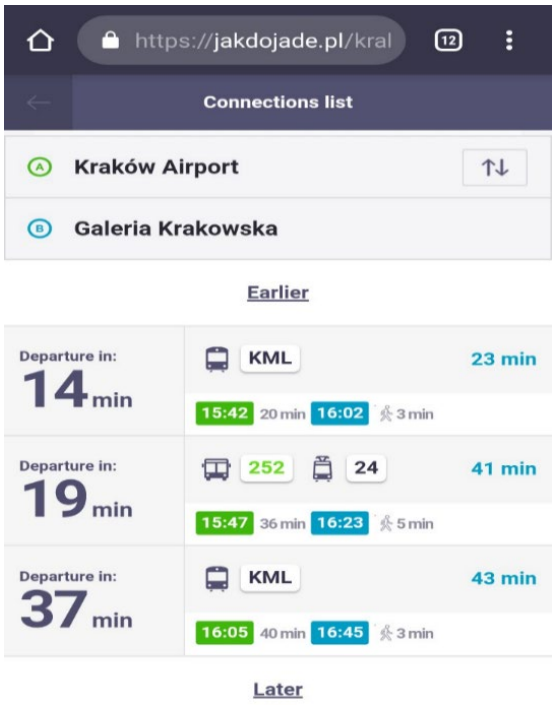

Figure 1.4. Example of using the site to route public transport from the airport to the Krakow Gallery in Krakow

Public transport follows the timetable, so it is possible to plan safely. It should be noted that the system of passenger transportation is not a miracle of the most modern information systems, but this system is simple and convenient for passengers.

Public transport reform in the Netherlands

The Parliament and the Government of the Netherlands have concluded that an unlimited amount of funding should not be continued in public transport. It is therefore important that public transport be better able to meet consumer demand.

The evaluation of the results of the reform after the tendering of routes should be carried out according to the following criteria:

- increase in the value of passenger-kilometers;
- improving the quality of passenger service;
- maintaining the fare at the same level or reducing it;
- change of compensation to transport companies;
- increase safety and improve working conditions for staff;
- preservation of jobs;
- guaranteed availability of transport services.

The country's transport is set a task: competition will be introduced on urban and regional transport routes only after transport service providers become independent of the government. Transport companies in Amsterdam, Rotterdam, The Hague, Utrecht, Dordrecht, Nijmegen and Maastricht are still partly or wholly owned by the municipality. According to the law on passenger transport, privatization is not mandatory. And local authorities, choosing a transport company to service the route, it is impractical to act simultaneously as the owner of the company. Therefore, it is the municipal transport companies that should be privatized as soon as possible.

The Netherlands Passenger Transport Act stipulates that transport service providers must have a concession to provide public transport services. The concession gives the supplier the exclusive right to operate in a particular area. Transport service providers compete with each other to try to win tenders. Thus, the law ensures the existence of competition in the field of public transport.

Tendering of concessions by state structures should maintain control over public transport. Therefore, the law on passenger transport requires them to

develop requirements that must be met by the transport service provider applying for the tender. Local authorities are given the right to decide on the term of the concession, provided that it is a maximum of six years.

Transport service providers usually do not have to operate without a concession, as it gives exclusive rights. However, these rights are not entirely exclusive, so that in certain circumstances the operation of public transport may be provided without a concession. The transport service provider may request to hire his authority and agree on the exceptions provided. However, the request may be rejected if the requested services may adversely affect the services for which the concession was previously granted.

The introduction of the new system may mean that the owner of the transport company will have fewer concessions than before, and that the volume of traffic and work in general will be reduced. However, the introduction of market mechanisms should not lead to socially unacceptable policies, as the law protects the rights of transport workers. A separate section of the law deals with the situation when a concession is transferred from one transport service provider to another.

The law also regulates the question of how to prevent any of the transport service providers from taking a leading position in the market. The State Competition Agency can also prevent joint ventures, cartels, etc. by forming joint ventures. It will monitor the development of the public transport sector and focus on tender procedures to determine the objectivity and transparency of concession transfers.

The quality of services to the population as a result of reforms is planned to improve in several ways. First, concessions will be tendered every few years, and transport service providers will be forced to enter the market with offers aimed at satisfying consumers. Second, local authorities may impose various types of requirements on the concession to ensure, for example, accessibility. They can thus force the supplier to provide services that are more acceptable to

the consumer. Third, government regulations guaranteeing the provision of services will be adopted.

One of the conditions for granting a concession is the responsibility of the service provider for the implementation of the schedule. The Law on Passenger Transport requires that all transport service providers develop and implement a procedure governing the system for filing complaints, receiving them and providing feedback.

Transport infrastructure management system in Germany (Berlin)

The body that pursues a unified policy in the field of transport and carries out a unified management of the transport system is, on behalf of the Council of Ministers of Germany, the Ministry of Transport. Due to the differentiated subordination of all modes of transport to the state transport authorities, as well as the availability of significant transport capacity in other sectors of the economy, the management of the transport system requires large and complex interconnections of planning, control and coordination.

Centralized management of modes of transport of national importance (rail, sea, inland waterway, air transport) is carried out by the Ministry of Transport. Road transport plants are managed by district councils, and urban passenger transport is managed by city councils. The German Minister of Transport has the right to give instructions to local administrative bodies on the main issues of transport policy, and the special bodies of the Ministry - to give guidelines to decentralized subordinate transport companies and monitor their work.

One of the primary tasks of the ministry is to identify transport problems, prioritize their solution and develop goals for the development of transport infrastructure of the city. This work is carried out with the broad involvement of various public organizations: transport unions, residents of the city, cyclists' associations, the disabled, businesses and various other communities of citizens.

In Germany, the strategic development plans of Munich, Dresden, Berlin, Stuttgart and other cities differ significantly both in terms of program goals and in terms of their implementation. However, all of them were developed and

implemented in full compliance with the Federal Law on Municipal Planning, which determines not only the minimum content of the plan, but also the algorithm of its development, as well as tools for its implementation.

The system of all modes of transport (buses, subways, trams, boats) is managed by several state-owned enterprises - Berliner Verkehrsbetriebe (BVG - Berlin Transport Company), Deutsche Bahn AG (DB), S-Bahn Berlin GmbH, Verkehrsbetriebe Potsdam GmbH (ViP Potsdam Transport company) and others who are partners of the Transport Association Berlin-Brandenburg - Verkehrsverbund Berlin-Brandenburg.

Non-state companies occupy a small sector of transport services (for example, the organization of private parking lots).

In Germany, there are absolutely all types of transport, if you take the country as a whole. If we consider each city separately, then

- metro is available only in large cities
- tram lines - a privilege of East Germany (former GDR) and Bavaria
- buses - everywhere
- trolleybuses have almost outlived their usefulness, today there are less than five cities with trolleybus connections.

Public transport in most German cities is represented by buses, trams, underground or high-speed trams (U-Bahn) and suburban trains (S-Bahn). Tariffs are the same for all modes of transport, the ticket is valid with transfers. There are a lot of travel and tourist tickets to save.

The smart accounting system has been introduced for more than 20 years. Tickets can be purchased in three places:

- in the branch of the transport company that serves this area;
- in machines that stand at almost every stop (shown in the line diagram with a special icon)
- in vending machines inside the vehicle (they accept payment only by credit card and they are not in every car. Basically, the presence of such a machine says a special sticker on the front door).

All tickets can be purchased in special cars at subway stations and commuter trains. Tickets must be composted in red cars on the platforms. The fine for ticketless travel is quite high.

Buses run strictly on schedule. Only entrance is allowed through the front door. You can buy a ticket from the driver for only one trip. If the ticket has already been purchased, for example, in the subway, it must be shown to the driver. In some cities, the entrance is through the front door only in the evening, when the controllers are not working.

The cost of a single trip in Berlin transport is 2 euros (for a short distance 1.2 euros), a ticket for the whole day costs 5.6 euros (with the surrounding area - 6 euros). Travel for a week costs 24.3 euros (with the surrounding area - 30 euros).

There are also two tourist passes, which include, in addition to free transportation, discounts on museums, attractions and tours. WelcomeCard for three days costs 21 euros and gives discounts of up to 50%. CityTourCard gives smaller discounts, is valid only in the central part of the city and costs 14.5 euros for 2 days and 18.9 euros for 3 days.

Wuppertal-Schwebebahn: "a train hanging in the air." If the width of the roads does not allow to lay a tram track, and geological conditions - to start the subway, it remains to use airspace. In 1901 a suspended monorail was built for the inhabitants of Wuppertal (Germany) (Fig. 1.5). 10 km "air train" rushes at an altitude of 12 m along the river. Another 3.3 km, it travels over the city streets at an altitude of 8 m. The train is 24 m long, with 48 seats and 130 standing seats, develops a speed of up to 60 km / h and runs between 20 stations. Wuppertalians are proud that their monorail is the oldest and most unique form of public transport. During the entire operation of the suspended monorail there was only one fatal accident, it is considered a reliable vehicle in the world. Every day up to 82 thousand residents and guests of the city choose Schwebebahn for travel. During the year, the number of passengers who used the monorail exceeds 25 million people.

Figure 1.5. Suspended monorail Wuppertal

Public transport in Tallinn (Estonia, Ühiskaart).

Public transport operates in Tallinn daily from 6.00 to 23.00 (some lines - until 24.00). The ticket control system is selective, so you can enter the vehicle through any door without presenting a ticket to the driver. All you have to do is register a ticket through a validator when entering public transport.

Ticket prices. You can buy tickets for one hour or one day to travel by public transport in Tallinn:

Temporary ticket (for 60 minutes) at the driver: 2 € (1 € for holders of ISIC Student cards and student ticket). Only cash is accepted.

Time ticket for travel within an hour (60 minutes): 1.50 €

Daily ticket (for 24 hours): 4.50 €

Ticket for 3 days (72 hours): 7.50 €

Ticket for 5 days (120 hours): 9 €

Ticket for 30 days: 30 €

Tallinn Card: for 24, 48 or 72 hours (the price includes free visits to museums and attractions): 16 € - 64 €.

Tickets are valid from the moment of the first registration of the ticket until the end of the last registered trip. You must re-register your ticket each time you enter public transport during the trip. A green light on the validator means that the ticket has been successfully registered, a red light means that the ticket is invalid or that the funds on the card have run out.

Time ticket and day ticket. You can buy an hourly ticket:

- the driver (only exact cash is accepted)
- in ticket machines located at the airport, at the bus station, in terminals A and D of the sea passenger port
- when paying by contactless payment card (Mastercard, Maestro, Visa and Visa Electron) at the orange validator located at the front door of the vehicle.
- you can purchase a day ticket and a time ticket (known as QR tickets):
- by downloading money or a corresponding ticket on Ühiskaart (the only green travel card) online, or at any point of sale of travel tickets. The ticket system registers trips during the day and charges from the Ühiskaart card (the only green travel card) or from a bank account according to the cost of the cheapest ticket per day: the maximum amount a passenger can pay for an unlimited number of trips per day is the daily price. ticket.
- online at tallinn.pilet.ee
- through the smart application pilet.ee (for iOS and Android). If the ticket is purchased through the application, then an additional 0.32 € is paid for the service, the amount will be added to the account when paying.

If the ticket is purchased on the website tallinn.pilet.ee, you can both download the ticket and send it to the e-mail address. If you create a user account, all tickets will be in the "My Tickets" section.

Tickets for 3, 5 and 30 days. Tickets for travel for 3, 5 or 30 days can be downloaded to a single Ühiskaart card - the only green travel card, also known as Smartcard or Travelcard. You can buy Ühiskaart for a deposit of 2 €, and then download the credit or download the ticket online on the Internet, through the

application tallinn.pilet.ee, through the application pilet.ee (for iOS and Android) or at the point of sale of the card.

Tallinn Card: 24, 48 and 72 hours. The Tallinn Card acts as a ticket, giving its holder the possibility of unlimited use of public transport during its entire period of validity. The card also offers free access to the best museums and attractions in Tallinn, a free Tallinn City Tour with a Tallinn Card PLUS and other discounts. You can buy a card for 24, 48 and 72 hours.

How to use different tickets. Temporary QR-ticket. The QR-ticket can be registered with the orange validator in the front entrance door of the vehicle by placing the QR-code, which is displayed on the screen of the smart device (Fig. 1.6) or printed on paper in front of the code reader at the bottom of the square validator. An unregistered QR-ticket is valid for one year.

The following categories of passengers can use free travel on public transport:

- children under 7 years old;
- passengers accompanying children under 3 years of age;
- Tallinn residents (registered, using a personal Ühiskaart travel card and carrying an ID card).

Figure 1.6. Validator in the front entrance door of the vehicle (Tallin, Estonia)

Organization of passenger road transport in the United States

In terms of ownership, the United States currently operates mostly municipal transportation, with virtually no private transportation. Transport decisions are made at four levels of government: local, regional, state, and federal.

At the local level, transportation funds consist of property taxes, transit fees, and other sources, such as part of the state and federal taxes on motor fuels and sales taxes. Most of the funds are used for the construction and maintenance of streets, roads and transit services, including small projects such as the installation of traffic lights, road signs and bus stops.

Regional transportation agencies such as the Southern California Association of Governments (SCAG), the San Diego Association of Governments (SANDAG), the Los Angeles County Metropolitan Transportation Authority (MTA), and the Orange County Transportation Authority (OCTA) play important roles in transportation decisions. Their responsibilities include: long-term planning on transport issues, evaluation of projects to improve passenger transport systems, selection of projects for the staff, etc. Decisions are made by the board of directors, which consists of representatives of different cities and counties.

At the state level, transportation decisions are made by the legislature and the state governor, the transportation commission, and the state's transportation department. Legislatures and the governor issue laws that determine the main directions of development of public transport services, determine the amount of tax.

At the federal level, Congress sets the federal tax and distributes federal funds among the states. The US Department of Transportation oversees the distribution of state revenues, designs transportation projects, monitors their quality, and enforces compliance with federal environmental laws.

On average, $ 6 billion is allocated annually for the needs of the country's passenger transport. USA at the rate of: 80% - from the federal budget, 20% - by collecting fares on the ground. The purchase of rolling stock on the ground comes from the federal budget at the expense of the same 80%. Each year, the federal budget increases subsidies for passenger transport by about 2%.

The cost of a single ticket in various cities and towns in America ranges from 1.5 to 2 dollars. The fare in each case is claimed by the local municipality. The distribution of funds to compensate for the travel of beneficiaries is approved at the federal level. In the United States today, there are only two categories of beneficiaries: people with disabilities of different groups and causes of disability and veterans. The money from the federal budget goes to the municipalities, which distribute it to all categories of beneficiaries. These subsidies are distributed in the form of tickets. All privileged passengers get on the bus with tickets, ie compensation goes directly to purchase a ticket.

Mostly 12-meter buses are used in America. Passengers board all buses through the front door, where devices are installed, which, passing through the magnetic cards, fix the entry of passengers and at the same time count them. In the absence of a magnetic card, travel can be paid in cash. Unlike us, they have no conductors. The driver collects the revenue himself and hands it over. It should be noted that all buses are equipped for use by people with disabilities. This means that a passenger is able to enter any bus in a wheelchair.

All routes are thoroughly and carefully studied, an in-depth analysis of passenger traffic. If there is growth, the carriers consider and decide on the expansion of the route network or on the continuation of individual routes. The cost of one hour of work in the United States is from 30 to 50 dollars. Private owners do not show much desire to occupy this niche in the country's economy, as profits are not large and costs are high. Therefore, they try to avoid working on public transport.

In the United States at all levels of passenger transport management there is no division into types - electric, underground and others. All passenger

transport is managed by a single body in the governments of different administrative-territorial entities.

Public transport in Spain

In the mid-1980s, Spain had major problems with public transport: the same routes tried to serve different companies that produced obsolete and motley equipment, set fares at retail and almost did not burden themselves with concerns about passenger comfort, safety and adherence to schedules. The problem was so serious that the government put it in second place after unemployment.

In May 1985, a transport consortium appeared in Madrid, thanks to which this five-million city has now achieved one of the highest percentages of public transport in Western Europe. This was facilitated by the new law on land transport adopted in 1987 in Spain.

According to a government decree, the Madrid Regional Transport Consortium received the status of a public organization, and its founders and shareholders were the state of public works and transport, the authorities of the metropolitan province and the municipality of Madrid. Their total cash contribution to the consortium in 2001 alone was € 452.8 million. At the expense of a small part of these funds is the device, the rest goes to pay for the carriage of privileged passengers, expansion and modernization of the fleet, infrastructure development. This organization was tasked with:

1. Coordination and regulation of all types of public transport: city and suburban buses, subways and suburban electric trains.

2. Unification of fares in different modes of transport and unification of tickets so that people can use any mode of transport according to the same travel documents.

3. Improving the quality of passenger service.

4. Perspective planning of transport development and control over its work.

The consortium itself does not own transport. City buses and subways are owned by the municipality, trains are state-owned, and suburban bus routes are serviced by private commercial companies. However, all act only in agreement

with him. The consortium determines the number and configuration of buses on each route, the number of seats, the availability of air conditioners and environmental parameters of engines, traffic schedules, location of stops, fares. Now one trip in public transport costs one euro ten cents at a cost of two euros. Therefore, municipal buses payback by about 85%, and the subway by 50%. The difference is covered by the founders of the consortium, as social stability is important to them, and the current fares can be considered political.

The average age of city buses in Madrid is 5.1 years, of which 99.6% are air-conditioned, 58% - low-floor (for the convenience of passengers, especially the disabled and mothers with baby carriages), several dozen buses run on clean gas, and one - experimental - and completely on hydrogen.

The organization of passenger traffic is markedly different from the Russian. Thus, for public transport on the streets of Madrid allocated a right lane. Departure of private cars threatens her with a fine of 100 euros, so the buses run smoothly and on schedule. Passengers enter the bus - only through the front platform. It, like the door, is large enough that one person can, if necessary, buy a ticket from the driver, while others go to the cabin and punch their tickets (including travel) through electronic composters-validators.

Resolved and the issue of beneficiaries: the Spaniards are privileged to pay a discount:

- for people with disabilities of different groups, it is from 20 to 50%;
- for parents with many children, depending on the number of children, from 20 to 60%.

All carriers-transport enterprises are fully reimbursed by the state and the mayor's office through a consortium.

For the convenience of passengers, all city buses in Madrid are painted in red, and suburban - in green. Unprofitable red buses are contained by the municipality, and transportation from the capital to the surrounding towns and between them brings significant income to private companies. However, their business is completely transparent and controllable.

The information support system is well thought out. Every passenger can get a convenient brochure with the scheme and schedule of buses and trains, and at any stop from afar you can see the numbers of routes and intervals.

The advertising and propaganda campaign launched by the municipality in favor of public transport is truly supported by a well-thought-out and powerful infrastructure and technical base.

Public transport in France

Public transport in most French cities consists of buses, sometimes trams and commuter trains. Paris city transport (www.ratp.fr) consists of buses, metro, commuter trains (called RER), and in a couple of suburbs there are trams.

The basis of the Paris transport system consists of 14 metro lines (it is the densest metro system in Europe and possibly in the world. The norm is to have at least one metro station 500 meters from any house within the vast central part of Paris), as well as 5 RER lines. Buses complement this network.

The tariff system is based on the principle of ring tariff zones, of which there are eight with distant suburbs. Zones 1-2 are the only zone, central Paris. Zone 3 includes the nearby suburbs - Vincennes, Saint-Denis, Defense and others. In 4-5 zones are both Paris airports, as well as Versailles and Disneyland. Due to the large number of zones and tickets, there are many fares in Paris, and we will give just a few examples.

A single ticket in the center costs 1.4 euros, a block of 10 tickets - 10.5 euros. The night bus costs 2.7 euros. The ticket for the Mobilis Pass day costs 5.3 euros for 1-2 zones, 7 euros for zones 1-3, and 12.1 euros for zones 1-5. Weekly travel Carte Orange costs 15.4 euros for 1-2 zones, 20.3 euros for 1-3 zones, 30.2 euros for 1-5 zones. However, it is not valid for any seven days, but for a calendar week, from Monday to Sunday. The last day when you can buy it for the current week is Wednesday.

In Paris, 16 metro lines marked with the names of terminal stations, so you need to know the name of the final station of the line you need. The metro runs from 5.30 am to 1 am. Races between metro stations are usually very small. You

can make as many transfers ("correspondence") as you want with one ticket. Metro tickets are also suitable for RER buses and trains within Paris. You can buy a ticket for 1 trip or 10 trips, the cost will depend on the area.

There are also tickets for the week ("coupon jaune", valid from Monday to Sunday) and for the month ("carte orange"). Tickets "Mobilis" or "Paris Visit" entitle to one, 3 or 5 days of unlimited travel by subway, bus and RER trains (valid from any day of the week) and entitle to discounts when visiting some museums (depending on zones). The "Musees-Monuments" ticket entitles you to free and preferential access to the permanent collections of 70 museums and monuments in Paris and Ile-de-France (sold at the Paris Bureau of Tourism).

In addition to the usual seats, the subway cars have folding, which in rush hour or when the car is crowded should be released.

Trolleybus "What is going". The official name of the only type of public transport in the world, which combines a trolleybus with a guide rail and just a trolleybus - "tram on tires" (Fig. 1.7).

Figure 1.7. "Tram on tires" (Nancy, France)

Has been running in the French city of Nancy since 2000. The 11.1 km route with 28 stops is covered by an unusual tram in 40 minutes. The average speed of transport is 16.5 km / h, and the maximum is 70 km / h. Bombardier vehicle with 200 seats, including 55 seats. The tram on tires consists of three

sections. Under the first section 2 axes are attached, and under the second and third - on one axis. In the center of each axle is a special guide wheel for driving on sections with a rail. The 2.1 km railless route is transported as a trolleybus or bus, as an auxiliary diesel engine is provided.

Transport management systems in major cities of China

SHANGHAI. Shanghai today has the most powerful and balanced urban public transport system, as well as the most extensive and modern network of urban highways in China. Moreover, according to these indicators, the new financial and business capital of the country is second only to a few cities in the world. As in other major Chinese cities, public transportation is the most popular way to travel in Shanghai. The streets of the city are kept clean, and in terms of air quality it surpasses most other urbanized agglomerations of the country.

The city's transportation system consists of radial lines connecting central Shanghai with the suburbs, and peripheral routes. Transport infrastructure is well developed in the central part of the city, but not always enough - on the outskirts. The main public transport in the city is the subway, buses and taxis.

In 2004, the Shanghai government built the first main railway line in China between Longgang Railway Station and Pudong International Airport. The journey of 30 kilometers takes only 8 minutes! The extreme speed of the Maglev train (Fig. 1.8) can reach 431 kilometers per hour, which is 5 times higher than the car, 2 times faster than the high-speed railway. It is the world's fastest train of regular commercial services since its opening in April 2004.

The Muggle train does not look so different from a regular train. The secret of such a high speed lies in the small distance between the vehicle and the guiding method. The guide track uses magnets to create both lift and traction, and it is this small space that significantly reduces the friction that usually exists between the wheels and the track. Thus, magnetic trains can move much smoother, calmer and faster. And since friction is no longer a problem, the driving force is only to overcome air resistance and raise the vehicle, and the

latter only a small percentage of total energy consumption. Therefore, total energy consumption will also be reduced.

Figure 1.8. Muggle train in Shanghai

HONG KONG. Fare is paid in the Octopus system - a contactless card for electronic payments, which is used in Hong Kong's transportation system and at many service facilities. It was introduced by Creative Star Limited in September 1997 as a means of electronic payment in the subway and then in other public transport (ferries, airport express trains, buses and trams).

There are five major public transport operators in Hong Kong, which in 1994 set up a joint venture known as Creative Star Limited (renamed Octopus Cards Limited in 2002) to oversee the development and implementation of contactless smart card technology.

Octopus Holdings Limited is owned by Hong Kong's major transport operators and is the holding company of Octopus Cards Limited, the operator of one of the world's leading contactless smart card payment systems.

For reference: Octopus Holdings Limited are developers of smart card systems for the following countries:

- The Netherlands (Rotterdam-2005, Amsterdam-2006, further developed throughout the country)
- United Arab Emirates - Dubai (2009)
- New Zealand - Auckland (2012)

The system of settlements of operations with bank cards is aimed at storing and deleting data without any requirements for card reader units, which allows real-time communication with a central database or computer.

Transaction data is stored in the card reader or transmitted over the network, or can be retrieved using a handheld Pocket PC device.

Area Networks (LAN) local area networks at MTRC stations are connected to various components of the Octopus card system - turnstiles, special transport devices, customer service terminals, etc.

Operations from MTRCs are transmitted to the head office via the global computer network (WAN) of the main telecommunications service provider in Hong Kong and then to the Central Clearing House System.

Similar clearing and settlement mechanisms are URL MTRC stations, supermarkets, and shops of everyday goods.

For minibuses and regular buses, hand-held devices and wireless payment data scanning systems from autonomous mobile card readers Octopus, which are used by these modes of transport, are used.

In each of these cases, all transaction data is transferred back to the Central System (CCHS) and at the end of the day for clearing and settlement. CCHS then makes payments between the Octopus smart card system and numerous operators / sellers.

The system provides 15 million transactions per day.

London (United Kingdom)

Transport for London (TfL), a public body corporation that is a functional unit of the Greater London administration, manages and controls the operation of public transport in the city. TfL was established in 2000 to manage London's

transport system, including the coordination of public transport, the maintenance of major roads and traffic lights.

The main functions of TfL:

- provision of transport services through the operation of the subway, light rail, city train (London overpass), buses, tram system Tramlink, water routes London River Services, international and long-distance bus station "Victoria";
- maintenance of main roads with a total length of 580 kilometers;
- maintenance of traffic lights and road signs;
- Management of entrance fees to central London.

Certain activities are carried out by subsidiaries of Transport Trading Limited.

Fare is paid in the system Oyster card "pay as you go", on which travel can be paid in any mode of transport in London: subway, bus, tram, walks on the Thames and even some suburban trains.

Oyster card can be purchased at local Oyster ticket kiosks, in the subway, at public transport stops, at some stations of the National Railway, in the Visitor Centers.

Budapest - Hungary (Lítačka).

Within the administrative boundaries of Budapest there are about 50 different tariff plans. In addition, there are tariffs for river transport and tariff plans, taking into account the suburban area. City tariff plans can be divided into three groups: one-time tickets (tickets), travel cards and travel passes.

Budapest has a single charging system, regardless of the mode of transport: metro, tram or trolleybus (Table 1.7). Payment is made in local currency - forints, however, for convenience, in individual work all amounts will be converted into US dollars.

Table 1.7 – Tariff plans for travel in urban passenger transport of Budapest and their features (summarized on the basis of [56])

Type of tickets	Features	Tariff plans
One-time tickets	Require validation at the beginning of the trip and have a validity period from the moment of validation.	The ticket costs $ 1.17 forints. Such a ticket can be purchased from the driver, but then it will cost $ 0.33 more. One-time tickets can be purchased in bulk in the amount of 10 pcs. at the cost of one ticket $ 1 (discount - 14%). A single ticket with a change costs $ 1.77 and allows you to make two consecutive trips on the subway and one land transport (discount - 24%). A single ticket is valid for one non-stop trip, except for transfers between different metro lines. This ticket is valid for 80 minutes from the moment of its validation (at night - 120 minutes).
Travel card	This group of travel documents does not require validation. They are not registered, except for the 7-day card. They are valid, as a rule, for a certain period and allow you to make an unlimited number of trips during this period.	Travel card for 24 and 72 hours and for 7 days - useful for tourists or those who come to the city for one day. Savings on travel - on the 5th trip, and for 7-day - on the 3rd every day. 5/30 BKK - includes 5 daily travel cards that can be used for 30 days. Savings - on every 3rd trip every day. Student group for 24 hours - ordered by educational institutions for groups of children from 10 to 40 people + 2 accompanying persons. Savings - for 2 trips. Group (up to 5 people) 24-hour travel card - allows an unlimited number of trips for a group of up to 5 people in 24 hours. This card is useful for family or group holidays. Savings - up to 54%.

		Budapest card for 24, 48, 72, 96, 120 hours, "plus" version - these tariff plans are aimed at tourists.
Travel tickets	Budapest Card in addition to unlimited use of public transport for a certain period of time provide free (or discounted) visits to some tourist locations, tours, restaurants.	Opportunity to purchase a ticket for different terms: 15 days, month, quarter (100 days), semester (150 days - only for pupils and students), year (complete and incomplete). A weekly supplement is offered for monthly and quarterly tickets. In this case, the longer the period, the cheaper the trip. You can buy an annual ticket for any day until the end of the calendar year in the form of monthly coupons for the remaining months. The cost of such travel is determined at the rate of $ 31.75 for 1 month. Travel tariff plans provide for a significant discount - at the level of 65% - for pupils, students and pensioners. There are also monthly passes for parents who receive social assistance for a small child, for dogs and bicycles.

Budapest's public transport also offers free travel benefits. They apply to the following categories of passengers:

- preschool children accompanied by an adult (regardless of whether they occupy a separate place in the cabin);
- passengers over 65 years of age (citizens of Hungary, EU countries, the European Economic Area and Switzerland, foreigners receiving an old-age pension from the Hungarian Pension Fund, foreign citizens of Hungarian nationality and others);
- refugees over 65 years of age;
- blind and deaf;
- disabled people;
- one person accompanying a blind, deaf or disabled person;

– war invalids and military widows and others [17].

Students and pupils of full-time and part-time education and in any case children under 14 have the right to student and pupil travel.

In the absence of conductors in land transport and selective control of travel documents, in public transport in Budapest are quite severe fines. The grounds for the fine may be different: lack of a travel ticket valid at the time of the inspection, absence of an ID or other document confirming the right to benefits, discrepancy between the ID number and the number indicated in the travel ticket, etc.

At the same time, the system of fines is very flexible. If the fine is paid on the spot in cash or at a service center within 2 days (by card or cash), the amount of the fine is $ 2.67. This is 23 times the cost of a single ticket. If the fine is paid within 30 days (postal or bank transfer, cash, card), the fine is $ 5.34. This is 46 times the cost of a single ticket. If the fine is paid after 30 days, the amount of the fine reaches $ 10.68. This is 91 times the cost of a single ticket. In case of non-payment, this issue is resolved in court, in the future the rights to the debt are transferred to a third party [56].

In the event that a valid travel document, ID or document entitling you to free travel has been forgotten at home, it is possible to show them at the Service Center within 5 days. The fine will be only $ 6.68, and in the case of documents for free travel, annual, semester and quarterly travel - $ 3.34. For those who use free travel, the third fine in a year will cost $ 6.68 instead of $ 3.34.

Prague - Czech Republic (Lítačka)

Management of public transport in Prague (metro, trams, buses, suburban buses, cable car Petršín) is carried out by the Trading Company - Public Transport Prague Co. Inc. - organization accountable and controlled by the city of Prague (100 shares). This organization also coordinates the activities of the OPENCARD Operator, which processes personal data and sells travel documents.

On January 25, 2016, a new map of the transport system of Prague - Lítačka - was officially presented to replace the current OpenCard.

Tariffs in the city of Prague are divided into tariff zones. Now there are the following types of tariffs:

1. Individual rates for 1 person (90, 30 minutes, 1, 3 days).

2. Prepaid temporary tickets for 1 person - electronic or paper card to pay for travel (30, 90 days, 5, 10 months, 1 year).

3. Personal prepaid temporary tickets - electronic or paper card to pay for travel (30 days, 90 days, 1 year).

Paper tickets must be composted in special yellow composters, which are installed near the doors of buses and trams, in the lobbies of subway stations. The ticket needs to be composted only once at the place of initial landing.

Coupons do not need to be composted. They take effect from the moment of purchase.

Transport in the Czech Republic works strictly according to the schedule, which can be seen at any stop or metro station, as well as on the Internet. There are no turnstiles and conductors in public transport. The presence of tickets is checked by groups of controllers.

Since July 1, 2013, the SEJF (SAFE) mobile application has been running, which allows you to buy tickets for public transport, control the validity of tickets and payment history.

The sejf app can be downloaded for free on Google play or iTunes. You can top up your ticket with a bank card, non-cash transfer or deposit at one of the banks.

In cooperation with all mobile operators, Prague TransitCo provides passengers with ticket sales services via SMS.

Immediately before boarding, you must send an SMS with the text DPT to the number indicated on the doors of vehicles and stops. Usually, in 1-2 minutes an electronic ticket arrives, which will indicate its validity.

Transport policy in many countries is aimed at encouraging more frequent travel by citizens. Particular attention should be paid to the tariff policy of the Transport Center of the Hungarian capital.

1.3 International experience in building the concept of Smart-City

The term “smart city” can be interpreted broadly and differently. But in any way, information and telecommunication technologies that help solve public problems within the framework of a multilateral partnership between citizens, business and government play a key role [12; 19]. This understanding dates back to 1993 in the Silicon Valley, USA, where the concept of “smart community” appeared. Such communities were defined as any purposeful co-operation between businesses and residents in terms of improving living and working conditions with the use of accessible information technologies.

In Ukraine, the term "smart city" is also gaining momentum. In November 2013 the seventh time in Kiev hosted the International Forum of smart-city and exhibition under the same name. The forum considered new approaches to urban development, security, ecology, housing and transport infrastructure, and social sphere. The exhibition presented the latest technologies of intellectual construction, leading world technologies, equipment and solutions in the context of the entire city. The concept of Kyiv Smart City 2020 (2017) development provides the following key areas:

- improving the quality of life of citizens;
- modernization of physical and technological infrastructure development of the city;
- use of technologies for effective city management;

- compliance with environmental standards, sustainable economic development and social inclusion;
- active public involvement.

The concept of Kyiv Smart City was created on the basis of the British Institute of Standards methodology. The document suggests the city's vision of smart city, which includes important conceptual foundations of smart city that distinguish cities from cities that are engaged in the introduction of electronic services or automation processes.

Thus, the first step towards building the concept of Kyiv Smart city is that Kyiv must become an innovative city, that is, it will be aimed at creating an innovative ecosystem of the city, which combines territorial communities aimed at collective actions in the field of creating knowledge flows, support for technological development and commercialization of innovations.

In practice, this is a combination of inventors, incubators, venture business and intellectual property institutions, and in the case of smart grandeur, creating a smart city hub, research laboratories, open source data incubators, educational centers, smart city schools and innovation education (as in form both in terms of content), computer centers from the smart grid and others.

The innovation ecosystem should include three components, namely education (research, progressive scientists), activation of innovations (implementation) and their output on a broad market, that is, business. It is a prerequisite for the transformation of the city in a smart city. Thus, innovative ecosystem allows the city to become more competitive and comfortable for residents. There are some smart conditions in Kyiv, namely the presence of a significant number of educational centers, an environment for innovation (coworkings and first incubators), 90,000 registered IT outsourcing companies, but this still needs further development.

The second direction is extremely important, which emphasizes the majority of sociological surveys - this is a matter of transforming city management. The fact that the concept of Smart city - is not only the introduction

of e-services, but also qualitative change in management (Dewi Mutiara et al., 2018). The strategic approach to Smart city concept is when the problems are solved by increasing the managerial and technological level, which means finding solutions, new design and reengineering processes along with technological solutions, namely:

1. Urban data – the organization of data collection should become the center for turning the city into a smart city and the basis for the introduction and development of new management processes, models and functions. All smart grids are closely linked to ICT, but these devices are worthless without a well-established data management;

2. Development of integrated and open IT infrastructure of the city;

3. Integration of management systems and the creation of integrated services and solutions (not just the automation of existing ones) - that is, the introduction of the principle of managerial interoperability beyond the technical;

4. Development of partnership and cooperation between the city government, businesses and citizens to develop modern services, improving them based on clear KPIs.

The third step towards building a Kyiv smart city concept - without which no "smart city" in the world can do - is involving citizens in managing the city. According to sociology in the capital, there is a very high demand for public participation and it is no coincidence that the e-petition and e-budgeting service that is already operating in Kyiv is developing so actively. Smart City is a city of smart citizens. That is why it is not only a matter of developing democracy-based e-formats. But as proposed in the concept, creating a wide range of opportunities for citizens to participate in city management. For example, the creation of special working groups on e-government, anti-corruption council and public information. In modern cities around the world, any tools are used to engage citizens in strategic processes and decision-making, assessing the quality of services and the work of officials.

The fourth component of the Kyiv Smart city concept is transforming the city into a comfortable and modern one, but it is about quality of life here and the city's compliance with the international standards proposed for the implementation of ISO 37120. To do this, key priorities were identified, as a result of a survey of key groups of influence in the city were identified: representatives of the departments of the Kyiv city state administration, business, the public and the IT community. The polls confirm that Ukraine is far behind the modern European and successful cities of the world.

A very important aspect for introducing the concept of Kyiv Smart city is the need to appeal to international experience and expert organizations, as well as search for resources for investing in Kyiv Smart city concept in international markets, EU funds and special programs. In fact, it is necessary to create an external innovation ecosystem around Kiev, the city must go to the international Smart city environment, which is very actively developing, growing and becoming competitive.

In today's discussions at the international level, the concept of a smart city is not confined only to technologies as the main factor of development. Truly smart are cities that create conditions for the growth of human capital. The more these opportunities and the more favorable the environment, the smarter the city. This approach was the basis of the European vision of a smart city and was described in 2007 by the Center for Regional Science of the Vienna University of Technology, which is presented in Table 2.1.

A smart city is strategically suited to the development of these six areas, while wisely utilizing the resources and activity of its residents, acting consciously and independently. The authors of the definition emphasize that the main thing - to maintain the integrated principle of development and the list of components given - is not exhaustive.

The definition of the European Parliament (2014) is based on the same six points. According to him, a smart city seeks to solve social problems, using IT solutions in the activities of various municipal entities and their. At the same

time, the European Parliament points to the problematic context: smart cities are seen as responses to the challenges of large-scale urbanization (overpopulation, energy consumption, resource allocation, environmental protection). Cities are turning into strategic points for addressing poverty and inequality, unemployment and energy flows management.

Table 2.1 – Characteristics of a smart city

1. Smart environment (natural resources)	2. Smart living (quality of life)	3. Smart people (social and human capital)	4. Smart economy (compete-tiveness)	5. Smart mobility (transport and ICT)	6. Smart governance (participation)
1.1 Attractivity of natural conditions; 1.2 Pollution 1.3 Environmental protection; 1.4 Sustainable resource management	2.1 Cultural facilities; 2.2 Health conditions; 2.3 Individual safety; 2.4 Housing quality; 2.5 Education facilities; 2.6 Touristic attractivity; 2.7 Social cohesion	3.1 Level of qualification; 3.2 Affinity to life long learning; 3.3 Social and ethnic plurality; 3.4 Flexibility; 3.5 Creativity; 3.6 Cosmopolitanism/ Open-mindedness; 3.7 Participation in public life	4.1 Innovative spirit; 4.2 Entrepreneurship; 4.3 Economic image & trademarks; 4.4 Productivity; 4.5 Flexibility of labour market; 4.6 International embeddedness; 4.7 Ability to transform	5.1 Local accessibility ; 5.2 (Inter-) national accessibility; 5.3 Availability of ICT-infrastructure; 5.4 Sustainable, innovative and safe transport systems	6.1 Participation in decision-making; 6.2 Public and social services; 6.3 Transparent governance; 6.4 Political strategies & perspectives

By definition of community and forum "Global smart cities", created by the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC) and the International Telecommunication

Union (ITU), smart city is sustainable and resilient. Sustainability implies that current needs can be met without undermining the opportunities of future generations - in the environmental, social and economic aspects. Resilient means that the city is successfully adapting to changing conditions that exist.

Smart city in its best, according to international organizations is:

- male-centric (focused on people, businesses, workers, tourists, etc.);
- well managed;
- accessible and open (for all people and new ideas);
- discloses data about its activities;
- protects personal data;
- based on integrated services and infrastructure;
- proactive in the education and development of citizens.

The technological aspect of Smart city is reflected in the definition of IBM (2010) and the company has become one of the leading promoters of the concept of Smart city. The leader of the global IT-market considers smart city as "(instrumented, interconnected and intellectual». "Instrumented" means the ability to get different data on urban life and infrastructure in real time with sensors, measuring devices, personal devices. "Interconnected" points to the ability to integrate data on digital platforms, providing universal access to various city services. "Intelligent" refers to the processing of the information obtained through the services of advanced analytics, modeling, optimization and visualization in order to make the best decisions.

Only in Europe there are more than 240 cities claiming the status of smart according to Top 5 smartest Smart Cities in the world (2017). It is difficult to estimate their exact number, since the only criteria for assigning cities to the category Smart is not developed. Existing ratings present both socio-economic indicators of the effectiveness of innovations, as well as the degree of availability of technological infrastructure.

The implementation of "Smart City" projects has prompted research institutions to develop Smart city measurement indexes, the most popular of which are presented in Table 2.2. and 2.3

Table 2.2 – Indices of measurement of "smart cities"

Indices of measurement	Responsible organization	Year / Frequency	Number of cities	Measurement Criteria
Arcadis sustainable city index	Arcadis and Center for Academic and Business Research (Cebr)	2015 / annually	100	3 categories: social (people), ecological (planet) and economic (profit).
Cities in motion index	Spanish Business School IESE	2013 / annually	180	10 key areas: economics, human capital, technology, environment, international advocacy, social cohesion, mobility and transport, governance, urban planning and public administration.
Networked society city index	Ericsson	2011 / annually	41	4 characteristics: sustainability, cooperation, participation and mobility.
City prosperity index	UN-Habitat	2012	60	6 categories: productivity, infrastructure development, quality of life, social engagement, environmental sustainability, governance and legislation.

Table 2.3 – Leading cities according to estimates of different ratings [18; 19; 20]

Index of the sustainable city of Arkadis	Urban traffic index	Network society index	City prosperity index
Hong Kong	New York	Stockholm	Oslo
Zurich	London	London	Copenhagen
Paris	Paris	Singapore	Stockholm
Seoul	San Francisco	Paris	Helsinki
Prague	Boston	Copenhagen	Paris
Vienna	Amsterdam	Helsinki	Vienna

London	Chicago	New York	Melbourne
Singapore	Seoul	Oslo	Montreal
Stockholm	Geneva	Tokyo	Toronto
Frankfurt	Sydney	Seoul	Sydney

Analyzing the above data, we can conclude that it is often impossible to find the necessary indicators at the city level (most of them are URL the regional level), so researchers have to use averages; with the majority of indices it is impossible to work in dynamics, to compare indicators for different years, because of change of methodology and number of the countries participating in research; most research is based on the development of large cities (usually capitals), avoiding medium and small cities.

Today, there are already notions of the reference architecture of a smart city, and critical technologies have been developed within the framework of individual projects. There is a need to move from isolated vertical projects to common platforms that open access to data and provide all security requirements. This approach, according to European ideologues of smart-city, will ensure the transition from "digital" cities to truly smart.

1.4 Theoretical and methodological principles of tariff policy formation in urban public transport

The transport tariff is a system of target rates or prices, according to which a fee is charged for the transportation of passengers within the framework of transportation.

During the formation of the tariff, it is necessary to take into account the interests of transport companies in terms of covering operating costs and making a profit and passengers in terms of obtaining quality transport services. This means that transport services need to be seen from a broader perspective. Their

cost should include not only direct monetary fees (fuel and lubricants costs, drivers' salaries, depreciation, etc.) that arise in the process of passenger transportation but also the time and costs associated with the inefficiency of services, discomfort and risks transportation of passengers. However, they are difficult to calculate, as there is no single approach to their assessment, and they can be fully assessed only after the carriage of passengers.

The tariff for transportation is based on a detailed study of the cost structure of operating activities. Transport companies, which entirely use modern vehicles, managing technologies, adequately and thoroughly take into account the dependent and independent of the size of the movement of costs, in their activities implement a strategy of leadership in costs. This allows you to rationally reduce operating costs, increase the level of competitiveness, profitability and profitability of the enterprise. The basis of such a strategy is to improve the methodology of tariff formation based on a detailed study of the costs of the transport company.

The algorithm for calculating the cost of passenger transportation can be represented as:

$$C = C_1 + C_2 * D_t * K_a \quad (1)$$

where C_1 – the cost of initial and final operations, UAH/rolling stock;

C_2 – the cost of mobile operations, UAH/hp-km;

D_t – tariff distance of transportation, km;

K_a – coefficient that adjusts the cost of a moving operation depending on the distance.

To study in more detail, the question of determining the rational use of the vehicle is necessary to break down the costs of the enterprise into components. In expanded form, the total specific total costs (JI) for the operation of buses can be represented as an expression:

$$CB = \frac{A_1 + A_2 + A_3 + A_4 + A_5 + A_6 + A_7 + A_8 + A_9}{T_o} \quad (2)$$

where A_1 – fixed costs (overhead costs);

A_2 – variable costs related to fuel and lubricant costs;

A_3 – tire costs;

A_4 – depreciation deductions;

A_5 – salary costs of drivers and conductors;

A_6 – maintenance costs;

A_7 – costs of current repairs;

A_8 – costs of diagnostics and maintenance;

A_9 – costs of spare parts and materials;

T_o – operating time of the bus for the calculation period, km.

The method of determining tariffs for passenger transportation by urban passenger transport should be focused on solving the following tasks:

- the level of tariffs for passenger transportation should ensure the availability of passenger transport services for people with different income levels;
- the level of the tariff must be sufficient to reimburse economically justified costs of passenger transport enterprises,
- uncompensated funding from the budget;
- the level of the passenger tariff should provide the necessary and adequate level of profitability for the social development of the team.

The modern practice of fare in urban passenger transport includes the following areas: payment for a route trip in the cabin; depending on the distance of the journey; on a single ticket. Each of the regions has its scheme of distribution of financial flows.

The total cost (TC) for the organization of passenger traffic can be calculated by the formula based on the volume of traffic in the city:

$$TC = \sum_{i=1}^{n} \left[\frac{l_{mi} Q_i}{q_i \, y_{si} \, \beta_i \, k_{var}} (V_{var} + \frac{V_{const}}{v_{ei}}) \right] \quad (3)$$

where l_{mi} – length of the i-th route, km;

Q_i – annual volume of traffic on the i-th route;

q_i – passenger capacity of the vehicle;

y_{si} – respectively the coefficient of static filling of the vehicle interior on the i-th route, the coefficient of mileage on the i-route;

k_{var} – coefficient of variability on the i-th route;

V_{var}, V_{const} – respectively variable and constant costs on the i-th route, UAH/km, UAH/hour;

v_{ei} – operating speed on the i-th route, km/h.

The method of determining the tariff includes:

- formation of tariffs for transportation by public routes in connections taking into account the operating conditions;
- calculation of the cost of transportation based on economically justified costs;
- calculation of tariffs for transportation in suburban communication taking into account volumes of transportations of privileged categories and financial possibilities of budgets concerning compensation of losses of incomes of carriers.

The value of the tariff is calculated by the formula:

$$T_r = C * (1 + P) \quad (4)$$

where T_r – the value of the tariff for urban passenger transport services;

C – the cost of transportation;

P – profitability of transportation, which allows you to take into account the level of profitability of the carrier.

1.5 Smart accounting systems: the essence, principles of organization, importance in ensuring the security of data storage

New approaches to city management and technology development provide new and useful tools for city management, create ample opportunities for citizens, businesses and other organizations of the city to take an active part in implementing the changes required today. Simply put, technology can help cities become "smarter". Smart city systems are becoming a major response to the common challenges of resource management and economic growth in cities - nationally and globally. These systems will displace traditional means of delivery for physical and social resources, potentially providing cost-effective and innovative resource delivery channels. A “smart” city is a city that “rapidly increases its socio-economic and environmental (sustainability) performance by responding to challenges such as climate change, rapid population growth and political and economic instability” by fundamentally improving its interaction with society and its use. common leadership methods, its work in different areas, and how it uses information and modern technology to provide better services and quality of life for those who live and are connected to the city (residents, businesses, guests), in the present time and in the near future, without unfair harm to others or environmental degradation.

The concept of "smart" city includes the following features of the organization of the urban environment:

- focus on "green" technologies, the main direction of which is to reduce emissions of harmful substances;

- effective traffic flow management;
- use of renewable energy sources;
- accumulation and redistribution;
- city information systems.

Mobility in modern cities is a guarantee of development, so the municipal government, for its part, must ensure the appropriate level of transport services to its citizens. Developed public transport is a sign of a developed city. In recent years, the sphere of public transport in Ukrainian cities has been declining, there have been some bursts of development, but the lack of significant systemic changes has not allowed this area to develop.

Worldwide, urban transport development is being addressed through the development and implementation of a sustainable urban mobility plan, which includes a public transport development strategy and a new transport model, as a fundamental basis for introducing new approaches to public transport.

A smart city, this city is provided with energy-efficient, environmentally friendly public transport, which is managed by modern systems based on IT technologies. Therefore, the priority is to purchase public transport as well as to improve the public transport infrastructure in the city.

In this direction, the city authorities in collaboration with the public are implementing a project in which it is planned to purchase new vehicles for the city. For example, in the city of Kherson, the municipality is currently actively preparing a loan agreement with the European Bank for Reconstruction and Development (hereinafter - the EBRD) for the purchase of 50 new trolleybuses (EBRD loans) and expansion of the contact network for trolleybuses (grant funds – 1.5 million euros).

The next step will be the introduction of a single integrated intelligent transport system. Implemented as part of an automated fare accounting system (electronic ticket) and an automated dispatch control system (display of traffic on the map on GPS-trackers, information boards at stops with a timetable, etc.).

Investment funds will be attracted for the project implementation. To date, the Regulations on the conditions of the tender to determine the person-investor have been developed. Draft documents have also been developed to ensure the implementation of the Law of Ukraine “On the Principles of State Regulatory Policy in the Sphere of Economic Activity”.

Further, within the framework of the project it is necessary to introduce an electronic control system of the city's transport system to improve the quality of passenger transport services on urban bus, trolleybus and inland water (river) public routes.

The demand for the implementation of technological solutions that automate individual processes, simplify life and business, is growing. The number of proposals in this area is also increasing. For example, tens of thousands of technological solutions from Ukraine and around the world are registered on the REACTOR platform. This system has developments in transport management and housing, for smart parking and lighting, smart homes, environmental monitoring, dispatching, Smart Government and many others. It is worth noting that these solutions are of interest not only to business, but also to representatives of the city authorities - city administrations, which are ready to introduce new technologies.

A number of studies of the international transport market show a trend towards increased competition, which, of course, leads to increased pressure on prices, so international players, coming to the domestic market, are forced to play with price and use additional resources to increase efficiency, including the introduction modern automated control systems [2, p. 12]. This allows you to significantly reduce production costs, save time on logistics operations, increase productivity and efficiency.

The business of transport companies is very diverse, so the automation of each industry has its own specifics. For example, in terms of accounting, warehousing, as well as logistics, transport companies solve the same problems as any other company.

The concept of building an automated fare accounting system in public transport is based on the results of the introduction of similar systems in the cities of Ukraine and the study of international experience in this field.

The program "Automated fare accounting system in urban passenger transport" is implemented in compliance with the laws of Ukraine "On Road Transport", "On Local Self-Government in Ukraine", "On Rehabilitation of Victims of Political Repression in Ukraine", "On the Status and Social Protection of Citizens affected by the Chornobyl disaster "," On the status of war veterans, guarantees of their social protection ","On child protection", "On the basics of social protection of disabled people in Ukraine "," On social and legal protection of servicemen and their families", "On the status of veterans of military service, veterans of internal affairs bodies, veterans of the National Police and some other persons and their social protection", "On amendments to some legislative acts of Ukraine on the introduction of an automated fare accounting system in urban passenger transport "from 17.01.2017 № 1812-VIII.

In terms of cargo and passenger traffic management systems, a certain set of technological knowledge in the relevant areas of transport is already required, as well as the use of a smart accounting system. Automated system of accounting for payment of transportation (hereinafter - ASAPT) - is a system that allows you to pay for travel in transport. It consists of the following elements:

– ticket or RFID electronic city card;

– GPS GPSM validator Lucky-Pay is a device (terminal) that reads an electronic card. It is established in passenger salon of transport on hand-rails or other places convenient for masseurs;

– GPSM U1 driver's main device - displays current validations, number of passengers in the bus, allows the driver to change the route and fare plan. The main device communicates with the server and transmits information about the validations (fare).

ASAPT allows passengers to pay for travel, and the customer of the system to receive detailed statistics of transport: passenger traffic, number of

beneficiaries, calculates compensation for transportation of beneficiaries to private carriers, control the schedule of transport (advance or lag behind schedule). The system comprehensively solves the problems of municipal transport and translates the work of transport to a qualitatively higher level. The system may include electronic stop signs to predict the arrival time of vehicles, a city traffic light control system to control traffic and avoid congestion in the city.

For the effective functioning of the ability to pay for travel by electronic ticket, you need:

a) GPSM Lucky-pay validator. Carries out reading of the personal card (electronic ticket).

b) The main device of the driver GPSM U1. Designed to select the route number, tariff, transfers data to the server software.

c) The data center where the software is located. Displays reports, statistics, traffic information.

The data center of the automatic fare payment system includes servers on which the software is hosted. Perform a key function of collecting, processing, entering information and generating reports.

The main functions of ASOP software:

a) Counting the number of beneficiaries. Compensation to private carriers for actually transported beneficiaries.

b) Calculation and collection of statistics on the carriage of paid passengers. Making non-cash fare payment by bank card or electronic ticket, citizen's card.

c) Display of the online location of transport.

d) Module for monitoring compliance with work schedules. Display an advance or delay.

e) Visualization of information for the control center.

f) Registration by the city dispatcher (usually by the Department of Social Protection) of beneficiaries: entering personal data of the beneficiary, photographing the beneficiary, printing a photo card.

The implementation of the system consists of four parts:

1. Acquisition of necessary equipment (validators and main devices of the driver). The equipment is purchased for the budget of the executive committee of the city council and transferred to the responsible use of city carriers.

2. Adjustment and installation is carried out by our company.

3. Development of citizen card design. Several card design options are being developed. The best is chosen.

4. Organization of issuance of beneficiary cards. We help to organize a workplace for the reception of citizens. One dispatcher will be able to take a photo, enter the data of the beneficiary and issue a personal card with a photo in 3-5 minutes.

Transport of a "smart" city is based on technological innovations in the transport system, which provide for the integration of operational management of all modes of transport and the ability to respond to events in real time. Such innovations are:

– construction of "smart" stops. Examples of such systems are reasonable stops implemented in such cities as Lutsk, Lviv and Ternopil. For the most part, the system is a structure installed at bus stops and is able to provide information on the schedule of public transport.

"Smart stops" are implemented in the form of electronic boards that contain data: the estimated waiting time of vehicles at the stop, the direction of the route, the time of arrival according to the schedule, the treadmill, advertising, video cameras. Electronic scoreboards are placed at stops, have a built-in control module and are synchronized with the data center via mobile Internet. Unlike existing systems, the GPSM scoreboard when calculating the time of arrival of the vehicle is based on:

- current location of transport.
- traffic jams according to Google Maps.
- transport schedule.

Due to this, forecasting the time of arrival of transport is more accurate than similar systems and brings satisfaction to citizens.

An example of a "smart" stop is shown in Fig. 1.9.

Figure 1.9. Example of a “smart” stop [70]

The following information is dynamically placed at the stops:

- forecasting the time of arrival of transport;
- transport schedule;
- information messages to passengers.

To protect citizens and reduce the crime situation, an alarm SOS button is placed at the stops to communicate with the police via loud two-way communication.

Advanced system features:

- plan / fact analysis of transport running;
- announcement of stops;
- control of intoxication of the driver (by means of the connected breathalyzer);
- control of style (aggressive) driving.

Innovations are the equipment of public transport units with automated passenger flow accounting systems, installation of GPS-trackers in vehicles.

The implementation of the “electronic ticket” system (Fig. 1.10) deserves special attention, which makes it possible to abandon cash payments in transport.

Figure 1.10. Example of a validator for the e-ticket system [71]

The automated fare payment system includes: contactless cards, turnstiles, validators, driver and controller terminals, devices for replenishing contactless cards, mobile transport servers.

Thus, there are a large number of methods of forming a tariff policy, we consider the most suitable one that relies on costs + profit. Accordingly, it is necessary to investigate,

a) what price increase would be comfortable for consumers, provided that the trip is more comfortable;

b) what factors most positively or negatively influence the choice in favour of using public transport.

A contactless card is a plastic card with a built-in microprocessor and antenna. The principle of the card is based on the exchange of information between the card and the reader on the radio channel. The card is a complex electronic device. The service life of a contactless card is several (up to ten) years and is limited almost exclusively by the mechanical strength of the card. The main areas of application of contactless cards are fare payment systems in public transport, access control, etc.

Each contactless card has its own unique serial number. This number is set during card production and cannot be changed during the entire period of card use. The card memory consists of 16 independent sectors. This memory structure allows you to use the card in various, unrelated applications. Other card features:

– term of data storage in memory - not less than 10 years;

– number of recording cycles - not less than 100 thousand;

– working distance from the reader antenna to the card - up to 100 mm (depending on the type and size of the antenna);

– the ability to work with multiple cards;

– the time of a typical transaction for transport use - about 0.1 sec., The user can simply carry the card near the reader antenna, and this time is enough for the transaction.

The electronic card as a means of payment for transport services can be used not only in the subway, buses, trams and trolleybuses, but also in taxis and minibuses. At the same time, the most acceptable technology for paying for taxis and minibuses is payments using non-prepaid specialized transport cards, namely cards with a bank payment application and a social application.

Turnstile - a device for admission to the cabin of rolling stock of passengers who have a valid contactless electronic card and registered it with a validator. Validator - a device for reading or registering contactless electronic cards. Mobile terminal of the driver, conductor - a device for printing one-time tickets,

checking the status and replenishment of contactless electronic cards. Located by the driver and conductor. The controller's mobile terminal is a device for checking contactless electronic cards and printing and accounting for penalty receipts. Is at the controller. Card recorder - for self-service of ASOP users and paid access systems, namely: account replenishment, sale of the number of visits or trips and so on. Mobile transport servers designed to manage the equipment network in the cabin, transmit reports to the central server and organize the management interface.

Passengers who have a contactless electronic card are boarded through the front doors and rear doors equipped with turnstiles. Passengers who do not have a contactless electronic card board only through the front door, paying in cash to the driver or conductor. After paying the fare, the driver or conductor unlocks the turnstile for the passage of the passenger into the cabin and issues a one-time ticket.

Long-term travel ticket (contactless electronic card), purchased for cash at points of sale and registered by a validator located in the cabin of rolling stock. One registration by a validator of a durable ticket purchased for cash entitles one passenger to one trip within the final stops of one route of one direction. The passenger has the right to pay the fare of several people, for this you need to make the appropriate number of registrations by the validator. The number of passenger trips depends on the number of trips paid for when purchasing a contactless electronic card. The passenger has the opportunity to replenish the account at the points of sale of contactless electronic cards, as well as to check the status and replenish the card from the driver or conductor. Discount long-term travel tickets (student, student, professional, etc.) give the right to travel only if the passenger has a student (student) ticket or a certificate and is valid for the period specified on the card. Long-term travel ticket (contactless electronic card), which gives the right to preferential travel in urban land transport, does not give the right to free luggage.

The main features of the system:

– precise control of passenger traffic, with the possibility of analysis by the number and categories of transported passengers, by routes and time of transportation;

– issuance of a ticket (control coupon) to the passenger, confirming the fact of travel in this vehicle at present;

– change the route of the vehicle during the change without returning to the park;

– control of the number of transported passengers enjoying benefits (possibly with different types of benefits);

– control of fare payment without the participation of conductors;

– data transfer to a PC via a wireless interface;

– travel is registered by the passenger independently, without the participation of the driver or conductor.

Based on the information supplied by the system, the transport company will be able to plan the transportation process, reimburse the costs of transportation of privileged categories of citizens, improve the quality of service and reduce costs.

The system allows:

– take into account the different fares in different modes of transport: tram, trolleybus, bus, minibus, suburban route (by writing off a certain fare);

– take into account the different fares on different routes;

– take into account the possibility / impossibility of using one or another benefit for different types of transportation in different groups of transport companies;

– when prepaying the fare, the system allows you to provide various discounts.

Advantages and disadvantages of using purely accounting (registration) electronic cards.

Advantages:

– ease of production and issuance of cards;

– low cost of registration cards;

– simple process of issuing cards to beneficiaries (without contracts);

– a large number of places where such cards can be obtained by beneficiaries;

– simpler infrastructure than for payment cards;

– the possibility of organizing a simple social processing;

– the appearance of the card and its number are determined by social authorities;

– a simple system of agreements and settlements between the participants in the process.

– Disadvantages:

– limited use of the registration card;

– impossibility to further provide monetized or combined benefits, if there will be a legal basis for this;

– the need to develop a significant amount of regulatory, technical, technological and administrative documentation required for the operation of a computerized accounting system;

– the need to create an appropriate infrastructure;

– the need to attract a significant amount of budget funds to create a system.

Advantages and disadvantages of using electronic accounting cards with the placement of various applications (cartoon cards).

Advantages:

– simpler than for payment process of making and issuing cards;

– simple process of issuing cards to beneficiaries;

– a large number of places where such cards can be obtained by beneficiaries;

– the appearance of the card and its number are determined by the social authorities taking into account the requirements of payment systems;

– the possibility for the beneficiary to choose the applications that will be placed (or activated) on the cards;

– the possibility of gradual expansion of the scope of cards;

– a simple system of contracts and settlements.

Disadvantages:

– the need to develop a significant amount of regulatory, technical, technological and administrative documentation required for the operation of a computerized accounting system;

– the need to create infrastructure for the use of the social component of the card;

– the need to attract at the initial stage a significant amount of budget funds to create a system.

For passengers, the advantages of contactless cards are:

– ease of use of the ticket (the card can not be removed from the wallet or bag), reducing the cost of time to pay for travel;

– no need to have small money (coins, tokens) to pay for travel;

– the possibility of using one ticket (one card) in different modes of transport;

– the possibility of automatic (with the help of automatic replenishment of resources) and manual (at the box office) ways to replenish the resource on the cards;

– the ability to personalize the card to ensure a refund in case of loss or theft of the card (the card is placed in the "stop list" and blocked);

– the possibility of obtaining a loan (within the collateral value) in case of need to make a trip with a rate higher than the balance of the resource on the card at the beginning of the trip.

For transport companies, the use of contactless cards allows to increase the service for passengers and get the following opportunities:

– a significant reduction in equipment maintenance costs, as all devices that work with contactless cards require virtually no maintenance;

– reduction of costs for the issue and circulation of travel tickets due to the longer service life of the cards;

– the possibility of conducting a flexible tariff policy, as the introduction of new types of travel tickets or tariff tables is performed only by software. This allows to increase the revenues of the transport company at a given level of tariffs by optimizing the structure and policy of fare;

– increase of incomes at the expense of the exact account of trips by passengers who have the right to preferential or free travel;

– increase revenue by eliminating counterfeit travel tickets based on contactless cards.

For banks, the implementation of the system will provide an opportunity to expand the use of non-cash payments and card systems, in particular NSMEP or other payment systems.

For the city authorities, the introduction of the system will reduce the shadow turnover of money in urban passenger transport, increase budget revenues through fuller taxation of transport companies, solve the problem of calculating the amount of budget compensation for the passage of privileged categories of passengers.

The economic effect of the implementation of the system will consist of the following components:

– reduction of operating costs for fundraising for services provided (including for privileged categories of citizens);

– accurate accounting of services provided to beneficiaries;

– exclusion of travel or receipt of services on false documents;

– optimization of tariff structure, introduction of new types of services;

– introduction of a flexible charging system;

– reduction of theft and fraud due to the mass transition to non-cash payments;

– raising the level of culture of payment for services;

– obtaining additional income from multi-purpose use of contactless cards;

– increase the efficiency of payment control.

Thus, summarizing the world experience (mainly European) of the introduction of smart accounting system, it can be noted that it is built on a similar principle and the introduction of technology of integrated automated passenger traffic management system allows to organize:

– an automated fare payment system with the use of new generation means of payment and the formation of detailed transparent reporting, including for privileged categories of passengers, to increase the collection of fares;

– an automated system of dispatch control of vehicle traffic and accounting of transport work on the basis of a GPS receiver installed on board the vehicle and the dispatch center;

– an automated system for monitoring passenger traffic, ie automatic collection of data on the number of incoming and outgoing passengers at each stop;

– an automatic fare control system based on automatic fare payment systems, passenger flow monitoring and passenger information, which allows to implement a conductor-free fare payment scheme and transmit real-time information on the number of passengers who paid for the fare to the controllers;

– automatic informing of passengers and the driver and to provide communication channels of the driver not only with the control center, but also with services of immediate response in emergency situations [26];

– automatic control of technical and speed parameters of vehicles and the state of the environment through the use of various sensors, impact sensors, fuel level, sensors to determine the presence on board of vehicles of explosives, toxic and radiation substances, etc.;

– video surveillance in the interior of the vehicle and the road situation by installing video cameras and video recorders, which allow to store

information for up to one month and transmit information to the immediate response services by radio in case of emergency;

– control of speed of movement of vehicles and modes of work and rest of drivers due to introduction of authorization of each driver by means of service cards;

– the transmission of video images and alarm signals from the objects of transport infrastructure to the security service of the control center and the emergency response service;

– informing of passengers about the movement of vehicles in emergency situations and voice communication of passengers and security service of the dispatching center from objects of transport infrastructure.

CHAPTER 2.
METHODS FOR DETECTION, ANALYSIS, EVALUATION AND MINIMIZATION OF NEGATIVE RISK IMPACT

2.1 Defining the essence of the category "risk"

Risk is a complex and contradictory category; risk exists independently of us and our knowledge of it. The concept of risk reflects the actual phenomena and processes, most of which are probabilistic, ie the risk is objective.

At the same time, the risk is associated with the need to choose certain alternative solutions and calculate the probability of their results. In addition, management entities perceive the same level of risk differently due to their individual traits, which are reflected in the concept of risk appetite. This is the subjective side of risk.

Etymologically, the word "risk" in different languages is associated primarily with the presence of danger and uncertainty in various areas of governance and socio-economic life.

The term "risk" comes from the Latin recess - "cut off", "reduce" or the ancient Greek. ῥιζικόν - "danger". In Italian rischio is a danger, a threat; risikare - to move among the rocks; in Spanish, riesgo - the possibility of an accident or misfortune, someone or something that has been damaged or harmed; the French - risque - threat, risk (literally - to bypass the rock).

Risk as an economic category arose at the dawn of civilization, when a person became aware of the possibility of adverse situations, cold, hunger, and so on. Thus, at the household level, the origin of risk is somehow related to the

awareness of danger, possible losses, threats, insecurity, ignorance, uncertainty, and so on.

In the modern economic literature, the concept of risk is interpreted differently. As a result of discussions in economics, there are two theories of risk: classical and neoclassical.

Classical theory, the most prominent of which is J. C. Mill and N. W. Senior [54], studying the profits from business, identifies two components in the structure of entrepreneurial income:

1) interest as a share in invested capital;

2) payment of risk as compensation for possible risk associated with business activities.

According to this theory, the risk is identified with the expectation of losses that may arise as a result of the implementation of the decision. From an economic point of view, the risk in this theory is nothing more than the possible material damage that can be caused by the implementation of the decision.

This interpretation of risk is one-sided. This led to the development of another theory, which was called neoclassical. This theory originated in the 20s and 30s of the twentieth century in England and France. Its representatives are FH Knight, AT Marshall (England) and AS Pigou (France) [6].

It is based on the following provisions: an uncertain company, the profit of which is a random variable, should be guided in its activities by such criteria as the size of the expected profitability and the magnitude of possible fluctuations. According to this theory, the behavior of the entrepreneur is due to the concept of so-called marginal utility: if you want to choose one of two options for investing capital, which give the same return on business, then you should choose one of the options in which profit fluctuations will be smaller. It follows from this theory of risk that a reliable profit is always more useful than a profit of the same expected size, but associated with probable fluctuations.

To date, none of these theories is used in its original form. The most relevant is the neoclassical theory of risk with certain additions to Keynes, who

first systematized the theory of risk and gave a detailed classification of business risks, and added neoclassical theory to the factor of "satisfaction", the essence of which is that the entrepreneur, expecting more profit , will take a greater risk.

In the economic literature, risk is considered in terms of possible material damage associated with the implementation of economic, organizational, technical solutions, accidents, natural disasters, bankruptcy, impairment of shares, currency, etc., as well as in terms of decision-making, with profit.

The economic nature of risk means that risk is characterized as an economic category that occupies a certain place in the system of economic concepts associated with the implementation of the economic process of the enterprise. It is manifested in the economic activity of the enterprise, is directly related to the formation of its profits and is often characterized by possible economic consequences in the process of financial and economic activities.

There are two opposing views on the nature of risk.

First, the risk is understood as a failure, the danger of material and financial losses that may arise as a result of the implementation of the chosen solution.

Second, risk is identified with projected profits.

For the first time, the most common definition of risk was given by F. H. Knight: risk is a way of acting in a blurred, uncertain environment [23].

As an economic category, it is an event that may or may not happen. In the event of such an event, three economic results are possible:

- negative (lesions, damage, loss);
- zero;
- positive (profit, profit, earnings).

In a professional risk assessment, risk usually combines the probability of a future event with the consequences it may have had, as well as the circumstances surrounding the occurrence of that event.

Key risk characteristics include:

- economic nature;

– objectivity of manifestation;
– probability of occurrence;
– uncertainty of consequences;
– expected adverse effects;
– level variability;
– subjectivity of assessment;
– availability of analysis;
– importance.

The general understanding of risk covers the so-called three-factor perspective, which covers assets / values, threats and vulnerabilities [5].

There are different versions of these perspectives, including the following:

1. Risk = f (asset value, threat, vulnerability), where f denotes the function [23].

2. Risk = asset * threat * vulnerability [7].

3. Risk = threat * (vulnerability and consequences) [39]

4. Risk = threat * vulnerability * consequence [24].

Of particular note is the Black Swans theory, authored by Nassim Nicholas Taleb, [46] which appeared less than a decade ago. The metaphor and concept of the black swan have attracted a lot of attention recently and are a hot topic in many forums where safety and risk issues are discussed [12; 4].

In the scientific community, this has also focused on the consequences, N. Taleb refers to the black swan as an event with the following three features:

1. This deviation, because it is outside the scope of regular expectations, because nothing in the past can convincingly indicate its possibility.

2. It has an extraordinary impact.

3. Despite its rejected status, human nature forces us to invent explanations for its origin after the fact, making it explicable and predictable.

From the author's point of view, almost all significant scientific discoveries, historical and political events, achievements of art and culture are Black Swans. Examples of Black Swans are the development and

implementation of the Internet, World War I, the fall of the Soviet Union, and the 9/11 attacks. Taleb also notes that humanity is unable to predict its future successfully, and confidence in their knowledge precedes knowledge itself and gives rise to the phenomenon of "excess of faith." This confirms the fact that no forecasting model has predicted the scale of the current economic crisis, and its consequences continue to confuse scientific economists and business school teachers.

Given the definition of foreign and domestic scientists, the nature and characteristics of risk, as well as modern views, we propose the following definition of the category:

Risk is the probability of occurrence of an unexpected adverse event in conditions of uncertainty, which retrospectively has a rational explanation [11; 28; 13; 17; 43].

2.2 Review of existing domestic and global methods for identifying risk, its assessment and minimizing the negative impact

Imbalance, uncertainty, multicriteria - typical features of a market economy, which is always accompanied by risks.

Most foreign and domestic scientists are inclined to the Austrian national risk management standard AS / NZS 4360: 1999 [81].

According to this standard it is necessary:

- establish the context of risk;
- identify and analyze risk factors;
- assess the likelihood and consequences of risk factors;
- develop measures to influence risks;
- monitor and share information about the risk management process.

Various approaches have been proposed in the foreign literature to try to solve the problems of complex systemic risk analysis. One of the most interesting are two theories [18]:

- model of functional resonance case / Functional resonance;
- method of analysis (FRAM);
- model and processes of theoretical accident (STAMP).

The key elements of FRAM used for risk analysis are [32]:

1. Identify and describe the main functions of the system;

2. Estimate the variability for each function;

3. Evaluate how the variability of several functions can combine and lead to nonlinear results (called functional resonance);

4. Identify countermeasures.

The STPA analysis has the following structure (based on Leveson [35] and Leveson et al. [36]):

1. Identify the accidents to be considered, system-level hazards, safety limitations, and functional requirements.

2. Create a model of functional management structure for this system.

3. Identify potential hazardous control actions (hazardous system control).

4. Identify how each potentially dangerous control action from step 3, ie the scenarios leading to the dangerous control, can occur.

Risk detection methods. Each individual risk should be analyzed in terms of how it affects the company. The company's management must identify the company's goals and the most important risks that prevent them from being achieved, using the following measures, methods and techniques:

- working meetings and interviews;
- brain storm;
- questionnaires;
- graphical representation of costing processes, including the definition and presentation of business processes and cost chains, as well as external and internal factors that affect them;

– comparison with other organizations;

– discussion with management [82; 83].

There are many methods, each of which helps to obtain information about the characteristics of individual risks inherent in a particular activity. Therefore, it is advisable to use a set of methods to solve the problem.

Some methods are based on the analysis of statistical, financial, management and other accounting documents of the enterprise, others require direct verification of sources of danger. There are methods that are more appropriate for event after event than for existing situations. Some risk detection methods are based on quantitative analysis, while others use only qualitative approaches. However, they all aim at one thing - identifying and describing the risks that exist in the organization.

Therefore, the main methods of obtaining source information:

– standardized questionnaire;

– consideration and analysis of primary management documents and financial statements;

– analysis of quarterly and annual financial statements;

– compilation and analysis of the diagram of the organizational structure of the enterprise;

– compilation and analysis of technological flows of production processes;

– inspection visits to production units;

– consultations of specialists in a certain technical field [14];

– examination of documentation by specialized consulting firms;

– SWOT-analysis (external threats and opportunities) [8; 16; 17].

Risk assessment methods. As soon as risk factors are identified, the possible consequences of these events and the likelihood of their occurrence will be assessed. At the planning stage, it is necessary to decide in advance how to assess the consequences and probability (ie what scale to use).

Consequences. The assessment of the potential consequences of a particular event may be hampered by the fact that the consequences vary widely, or that the event itself occurs several times over a period of time. Such difficulties should be taken into account and developed accordingly, taking into account them: for example, consider the worst-case scenario for, say, 12 months. Assessment of the impact of the event on the organization should take into account the financial consequences, the impact on the sustainability of the organization and the company's goals, the impact on the political and regional situation of the organization.

In general, the probability of an event is estimated without considering the measures that the company may take to reduce this probability.

The probability is assessed in its pure form, taking into account that all possible measures will be taken to avoid the risk or reduce its probability.

Targeted approach means that certain risk factors are set for probabilities that reflect the opinion of the company's management. If the net probability and targets are different, then you should look at the risk profile.

Methods of minimizing the negative impact of risks. The most common methods of risk management to minimize its impact are [14; 48]:

- avoidance or rejection of risks;
- take risks;
- damage prevention;
- reduction of losses;
- insurance;
- self-insurance;
- transfer of risks (except insurance).

Risk avoidance or rejection - choosing the alternative with the lowest level of risk. Refusal to implement a project or enter a new market.

To take risks is to cover losses at the expense of the company's own financial resources. It can be about planned risk and unplanned. In the latter case,

the risk manager does not know if there is any risk at all, or he could not identify it.

Damage prevention - taking measures to reduce their likelihood.

Loss reduction - the impact on risk by reducing the likelihood of risk and / or reducing the negative consequences in the event of future risk.

Insurance - reducing the participation of the firm in compensation by transferring it (insured) to the insurance company (insurer) liability.

Self-insurance - the creation of their own insurance funds to cover losses, such as funds of insurance and reinsurance companies.

Transfer of risks (except insurance) - the transfer or partial transfer of risk to another party, which reduces the negative impact on the achievement of the company's goals. It should be borne in mind that reputational risk cannot always be transferred.

Risk transfer methods are different from insurance. This group includes hedging, leasing, warranty.

Hedging is an investment to reduce the risk of adverse asset price movements. Typically, a hedge consists of taking a compensatory position in a relevant security, such as a futures contract.

The lease allows the lessee to transfer the risk of becoming obsolete leased property to its owner. An example of another method of risk transfer, in addition to insurance, is also the so-called guarantee agreement.

Therefore, the main purpose of risk management is to eliminate or minimize its negative impact on the results of economic activity of the enterprise on the basis of forecasting the risk event and implementing risk management measures.

It is important that risk management is an integral part of the processes of continuous planning and business management. The company's strategy should identify the main risks, their possible impact on the company's activities, the probability of risks and appropriate management tools.

2.3 International experience in passenger risk management and implementation of automated fare payment system

As the analysis of international experience has shown, the introduction of an automated fare payment system took place naturally as an obvious next step in improving the transport system and the quality of transport services for the population.

In Ukraine, the situation is somewhat different: some cities are implementing such a system without improving the rolling stock of vehicles or at least optimizing routes, so to understand how to manage the risks of passenger traffic or the introduction of automated fare payment system, it is necessary to analyze the risk management experience of new technologies. among the population.

Natural disasters (such as earthquakes and volcanic eruptions), bad weather (such as floods and droughts), and health problems (such as individual or epidemic diseases, disability, old age, and death) have always been the subject of care for individuals and society. The risks associated with these sources have led to separate prudential strategies (e.g., crop diversification and stockpiling) and, perhaps more importantly, the creation of informal risk-sharing mechanisms through exchange, through extended families, mutual gifts, and egalitarian tribal systems, agreement on the distribution of crops with landowners, etc. Much of the population in developing countries still relies heavily or exclusively on these informal risk management agreements.

Industrialization and urbanization have brought two important changes: the disintegration of traditional and informal risk-sharing mechanisms and the introduction of new risks.

Risk research over the past three decades has focused on developing methods and procedures for risk analysis and risk management. As a result of

this study, risk management agencies attempt to make risk assessments a routine operation to assess various hazards, chemical agents, or technologies. The problem with the global routinization of risk assessment methodology, however, is that formal analysis may overshadow the conceptual underpinnings and limitations of this method and may give rise to an erroneous degree of certainty when considering potential side effects of human action and intervention. One of the main tasks of the risk community should be to emphasize the need for integrated risk assessment and the development of innovative risk management strategies based on knowledge of natural, technical and social sciences. To integrate risk assessment and risk perception, the article analyzes the strengths and weaknesses of each approach to risk analysis and highlights the potential contributions that technical and social sciences can offer to risk management. Technical assessments provide the best estimate for estimating the average probability of adverse effects associated with an object or activity. Public perception should guide the choice of criteria by which acceptability or tolerance can be judged. In addition, the public must be involved in determining the compromise between the criteria. Finally, societal benefits are needed to develop sustainable strategies to overcome uncertainty.

Analysis of international experience shows that different strategies can be used to manage risks at different levels of society - from the household to the international community (from micro to mega).

According to international experts, an adequate risk management strategy should include all 4 components of risk management: knowledge (understanding the nature of shocks, internal and external conditions, and potential consequences to reduce uncertainty), protection (reduce the likelihood and scale of damage, increase the likelihood and scale benefits), insurance (transfer of resources from one person to another, or in time - from favorable to unfavorable) and adaptation (recover from harm and make the most of benefits). These components interact with each other, potentially improving the quality of each other from the micro to the mega level of risk management.

Megalevel of risk management. The mega-level of risk management implies risk management at the level of the international community.

Unmanaged risks know no borders, and no country or entity alone can effectively deal with cross-border or intergenerational risks (pandemics, financial or economic crises, natural disasters, climate change, biodiversity loss, desertification, land degradation, etc.).

Risk management at the mega-level is carried out through participation in bilateral, multilateral, regional and global international agreements (accession, ratification, implementation and improvement of international treaties / conventions, such as the UN Convention, the ILO Convention). Within the framework of the concluded agreements, the international community can offer consulting services, assist in the coordination of international policies in various spheres of public life (social protection, health care, environmental protection, etc.), as well as provide common resources in cases where risks outweigh potential of individual countries or are cross-border in nature. In this case, joint efforts increase the national capacity of the parties to the agreements to counter cross-border risks, with a focus on preventive, coordinated action by the international community.

Macro level of risk management. The macro level of risk management refers to risk management at the state / government level.

The state has the scale and tools to manage systemic risks at the national, regional and local levels, to create favorable conditions for the functioning of other structures and to provide direct support to socially vulnerable groups.

Country experience shows that macro-level risk management requires abandoning the deterministic approach inherent in traditional planning and the application of alternative approaches that take into account uncertainty. In other words, it requires taking into account not a single option in the future, but a number of such options, according to their degree of probability.

Risk management/risk management is one of the tools to increase the efficiency of the public administration system. The OECD Panorama of

Government Administration 2011 (Government at a Glance 2011) notes that in order to mitigate future crises and adapt to ever-changing conditions, it is necessary to increase the capacity of public administration in terms of strategic forecasting and risk management.

Meso level of risk management. The meso-level of risk management means risk management at the level of organizations (governmental / non-governmental / business). Risk management and prevention is a rather complex process, which involves a set of different competencies that have a synergistic effect.

Competencies are becoming a new name for the efficiency of the organization / the efficiency of employees. In modern conditions of development to achieve efficiency in the work of each organization it is necessary to go through the process of developing its own model of competencies, which would emphasize the specific features of its activities.

The competency model is a set of key competencies needed by employees to successfully achieve the strategic goals of the organization, with specific indicators of their manifestations in professional activities [97]. In many countries, in order to effectively achieve development goals, competency models are developed for employees in various fields of activity, including for public administration.

For example, governments in many countries are actively taking steps to implement competency management technologies to ensure the effective performance of their employees in order to provide quality public goods and services to the general population.

Most countries have centrally developed competency models that vary significantly by target groups (managers or all civil servants).

Risk management / strategic foresight is one of the key roles of central government bodies (central authorities) in most countries.

Risk management can also be carried out by public authorities in the implementation of tasks and functions of public authority.

In international experience, the method of analysis "tie-butterfly" is increasingly used. "Butterfly tie" analysis is a method of identifying risks, describing and analyzing the ways of realization of the event (consequences) and causes, which is used during brainstorming. This method focuses on the obstacles that arise between events, their causes and consequences. Inputs are information about the risks of an event, their causes and consequences, obstacles and controls that can prevent, localize, mitigate, reduce or stimulate them. The stages of this analysis are:

– detection and determination of the event selected for analysis, its image as the central chain of the bow tie;

– creating a list of causes of the event under investigation; research of sources of danger or threat;

– identification of the development of a threat to a critical event;

– identify the boundaries that separate the causes from the event, and formulate the left side of the diagram. It is also possible to identify and include in the bow tie factors factors that may lead to escalation of risks or events and their possible consequences;

– creating obstacles or barriers that prevent unwanted consequences of the event. Provided that the factors that may cause the risk to escalate are identified, barriers are created to prevent it (used if the identified effects are positive).

– identification of various consequences of the event under investigation; defining the boundaries that connect the central chain with each consequence;

– in the presence of positive or favorable consequences, obstacles are provided in the direction of the consequence; used if the "obstacles" are the means of control that contribute to their emergence.

Let's show on a practical example of application of this method.

The identified risks of implementing a smart metering system in public passenger transport by the method of "bow tie" are given in table. 3.1-3.7, in

which the center is a risky event, on the left - the causes, on the right - the possible consequences.

In the table. 2.4 The central chain of risk is public dissatisfaction. The reasons for this risk are various: from distrust to innovations to the constant increase in travel. The consequences are the search for alternatives.

Table 2.4. – The first risk

Reasons		Consequences
Distrust of the new technology: complexity at the first stage of use; prolonged difficulty (in some people); spreading erroneous judgments; not public awareness.	Dissatisfaction of the population	Reduction of public transport users – promotion of alternative transport (own bicycles, rental systems, etc.) or arrival at the destination on foot. Problems with using the new system and delays in payment.
The desire to keep the usual; mental features; lack of desire to adapt to the new system.		
Increased travel: the new system requires more costs (cost increase), focusing on the experience of other countries.		Refusal to use public transport or its reduction – reduction of revenue, increase in costs.

In the table. 2.5 The central chain of risk is protest among drivers. The reasons for such behavior can be both lack of motivation and forced de-shadowing of income. The consequences are the search for new qualified personnel who agree to work in the system.

In the table. 2.6 The central chain of risk is the inability to monetize benefits. The reason for this is not the creation of a database of privileged categories. The consequences are the inability to monitor and control the travel of privileged categories of the population in the city or outside it.

Table 2.5 – The second risk

Reasons		Consequences
De-shadowing of income: lack of interest, motivation.	Protest among public transport drivers and conductors	The refusal of some drivers to work in the new system is the need to find a new workforce; concluding contracts with supporters; "Ultimate measures".
Maximum increase of transparency and accuracy of accounting of actually provided services for transportation of privileged and other categories of passengers.		Lack of machinations of some drivers and reduction of their "shadow profit".
Providing complete, reliable and detailed information about the performed transport work.		Availability of reliable statistical information.
No need for conductors - reducing the number of employees: the need to find a new job; desire to keep the old.		Ability to solve problems of analysis and planning of passenger traffic.
Resistance of conductors of the new system (provided they remain in the role of controller): lack of competence, lack of interest.		Reputational damage: disgust of transport users.

Table 2.6 – The third risk

Reasons		Consequences
Not creating a single database of privileged categories of citizens: technical complexity, negligence.	Unable to monetize benefits	Lack of possibility to monitor the travel of privileged categories of the population; unable to return funds to the budget in case of travel of the Kiev "privileged" in Odessa and vice versa
The refusal of "privileged" to use the new system: the habit of the old system.		The need for motivation and training activities; issuance of cards in banking institutions (subject to the conclusion of an agreement with the bank); "Ultimate measures".

In the table. 2.7 the central chain of risk is system failures. Prerequisites for their occurrence may be poor quality equipment, incorrect program settings. The consequences of these events can be delays in customer service, forced downtime.

In the table. 2.8 The central risk chain is the lack of funding. The reason for this may be the lack of interest of investors or their lack of awareness. The consequences are additional costs and delays associated with implementation.

Table 2.7 – The fourth risk

Reasons		Consequences
Poor quality equipment: wrong choice of manufacturer, supplier; lack of production.	System failures	Delays in customer service; forced downtime: no customer satisfaction; discomfort and inconvenience in fare payment, poor passenger service, errors.
Incorrect program setup: staff negligence.		
No detection of information violations in the system.		

Table 2.8 – The fifth risk

Reasons		Consequences
Investors were not interested in the project: long payback of the project, difficulties in implementation, lack of awareness about the project, subjective judgments.	Lack of funding	Project implementation without financial assistance: additional costs, increasing the duration of project implementation.
Lack of investor awareness: low publicity of the project.		

In the table. 2.9 The central chain of risk is fraud and fraud. The reasons for this phenomenon are the lack of a register of valid and blocked electronic media and the desire to save money on travel. Consequences include use for their own purposes; profit reduction.

In the table. 2.10 The central chain of risk is the loss of a ticket caused by the human factor. This contributes to the need to buy a new ticket and distrust of the controller.

Table 2.9 – The sixth risk

Reasons		Consequences
Lack of a register of valid and blocked electronic media prohibited for acceptance and maintenance	Manipulation and fraud Users	Use for their own purposes; profit reduction
The desire to save: fare, not honesty		

Table 2.10 – The seventh risk

Reasons		Consequences
Human factor: inattention, theft	Loss of a ticket	The need to buy a new ticket; distrust of the controller

Thus, the adoption of the world experience of urban passenger transport will help to increase the efficiency of passenger electric transport for Ukraine. But despite the advantages of implementing a smart metering system in urban passenger transport, using the latest technologies, we must not forget to track and localize risks that are unfavorable, increase the risks that have positive consequences and some take – manage risks. The study identified a number of risks, their causes and consequences that need to be considered when implementing an automated fare payment system.

2.4 Theoretical bases of risk management of smart accounting system implementation

The development of an automated fare accounting system in urban passenger transport is extremely important for Ukraine today, as the legal framework governing its operation in urban public transport has already appeared.

According to the amendments to the legislation adopted by the Verkhovna Rada of Ukraine on the introduction of an automated fare accounting system in urban passenger transport, cities have the right to determine whether to introduce an "electronic ticket" or not. At the moment, the city authorities of Kyiv, Lviv, Dnipro, Vinnytsia, Mykolayiv, Uzhhorod and other cities have announced their desire to implement such a system. As the "electronic ticket" involves the use of special cards, a one-time full transition to this system is not possible. There are many proposals for the transition period of the system, one of which is the equipment of public transport units with automated passenger traffic accounting systems and GPS-tracker with the ability to scale them to the system of "electronic ticket". Such hybrid systems can be quite effective for the transition period of e-ticket systems.

Modern tasks of enterprise automation include processes that involve not so much people as equipment, the so-called "Internet of Things" - a concept that can radically restructure the quality of economic and social interactions, excluding from some actions and operations the need for human participation.

The organizational and economic effect of the introduction of such smart accounting systems is obvious: organizational, associated with the introduction of advanced methods of planning and control of operations, improving the overall management culture, reducing paperwork, using the most rational business process schemes; the economic effect is to increase the profitability of the enterprise from the use of the system. Another aspect related to the "human factor": the introduction of automated accounting systems increases the

discipline and responsibility of employees, providing greater control and exempt from certain functions related to, for example, cash handling.

In any city there are many companies operating in the field of passenger transport. However, the passenger, who is only interested in comfort and speed, is not interested in understanding the intricacies of their relationship. In our opinion, the solution that increases the efficiency of the passenger transport complex as a whole, as well as at the level of a separate metropolis, is to create a common system that synchronizes and unifies the ticket menu, which connects all operators, including commercial. Such a system must also take into account all categories of privileged passengers, who must be able to travel on any type of municipal and commercial transport, in accordance with the law.

In urban public transport management, three primary models are commonly used:

1. Public Ownership and Operation: In this model, the government or a public authority owns and operates the transportation system. It's funded through taxes, subsidies, or user fares. Examples include many municipal bus services or subway systems that are owned and managed by government agencies.

2. Public-Private Partnership (PPP): This model involves collaboration between the government and private entities. The government might still maintain ownership or control but partners with private companies to operate, maintain, or invest in the system. PPPs can bring innovation, efficiency, and private capital while maintaining public oversight. For instance, a private company might manage ticketing or infrastructure while the government retains ownership.

3. Private Ownership and Operation: Some urban transport systems are entirely owned and operated by private companies without direct government involvement. These could include privately run bus services, ride-sharing apps, or even certain types of commuter rail systems.

Each model has its advantages and drawbacks, and their effectiveness often depends on various factors like local regulations, funding availability, the

specific needs of the community, and the desired level of government involvement in transportation.

In the world practice of urban public transport management is used mainly three models: administrative (France, Canada, USA), regulated market (Czech Republic, Poland, Baltic States and Scandinavia), free market (UK, South America) [12; 33]. According to the same sources, the model of the regulated market has become the most widespread. Thus, in Finland, which is considered to be the first country where non-cash payment in urban transport was tested in the 1980s, the fare depends on the duration of the trip and the route [7]. Regulated market management has made Finland's urban transport system one of the safest and most economical in the world. Another positive example is the Netherlands' public transport system. The only type of fare is a type of chip card with a limited validity of 5 years, which can be used on all modes of public transport. The card is not personalized and has the function of returning unused money. A feature of the transport system of this Central European country is the registration of passengers both at the entrance and at the exit of the vehicle. If you do not register the card at the exit, the increase in the amount will not be stopped [7]. That is, the card is differentiated by travel distance.

In Italy, introduced a system of electronic payments in public transport, the only one for the whole region [15]. In the administrative region of Piedmont, an electronic ticketing system has been operating since 2014, which is also a reliable source of information on passenger transportation. The use of data from smart cards allows for a detailed analysis of the time and distance of movement of each passenger, and also allows you to track travel chains. Based on these data, the system automatically calculates the efficiency of routes and load factors of rolling stock. The data are considered reliable both for the permissible error of calculations and for the protection of personal data of passengers.

The public transport operator of Dresden (Germany) has been successfully transformed from a former socialist enterprise into a modern company over the last 20-25 years. He, like all Ukrainian carriers today, suffered from a lack of

investment, a lack of support from municipal and state authorities, low profitability and a socially oriented tariff system. The company remained in municipal subordination, but was completely restructured: subsidiaries and branches responsible for specialized business areas were established, sales and marketing departments were significantly expanded, and the number of staff was reduced. By implementing these and other (exposing cross-links between the city's various municipal utilities and abolishing them), the Dresden municipality has achieved a positive increase in the transport operator's cost recovery ratio from 16.8% in 1990 to 78.1% in 2011, thus unloading the local budget. This allowed reorienting funds for the following purposes: purchase of new modern low-floor and energy-efficient rolling stock, introduction of a single intelligent transport management system, gaining priority of public transport at traffic lights, optimization of the route network, raising awareness of passengers, thorough cleaning. stops. And the most important thing that the local municipality has achieved in this direction is the introduction of an integrated electronic cashless fare system in public transport, differentiated for different consumer groups: there is a one-way ticket, day ticket, multiple ticket, weekly and monthly tickets (with different fares). for travel). And all tickets include the possibility of transfer to the routes of different operators. New advanced sales systems have appeared - vending machines at stops and trams, as well as devices for printing tickets on all buses. The Dresden transport operator has also introduced a system for selling electronic tickets on smart cards and a system for selling electronic tickets using mobile phones. Subsequently, the system "Be in / Be out" was introduced - registration at the entrance and exit of the vehicle, which allowed automatic calculation of fare depending on the point of embarkation and disembarkation of the passenger. Tariffs have become even more flexible, which has affected the further increase in the number of passengers in municipal transport.

In the city of Varna (Bulgaria), the automated ticketing system according to the concept developed for this city, "is designed to improve the quality of

services, reduce costs to support the functioning of public transport in the city." The introduction of a modern automated system allows the transport operator to collect statistics on fares to plan the current work and development of public transport in this resort and port city. The system uses contactless reusable cards with the possibility of multiple replenishment, paper tickets for a single trip (sale is carried out using a vending machine for cards and tickets, respectively). Given the specifics of the city, where there are many visitors, it is possible to pay the cost of travel in cash in the cabin of the vehicle. Check the correctness of payment is carried out by controllers using a mobile device.

The peculiarities of the Asian market are such that they are very different from developed and less developed countries. If in China, which is developing at a faster pace today, a new system of payment for the use of public transport using mobile devices is gaining unprecedented popularity, and it is expected that in the near future it will reach more than 65% of all calculations [19], then for the Philippines, where a significant percentage of the population is below the poverty line, before the introduction of electronic payment systems (in September 2015) the main means of payment is a paper one-time ticket [16].

According to this source, the Philippine public transport system uses a variety of means (up to a change in the management of the company and a radical change in the entire management structure) to promote smart cards (valid for 4 years) to pay for travel, but more half of the passengers continue to use tickets for one flight. In the Philippines, the cost of a ticket depends on the distance traveled, discounted tickets are issued in person when applying and providing the relevant certificates, students are not granted benefits. Although the use of smart cards is gradually increasing, the growth rate does not satisfy the Philippine transport company. The main results of the Asian market study showed that only groups with a high level of education, stable income or stable work use smart cards, and passengers with lower level of education, low income or unstable work prefer one-way tickets.

In Hong Kong, transport smart cards are designed not only for transport but also for other purposes. They can be used for payment in shops, restaurants and for payment on the Internet [23; 24]. In Seoul (Korea), the use of smart cards provides a large number of discounts on transportation services compared to a paper ticket [25]. In Guangzhou (China), when a passenger uses a smart card more than 15 times in a row, there is a 40% discount on each subsequent trip until the end of the month [26]. In the cities of Tokyo, Singapore and Kuala Lumpur, the same type of smart card is suitable for use on all modes of public transport [27-29]. In the cities of Tokyo, Hong Kong and Seoul, passengers can return money previously credited to the transport card [30-32].

World practice shows that the most efficient and viable smart accounting system, when the automated fare payment system is under one operator, which organizes ticket sales, accumulation and accounting of income, other operations related to transport tickets. Carriers, connecting to a single system, receive income from the provision of transport services. That is, such systems should be based on both automation of fare payment and automation of transport control. Examples of such successful smart accounting systems are Octopus smart cards operating in Hong Kong, which, incidentally, can not only pay for travel on public transport, but also pay for purchases in stores, restaurants and vending machines, or London transport map Oyster, with which you can travel in the London Underground, buses, London Overground (London overground), light rail trains (DLR), trams [3, p. 224].

World practice shows that the collection of income from the payment of travel by passengers in large cities requires non-standard solutions using information technology. In the realm of large city transportation, the quest for revenue collection from passenger fares has indeed spurred unconventional solutions leveraging information technology. These innovative approaches often revolve around enhancing user experience, efficiency, and accessibility. One prominent avenue of this evolution is the introduction of contactless payment systems. These methods allow passengers to seamlessly pay for their journeys

using smart cards, mobile payment applications, or even credit/debit cards equipped with Near Field Communication (NFC) technology. By facilitating a tap or scan at entry points, these systems eliminate the hassle of physical tickets or cash, ensuring a smoother and more convenient experience for commuters. Moreover, the advent of real-time payment and information systems has revolutionized the passenger experience. Information technology enables the provision of up-to-the-minute updates on arrival times, service changes, and disruptions.

However, the introduction of new sales channels is not as fast as we would like: despite the rapid development of mobile services, a significant amount of sales is still going through regular cash registers. Even in large cities, where the main users of modern Internet services are concentrated, such types of sales do not exceed 5-10% of the total [4, p. 45].

However, increasing the profitability of revenue collection is impossible without optimizing operating costs for cash services. At the same time, it is significantly important to increase the level of quality and availability of the ticket sales service. The work of the cashier is associated with all the risks caused by the human factor: errors, fraud, loss of productivity, etc. The introduction of a self-service ticket sales system is a necessary requirement of any efficient urban passenger transport system. In general, comprehensive automation of the ticket sales process will provide:

- increase in the collection of income from fare by at least 15%;

- the possibility of partial, and at some transport hubs - complete replacement of cashiers with vending machines;

- reduction of queues during rush hours without increasing the number of ticket offices;

- availability of ticket sales service around the clock seven days a week without the involvement of additional staff.

Online services are becoming popular among Ukrainians, they are used for language learning, data storage, business planning, accounting. The idea of

online accounting is not new, such products have long been used around the world. You can work in the online service wherever you have access to the Internet: from a laptop or even a smartphone, without being tied to a specific computer. In addition, online accounting is updated automatically, the help of specialists is not needed.

And cloud services have an attractive appearance, a modern and clear interface, full of tips, so it's easy to work with them.

Yes, in "Smart Accounting" an entrepreneur can work independently, even if he has no skills, or with an accountant.

For an accountant, the service is convenient because you can keep an unlimited number of business clients in one account, all the data is always at hand. You can give the entrepreneur access, and he will import account statements, record cash payments, add documents, etc., this data will be automatically displayed in the system. And you will not waste time on meetings and phone calls. And if there are more than five businesses in your account, you can get a discount. what can be done in "Smart Accounting":

- Keep records of income and expenses. Data can be entered into the system manually, and if there is a business account - to import bank statements. At the same time keep records of the amounts that should be included in the declaration, as well as record the so-called management income and expenses that do not fall into the reporting. You can analyze mutual settlements with counterparties and creditors with the help of convenient analytics.

- Create invoices, acts and invoices and send them by e-mail to customers simply from the service. You can do this even from a smartphone. There are also 15 templates of contracts, including lease, supply, services, etc., they are ready to use, you only need to add special conditions.

- Automatically fill out a single tax return and income book. You do not have to bother with filling out reports, calculate income and a single tax, the system will calculate and fill everything.

- Create an online store. With the help of the site designer "Smart Showcase" you can create a site yourself, without the cost of a designer and programmer, the domain also does not need to buy. Even an accountant can create their own website and offer their services on the Internet, find new customers throughout Ukraine.

- Get tax advice. Both entrepreneurs and accountants need the help of experts. And the care service "Smart Accounting" advises not only on work in the service, but also on doing business on a simplified taxation system.

The capabilities of the service comply with current tax legislation, you do not have to track changes yourself: report forms and details for the payment of a single tax and SSC are always relevant. The system will prompt if the rules of work on the single tax are violated, and will help to avoid mistakes and penalties.

The capabilities of the service comply with current tax legislation, you do not have to track changes yourself: report forms and details for the payment of a single tax and SSC are always relevant. The system will prompt if the rules of work on the single tax are violated, and will help to avoid mistakes and penalties.

Today, cloud services are the most secure way to store information. For example, all Smart Accounting user data is stored on Microsoft Azure's cloud servers in Europe, which ensures the highest level of security and prevents third-party access to information.

Smart City is, first of all, a rational economy. Reasonable use of electricity, heat, gas and water resources helps to increase the efficiency of the city budget and the quality of life of citizens in general. Cities need to transform their existing infrastructure into smart ones. When implementing Smart City projects, the emphasis is on minimizing costs and return on investment. The technical base and world experience for the implementation of "smart city" projects are already available in Ukraine, including through our company. There are more and more successful implementations and now is the time to intensify the process of implementing appropriate technologies in urban infrastructure

throughout the country - so that Ukrainian cities do not lag behind the overall pace of European development.

In combination, both of these factors allow you to quickly analyze the flow of information and flexibly adjust the operation of communal infrastructure to the needs of residents and businesses. The economic effect, as a rule, is not long in coming - the experience of implemented global projects shows that the introduction of technology "smart" homes can save from 10 to 30% of electricity and up to 20% of water. "Smart" transport reduces the time spent on the road by 20% and reduces the time to find a free parking space by 15%. But, most importantly, the implementation of the Smart City concept contributes not only to the optimization of the expenditure side of the budget, but also to the formation of additional revenues. The introduction of an automated system for receiving and storing revenue involves the use of automated deposit machines (ADM) with modules for automatic acceptance of banknotes and coins. This comprehensive system will allow the transport company to save on the cost of collection in remote collection points by storing revenue in ADM for several days, reduce the cost of purchasing cash registers, optimize maintenance costs of the entire fleet of ADM, as well as staff costs [5; 86].

Managing income collection from passenger payments in large cities often necessitates innovative solutions utilizing information technology. This requirement stems from the complexity and scale of urban transportation systems. Information technology has been pivotal in implementing solutions that simplify payment processes, enhance efficiency, and improve the overall user experience.

In urban public transport management, three primary models are commonly used:

Public Ownership and Operation: In this model, the government or a public authority owns and operates the transportation system. It's funded through taxes, subsidies, or user fares. Examples include many municipal bus services or subway systems that are owned and managed by government agencies.

Public-Private Partnership (PPP): This model involves collaboration between the government and private entities. The government might still maintain ownership or control but partners with private companies to operate, maintain, or invest in the system. PPPs can bring innovation, efficiency, and private capital while maintaining public oversight. For instance, a private company might manage ticketing or infrastructure while the government retains ownership.

Private Ownership and Operation: Some urban transport systems are entirely owned and operated by private companies without direct government involvement. These could include privately run bus services, ride-sharing apps, or even certain types of commuter rail systems.

Each model has its advantages and drawbacks, and their effectiveness often depends on various factors like local regulations, funding availability, the specific needs of the community, and the desired level of government involvement in transportation.

In the realm of large city transportation, the quest for revenue collection from passenger fares has indeed spurred unconventional solutions leveraging information technology. These innovative approaches often revolve around enhancing user experience, efficiency, and accessibility.

One prominent avenue of this evolution is the introduction of contactless payment systems. These methods allow passengers to seamlessly pay for their journeys using smart cards, mobile payment applications, or even credit/debit cards equipped with Near Field Communication (NFC) technology. By facilitating a tap or scan at entry points, these systems eliminate the hassle of physical tickets or cash, ensuring a smoother and more convenient experience for commuters.

Another pivotal advancement lies in the integration of fare systems across diverse modes of transportation. Through information technology, cities are striving to establish unified payment mechanisms, enabling passengers to use a single payment method across buses, trains, subways, and other transit services.

This integration not only simplifies the payment process for travelers but also encourages the utilization of multiple modes of transport, fostering a more interconnected and efficient urban transit network.

Moreover, the advent of real-time payment and information systems has revolutionized the passenger experience. Information technology enables the provision of up-to-the-minute updates on arrival times, service changes, and disruptions. Additionally, some systems now allow for payment based on the actual distance traveled or time used, moving away from fixed fares. This dynamic payment approach offers greater fairness and flexibility for passengers, aligning fares more closely with the services availed.

These innovative solutions underscore the transformative power of information technology in revolutionizing revenue collection from passenger fares in large cities. By focusing on enhancing convenience, integration, and adaptability, these advancements strive to create a more user-centric and efficient public transportation experience.

Assessing the prospects for the development of a smart metering system using the latest information technologies in urban passenger transport, it is possible to identify two main trends. First, it is the unification and centralization of solutions that are necessary for the further development of the entire transport industry. And this is a world practice: the only system operator to which independent agents and partners connect, the only system that has, among other things, its own API with the ability to develop their own "add-ons", a single database to which agents can use all accumulated statistics for their work. And the passenger should receive any service literally "in two clicks".

Then the level of comfort and satisfaction with the service will only increase. Secondly, the modern reality is that the transport industry (like most other industries) is a distributed infrastructure of various objects, be it a self-service terminal, information boards, roadside lighting lines, automation cabinets, etc. All these "farms" need to be managed, maintained and monitored to ensure that

there are no disruptions. This requires a special system that would allow you to flexibly add to a single control loop objects or remove them from it, configure, set usage scenarios, communicate with external systems. Only in this case it is possible to create a common mechanism in which not people but devices will interact with each other.

Given the urgent need for city authorities and urban transport companies to create a citywide automated fare payment system, the first step is to decide on the choice of basic technology for the development of the latest socially oriented payment technology, which can be further improved.

2.5 Security orientation as the principle of risk management

Safety-oriented management aims to create conditions for the optimal functioning of an enterprise, where preventive measures implemented at the management system level as a whole contribute to a positive impact on economic security and enable the enterprise to implement its overall development strategy. The main principle of this type of management becomes safety-orientedness.

At the same time, safety-orientedness as a challenge and a principle of managing the development of innovation-active manufacturing enterprises is manifested in their process of seeking ways for safe economic development. In our opinion, it becomes one of the key features of management in conditions of continuous strategic changes and unpredictability [87; 88]. *This involves:* a) The issue of environmental risk is closely linked to recognizing the inevitability of its emergence, prompting the search for a management tool that allows the enterprise to ensure conditionally safe development. This approach requires the selection or definition of principles, quality, and quantity of necessary changes, as well as a system (description of its structure, elements, model); b) An important characteristic of modern management is the set of dynamic capabilities provided by the safety-oriented management system, the mechanism

of which deals with the risky nature of the environment; c) The development and implementation of such a system involve improving and/or adapting the existing management toolkit applicable to the management of the development of an innovation-active enterprise as a continuous process.

These input settings help understand the scale of the issues in forming a safety-oriented management system for the development of an innovation-active enterprise: the hierarchy (not only at the enterprise level but also at the levels of the region, industry, national, and global economy) and the multifunctionality of the latter. Safety-orientedness is determined by a risk-prone environment through *four main sources of threats* [89, p. 81], identified by *the criterion of the origin of risks*:

– Naturagenic threats caused by nature (natural disasters, catastrophes);

– Sociogenic threats caused by society (political crises, economic reforms, legislative changes, migration of people);

– Anthropogenic threats—risks caused by the actions of individuals and their social groups (competitors, suppliers, contractors, clients);

– Technogenic threats arising within technological processes and the operation of various technical objects.

At the same time, a somewhat different list of global risks, statistically and qualitatively important, is based on The Global Risks Report presented by the World Economic Forum. It identifies five categories of global risks categorized by the nature of the risks: economic, environmental, geopolitical, social, and technological [90, p. 89]. Both classifications are effective for understanding and managing risks, but their use may depend on the specific context and management goals. Among the drawbacks of classifications are:

a) Subjectivity, as each classification may vary depending on the methodology and chosen approach, influencing the subjectivity of category allocation;

b) Generality: some threats may impact multiple categories, complicating a clear distinction between them.

Their common features include: considering the nature of risks by categorizing them based on sources and nature, and a systemic approach. A systemic approach is defined by the principle of viewing the system as a single entity composed of interdependent elements. Both risk classifications exhibit a systemic approach in their construction (Table 2.11).

Table 2.11 – Comparison of the systemic basis of safety-oriented and global risk classifications *(compiled based on [89, 90]).*

Safety-oriented classification Forum		Global classification	
Risks	Systemic Approach	Risks	Systemic Approach
1.Naturagenic	Examination of natural phenomena as elements of the natural system, the interaction of which can pose threats.	1.Ecologica	Consideration of the impact of the natural environment as a system.
2. Sociogenic	Examination of social phenomena as interacting elements of the social system (political crises, economic reforms).	2. Social	Considering social phenomena (poverty, unemployment) as elements of the social system.
3.Anthropo-genic	Examining risks related to human activity as elements of the socio-economic system, where the interaction of various entities can create threats.	3. Economic	Examination of economic elements as part of a unified system, considering the interaction and influence of various economic aspects on each other.
		4. Geopoliti-cal	Examination of global interactions between countries as a system.
4.Technogenic	Examination of technological processes as interacting components and parts of a technical system.	5. Technolo-gical	Consideration of technological changes as elements of the technical system.

So, both classifications consider interdependence, interaction, and complexity of risks, indicating their systemic approach. Research on scientific studies and generalizations of their results has concluded that in the aspect of safety-oriented management of innovative enterprise development, the key principles are (Table 2.12):

Table 2.12 – Key Principles of Safety-Oriented Development Management *(source: developed by the author based on [89, 91-102])*

Principles	characteristic
1. Safety and Systematicity	Ensuring the stability and safety of the innovation development system through the consideration of all components, Interacting elements, taking into account both internal and external factors.
2. Integrity and Coherence	Ensuring the unity of all stages of the innovation process, facilitating harmonious interaction among all components.
3. Alignment of Interests	Creating innovations that bring economic and social benefits to all participants, taking into account the interests of innovators, investors, and other stakeholders.
4. Efficiency and Resource Optimization	Choosing and implementing conditions that ensure achieving the desired result with minimal resource expenditure.
5. Continuity and Adaptability	A continuous process of creating, producing, and commercializing innovations for effective adaptation to changes in the environment.
6. Openness	The ability to attract external resources and innovations, as well as providing access to proprietary developments.
7. Strategic Direction	Developing measures that align with the overall enterprise strategy to achieve innovative development in the long term.
8. Ensuring Innovative Security	Finding the optimal balance between the level of economic security of the enterprise and the profit from the implementation of innovative projects.

These principles are implemented through management functions such as planning, organization, motivation, control, and regulation. They rely *on general requirements for managing dynamic complex processes and systems in the conditions of innovative chaos, such as* hierarchy, integrity, dynamism,

continuous improvement, standardization and regulation, optimization constraints, informativeness, organization, safety of development, and consideration of stakeholders' interests:

– Hierarchy – creating a system that considers requirements allowing the inclusion of specific subsystems and their mechanisms at a lower level in the hierarchy in the system and mechanism at a higher level.

– Integrity – firstly, the connections between elements used in creating and improving the system and its parts that should ensure the integrity of the system. Secondly, it is the unity of goals, tasks, conditions, actions forming subsystems based on interconnection and mutual influence.

– Dynamism and continuous improvement – the format of transformation of the mechanism and its system associated with continuous improvement and complication of organizational and economic activities in the management system based on the innovative model of economic development.

– Standardization and regulation – firstly, the unification and typification of subsystems and elements of a certain mechanism. Secondly, the establishment of rules, norms, and regulations to organize the creation and development of mechanisms and systems.

– Optimization constraints – a dual-focus principle. Optimization is the functioning and development of mechanisms and systems with minimal costs to achieve optimal results in planned terms. Constraints are the priority development of those elements, functions, conditions, and factors that have the greatest impact on the process of improving a specific activity in management in the conditions of innovative chaos.

– Informativeness – providing information to all stakeholders of a specific process and justifying the goals, tasks, strategies, resources, and target indicators of the development of its mechanisms and systems.

– Consideration of stakeholders' interests – making management decisions that take into account and satisfy the expectations, needs, and interests of various groups of individuals or organizations that can influence or be

influenced by the activity or decisions of a particular subject. This principle recognizes the role of various stakeholders (customers, shareholders, employees, government agencies, public groups, and others) in shaping strategies, making management decisions, and conducting activities. Considering stakeholders' interests contributes to creating a more balanced and sustainable approach to management, emphasizing conflict avoidance and maximizing positive relationships with all stakeholders.

– Organization – belonging to a whole that significantly influences the state and behavior of the main elements of systems and mechanisms.

– Relative safety of development – the development of enterprises by building safety-oriented management (its system, mechanism, and toolkit) at all levels (micro, meso, macro).

Regarding the last principle:

a) The principle of complexity is relevant, manifested in the cause-and-effect relationships between systems and subsystems of the mechanism, where the nature of the connections can be direct or feedback.

b) The principle of conditional safety of development is extremely important for this study. The safety of enterprise development is conditional due to constant changes in the economic, technological, and social environment. This principle is not absolute, as after safety, one can always consider conditions limited by specific factors such as economic feasibility, social responsibility, and environmental aspects.

Business safety is conditional for several reasons:

Firstly, the world is constantly changing, and what was considered safe yesterday may become outdated today. Technologies, markets, consumer needs – all evolve, and businesses must adapt to these changes. Internal and external factors, such as economic transformations, technological innovations, and socio-cultural shifts, can suddenly alter the landscape of entrepreneurial activities. New technologies may open up new opportunities but can simultaneously pose new challenges and threats.

Secondly, there are many factors that cannot be influenced or predicted in advance. Economic crises, natural disasters, political turbulence – all these can impact even the best-managed businesses. Market competition, changes in consumer preferences, and unforeseen events – all these factors introduce elements of uncertainty into the decision-making process. Global issues (climate change, social inequality, geopolitical tension, etc.) also affect the conditions of business safety.

Thirdly, the human factor always remains unpredictable. Even with the best strategies and risk management systems in place, errors and misunderstandings can occur due to human actions or incorrect decision-making. Depending on the internal culture of the company, the qualifications and motivation of personnel, the level of communication, and the perception of risks, people can influence the safety of a business's development.

Taking the above into account, it can be generalized that *the business environment is constantly changing*. Therefore, for enterprises in the conditions of innovative chaos, environmental turbulence, and strategic global changes, ensuring absolute security of development is impossible.

Hence, *the secure development of an enterprise is more of a state of motion than a predetermined state.* Therefore, enterprises need to demonstrate a high level of flexibility, adaptability, and constant readiness for change to effectively manage risks and ensure stable and sustainable development, providing conditions for conditional security in the development process.

Therefore, s*afety orientation is simultaneously a challenge and a principle of managing the development of innovation-active manufacturing enterprises in the search for paths of secure economic growth*. Its application will provide the enterprise development management system.

Security orientation in the context of managing an innovation-active enterprise should be regarded as the need to consider and ensure safety at all stages of the life cycle of innovative processes. Therefore, safety-oriented management of an innovation-active enterprise places security at the centre of

strategic planning and implementation of innovations, which, in turn, contributes to the sustainable and timely development of the enterprise. This is based *on key principles* (*see table 2.12*) *and management processes (goals of influence, actual processes, and their results)*, the application of which is driven by their outcomes:

a) Innovation security: Safety and innovation are not opposites. Enterprise innovation management should include measures to ensure the safety of innovations. This may involve analysing and mitigating potential risks associated with the implementation of new technologies or products;

b) Strategic adaptability: Security orientation is characterized by strategic adaptability. The enterprise must be ready to adapt to changes in its environment while maintaining stability and efficiency in innovative processes;

c) Ethical innovation management: Safety-oriented innovation management applies an ethical approach. It involves considering the interests of stakeholders, taking into account ethical aspects in decision-making, and ensuring social responsibility for safety and sustainable development;

d) Formation of a safety culture: Ensuring safety in an innovative environment involves cultivating a safety culture at all levels of the enterprise. This means engaging staff in management practices and training them on safety aspects when implementing innovations;

e) Continuous improvement: Safety is not a static state but a continuous process of improvement. Accordingly, enterprise development management should involve systematic risk assessment and the implementation of measures to reduce them.

The theoretical-functional and methodological-instrumental framework for enterprise development management based on safety orientation consists of four interrelated dynamic systems (Figure 2.1). These systems rely on the concept of safety-oriented management and the current environmental factors:

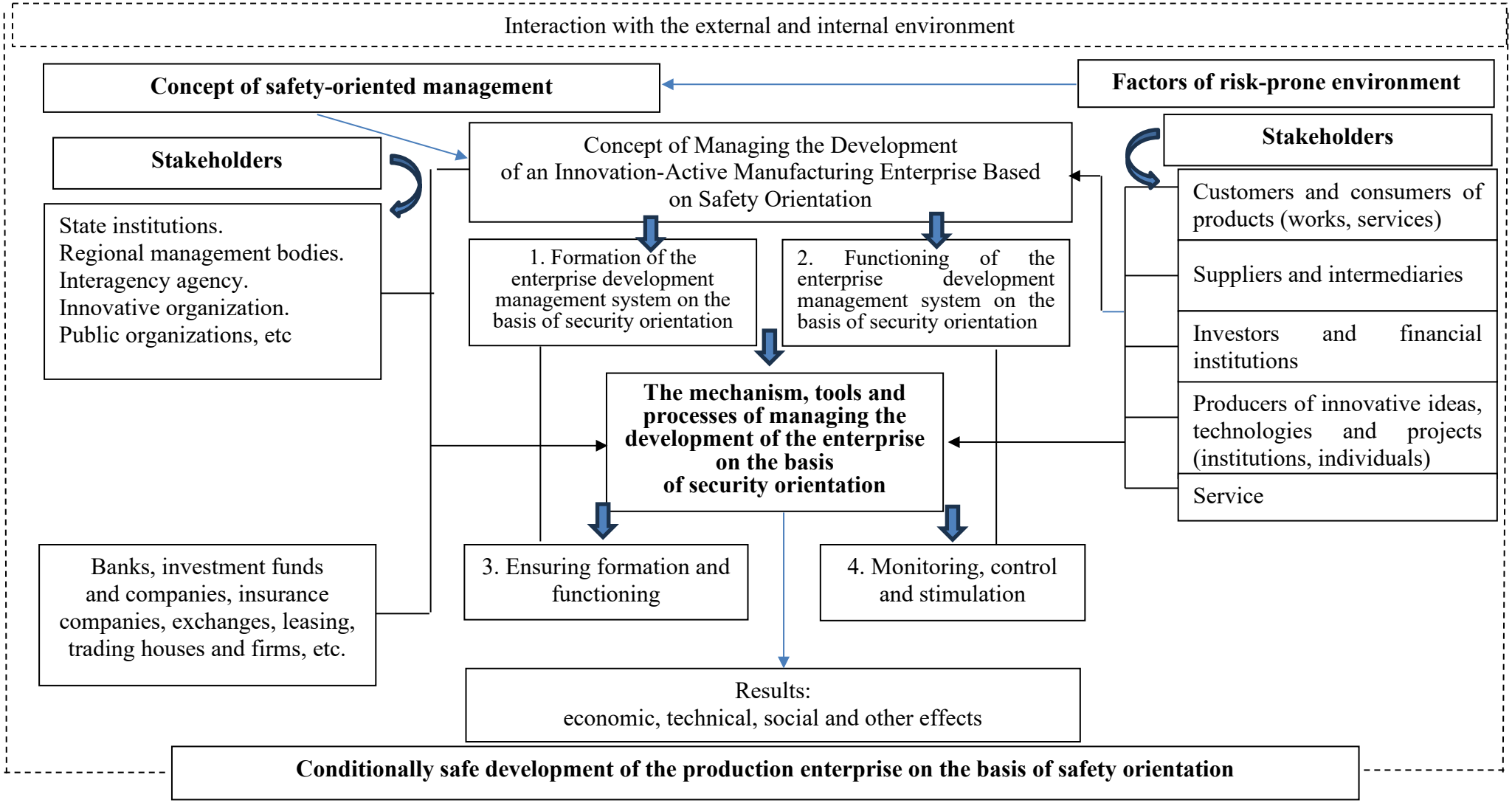

Figure 2.1 – Theoretical-functional model of managing the development of innovation-active production enterprises based on safety orientation *(source: author's development)*

– *theoretical-methodological foundation*: The concept of safety-oriented management of the Odessa School of Innovative Transformatics (S. Filyppova, I. Bashynska, V. Filippov [17; 24; 25; 43; 74; 87], L. Voloshchuk [95], researchers from other schools [93-94], and the author's conceptual vision of managing the development of an innovation-active production enterprise based on safety orientation;

– *structural components of the enterprise development management system on the basis of security orientation:* the mechanism, tools and processes of enterprise development management on the basis of security orientation;

– *the process outline of managing the development of the enterprise on the basis of security orientation*:

a) formation of the appropriate system;

b) functioning of the relevant system;

c) ensuring the formation and functioning of the relevant system;

d) monitoring, controlling and stimulating the development of the enterprise on the basis of security orientation;

– *the resulting block of managing the development of the enterprise on the basis of safety orientation* (economic, technical, social and other effects, as well as conditionally safe development of the production enterprise on the basis of safety orientation as a direct resulting effect).

The theoretical foundation of the dissertation developments is the concept of security-oriented management initiated by scholars of the Odessa School of Innovative Transformatics. This concept seeks a strategic approach to management, taking into account safety aspects, highlighting its general aspects, toolkit, and mechanisms.

It is within the framework of this concept, developed based on the author's conceptual vision of managing the development of an innovation-active production enterprise on the principles of security orientation, that adapts the concept to the conditions of a risk-generating environment.

The structure of the management system consists of the mechanism, tools and processes of managing the development of the enterprise on the basis of security orientation [89; 95; 97]. The mechanism of managing the development of the enterprise on the basis of safety orientation includes a system of methods, procedures and tools aimed at implementing the concept of safety-oriented management. This includes planning, risk analysis, development of solutions and implementation of security measures. The toolkit provides the means to implement security-conscious management strategies and practices. This may include monitoring systems, risk assessment methods and other tools.

Various processes of managing the development of the enterprise on the basis of security orientation [89; 95; 98] determine the sequence and interrelationship of the actions of the management personnel for the effective development of the enterprise taking into account security. They cover various functional tasks and processes. Thus, the formation of an enterprise development management system based on security orientation includes the definition of strategies and structures that take security into account. It is important to create a system that flexibly responds to threat opportunities. The functioning of the system covers the organization of the life activities of the enterprise in accordance with the adopted strategies and methods aimed at ensuring security. Ensuring the formation and operation of the enterprise development management system on the basis of security orientation includes all processes that ensure the effectiveness and reliability of the management system in the presence of an unpredictable risk-generating environment. Monitoring, control and stimulation of the development of the enterprise on the basis of safety orientation involves the organization of a system of control and stimulation to ensure constant improvement and response to changes in safety and risks.

The result block reflects the real results of the implementation of enterprise development management on the basis of security orientation: economic, technical, social, environmental and other effects. This includes economic benefits, technical progress, social impact and other positive effects of development.

Since the totality of the listed dynamic management subsystems is formed on the basis of the concept of safety-oriented management and takes into account environmental factors, it creates a comprehensive approach to management.

The goal of hierarchical management of enterprise development on the basis of security orientation should be [95; 97-99]:

– at the meta-level (world, planetary level) is active participation in global initiatives for economic, social and environmental security through cooperation with international organizations, participation in global development projects, compliance with international standards and norms in the field of security, ensuring sustainable development and interactions with global stakeholders. For the company, this means that it not only takes care of its own safety and sustainability of development, but also actively participates in the formation of global standards and practices aimed at ensuring safety and sustainable development on all scales of the world. This level is not considered in the study, as it is not included in the set of tasks, as it requires other approaches and grouping of results;

– at the macro level – creation of a favourable economic environment that contributes to the sustainable development of the enterprise at the macro level. This includes interaction with the economic policy of the country, the development of strategies to maintain high levels of security in the economy, as well as the identification of key factors that can affect the security of enterprise development at the national level;

– at the meso level – development and implementation of risk management strategies, ensuring the security of the supply chain, determining optimal development strategies that take into account security aspects, as well as establishing partnerships with other enterprises and industry organizations for the joint implementation of safe initiatives and projects;

– at the micro level – the implementation of specific security strategies related to the internal operations and activities of the enterprise. This includes creating a safety culture among staff, developing and implementing safety standards

and procedures, and engaging with all stakeholders at the enterprise level to ensure a high level of safety in all aspects of operations.

Summarizing the above, it can be stated that the purpose of managing the development of the enterprise on the basis of security orientation is:

a) in the theoretical aspect (conceptually) in the creation and maintenance of a stable and effective management system, which provides the enterprise with conditionally safe development at all levels of influence - from the macro- to the micro-environment;

b) in the applied aspect – determination and achievement of target economic indicators within the specific tasks of managing the development of the enterprise on the basis of security orientation at the micro-, meso-, macro- and meta-levels.

Achieving the goal is facilitated by a qualitative terminological or conceptual apparatus (categories, concepts, terms), which creates a system that includes principles, functions, methods, bodies and technologies, which is the starting point for any research. This work uses both commonly known categories, concepts and terms, as well as author's definitions of some concepts.

The first commonly known concept used in research is *a system*, the creation of which includes the process of developing and debugging interacting components that work together to achieve specific goals or solve certain tasks in the following sequence:

1. Analysis of needs and requirements: determination of specific needs for the satisfaction of which the system will be created; study of the conditions and limitations of the system, situation. It is important to identify the key problems and the solutions needed.

2. System design: definition of goals and objectives, conceptual scheme or model (mathematical, structural or other) of the system structure, its connections.

3. Development and implementation of the mechanism of action of the system: determination of the structure and components of the system. Testing and debugging.

3. Setting up and working out the operation of the system: improving the scheme, connections, influences, tools. Correction of errors in the structure and/or operation of the system.

4. Operation and support of the system: regular use of the system's capabilities and satisfaction (provision) of its needs.

5. Improvement of the system: introduction of innovations in subsystems, the composition of elements and connections of the system.

The second and third commonly known concepts used in research are mechanism and tools.

A mechanism is a system of interacting parts or elements aimed at achieving a specific goal or performing a specific function. In the context of management, a mechanism is a system of structured elements and processes used to achieve goals and ensure efficiency. The management mechanism may include such components as rules, procedures, methods, tools, technologies, structures, information.

An important feature of the mechanism is its systematicity and focus on achieving a specific result or effect in management [24; 25; 91, 97-100].

A toolkit is a set of tools, devices, methods, technical means or programs that are used to perform specific tasks or achieve specific goals. Management tools may include software for data analysis, planning and control methods, standard operating procedures, technical automation tools and other tools aimed at improving management processes [95, 98, 100, 102].

For example, project management tools may include programs for graphic planning, risk assessment methods, cost control systems, and other tools aimed at successful project execution.

Therefore, *the toolkit serves as a means of optimizing and improving management practices.*

Mechanism and tools in the context of management are related, but they have their differences. A mechanism is a more general term that refers to a system of interrelated elements that work together to achieve specific goals. Tools are specific

means or facilities that are used within a mechanism to perform specific tasks or functions.

So, a *mechanism is a general framework of managerial influence or a system of tools, and tools are specific components of this system that are used to achieve certain results or perform specific functions.*

The process of creating the mechanism and tools of the control system is an identical multi-stage process, which includes the *following stages*:

1. Analysis of needs: begins with the result of studying the situation, defining the goal and tasks of management. It is important to identify key issues and solutions, which specific needs should be addressed.

2. Development of the concept: the general idea of the mechanism and tools is formed, the main principles and directions of development are developed. Factors that can affect the effectiveness of the management system are taken into account.

3. Design: specific details of the structure of the mechanism and tools are determined. It is important to develop clear projects, to place functional connections and the role of each element.

4. Development of tools: at this stage, specific tools are created for the implementation of the management process. It can be software, methodological materials, standards or other means that facilitate the use of the mechanism.

5. Implementation: transition from development to active use. At first, the system is launched on a limited basis for testing and debugging.

6. Evaluation and adjustment: the effectiveness of the mechanism and tools is evaluated. If you have problems or opportunities for improvement, the system is adjusted and optimized.

7. Support and development: after the implementation of the management system, it is necessary to constantly support and improve it. Responding to changes in the environment and internal processes allows the system to remain relevant and effective over time.

Knowledge of the stages of creation of the system, mechanism and tools is decisive and provides a clear structure for management influence, its distribution in time and space. In practice, this improves planning, allows effective implementation of strategies, helps optimize processes, and allows timely recognition and resolution of problems.

A detailed analysis of the management toolkit ensures its consideration as a hierarchical system of organizational and economic influences and connections, which forms a methodological-instrumental contour of managing the development of the enterprise on the basis of security orientation (Fig. 2.2).

Analyzing this outline, it can be argued that all subsystems of tools, indicated as local at different hierarchical levels, must interact with each other, creating a single integrity, that is, a system. If they interact with each other, acting as dynamic formations, then each component of the system changes (deteriorates or improves) in their dynamic relationships.

Therefore, the interaction of local subsystems of tools at different levels of the hierarchy of enterprise development management on the basis of security orientation, in particular in the sector of innovative and active manufacturing enterprises, will create a complex and interdependent system.

This interaction will grow and be significantly complicated by the dynamic processes occurring in the system itself, since each of its components under the influence of these dynamic relationships can evolve, improving the functionality of the system and its mechanisms or, faced with changes, reduce their characteristics.

This means that it is necessary to determine the key aspects of the interaction of tools in the system, to look for opportunities to optimize these interactions, to introduce additional mechanisms to support positive evolutionary changes and adapt to the challenges of the environment.

It is also important to study the interrelationships of system components and direct attention to those aspects where the possibility of improvement can lead to positive changes in the functioning of the system as a whole.

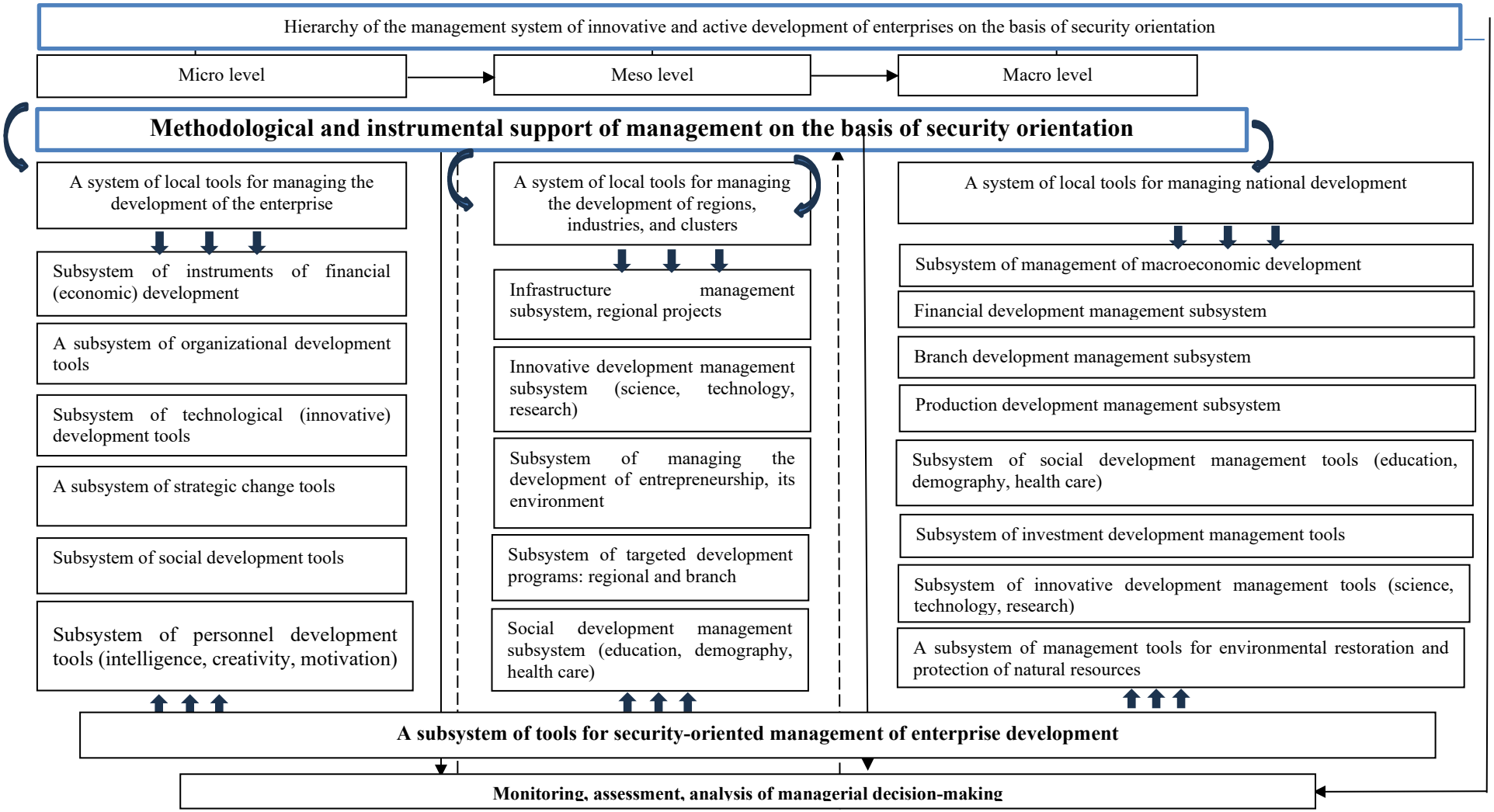

Figure 2.2 – Methodological-instrumental circuit of managing the development of the enterprise on the basis of security orientation *(source: author's development)*

The given list of subsystems is only one of the possible variations. For example, *a system of local tools for managing the development of regions, industries and clusters* may include various elements and tools to ensure effective management and development stimulation. *Possible components* of such a system include:

– marketing and promotion: development of marketing strategies to attract investors and customers; conducting advertising and PR campaigns;

– strategic planning: development of strategies for the development of regions, industries and clusters; definition of the mission, visions and specific development goals;

– economic analysis: assessment of the economic potential of the region, industry or cluster; analysis of market and financial indicators;

– innovative programs: launch and support of innovative initiatives and projects; promoting the introduction of the latest technologies and methods;

– entrepreneurship support: development of a program to support local enterprises; provision of financial and consulting services;

– education and training: development of the system of education and training of the workforce; providing access to the latest knowledge and technologies;

– infrastructure projects: implementation of infrastructure projects to improve living and working conditions;

– cooperation with stakeholders: interaction with all interested parties, such as government, business, public organizations;

– financial support: providing financial assistance and investments for the implementation of strategic regionally important (strategically important for the industry, national economy) projects;

– monitoring and evaluation: a system of control over the implementation of strategic tasks: evaluation of the effectiveness of the implementation of measures.

These elements may vary depending on the specific context, but in general they reflect key aspects of development management at the local level.

The list of components of the system of local tools for managing national development may look as follows (Table 2.13):

Table 2.13 – Component systems of local tools for managing national development *(source: developed on the basis of [89, 91-96])*

Toolkit	Description of assignment
1. National development strategy	– Development and implementation of the national strategy; – determination of long-term goals and objectives for general development;
2. Macroeconomic policy	– regulation of economic processes at the national level; – management of monetary policy and budget resources;
3. Infrastructure and social projects	– development and modernization of transport, energy and other infrastructure; – access to education, healthcare and social services;
4. Innovative policy	– support and stimulation of innovations in the economy; – development of scientific research base and technological infrastructure;
5. Export-import strategies	– development of export opportunities and sales markets; – regulation and support of foreign economic relations;
6. Tax policy	– formation of the development tax system; – tax benefits for entrepreneurship and investments;
7. Regional development	– promotion of balanced development of the country's regions; – implementation of projects, programs of regional initiatives;
8. Financial support and investments	– attraction of investments for implementation of key projects; – formation of financial mechanisms to support economic development;
9. Trade policy	– development and protection of the internal market; – conclusion and management of international trade agreements;
10.Sustainable development	– implementation of sustainable development goals in all spheres; – ensuring a balance between economic growth and preservation of natural resources;
11. International cooperation	– participation in international programs and organizations to exchange experience and implement joint projects; – development of foreign policy to promote national development.

The given component systems of local instruments of national development management interact both within this system and with other meso- and micro-level subsystems, since the goals of socio-economic and technical and technological development intersect in the process of creating a comprehensive national development management strategy aimed at achieving sustainable and effective economic growth. The introduction of the principle of security orientation will not change the situation, but, on the contrary, will force interaction, as it will become an additional catalyst for coordination of all levels of management and will promote interaction between system components.

Such a conclusion emphasizes the importance of the harmonious interaction of different levels of management of the development of innovative and active manufacturing enterprises on the basis of security orientation for the achievement of overall national development, in particular, in conditions of uncertainty and conditionality of development security.

For this purpose, *the safety-oriented functionality in the management of the development of innovative and active production enterprises* should include a number of key elements that are aimed at ensuring safety in the process of finding ways of safe economic development and are able to ensure this:

a) joint goal-setting of innovation and information management: development of clear goals and objectives aimed at innovation and information management, taking into account security requirements;

b) integrator technologies of the 2nd generation: the introduction and development of such technologies is necessary for effective interpenetration of functionalities and ensuring a high level of security of subsystems of tools of various spheres and levels of management;

c) the development of forecasting technologies: the introduction and continuous development of technologies and tasks allows predicting the variable development of events, processes and their possible consequences;

d) protection of strategic management: establishment of effective mechanisms to protect strategic management from redundant information and pseudo-innovations to ensure confidentiality and focus on strategic tasks;

e) adaptability and stability: development of functionality that supports adaptability to changes and resistance to risks, which allows the enterprise to respond effectively to unforeseen circumstances;

f) control of safety parameters: establishment of control systems for safety parameters at all stages of the innovation cycle, including development, implementation and operation;

g) strategic security planning: development and implementation of strategic security plans that take into account the peculiarities of the risk-generating innovation environment;

h) information protection systems: implementation of effective information protection systems to protect against modern cyber threats and ensure the confidentiality of information and management decisions.

This functionality not only ensures safety-oriented management of innovative and active production enterprises, but also creates a foundation for sustainable and safe economic development.

Therefore, since safety orientation is a challenge of the risk-genic environment for all modern enterprises, and it is much more relevant for innovative-active manufacturing enterprises due to the majority of risks associated with the production and production of innovations, so the management of the development of innovative-active manufacturing enterprises should be carried out according to the principle of safety orientation.

Moreover, the implementation of the latter in practice should be embodied not only in the formation of safety-oriented management systems, but also in the process of their search for ways of conditionally safe innovative development.

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CHAPTER 3.
RESEARCH OF WORLD LEADING EXPERIENCE OF ACHIEVEMENTS IN URBAN PASSENGER TRANSPORT, SMART INNOVATIONS, TECHNOLOGIES AND MARGAROUT

3.1 Global advances in smart innovation, information technology and marketing tools suitable for use in urban passenger transport

The dynamic development of modern society and globalization contributes to the intensification of the use of smart innovations. Today, more important issues are the optimization and efficient use of modern technological resources in the functioning of megacities in accordance with the needs of their inhabitants. Energy and transport resources are important in terms of the content of technological development of society. Smart energy technologies increase environmental friendliness, safety, power grid capacity, reduce energy consumption costs. Most experts characterize alternative energy as a group of technologies whose generation has already developed. These technologies continue to spread and their efficiency is increasing. Intelligent transport systems are gaining popularity, these technologies are considered part of smart-city systems, are a set of innovative solutions in the field of modelling and traffic management, which are aimed at increasing the information and safety of road users, as well as increasing interaction between them. Therefore, the use of smart innovations should ensure the development of the potential of cities, combining strategic management approaches, the latest technologies and motivating citizens to form a new, better standard of living in it.

From the point of view of city residents, the main benefit of Smart City is in attractive living conditions, efficient transport, clean environment, advanced

economy, safe environment. All this is possible through the integration of previously isolated urban systems, quality governance and "urban algorithms", as well as information technology and communications [69]. Developments in the concept of smart-city can be used in many sectors of urban management: transport, so-called "e-government", and energy, and health care, and construction, and public life. In each of these industries, smart innovations can be implemented that will reduce the cost and optimize the use of resources [70]. Consider some smart innovations used in the concept of smart-city.

Today, more and more structural changes are taking place at the level of the overall energy architecture. The end user of the energy system is an active consumer who not only uses but also produces energy. Through adaptive digital networks, it partners with the rest of the world, whether it is the country's only energy system, the city's energy system or a neighboring household. Energy exchange is monetized with the help of a digital platform, which allows to design services and make micro-investments without intermediaries. Thus, around this active consumer is formed the Internet of energy - an ecosystem of producers and consumers of energy, which are seamlessly integrated into the overall infrastructure and exchange energy.

According to many scientists, a package of new technologies will be fully formed within the next five years. It will include power electronics, which will control power flows in different networks; technologies of electricity storage, distributed intelligent control, which generates design and modeling, as well as high financial technologies - blockchains, smart contracts, decentralized autonomous organizations [13]. While they are relatively expensive, but by 2025 the efficiency will be much ahead of traditional solutions.

Technological changes affect all major segments (generation, transmission, energy distribution and final consumption), as well as restructuring the existing business models. The emergence of new generation smart grids is due to:

- introduction of distributed generation and growth of technologies based on renewable energy sources;

- the use of new applications for high-voltage transmission networks, which will be involved in data analysis;
- new approaches in the field of energy supply and distribution when using intelligent automated systems. Incorporation of advanced measurement and accounting infrastructure for reading, transmission and data exchange between data centers;
- new solutions for the management of consumer services and energy storage technologies.

Over the years, there has been a transformation of segments of the power industry, which is presented in Table. 3.1.

Analyzing the main changes in the segments of the electricity industry, we can say that the number of energy sources is growing, which are integrated into the general network. Among them: distributed solar panels, gas turbines, small wind farms, cogeneration systems and more. Due to this, technologies of microgreeds, consumption management systems are becoming popular. The key point for market restructuring will be the excess of additional energy production from distributed sources over centralized generation. This could happen in the mid-2020s.

According to forecasts, the market for automation of distributed networks will double in the next ten years, growing by an average of 8.7% per year. Among this group of technologies, the most promising monitoring systems for transformers are:

- CCADA distribution systems;
- energy quality management;
- high level of real-time monitoring, incl. equipment diagnostics, due to the use of new generations of sensors;
- advanced accounting and measurement infrastructure;
- integration of emergency shutdown control system [51].

Table 3.1 – Transformation of segments of the power industry

The main aspects of change	Value chain segments			
	Energy production, generation	Transfer, Transformation	Distribution	End Users
Technological trends	Energy production, generation - virtual power plants as a service; - increasing the efficiency and spread of generation through renewable energy sources	- high voltage technologies; - advanced power conversion and transmission systems; - high power conductors and high temperature cables; - system of monitoring of transitional modes	- monitoring of LV - networks / substation automation systems; - distributed energy management systems; - energy storage systems, including for electric cars; - development of Misrogrid systems	- demand management; - advanced energy metering infrastructure; - energy efficient infrastructure for a smart home
Business transformation	growing demands for energy efficiency and environmental friendliness	integration of markets (cross-border exchange - pan-European market, US interregional markets)	- changing the business role of network operators; - comprehensive intelligent demand management and consumption	energy consumers become producers, ie the sale of surplus energy
Effects from use	- additional capacity; - providing energy to remote isolated regions	loss reduction	- reduction of peak network loads; - reduction of operating costs; - reduction of lossesMicrogrid	accurate accounting of consumption

Examples of the implementation of ABB's smart grids are the following.

1. Introduction of a full-fledged smart grid system in 2013 in Houston (USA):

- deployment of an advanced energy distribution system;
- installation of remote monitoring of equipment at 29 substations;
- installation of 579 automated switches and monitoring devices at 226 distribution centers;
- integration of new components to stabilize and improve the technical condition of the network.

2. The first smart grid project in India, covering the entire state of Karnataka and its energy generation, supply and distribution systems:

- SSADA dispatch control and data collection project along with MF-TDMA data transmission technology via VSAT, which are connected to 867 locations;
- introduction of technologies: CCADA / EMS / DMS / Energy Billing, Energy Auditing & ABT Meter Interfaçe;
- collection of information and redistribution of energy in real time;
- processing and analysis of network visibility using Independent Power Producers and open access [7; 27].

3. Automated intelligent network of the Stockholm seaport:

- improving peak load management;
- integration of renewable energy sources;
- introduction of services for power plants for charging vehicles;
- improvement of energy storage system;
- electrification of bays, docks, ship berths;
- automation of systems of buildings and constructions of port services.

Examples of the integration of smart energy systems into Siemens' urban economy in Burbank (USA), Shanghai and London are [9]:

- introduction of smart meters and development of applications for monitoring;

- promotion of alternative energy sources and their integration into network infrastructure systems;
- thermal storage energy systems;
- voltage diagnostics.

In this growing segment, the central place is occupied by intelligent energy accounting systems. Decisions in the field of control and measurement data are based on the application of the following technologies:

- customer information system;
- data collection system and operational dispatch management;
- emergency shutdown control system;
- customer relationship management system;
- geographic information system.

The expected effects from the introduction of smart measuring systems include:

- potential reduction of the required new capacity by 20%;
- smoothing of energy consumption peaks and the ability to connect more consumers to existing capacity;
- reduction of commercial electricity losses by 95%, subject to prompt detection of unauthorized connections);
- reduction of technical losses by 50%, due to the installation of meters of higher accuracy and targeted repair of the network);
- reduction of operating costs by reducing the number of staff to 10%;
- timeliness of payment due to the possibility of limiting the load and reducing consumer debt by 50-70%;
- increase the reliability of electricity supply and reduce operating costs;
- higher level of energy supply quality;
- the ability to manage consumers' energy consumption in real time.

Also, to date, EU Member States have committed to deploying around 200 million smart meters and 45 million for gas by 2020, with a total potential investment

of € 45 billion. It is expected that by 2020, almost 72% of European consumers will have a smart electricity meter, and 40% - gas. Despite the fact that the cost estimates are different, the cost of a smart metering system averages 200 to 250 euros per customer, while providing benefits for the metric mark of 160 euros for gas and 309 euros for electricity, and an average of 3 % energy savings [43].

In general, the successful implementation of smart meters in the EU depends on criteria that are largely decided by the Member States. This includes regulatory mechanisms and the degree to which systems are technically and commercially compatible, as well as ensuring data confidentiality and security. There is also no consensus around the world on the minimum range of operations required for smart meters.

Another area where significant changes are taking place is the consumer segment. The key areas remain savings on energy sales and the disappearance of intermediate links in the value chain. With the help of analytical tools based on digital platforms, you can keep a profile of household consumption, and depending on it differentiation

With the help of analytical tools based on digital platforms, it is possible to maintain the consumption profile of households, and depending on it to differentiate energy prices during the day. New financial technologies will automate the calculation process. Ultimately, this will reduce the cost of consumption.

With the development of alternative energy sources and local generation systems, the consumer becomes both a producer. This allows, for example, to optimize energy consumption and increase the environmental sustainability of technologies. The consumer community is developing joint projects to develop the necessary infrastructure.

The key technologies in the consumption segment are:

- smart measurement systems, i.e. analysis of consumer activity;
- new technologies for infrastructure management, namely the Internet of Things in the utility infrastructure, software for analytical processing of various consumption indicators;

– active use of social networks and mobile devices for monitoring, detection and notification of consumers; involvement of users in management and control processes;
– new analytical settlement and payment services with the development of relevant financial technologies: blockchain, smart contract [13].

The global market for smart energy demand management systems by 2016 amounted to 687.2 million dollars. by 2020, it is expected to grow to $ 1.8 billion, with an average annual growth rate of 21%. The global market for smart metering systems in the field of smart electricity by 2015 amounted to 10.6 billion dollars. by 2020, it is expected to increase to 19.52 billion dollars, with an annual growth rate of 14% [81]. Now there are the following current technologies of smart grids (Tabl. 3.2).

Table 3.2 – List of current technologies of smart grids [104; 105]

Technological direction	Hardware	Systems and software
Monitoring and control	Use of new units of measurement	Dispatching data collection, broadband monitoring systems, broadband adaptive protection, broadband awareness
Integration of information and communication technologies	Communication equipment, routers, gateway switches	Enterprise resource planning software, consumer information system
Renewable, distributive conventional integration	Equipment for air conditioning of the main power and support of networks, communication and hardware for improvement of data storage technologies	Electricity management system, network distribution system, Dispatching department for data collection, geographic information system
Increase bandwidth	Superconductors, flexible alternating current transmission system, high	Network stability analysis, automated recovery systems

	voltage direct current transmission system	
Distribution network management	Reconnection circuit breakers, capacitors with remote control of distributed generation and storage, transformer sensors	shutdown control system, personnel management system
Advanced measurement and accounting infrastructure	Smart counters, displays, data servers	Meter data management system
Charging electric vehicles	Batteries, inverters, charging infrastructure	Payment systems, smart charging "network - vehicle" and discharge "vehicle - network"
Consumer systems	Smart devices, plug-in devices, thermostats, displays, automated building systems	Energy panels (shields), energy management systems, applications for monitoring energy from smartphones and tablets

Therefore, the development of scientifically sound proposals for the use of specific types of modern electric and electrical devices for various functional purposes, algorithms for analyzing the mutual influence of system elements and support mechanisms will significantly improve the condition and quality of electricity, bring its quality indicators in domestic networks to specific operating conditions. electrical and electrical equipment of general European requirements [74].

Today the document “10 Steps to Smart Grids; EURELESTRIC DSOs ’Ten-Year Roadmap for Smart Grid Deployment in the EU». According to this document, in order to implement smart grids on the European market, it is necessary to take 10 steps (Table 3.3), many of which are closely related and must be developed simultaneously [2].

Table 3.3 – Implementation of smart grids in the European market [66]

<table>
<tr><td></td><td>Step</td><td>2011</td><td>2012</td><td>2013</td><td>2014</td><td>2015</td><td>2016</td><td>2017</td><td>2018</td><td>2019</td><td>2020</td><td>2021 further</td></tr>
<tr><td rowspan="2">Large-scale implementation and commerciali-zation at the supranational level</td><td>10</td><td></td><td></td><td></td><td></td><td colspan="7">Movement to real consumer participation in the energy market</td></tr>
<tr><td>9</td><td></td><td></td><td></td><td></td><td colspan="7">Large-scale integration of e-mobiles, heating, cooling and storage</td></tr>
<tr><td rowspan="4">Deployment in Member States</td><td>8</td><td></td><td></td><td></td><td></td><td colspan="7">Aggregation of dispersed energy sources</td></tr>
<tr><td>7</td><td></td><td></td><td></td><td></td><td colspan="7">Movement towards the integration of local and central balancing for all types of generation</td></tr>
<tr><td>6</td><td></td><td colspan="7">Monitoring and control of networks and distributed generation</td><td></td></tr>
<tr><td>5</td><td></td><td colspan="7">Deployment of intelligent measurements - informed clients</td><td></td></tr>
<tr><td rowspan="4">Promoting national and European levels</td><td>4</td><td colspan="8">Testing with demonstration projects and knowledge exchange</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td colspan="5">Setting standards and ensuring data protection and privacy</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td colspan="10">Development of market models</td><td></td></tr>
<tr><td>1</td><td colspan="10">Providing regulatory incentives for innovative investments in the network</td><td></td></tr>
</table>

There are three stages of Smart Grid development: assistance to national and European levels; deployment in EU Member States; large-scale implementation and commercialization at the supranational level.

The best way to realize the new potential of energy is to use the concept of Smart Grid, ie self-regulating, analyzing and reporting technology. The effects of using Smart Grid systems for cities mean, first of all, increasing the reliability of networks and reducing the cost of their maintenance. Also, the potential effects of the introduction of advanced technologies include:

- development of systems for future use of electric vehicles;
- creation of a network of energy storage facilities located in the city;
- access to energy from multifunctional networks. In particular, various services can be deployed on the elements of the lighting infrastructure, for example, compact 4G substations, surveillance cameras, digital advertising objects, access points to electricity;

– balancing of consumption peaks and fluctuations in energy production, including through the integration of transport and energy networks: electric vehicles serve as a place of storage and a source of electricity.

The practical effects of the introduction of Smart Grid technologies are as follows [94]:

1. Different components of the Smart Grid system:

– saving 20-45% of electricity consumption;
– reduction of losses from power outages to 15%;
– reduction of capital costs for equipment by 5-10%;
– reduction of accidents and repair costs up to 10%;
– savings in electricity generation by thermal power plants up to 10-15%.

2. Smart control and measuring systems:

– improving the quality and reliability of power grids;
– balance of supply and demand of electricity;
– providing infrastructure for smart homes.

3. The new generation of management and control of distribution networks:

– minimization of costs in the construction of additional (spare) stations.

4. Renewable energy generators with low CO2 emissions:

– increasing environmental friendliness;
– increasing the stability of the network;
– uninterrupted energy supply, including remote areas of the country.

The construction of smart grids in Ukraine is rather slow, but there are some developments on this issue. The main issues of developing the concept of Smart Grid in Ukraine [104; 105; 106]:

1. Formation of a strategic vision of the future power industry in Ukraine based on the Smart Grid concept.

2. Redistribution of basic requirements and functional properties of domestic electricity based on the concept of Smart Grid and the principles of its implementation.

3. Defining the main directions of development of all elements of the energy system: generation, transmission and distribution, sales, consumption and scheduling.

4. Redistribution of the main components, technologies of information and management decisions in all the above areas [107].

5. Ensuring coordination of modernization (overcoming the technological gap) and innovative development in the Ukrainian power industry.

Also in Ukraine it is necessary to provide technical support for the integration of distributed energy sources, using available on the market of our country devices of power supply systems and drives, creating power management platforms for integrated distributed energy sources based on modern Smart Grid technologies, ensuring implementation of international standards and technical conditions.

To improve the efficient operation of the transport infrastructure in the concept of smart-city in the management of urban logistics, there is a noticeable trend towards the use of dynamic and multimodal information. Namely, big data is collected from car sensors, surveillance cameras, RFID tags, sensors on roads and railways. Data on the state of urban road systems, transit systems, bicycle roads and pedestrian areas are used to optimize traffic flows depending on passenger traffic, business needs, environmental conditions, as well as to monitor the condition of roads. Such systems require an integrated approach to management and maintenance.

In order to partially optimize passenger traffic and maintain a high quality of travel, the following smart innovations in transport segments are used:

- ridesharing is a system in which passengers do not increase the number of passengers, but use the vehicle together, reducing traffic congestion;
- bicycle sharing is the development of road infrastructure for bicycles, which has provided the active use of urban rental services for the city, which encourage people to use bicycles more often to travel around the city;
- car-sharing - these are new technologies that have allowed companies and consumers to rent cars by hours / days [108];

- on-demand transportation - Uber and Lyft systems allow ordinary drivers to use their vehicles as taxis at the request of users. Such services are equipped with mobile and GPS technologies that increase the competitiveness of their services.
- Elements of intelligent transport technologies in the concept of smart-city are:
- hybrid cars;
- batteries and energy storage infrastructure systems for hybrid cars;
- stationary superflywheels in power systems, they are used in transport systems due to the minimum consumption and weight and ease of maintenance;
- connected / automated cars. Connected cars (connected cars) have direct access to the Internet and allow you to control all connected devices, including smartphones, sensors, traffic lights, other vehicles;
- smart parking is a technology that includes the required number of sensors that determine the location and distance of free parking spaces;
- road transport system, ie safety, security, monitoring, control.

For example, Google's project is to develop technology for unmanned vehicles. The system combines data collection from cartographic Czech interfaces Street View with the use of LIDAR sensor technology, artificial intelligence for video content processing, GPS. The company expects that the improved detection system will reduce the number of deaths and injuries on the roads.

The intelligent transport system Siemens has developed a solution for a transport system where all vehicles and infrastructure systems are interconnected. This connection provides a more accurate definition of the situation on the roads to optimize traffic, reduce congestion, events, minimize fuel costs. The system is based on the principle of Vehicle-to-X (V2X). Qualcomm (together with Honda) - technologies for tracking objects approaching Vehisle-to-Pedestrian.

Today, there are traffic management systems from Verizon. The intelligent traffic management system provides data collection and processing for the

management of the entire road infrastructure. The following possibility of efficiency is declared:

- reduce travel time by 20%;
- reduce fuel costs by 15%;
- reduce the delay of traffic light signals by 41%;
- reduce transport stops by 44% [90].

In foreign practice, there is the following intelligent transport system for public transport, which includes:

- navigation data to control the passage of flights and routes, recording events;
- integration with external management and control systems of the transport complex;
- accounting for real passenger traffic;
- continuous monitoring of the situation during passenger transportation;
- optimization of vehicle fleet maintenance costs;
- remote control of technical condition of vehicles.

Automated parks contribute to better use of parking space. Information on the schedule of showing the arrival of buses at the bus stop, received in real time, information on available cars and bicycle parking allows you to reduce travel time and search for a parking space. For example, in Seoul, wireless communication between stops and buses has been introduced. 300 bus stops are equipped with terminals that exchange information with 9300 buses via wireless communication. The buses are equipped with Internet modems and GPS receivers [64].

Transport monitoring allows you to track vehicles during the trip and at terminals / stations. Similar technologies are used to varying degrees and in different cities. AVLS is implemented on public buses and trains to continuously monitor the vehicle and provide a range of services: traffic management, real-time passenger information, priority signaling at intersections, accident management, etc. These smart services help increase traffic efficiency , make public transport more attractive

and reduce travel time, giving city residents the opportunity to flexibly plan a route (the fastest or cheapest).

Floating data of cars / floating cellular data - a technological method that allows you to determine the average speed of traffic flows based on the collection of data on the location, time, direction of traffic.

Sensor technologies (RFID) - provide increased security and awareness of the condition of the road surface, the surrounding infrastructure. Automatic license plate recognition systems make it possible to monitor traffic in critical areas.

Pedestrian collision warning systems. GPS tags, lasers and accelerometers allow you to estimate the required distance to prevent collisions with pedestrians.

The use of driver alert technologies is available in Singapore and Eindhoven. So, in 2015, Singapore used a driver app that analyzes historical and current traffic data in real time to assess the situation on the road and issue an hourly forecast of the state of the transport network.

In 2015, the city of Eindhoven used a system for tracking the humidity and smoothness of the road surface, which is installed on special cars. The data is transmitted to the central monitoring station, dangerous sections of the road are detected, then drivers are notified via road information displays and navigation maps.

Currently, most cities use both cash payments and smart cards, although trips using smart cards are often more profitable. A system based solely on the use of smart cards would allow tracking all passenger movements and regulating the balance of supply and demand of public transport. Cities such as London, New York and Seattle are moving towards an intermodal contactless fare system, in which one smart card can be used for all modes of transport.

In Singapore, the electronic fare payment system has existed since 1975, and is now fully automated. The business center has 34 special arches that can fix the passage. Personal cars are equipped with devices with cash cards to pay for travel with the ability to replenish the balance. In the absence of equipment, the system photographs the car number and issues a bill for each day of road use. There is a

system of tariffs and coefficients during peak hours, on weekends and holidays travel is free. The system also collects traffic information and adapts prices to current traffic. Price information is available online, the driver can choose the route based on the price / duration ratio. The introduction of electronic payment reduced traffic during peak hours by 25,000 cars (about 3% of the total number of cars in the city) and increased the average speed by 20 km/h. This saved more than $ 40 million. [97].

In the city of Oslo, there is an electronic toll collection system for drivers, including the ability to pay at gas stations and by SMS. The project has been implemented since 2008, at least $ 17.5 million has been invested. The created system allowed to unload fare points, reduced fuel consumption by a third due to queues.

However, unfortunately, today in Ukraine there is no record of actually provided to beneficiaries of transport services for travel in urban and suburban transport. The largest category of beneficiaries is entitled to free travel in public passenger transport and suburban routes. Therefore, the use of social electronic cards is becoming an increasingly important topic. These cards are in the form of traditional credit cards or identity cards, and in addition, they provide the opportunity to contactlessly pay for services consumed, identify the owner and certify the right to receive certain types of benefits. In addition, it is multifunctional. In particular, you can use it to find out the cost of travel, keep track of trips, check the expiration date and issue invoices. Also, the provision of benefits through social electronic cards can prevent the illegal use of travel benefits and strengthen people's sense of personal security, as illegal travel on preferential terms is often a factor in the deterioration of safety in public transport.

Today, no country in the world can give a ready-made recipe for solving this problem. In most European countries and the United States, the cost of public transport benefits is covered by local authorities, and in fact the benefits are provided only to residents of the region in local communities. Along with electronic cards in

the vast majority of countries, magnetic cards and paper tickets are also used to pay for travel, which facilitates the use of transport for temporary residents and tourists.

Another positive example of the use of transport technology is the railway companies, which install sensors all the way and on all important parts of the warehouse to monitor their condition and reduce the likelihood of events. Sensor data is accumulated and stored to later analyze them and optimize repair work.

The most common transport technologies in the field of smart-city concept development by key segments are presented in Table. 3.4.

Table 3.4 – Transport technologies in the field of smart-city concept development by key segments [37; 40; 44; 109]

Traffic management and control	Transport management systems and user behavior monitoring	Construction of logistics routes and fleet management
Active traffic management system	Electronic navigation systems for all modes of transport	Computer construction of shipment plans
Traffic monitoring cameras	Collection of transport movement statistics	Operating cargo control systems
Electronic signs / displays	Dynamic stable information / control information panels / stops	Dynamic system of synchronization of information about sending / receiving
Radio channel for communication on the roads	Urban route planning systems for tourists	Parking assistance system for commercial (trucks)
Information systems for monitoring road weather conditions		

The transport system can be optimized, for example, by setting dynamic pricing for travel on highways. Dynamic fare pricing will reduce traffic during rush hour, such as in Singapore; dynamic parking pricing - congestion of parking cities, such as in New York; differentiated pricing promotes the proliferation of environmentally friendly vehicles, as in Stockholm. In particular, in Stockholm for seven months of testing, traffic decreased by 22%, and carbon dioxide emissions in the city center - by 14% (25 thousand tons per year). London's intelligent traffic management system is able to learn from statistical observations, as a result of which

it begins to predict traffic flows and traffic. It is estimated that from 2014 to 2018, the system will reduce traffic by 8% per year [73].

There are integrated data collection services in Rio de Janeiro and London. Centro De Operaces Prefeitura Do Rio in Rio de Janeiro is a partnership project between the city government and IBM. It is a citywide data analysis center that combines data streams from 30 organizations, including traffic and public transport data, municipal and infrastructure data, emergency services, weather forecasts, information downloaded by staff and the public by phone. , internet or radio.

The City Dashboards app in London provides citizens with real-time data: weather information, air pollution, transport delays, public bicycle availability, river water levels, electricity demand, financial market data, the city's Twitter trends, and access to road cameras. Data can also be displayed on a city map [22].

Today, adaptive traffic lights constantly collect information (register vehicles and pedestrians) and adjust the signal time depending on current demand. Coordination of traffic light signals at intersections allows the system to optimize travel time by minimizing the number of stops at intersections, so that higher passenger flow efficiency is achieved and fuel consumption and travel time are reduced. This system is fully implemented in Singapore (all traffic lights are smart), partly in London, New York and Melbourne (most traffic lights are smart). An example of use is the Gothenburg motorway management system, which was introduced in 2004 and is now automated. The following functions are available:

- traffic control;
- detection of events;
- detection of traffic jams;
- accident warning;
- variable speed limits.
- the results of such a system are as follows:
- the number of accidents decreased by an average of 20%;
- average time of one trip - by 5%;

– traffic in general is harmonized, the difference in speeds on different lanes has decreased [72].

Thus, assessing the development of transport in the paradigm of the concept of smart-city, we can say that it can have the following effects in the lives of citizens in the city:

– reducing the load of transport infrastructure;
– savings on the maintenance of roads and parking spaces;
– reduction of consumer spending;
– improving mobility for pedestrians and public transport users;
– improving access to the city;
– reducing the number of accidents;
– energy saving;
– reduction of emissions and pollution;
– improving public health;
– reduction of travel time;
– increasing reliability in the transportation of goods and cargo.

The dynamic development of modern society and globalization contributes to the intensification of the use of information technology [110-112]. Today, more important issues are the optimization and efficient use of modern technological resources with the help of marketing tools in the functioning of megacities in accordance with the needs of their residents. In general, the progressive technologicalization and informatization of economic and everyday life are making significant changes in modern marketing, significantly expanding its capabilities, changing the functionality and set of tools needed to achieve the goals and objectives of enterprises. Thus, modern information technologies provide a wide range of marketing tools and opportunities for rapid and successful adaptation to external conditions that are constantly and multi-vector changing.

According to the results of forecast research of world-renowned scientists from one hundred predicted technologies, including information, were selected the

ten most promising and innovative, which are at different stages of development and will be of paramount importance in the period 2010-2030 (Table 3.5).

Table 3.5 – Ten breakthrough technologies, including information, that will be of paramount importance in 2010-2030 [73]

Technologies	Promising changes
1. Portable electronic devices	They combine the capabilities of a personal computer, Internet access, television image acquisition and telephone communication.
2. Fuel and battery cars	Cars with hybrid engines based on the use of hydrogen-oxygen fuel and electricity.
3. Precision agricultural production	Computerized management of grain production taking into account land conditions.
4. Mass customization of products via the Internet	Trade via the Internet. It is estimated that virtual trade in 2007 accounted for 30% of the US economy.
5. Life in television	The emergence of a lifestyle associated with the use of information technology and the Internet in all its aspects - work, study, shopping, etc.
6. The emergence of virtual secretaries	The advent of high-level intelligent computer programs that help solve numerical problems and navigate the sea of information, and eventually perform a series of routine operations and perform them with the help of robotic devices.
7. Genetic construction	Genetically modified organisms.
8. New medicine	Computerized medical care.
9. Alternative energy sources	Traditional fuels - oil, gas and coal - will retain their leading role in the future, with the share of wind, geothermal, hydro, solar, biomass and other alternative sources increasing from 10% of total energy consumption today to around 30% by 2015.
10. Intelligent, mobile works	The next generation of industrial robots will be able to perceive the environment, make complex decisions and self-learn.

Consider in more detail the use of some information technologies, taking into account marketing tools.

Here is an example of platform technology from Fujitsu. So the company created the SPATIOWL urban traffic management platform based on GPS data and data from road-mounted sensors. The service allows you to collect data on the location, speed of the car, generating aggregate information about traffic, congestion, downtime. Based on the data, the efficiency and cost of transport network maintenance are calculated, as well as forecast scenarios of behaviour of drivers and pedestrians are modelled.

According to the Ministry of Infrastructure of Ukraine, as of April 2017, 3,360 electric vehicles were registered in Ukraine, and the market growth rate in 2016 exceeded 500%. The Ministry of Infrastructure of Ukraine and the Ministry of Energy and Coal Industry of Ukraine aim to achieve a share of electric cars in 15% of sales of all cars in 2020. According to market participant Oxygen Group, by the end of 2017 in Ukraine will be 7-10 thousand passenger cars, and for freight chargers are not yet presented, but are expected to appear in 2018 [86].

Thus, considering the development of information technology in transport, we can say that they are able to create the following social effects in the lives of citizens in the city:

- reducing the load of transport infrastructure;
- savings on the maintenance of roads and parking spaces;
- reduction of consumer spending;
- improving mobility for pedestrians and public transport users;
- improving access to the city;
- reducing the number of accidents;
- energy saving;
- reduction of emissions and pollution;
- improving public health;
- reduction of travel time;
- increasing reliability in the transportation of goods and cargo.

Recently, the latest trends observed in the application of the components of the marketing complex, in fact, completely change the perception of the use of classical marketing tools. Thus, an effective innovation policy comes to the fore in the product policy of enterprises. The development of the Internet and the latest technologies encourages rapid product changes and updates to meet the new needs of consumers. The same applies to the transport system, which is one of the most knowledge-intensive sectors of the economy in the world. Thus, in the world, almost 25% of all investments in science and research are in the automotive industry [19].

Moreover, the changing tastes of consumers, and especially the younger generation, motivates manufacturers to increasingly change and improve the range. Therefore, the general penetration of the Internet encourages companies to transfer most of their activities to the Internet, ie there is a digitalization of communications. Potential consumers spend most of their time online and also use mobile communications. Therefore, companies need to use the Internet for close communication with the consumer.

Thus, Internet marketing is not just another information resource for customers, it is a marketing activity that aims to change consumer behavior through information resources, it has almost completely changed the usual buying process. Thus, the car becomes not only a source of movement, but also a place where a person spends up to 20% of his time [56]. Therefore, the car should have everything to make a person feel comfortable and convenient. That is why more and more cars are equipped with the Internet - access necessary for both consumer and car use. On the other hand, the main source of information about the car is the Internet. At the same time, online promotions and sales are growing exponentially every year. Thus, the share of budgets for Internet marketing of automakers in the world has increased over the past 5 years from 1.5% of the total marketing budget to 20%, and given the internetization of society (increasing the number of Internet users), which grows by about 10% per year worldwide, such budgets will continue to grow [80]. Therefore, Tesla did not even consider traditional schemes for selling cars through showrooms and dealers. It is present only on the Internet, has a virtual car dealership, and the whole process of buying a car is only virtual: from consultation to payment.

From yes, information technology plays a very important role in modern marketing. Now marketers around the world are conducting interactive marketing, creating e-shop windows, placing interactive advertisements, participating in forums, newsgroups and the Web - the Internet community, using e-mail.

Moreover, the use of information technology is beneficial for both consumers and marketers. The former simplify the system of mutual understanding with

consumers, reduce costs and increase efficiency, while the latter gain efficiency and quality of information and data.

Thus, having studied the international experience of using smart innovations, it is established that they are based on new methods, techniques and algorithms for data mining and decision making, necessary and used in the operation of innovative solutions of a smart city. Today, the use of smart innovations in the concept of smart-city will save energy consumption, improve the quality and reliability of power grids, reduce emissions and pollution into the environment, as well as reduce congestion and increase the reliability of transport infrastructure. The application of smart innovations in the energy sector will determine in Ukraine: the implementation of the requirements of the acquis communautaire in the legislation governing the activities and promoting the development of the energy sector; creating conditions for the formation of technological innovation parks using modern, scientifically sound solutions, technologies and equipment in the energy sector; maintaining a healthy competitive environment, unimpeded access to markets and existing infrastructure (except for natural constraints, as well as based on the rationalization of energy security factors in Ukraine); conducting communication policy in the field of energy to encourage market entry of international strategic and financial investors. Thus, as a result, the use of smart innovations in the field of transport leads to the following results: cheaper transport costs, removal of intermediaries, reduced travel time (distance compression effect). In the future it is necessary to understand that the use of smart innovations will meet the needs of the modern generation, provide opportunities for the development and realization of the potential of each individual.

Thus, as a result, the use of information technology in the field of transport leads to the following results: cheaper transport costs, removal of intermediaries, reduced travel time (distance compression effect). In the future it is necessary to understand that the use of information technology will meet the needs of the modern generation, provide opportunities for development and realization of the potential of each individual. The use of Internet marketing can be an effective means of promoting products or services, and even a fairly modest advertising budget

guarantees maximum return. For the current economic situation, Internet marketing is becoming a panacea for advertising. And this is true for a variety of business areas.

Therefore, internet marketing promises quite profitable prospects. Over time, the Internet and e-commerce will completely replace magazines and newspapers as a source of information and even shops for shopping. Already today, large and small businesses are rapidly incorporating interactive marketing tools into the list of marketing tools used. Manufacturers have the appropriate technical support for the implementation of Internet marketing and should pay more and more attention to this tool of marketing tools.

The practical use of marketing tools will allow transport companies to purposefully choose the most effective marketing measures in a particular market situation, optimize marketing processes, streamline and coordinate the choice of effective marketing tools. The use of marketing technologies will increase the efficiency of management of both marketing activities and enterprise activities in general on the basis of specialization of marketers, development and application of modern scientific methods and tools for planning, organizing, accounting, analysis and control [28; 113].

3.2. Research of foreign practice on tariff and compensation policy in urban passenger transport

To reform the tariff and compensation system in Ukraine, it is useful to consider international experience, as it provides an opportunity to find constructive moments and effective methods that can be implemented.

Transport policy in many countries is aimed at encouraging more frequent travel by citizens. Particular attention should be paid to the tariff policy of the Transport Center of the Hungarian capital.

Both the development of various tariff plans and the administration of revenues from the sale of travel documents and fines are carried out by the Municipal

Transport Center of Budapest, not the carrier. Revenues from the sale of travel documents are not enough to cover all operating costs. However, the functions of the Transport Center are much broader than those of a regular carrier. In addition, state and municipal subsidies, revenues from the sale of advertising space and the use of real estate, revenues from parking, fees for the issuance of work permits, etc. are used. At the same time, the Center's management is responsible for increasing additional revenues and revenues from the sale of travel documents through the introduction of new tariff plans. European Union funds are also attracted for development projects.

In Germany, the ticket price, in the case of a large city, depends on that part of the city and the destination. For example, in Berlin there are three zones - A, B and C. Zone A – is the city center, zone B covers almost the rest of Berlin, and zone C includes the suburbs, which includes Schönefeld Airport. Each German city has different tariff zones in number and size.

There are several categories of public transport tickets. A short-distance ticket – in Berlin, for example, it is valid for up to three stops on the S and U-Bahn or six stops by bus or tram. Ticket for one trip with the possibility of transfers for one or two hours, a ticket for a day, for a week, a month or a year. In addition, there are tickets for a group of up to 4-6 people and tickets for schoolchildren and students. You also need to buy a separate ticket to ride a bike.

For tourists in some large cities there are special travel. In Berlin, for example, such a ticket is called Welsome Card, in Hamburg - Hamburg Card. In addition to the travel tourist receives a catalog of discounts on sightseeing and a map of the city. And employees of many German companies have the opportunity to buy a monthly pass Jobtisket - it is more profitable than a regular ticket because the company assumes part of its cost.

The ticket price also depends on the region of Germany. In the same Berlin, the cost of a ticket for one trip is not the highest in the country - from $ 3.11 depending on the fare zone. The most expensive ticket in Hamburg - from $ 3.67, and the cheapest - in Erfurt (from $ 2.22). As for tickets per day, some of the most

expensive are sold in Cologne and Bonn (from $ 8.1). But in Frankfurt am Main, a day ticket is one of the cheapest in Germany and costs from $ 4.55.

Tickets can be purchased at vending machines, which are installed at the stop, next to it or in the tram itself. In the bus they are sold by drivers - and in this case they are not more expensive. In addition, some large stations and stations have customer service information centers, where you can learn how best to get from point A to point B, which category of travel to choose or buy a ticket.

Another option is to purchase online on the Deutsche Bahn website, via the DB Navigator application or the application of a specific transport association (Verkehrsverbund), which is responsible for a particular region of Germany. So it turns out cheaper. In the mobile application you can also pave the route and see the schedule of public transport.

It is also important not to forget to compost the ticket, otherwise it will be considered invalid. This should be done only if the ticket says "Hier entwerten" ("Compost here"). You can do this at the station, in the bus or tram car. The fine for ticketless travel (including an unbeaten ticket) in Germany is $ 66.56 [19].

Monetization benefits operate both on the European continent and far beyond it - in the United States, Australia and New Zealand. Therefore, it is advisable to consider the basic principles of providing transport benefits to the CIS.

In Poland, a large number of benefits were abolished in the 1990s. Compensation for travel benefits comes from state and local budgets through the Ministry of Infrastructure and Development. Disabled people, pensioners, children, the military, teachers, students have the opportunity to issue a ticket upon presentation of a document certifying the right to benefits. You can get a benefit with an income of less than $ 125 per month. The amount of benefits depends on the central and local government [19].

In Bulgaria, compensation is based on an agreement between the state represented by the Ministry of Transport and the carrier (for 5 years). The discount ticket is issued upon presentation of a document certifying the person's right to the

benefit. Disabled people, war veterans, pensioners, children from 7 to 10 years old, students up to 26 years old have this right.

In Austria, the tariff is set by an association of enterprises, which is approved by the city council. The tariff in Vienna covers 50% of the cost, outside the city - 100%. Semester tickets for students, compensation for transportation of schoolchildren and students of technical schools, pensioners (50%) have been introduced.

Lithuania reimburses the carrier in full for the intended purpose from the state budget through the Ministry of Communications. Accounting forms for groups of beneficiaries and routes are drawn up monthly. 15 categories of beneficiaries apply for a ticket upon presentation of a document certifying their right to benefits (people with disabilities, war veterans and their families, pensioners, children, etc.). Professional benefits have been abolished in the country. Free travel for social categories is replaced by travel with a discount - 80, 50% depending on the category of the recipient. Privileges in public transport are financed by local authorities, the state budget finances privileges for long-distance transportation.

It is noteworthy that in Western countries there is a widespread system of introduction of electronic social cards, which automates the provision of benefits. This allows you to create a geographically distributed information system that operates at the state, regional and local levels.

It is also advisable to consider the experience of providing transport benefits in the CIS countries.

In Moldova, compensation has been reimbursed from the state budget through the Ministry of Transport and the Ministry of Social Security to the carrier in full since 2000. Carried out upon presentation of a document certifying the right to benefits (certificate - suburban service, certificate and coupon - long-distance service) Benefits are established for people with disabilities, war veterans, traffic police and children from 5 to 10 years. For other categories (pensioners) targeted assistance is paid from the state budget together with social benefits. Privileges are set by local administrations.

Many countries have already overcome the problems facing Ukrainian society. At the same time, experts emphasize that the monetization of benefits, as well as other reforms related to the restructuring of the socialist model of management to a market economy and the transition of the Ukrainian economy to the capitalist paradigm, are introduced in our country with a delay of 15-20 years.

The introduction of "monetization" of benefits in the face of a shortage of funds for compensation policy at the regional level had the following consequences:

- significantly increased the financial costs of all levels of the budget;
- actually disavowed the main criteria of social policy: targeting and need;
- the haste in carrying out such a large-scale reform and the division of beneficiaries into federal and regional (sometimes within the same family) have had an extremely negative psychological effect;
- only partially solved one of the main tasks of monetization - "to finance the consumer, not the producer."
- the analysis allows us to draw the following conclusion: the strategy of support for beneficiaries should work in three directions:
- increase of pensions with gradual abolition of monetary compensations;
- to overcome poverty, the basic principle should be the need to assess income levels;
- in principle, support for the categories that are included in the active process of socialization should be increased. Then a multiple increase in spending on social needs can be considered more appropriate and effective.

Comparing the international experience of providing transport benefits in the EU and CIS countries, we can identify the advantages and disadvantages shown in Table 3.6.

Considering the tariff systems and compensation policy in public transport of foreign countries, we can see a stark contrast to the Ukrainian system, which is long outdated and does not meet the needs of citizens.

Table 3.6 – International experience in providing transport benefits

	EU countries	CIS countries
Advantages	– travel benefits are provided through targeted financial assistance and various discounts to transport companies; – maximum minimization of privileged categories (up to 5% of the population); – for the poor and the most vulnerable segments of the population, the state provides benefits in the form of salary indexation, tax cuts, etc .; – targeted payments are mainly made from local budgets; – transportation benefits are provided at the regional and local levels.	– travel benefits are provided through targeted financial assistance; – targeted payments are made from local and state budgets.
Disadvantages	missing	– the amount of compensation does not correspond to the actual amount of benefits due to the large number of existing benefits categories; – lack of a flexible system of payment of benefits (compared to EU countries).

Passengers depend on the will and mood of the drivers who administer the fare, and do not perform purely their duties as drivers. Citizens depend on private carriers, which are in fact monopolists on certain city routes. The Ukrainian tariff system does not provide a choice when planning daily and one-time trips around the city, namely the choice is the basis of economic freedom. Passengers do not have an equal choice: to go without a transfer or use two routes for the same money.

It is advisable to allow the possibility of increasing travel in Odessa to 10-12 UAH. for a single ticket. This would be a kind of extra fee in the system, which would encourage not one-time, but frequent travel. However, a system of tariff plans should be developed that would allow citizens and tourists to save, actively use public transport and have much lower actual travel costs. Such decisions will satisfy both the carrier and passengers.

CHAPTER 4.
IMPROVEMENT OF MEASURES FOR INTERACTION WITH STAKEHOLDERS OF THE SMART-ACCOUNTING SYSTEM IN URBAN PASSENGER TRANSPORT

4.1 Conducting a sociological survey to identify public opinion on the current state and future changes in the system of urban passenger transport

A theoretical study allows us to formulate three hypotheses that will be tested empirically.

Hypothesis 1: passengers are more likely to use urban passenger transport if it meets their requirements;

Hypothesis 2: passengers are ready for a significant increase in the cost of the ticket if additional benefits are provided.

Hypothesis 3: drivers are ready to abandon trips to work in their car completely.

Depending on the results of a sociological study, these hypotheses will be adjusted.

The study involved 3548 people, 975 were interviewed in person, 2573 answered online. The sample has the form (Table 4.1):

The theoretical study called to identify 18 factors that affect a person's decision to use or not to use public transport, all factors were combined into four groups – Safety, Comfort, Time Saving, Cost. If the factor could be assigned to several groups at the same time, we selected 1 group, to which it belongs to a higher degree.

Table 4.1 – The results of the conducted survey of residents of Ukraine online and internally (source: [15])

Sample size	Ppl. (%)
Total	3548 (100%)
Online	2573 (72,5%)
In a personal meeting	975 (27.5%)
Age	
Junior school age (7-17)	12,4%
Young age (18-44)	35,7%
Average age - 45-59	22,2%
Old age - 60-74	26,5%
Senile age (from 75 years)	3,2%
Car availability	
No	38,6%
There is a private car	36,0%
There is a car in the family	15,4%
Income level	
Do not have or minimum subsistence	21,4%
5000-10000	29,3%
11000-24000	32,5%
From 25000 and above	16,8%
According to the results	
Group 1 - use public transport regularly, no personal car	28,7%
Group 2 - use public transport, there is a private car	27,4%
Group 3 - practically do not use public transport, there is no personal car	10,3%
Group 4 - almost do not use public transport, there is a private car	33,6%
Purpose of use	
Only for study (work)	15,7%
For personal affairs	30,1%
For the study (work) and personal matters	54,2%

We allocated 0.25 points of influence for each group. Each factor was evaluated on a 5-point quality scale, namely:

refuse to use PPT;

most likely I will refuse to use PPT;

will not affect;

most likely will use PPT more often

will definitely use PPT more often (Fig. 4.1).

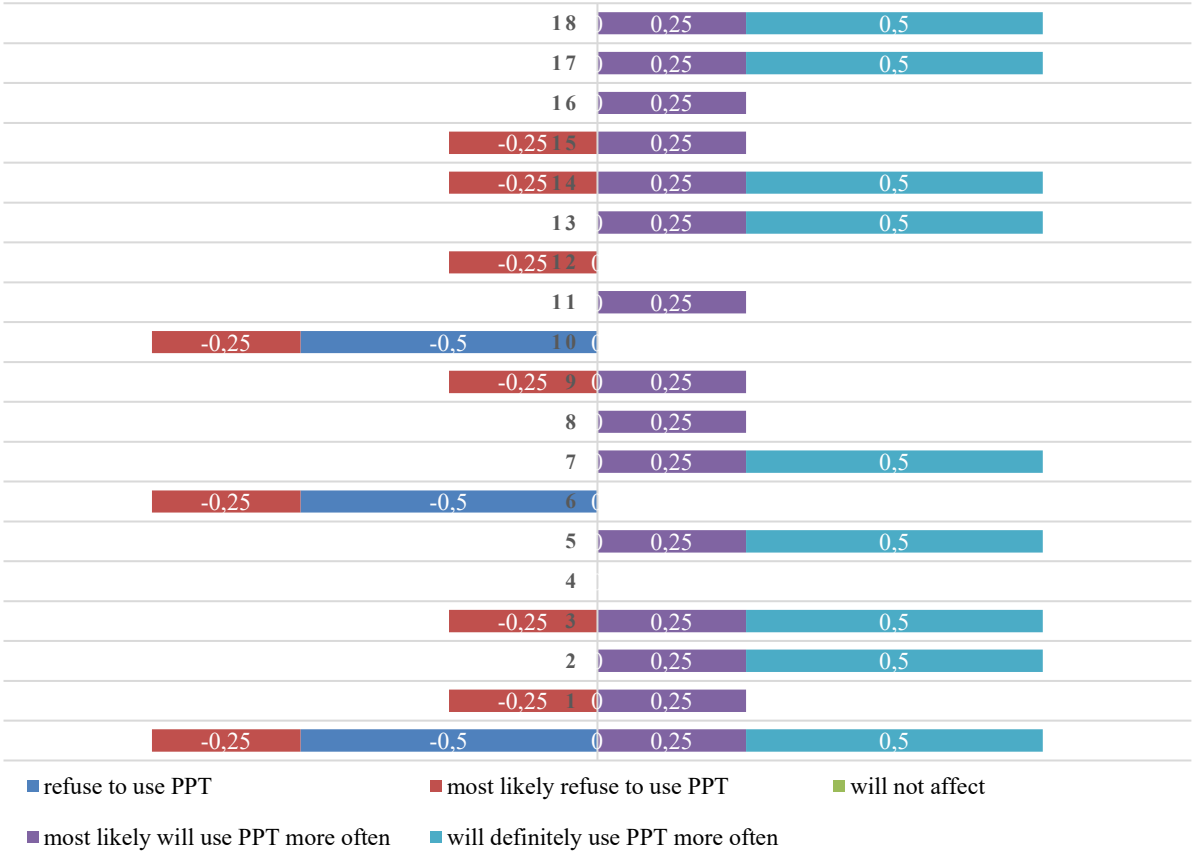

Figure 4.1. Influence of factors on the choice to use public transport

The results of the questionnaire were processed programmatically, grouped to identify trends in influence.

After receiving the answers, the authors conducted a correlation analysis of the factors affecting both positively and negatively the choice in favour of using public transport (Fig. 4.2).

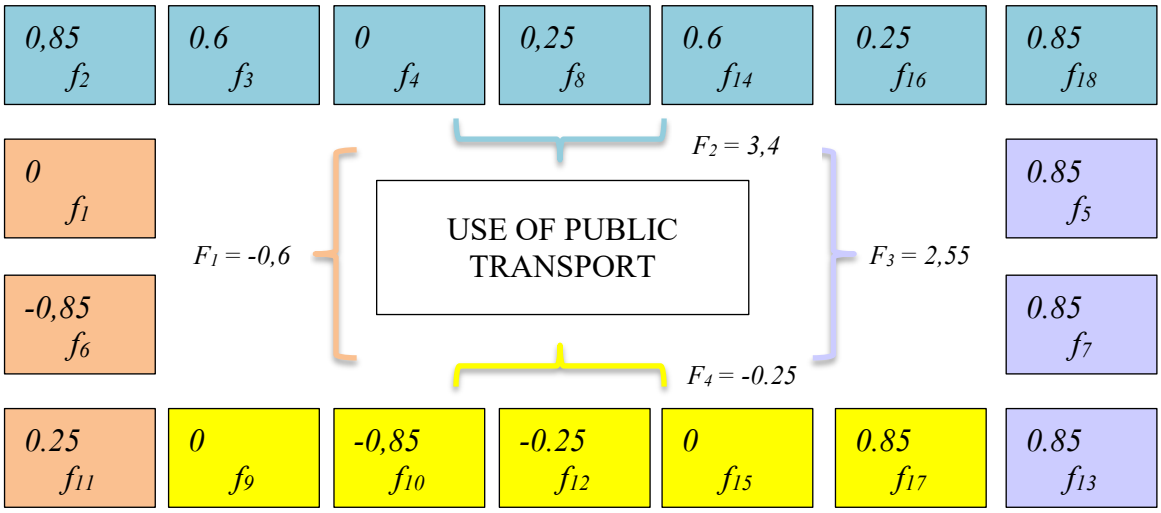

Figure 4.2. Correlation analysis of factors

Also, when developing proposals, it is necessary to take into account some aspects:

1. There is a category of people for whom to use or not to use PPT is not a choice – it is their necessity due to age (schoolchildren, pensioners).

2. The decision in the future to use or not PPT in today's schoolchildren depends on the experience of using PPT.

3. Pensioners – this is the category of people that can be corrected for the time of use.

Since the analysis showed that consumers are not ready for a significant increase in prices (3-4 times), i.e. the city or investor will not be able to satisfy absolutely all the needs of passengers, it is necessary to determine which factors have the highest positive and negative effects – they must be taken into account first of all when setting the tariff, which factors require minimal financial values, but I have an influence on the choice in favour of public transport, and what factors at this stage can be ignored (Tabl. 4.2.).

Table 4.2 – Ranking factors according to their degree of influence

Value	Factor	Factor	Group
0,85	2	availability of Wi-Fi	Positive significant impact
0,85	5	the ability to pay for the fare in the cabin with a card	
0,85	7	strictly scheduled traffic	
0,85	13	the ability to get to the right place without changes	
0,85	17	significant savings in the cost of a single trip when buying a subscription	
0,85	18	vehicle interior cleanliness	
0,6	3	air-conditioning	Positive significant impact
0,6	14	number of people in the cabin	
0,25	8	the ability to track the movement of the transport in real-time in the app	Slight impact
0,25	11	increased driver requirements	
0,25	16	round-the-clock traffic	
0	1	vehicle technical condition	
0	4	the ability to pay for the fare in the cabin	
0	9	50% increase in fare	
0	15	permission to transport animals in public transport (in compliance with the necessary standards)	
-0,25	12	extra charge for oversized baggage	Bad influence
-0,85	6	criminogenic environment	
-0,85	10	significant increase in fare (3-4 times)	

Thus, based on the research data, recommendations can be developed to improve the tariff policy.

A study of the theoretical and methodological foundations and a sociological study to enhance the tariff policy in urban passenger transport has allowed identifying such problems that directly or indirectly related to public transport:

1. 50% of respondents are not satisfied with the technical condition of trams and trolleybuses; however, 70% of them report improvement; 95% are not satisfied with the mechanical condition of minibuses (30% indicate the emergency state of some vehicles);

2. 77% of drivers use the vehicle on weekdays only for travel to and from work and 56% would transfer to public transport if

a) he went on schedule;

b) would go faster than a car;

b) there would be fewer people;

c) there would be no theft;

3. when eliminating the above problems and creating additional factors for the comfortable use of public transport (Wi-Fi, air conditioning, the ability to track the movement of public transport by application in real-time), 73% of respondents would use it more often;

4. 27% of those who use cars would never have moved to public transport, because:

a) getting to work is necessary with transfers; b) I use a car during the day; c) auto is my status.

5. 65% think personal vehicles are more manoeuvrable, i.e. the way to work takes less time;

6. 82.4% are willing to pay for one trip up to 15 UAH, 40.7% up to 30 UAH. It is worth noting that those who are ready for a reasonably high price have used public transport and know the fare abroad.

Thus, the proposals we developed are as follows:

1. monitoring of routes for their optimization and allocation of a separate lane for the movement of public transport only, especially in the “red” zones;

2. updating the fleet of vehicles in two aspects:

a) to private carriers to give a license only if certain conditions are met and to deprive it in case of violations;

b) modernization of trolleybuses and trams - Wi-Fi, air conditioning, smart metering system;

3. review of tariff policy:

a) set a different price depending on the time of day. This will relieve a load of public transport at rush hour. So, for example, for this, you must install a sizeable bright clock in the cabin.

b) cancel the effect of preferential tariffs at rush hour. This reinforces the impact of the first sentence.

c) increase the fare. It is especially important here that we do not confront the population about the increase in prices but explain them. Rising prices should be either simultaneously with the introduction of improvements, or after, but in no case "before", this will only cause a negative on the part of the population and the future complete rejection of innovations.

Regarding the tariff policy – we offer the calculation of the tariff (fare) according to the formula:

$$T_f = \frac{CS_a + P_{pl.a} + F_m}{V} \quad (4.1)$$

where T_f – a tariff for passenger transportation services in urban passenger transport;

CS_a – the planned annual cost of services, UAH;

$P_{pl.a}$ – planned profit on the route for the year, UAH (20%);

F_m – funds for modernization of the transport system, UAH (17%);

V – planned for the year the volume of passenger traffic on the route, people; (substantiated based on actual performance indicators or established by the results of the survey of passenger flows);

The following cost structure is used to determine the planned cost (CS_a):

1. Production cost:

1.1. Direct material costs: fuel; lubricants; tires.

1.2. Direct labour costs: drivers' salaries.

1.3. Other costs: costs of obtaining licenses, license cards, tech. passports, permits, inspections; accrual of drivers' wages; depreciation of rolling stock; wages of repair workers with accumulations; spare parts and materials.

1.4. Total expenditures.

2. Administrative costs.

3. Sales costs.

4. Other costs.

5. Financial costs.

Economically justified planned profit on the route for the year ($P_{pl.a}$) is determined according to its structure. The structure of profit use is as follows:

- funds needed to finance their own domestic needs, the costs of which are not included in the cost. Studies conducted by specialists have found that the share of such expenses in the total profit of the carrier is 5-10%;
- funds needed to upgrade fixed assets, especially rolling stock. In addition to advantage, depreciation deductions are also used for this purpose;
- taxes.

To take into account the interests of both passengers and carriers, as well as to prevent social tensions in the region, funds for the modernization of the transport system should be approximately 15-17% per annum.

Before raising the tariff, it is necessary to calculate what changes can already be made, first of all, these are the factors that do not involve a significant investment, but have a positive impact on the use of transport. For example, strictly scheduled traffic (f_7), the ability to get to the right place without changes (f_{13}) – it is necessary to review the current traffic interchange and vehicle interior cleanliness (f_{18}).

There are significant problems in the organization of the transport system in most cities of Ukraine. Their solution is carried out gradually. At the same time, it is worth taking into account the international experience in solving passenger transport problems. You can define the following steps:

- planning convenient routes according to the real needs of the population, providing a clear schedule of their way through the city;
- replenishment of the transport fleet with more economical and modern means of Ukrainian production, which will ensure the development of the domestic producer;
- improving the system of maintenance and repair, increasing speed and traffic safety;
- calculation of a single general economically justified tariff for urban transportation.

It is also important to remember the importance of developing a road network. That is why the complex task of restoring the transport network should include not only the revival of the public transport fleet, training of employees but also high-quality repair of roads. However, insufficient funding is a significant obstacle to the implementation of such a program, so under these conditions, every civil servant must be a lobbyist for the interests of his or her community in the relevant bodies, realizing his or her responsibility to it.

Thus, the problem of maintenance and development of rolling stock is to create such a system of its support, which would guarantee constant readiness, safety and efficiency of passenger transport for the entire period of its operation. This complex process must take into account both social and national aspects of the overall development of the system, best meeting the transport needs of the population and the development of domestic producers.

As for the tariff policy on urban transport, the study made it possible to identify the following conclusions:

- not all participants in the transport system have a full functional load. Carriers who win the tender do not have their own vehicles do not incur costs for its maintenance, but at the same time have constant cash flows that do not depend on the number of passengers carried;

- the method of calculating the tariff allows to include in the cost of the service a shallow level of the expenses for the restoration of the technical condition of vehicles. In these circumstances, the payback period of transport is very long, in some cases, taking into account the quality of the road surface, it exceeds the service life of vehicles;
- the current system of bringing inflated plans to the drivers of the route leads to significant violations, which significantly reduce the quality of passenger transportation services [114-118].

The solution of these problems is possible with the introduction of a single dispatching service of the common form of management.

Considering the tariff systems and compensation policy in public transport of foreign countries, we can see a bright contrast with the Ukrainian system, which has long become obsolete and does not meet the needs of citizens. It is advisable to allow the possibility of increasing the fare to 10-15 UAH. for a single ticket. This would be a kind of extra fee in the system, which would encourage not one-time, but frequent trips. However, a system of tariff plans should be developed that would allow locals and tourists to save, actively use public transport and have much lower actual travel costs. Such decisions will satisfy both the carrier and passengers.

Requirements for the professional level of specialists must be uniform for employees of enterprises of all forms of ownership and meet the needs of state regulations. The level of training of managers, specialists and drivers of transport companies should become one of the factors that are taken into account when conducting competitions for the right to work on city bus routes.

Sometimes the tariff is calculated taking into account the coefficient that takes into account the number of transported passengers who enjoy benefits, for example:

$$\mathrm{T} = \frac{\sum C_{\mathrm{i}} * KF * K_{VAT} * KB}{L * q_n} * \frac{\bar{\mathrm{I}}_{av}}{\bar{\gamma}_{bc}} \qquad (4.2)$$

where C_i – the total annual amount of regulatory costs of the carrier, UAH / year;

KF – coefficient of estimated profitability;

K_{VAT} – coefficient that takes into account the payment of value-added tax;

KB – coefficient that takes into account the number of transported passengers who enjoy benefits;

L – annual mileage of buses on the route, km;

q_n – nominal passenger capacity of the bus, passengers;

$\bar{l}_{av}$ – average distance travelled by the passenger, km;

$\bar{\gamma}_{bc}$ – average utilisation factor of bus capacity.

The paper [119] proposes the following method of calculating a socially-oriented fare based on the costs and revenues of the transport company, and depending on them is adjusted by coefficients to obtain a fare acceptable to passengers:

$$TSO = \frac{TEJ}{K_{sl} * K_{Iav} * K_p * K_{pc} * K_{tr} * K_{Lav} * K_c} \quad (4.3)$$

where TEJ – economically justified tariff, UAH;

K_{sl} – coefficient indicating the share of residents whose average per capita income is below or equal to the subsistence level;

K_{Iav} – coefficient indicating the ratio of average monetary income per capita to the subsistence level;

K_p – coefficient indicating the share among the population of pensioners and the unemployed population, as a percentage of the total population;

K_{pc} – coefficient indicating the share of the people that owns personal cars;

K_{tr} – coefficient indicating the required average value of the transfer coefficient;

K_{Lav} – coefficient indicating the average distance travelled on urban routes;

K_c – coefficient indicating the level of competition in the market of passenger transport services.

Methods for determining the amount of compensation:

– depending on the number of passengers that were transported and paid for the ticket (direct proportional dependence of the amount of compensation on the transported "paid" passengers of urban passenger transport);

– distribution of compensations by the losses incurred by carriers in the period preceding the reporting period;

– determining the amount of compensation per citizen. The calculation of the amount of compensation is carried out for the year according to the number of privileged categories in the area served by a particular enterprise.

– adjustment of the amount of compensation according to the volumes of work planned;

– coefficient (for example, as the ratio of passengers paying for travel and privileged categories to the total amount based on statistical data);

– promissory note (registration of beneficiaries with the help of season tickets, which are noted in the letters of registration and the amount is reimbursed by special bodies of the city);

– based on detachable tickets (the amount of compensation is calculated based on used tickets);

– convertible coupons (provide a one-time trip on urban passenger transport, regardless of ownership) [120; 121].

Thus, there are a large number of methods for the formation of tariff policy; the most appropriate is the one that relies on costs + profit.

Checking the relevant factors while a decision to use or not use public transport.

The study involved 32 experts, 15 of whom are scientists in the field of studying the problems of urban passenger transport management and 17 – managers

of different levels in companies that are directly or indirectly related to urban passenger transport. A theoretical study [122] called to identify 18 factors that influence a person's decision to use or not use public transport; all factors were combined into four groups – Safety, Comfort, Time Saving, Cost. If a factor could be simultaneously attributed to several groups of groups, we chose 1 group to which it belongs to a greater extent. Further, the experts were asked to evaluate factors from 1 to 18, while the points should not be repeated. After collecting the results, it is necessary to check the consistency of the opinions of the experts. For this we use the coefficient of concordance (expert consent) W is calculated by the formula:

$$W = \frac{12 \times \sum(S_j - \bar{S})^2}{m^2 \times (n^3 - n)} \quad (4.4)$$

where m – the number of experts, pers.

n – the number of ranking factors, pcs.

Sj – the sum of columns, score;

$\bar{S}$ – average sum in columns, point [31].

$$W = \frac{12 \times \sum(S_j - \bar{S})^2}{32^2 \times (18^3 - 18)} = \frac{5179576{,}32}{5953536} = 0{,}87$$

At a coefficient equal to zero, there is no consistency of opinion; at a coefficient similar to one - the highest level of flexibility. This tests whether the hypothesis of agreement between experts is accepted and whether the results of the expert group's questionnaire can be trusted. Thus, experts are consistent, and the results of the survey can be trusted. Thus, we obtained the following factors, which, according to experts, are decisive in the use of urban passenger transport (Tab. 4.3).

Table 4.3 – Comparison of the results of the expert survey and social research

Expert survey		Residents survey	
Factor's No.	Factor	Factor's No.	Factor
7	strictly scheduled traffic	2	availability of Wi-Fi
13	the ability to get to the right place without changes	5	the ability to pay for the fare in the cabin with a card
2	availability of Wi-Fi	7	strictly scheduled traffic
5	the ability to pay for the ticket in the cabin with a card	13	the ability to get to the right place without changes
17	significant savings in the cost of a single trip when buying a subscription	17	significant savings in the price of a single trip when buying a subscription
18	vehicle interior cleanliness	18	vehicle interior cleanliness
14	number of people in the cabin	3	air-conditioning
1	vehicle technical condition	14	number of people in the cabin
16	round-the-clock traffic	8	the ability to track the movement of the transport in real-time in the app
3	air-conditioning	11	increased driver requirements
8	the ability to track the progress of the transport in real-time in the app	16	round-the-clock traffic
11	increased driver requirements	1	vehicle technical condition
4	the ability to pay for the fare in the cabin	4	the ability to pay for the ticket in the cabin
15	permission to transport animals in public transport (in compliance with the necessary standards)	9	50% increase in fare
10	significant increase in tariff (3-4 times)	15	permission to transport animals in public transport (in compliance with the necessary standards)
9	50% increase in fare	12	extra charge for oversized baggage
6	criminogenic environment	6	criminogenic environment
12	additional charge for oversized baggage	10	significant increase in tariff (3-4 times)

Thus, the opinion of the experts coincided with the opinion of the population, but it is worth noting some exciting moments:

– in general, when the factors were divided into groups, the views of the experts and the population coincided, however, within the group, views on the importance of individual factors differed; Safety, Comfort, Time Saving, Cost;

– experts also considered factors from the “Time Saving” group to be more important than from the “Comfort” group, the population, in turn, singled out the opposite;

– experts found factors from the "Cost" group to have a total negative impact, although the people, in turn, was more loyal to some of them;

– in general, two factors coincided absolutely, the agreement in the groups reached 79.57% on average.

This study has proved that when making management decisions, it is necessary to take into account both the opinion of users and the opinion of experts; none of these opinions should prevail over the other, and therefore decisions should be made based on a balanced assessment.

The analysis showed that there are effective ways to improve the functioning of urban passenger transport, but for each local purpose should be defined evaluation criteria, limitations and main areas of implementation. The implementation of local goals is carried out by the measures developed by the responsible executors and approved in the prescribed manner. Deadlines and available resources should coordinate implementation.

Concerning pricing policy in urban transport, the study confirmed earlier findings:

– not all participants in the transport system have the same functional load. The winners of the competition do not have their own vehicles, do not spend money on maintenance and at the same time have constant cash flows that do not depend on the number of passengers transported;

– the method of calculating the price allows you to add too low a percentage of the cost of restoring the technical condition of cars to the cost. In these cases, the

return period of the vehicle is too long and in some cases may exceed the useful life of the vehicle, taking into account the quality of the road surface;

– the current system of imposing excessive plans for drivers leads to severe violations that significantly reduce the quality of passenger service.

To take into account the interests of both passengers and carriers, as well as to prevent social tensions in the region, funds for the modernisation of the transport system should be approximately 15-17% per annum. Before raising the tariff, it is necessary to calculate what changes can already be made, first of all, these are the factors that do not carry significant capital investments, but have a positive effect on the use of transport.

4.2 Improved procedure for calculating tariff plans, compensation systems and the cost of a round trip

The problem of tariffing passenger transportation is one of the key issues in the development and improvement of tariff policy, affecting not only the infrastructure of the transport industry, the financial well-being of market operators, but also the interests of consumers of passenger transportation services.

The procedure of improving tariff plans in the system of passenger road transport is preceded by the issue of clarifying the essence of the concept of "tariff", as well as identifying exogenous and endogenous factors that affect the search for a tariff solution that helps harmonize the interests of all participants in the transport services industry.

The generalization of scientific approaches to determining the essence of the concept of "transport tariff" allows us to highlight its main characteristics in Fig. 4.3.

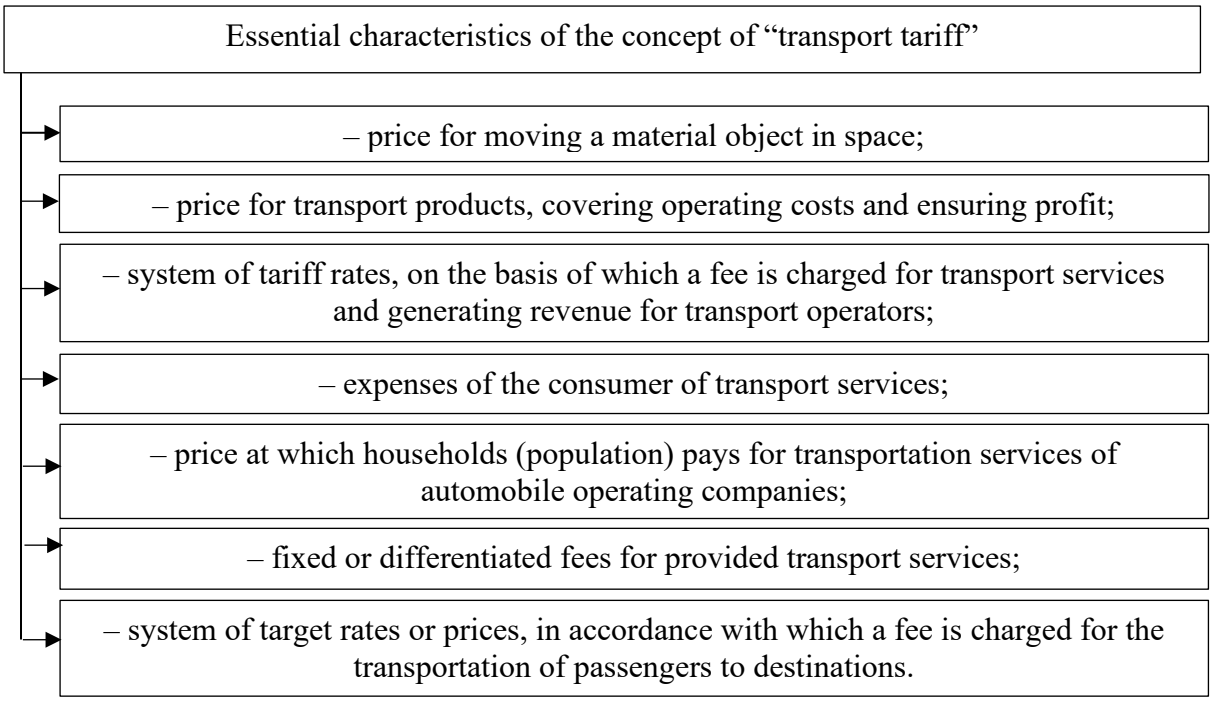

Figure 4.3 – The essential characteristics of the concept of "transport tariff" [1]

The analysis of the essential characteristics of the concept of “transport tariff” is required to be supplemented in terms of the legal support of this concept, as the tariffing of passenger transportation is the subject of state regulation. In accordance with paragraph 1.3 of the Methodology for calculating tariffs for passenger transportation services: "the fare on public bus routes is the cost of one-time travel of one passenger in a city connection or the cost of transporting a passenger per kilometer in suburban, intercity, international traffic" [5].

Systematization of scientific and legislative approaches to determining the transport tariff allows it to be defined as a combination of tariff rates, which include the cost and profit of motor transport enterprises providing passenger transportation services to the population, ranked by type of transport (urban, suburban, intercity and international).

Thus, in the process of development proposals for improving the procedure for calculating tariff plans, we will consider the specifics of a set of factors affecting the cost of services and profit of carriers, as well as the conformity of the stated recommendations on changing tariffs to the solvent demand of consumers of

transport services, as well as social expectations of the population, because this problem is in the economic, and infrastructural and social planes of study.

The main attention, in the conditions of introducing the Smart Transport System in urban passenger transport, will be paid to improving the tariff for passenger transportation services on public bus routes that are carried out in the usual mode of operation, as the research project provides a gradual transition from the "route taxi" to transfer all buses to normal driving mode.

The methodology for calculating the tariff is fixed at the legislative level and involves the calculation of the tariff for passenger transportation services on public city bus routes according to the following formula:

$$T_r = [(S_p + P_p) - I_i] / Q_p, \ (UAH/pass.), \quad (1)$$

T_r – tariffs for passenger transportation services on city public bus routes, which are carried out in the usual mode of movement;

S_p – the planned annual cost of services, UAH;

P_p – planned annual profit from the provision of services, UAH;

I_i – planned annual net income from other activities, and which are related to the provision of services;

Q_p – planned annual passenger traffic, pass.

Elements of the tariff require revision regarding the implementation of smart innovations and the current situation in the field of passenger transportation.

The analysis of the carrier's profit is viewed in dynamics through the prism of indicators of the economic efficiency of the functioning of entities providing passenger transportation services (Fig. 4.4).

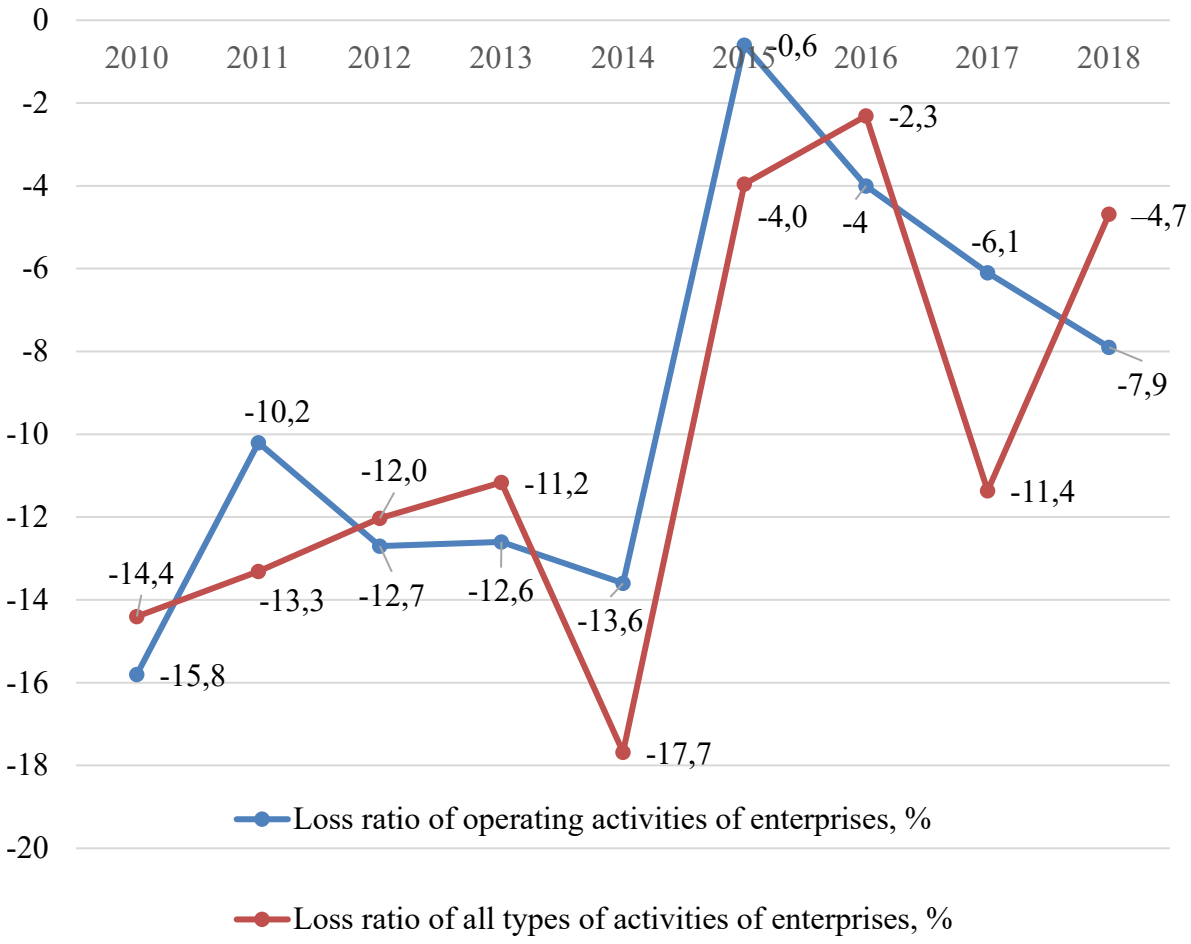

Figure 4.4 – Analysis of the economic efficiency of enterprises of passenger transport of urban and intercity connections by land for the period 2010-2018 [6]

Consideration of the results of economic efficiency of enterprises of passenger transport of urban and intercity connections by land allows us to conclude that the industry was unprofitable during 2010-2018, which indicates the shortcomings of profit planning processes, as well as a set of problems in the infrastructure sphere.

Factors directly affecting the decline in financial results are both a reduction in the number of carriers in the transport sector (Table 4.4) and passenger traffic (Table 4.5).

Table 4.4 – Analysis of the number of business entities in the field of activity 49.31 – Passenger land transport of urban and suburban traffic, units

Period	Number of business entities				
	Large business entities, units	Medium-sized businesses, units	Small businesses, units	Including microentrepreneurship, units	Total, units
2010	2	249	14550	13856	28657
2011	2	290	9645	8967	18904
2012	2	313	8433	7739	16487
2013	2	338	8816	8043	17199
2014	2	281	10191	9696	20170
2015	2	300	8076	7621	15999
2016	2	305	7328	6885	14520
2017	2	284	6209	5797	12292
2018	2	273	5569	5104	10948

The decrease in the number of carriers operating in the field of urban passenger transport in 2015 is due to the exclusion from the calculations of participants providing services in the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol and part of the temporarily occupied territories in Donetsk and Lugansk regions.

The number of business entities providing passenger transportation services decreased by almost a third over the period 2015-2018 mainly through the medium and small businesses, incl. microentrepreneurship. Only 2 large operators function on the market throughout the research period.

The decrease in passenger traffic also significantly reduced the financial result in the field of urban passenger transportations (Table 4.5).

The study of the number of passengers carried by the main types of urban transport shows the largest reduction in passenger traffic by bus and trolleybus modes of transport.

Table 4.5 – Analysis of the number of transported passengers by type of transport, thousand pass [6]

Period	Types of urban passenger transport				
	Car (bus)	Tram	Trolleybus	Metro	Total
2010 г.	3726288,6	713809,7	1203551,2	760551,2	6404200,7
2011 г.	3611829,9	797993,6	1346431,5	778253,4	6534508,4
2012 г.	3450173,1	799688,8	1345544,9	774057,6	6369464,4
2013 г.	3343659,5	757382,8	1306228,5	774794,0	6182064,8
2014 г.	2913318,1	769911,1	1096884,8	725819,9	5505933,9
2015 г.	2250345,3	738603,2	1080772,6	700369,5	4770090,6
2016 г.	2024892,9	694009,4	1038746,0	698367,3	4456015,6
2017 г.	2019324,9	675841,4	1058072,1	718886,9	4472125,3
2018 г.	1906852,1	666271,1	1016241,2	726585,1	4315949,5
2019 г.	1804929,3	627515,1	945694,5	714982,1	4093121,0

For the period 2010-2019 the overall reduction in the number of passengers carried by all modes of transport was 36.1%. The factors that affect the reduction of passenger traffic and require consideration during calculating tariffs are summarized in Fig. 4.5

Each of the factors presented in Fig. 3 has an impact on the planned annual volume of passenger traffic, which is an element of the formula for calculating the tariff for services for the transportation of passengers on public city bus routes, which are carried out in normal traffic. Let's consider some of the given factors in more detail to develop recommendations for improving the procedure for calculating tariff plans.

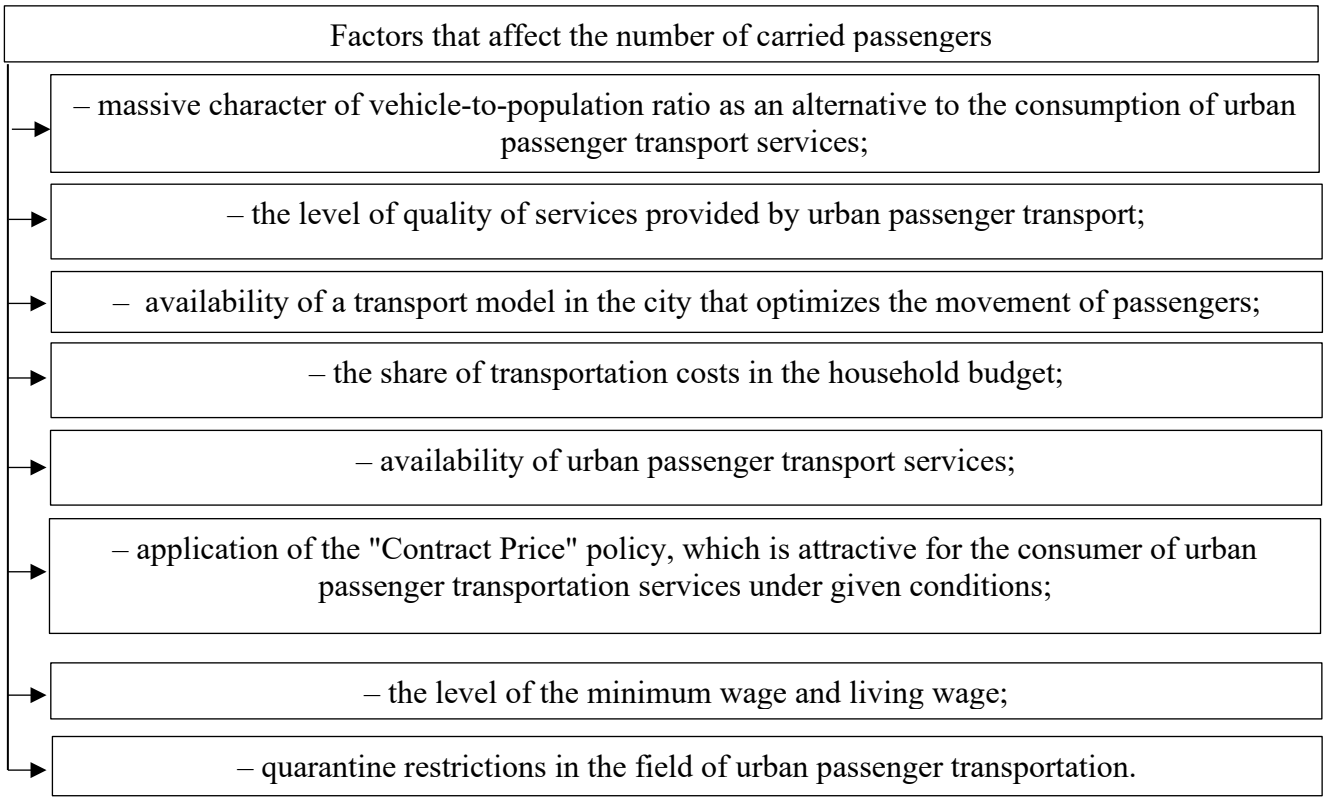

Figure 4.5 – Factors that affect the number of passengers carried in the urban passenger transport system

The presence of a transport model in the city, which optimizes the movement of passengers due to an extensive network of various types of passenger transport, allows solving a certain number of tasks systematized in Fig. 4.6 It should be noted that at the moment the transport model exists only within certain large cities of Ukraine.

In our opinion, it is necessary to establish an economic relationship between the tasks of the city's transport model and the application of the contractual pricing policy as part of the improvement of the tariff plan for the transportation services of passengers on public city bus routes, which are carried out in normal traffic.

To the current conditions of pricing on the Ukrainian market of urban passenger transportation, the name of the “costs plus charge” approach is applicable, which has significant errors in profit planning.

In the work of I.M. Aksenov [7], the essence of the concept of "contractual price" is substantiated, adapted to the field of passenger transportation, that allows to increase the volume of sales of services by transport companies.

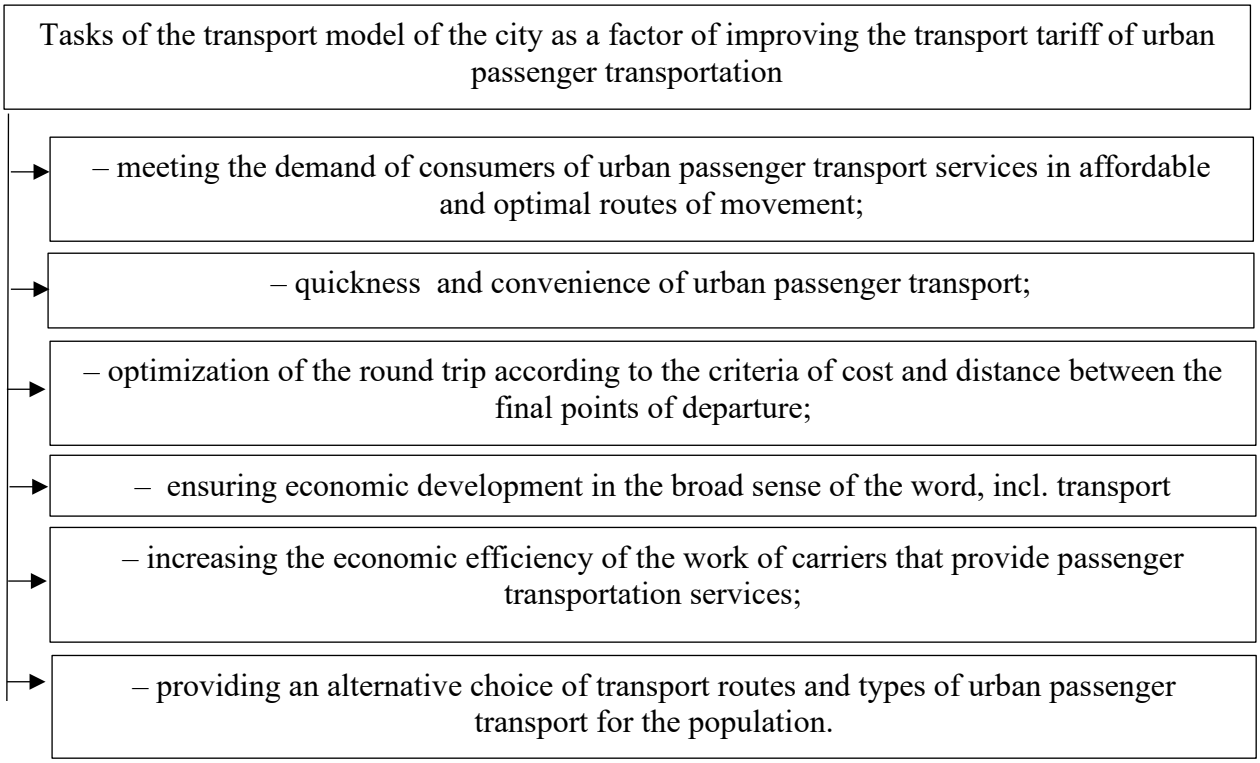

Figure 4.6 – Tasks of the transport model of the city as a factor of improving the transport tariff of urban passenger transportation

Proposals for the implementation of the "Contract Price" forms in the terms of the tariff plan for services for the transportation of passengers on public city bus routes, which are carried out in the usual mode of movement, are set out in Fig. 4.7.

The introduction of smart accounting systems within the transport model of the city will allow to supplement the information for a more accurate calculation of the cost of a travel ticket, travel passes, so that the level of economic efficiency of the work of carriers will be higher than in terms of calculating the cost of travel using the cost plus charge which is relevant for the transport of passengers on public city bus routes, which are carried out in normal traffic.

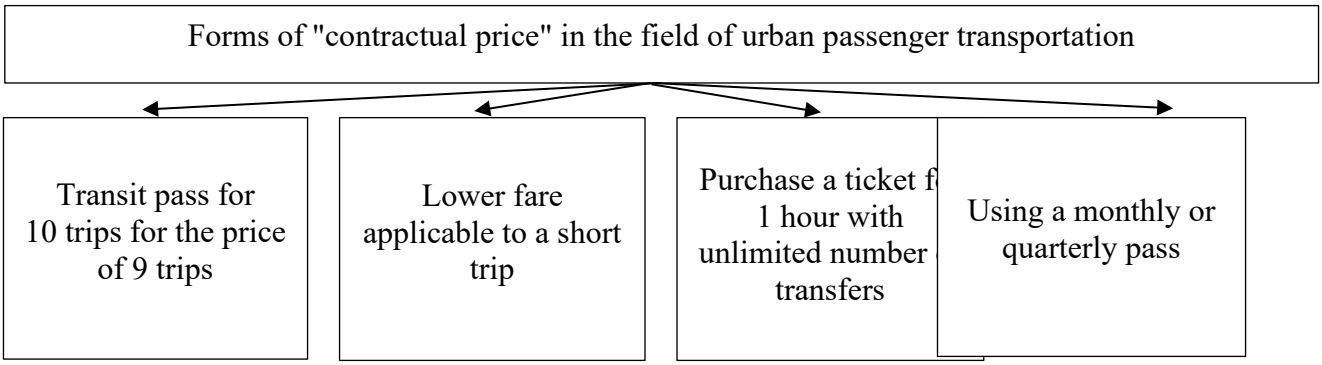

Figure 4.7 – Implementation of " contractual price" forms in the sphere of urban passenger transportation

The use of a flexible approach to pricing and differentiated transport tariffs allows us to meet the population's demand for urban passenger transportation, and meets the solution of specific logistics problems.

One of the proposals for improving the procedure for calculating tariffs for passenger transportation services on public city bus routes, which operate in normal traffic, is the application of a reduction factor during peak hours for alternative routes of passenger traffic. Thus, in order to unload the central city highways during peak hours, it is advisable to organize routes that lengthen the route of passenger traffic, but at the same time at a lower price, taking into account the reducing coefficient.

Thus, it is possible to supplement formula (1) taking into account the reduction factor as follows:

$$T'_r = T_r * K, \ (UAH./pass.), \qquad (2)$$

T'_r – tariffs for passenger transportation services on city public bus routes, which are carried out in the usual mode of movement, taking into account the reducing coefficient;

T_r – tariffs for passenger transportation services on city public bus routes, which are carried out in the usual mode of movement;

К – reducing coefficient during peak hours for alternative routes of passenger traffic.

When the city council introduces a system of compensation for the cost and profit of carriers, this proposal is updated and provides an opportunity to both redistribute traffic flows during peak hours, and increase the comfort of movement, take into account consumer demands in the context of a partial reduction in transport costs. However, it should be noted that the effective use of reducing coefficients is possible if there is an existing transport model of the city, which involves the organization of transport hubs to ensure mobility of movements and the convenience of changing types of urban transport when carrying out passenger traffic.

Features of the application of reducing coefficients to tariffs for passenger transportation services on public city bus routes, which are carried out in normal traffic, are presented in Table 4.6.

Two possible variants of the reducing coefficients used during peak hours are proposed, depending on the length of the alternative route and the type of urban transport.

Table 4.6 – Features of the use of the reducing coefficients on urban routes

Organization of passenger transportation	K= 0,8	K=0,75
On a public city bus route	$T'_r = T_r * 0,8$	$T'_r = T_r * 0,75$

The availability of alternative route options during busy traffic hours also solves the problem of reducing the share of household transport costs in the total aggregate of their average monthly costs, which is an especially actual problem for those whose average monthly income per capita is below the actual subsistence minimum. The dynamics of changes in the part of transport costs in the general structure of household expenditures by groups is shown in Fig. 4.8

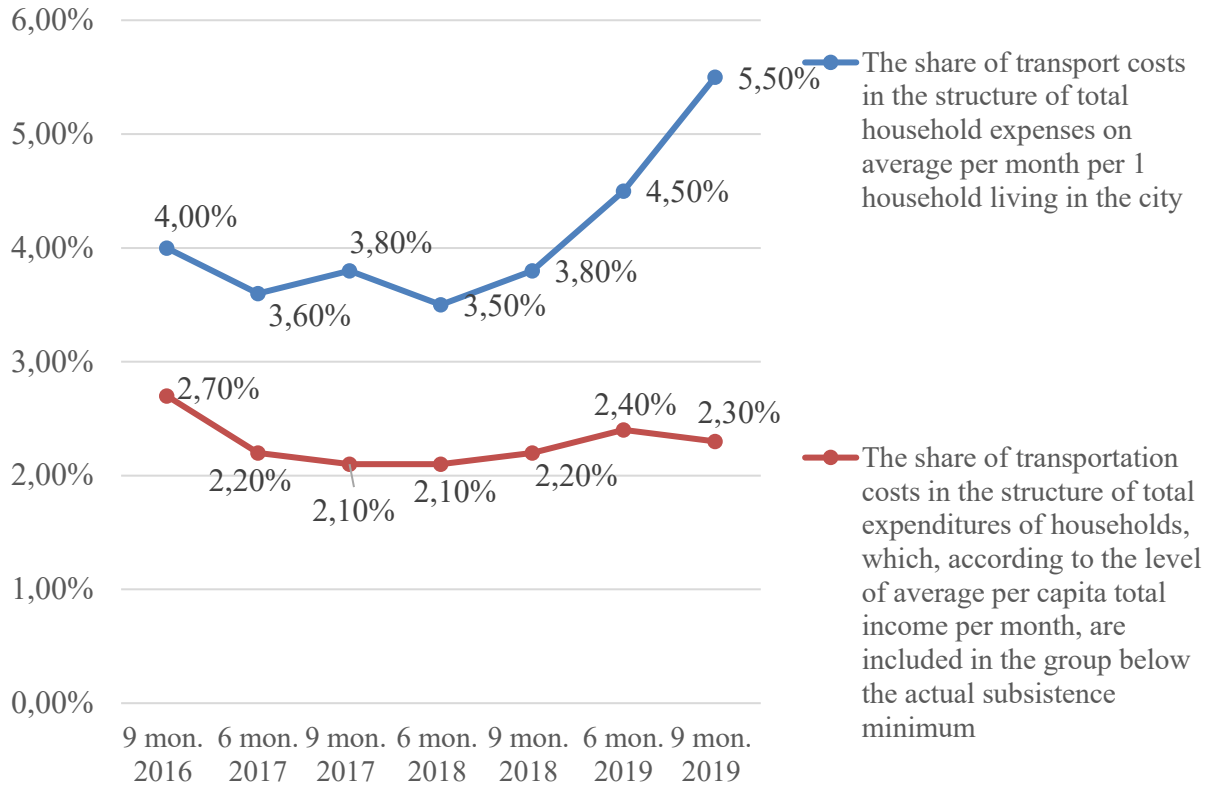

Figure 4.8 – Dynamics of changes in the part of transport costs of households in the structure of their total costs by groups

The share of transportation costs in the structure of total household expenditures on average per month per one urban household has been increasing since the end of the 1st half of 2018 from 3.5% to 5.5%.

In the group of households whose average monthly income is below the actual subsistence level, the share of transportation costs in the total amount of expenses is 2.3% at the end of the third quarter in 2019, which is 0.2% more than the same reporting period in 2017, which indicates about the constant level of expenses and the use of privileged travel.

As a result of the introduction of an automated accounting system in urban passenger transport, it is possible to expand the information base for optimizing routes and introducing reducing coefficients on urban routes during rush hours, which will take into account the interests of socially vulnerable groups of the population. Thus, consumers of passenger transportation services will have an

alternative: "pay at a higher transport tariff and arrive faster or pay at a discount due to a reduction factor, but take a detour and facilitate unloading of city-wide transport routes during peak hours".

Taking into account the interests of various groups of the population in the process of calculating the transport tariff supposes the introduction of an upper limit or cap-limitation to the estimated value of the cost of urban passenger transportation. The sequence for calculating the maximum tariff size is summarized in Fig. 4.9

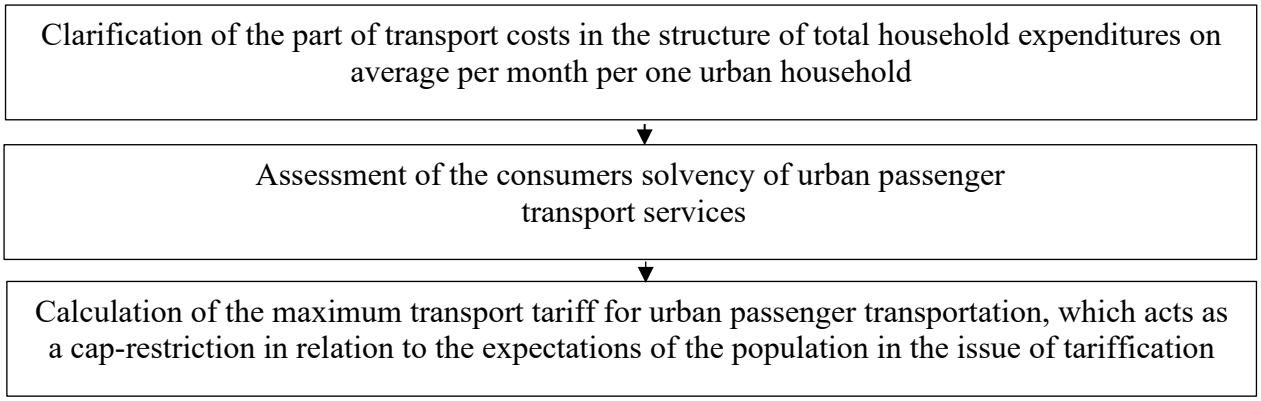

Figure 4.9 – Sequence for calculating the maximum rate

Taking into account the correlation between the average subsistence level, which determines the level of effective demand of the population, and the size of the transport tariff, it is advisable to calculate the maximum cost of passenger transportation using the following method (Fig. 4.10).

As the result, the main goal of calculating of the maximum tariff size lies both in the economic sphere, namely, the validity of the carrier's marginal level of profitability, and the social sphere – to ensure a transport tariff level that is affordable for all categories of the population.

For households that can be attributed to the group with an average and high level of average per capita equivalent income, the emphasis is shifted to considering such a factor that affects the total number of passenger traffic as ensuring the comfort of movement in urban passenger transport as an alternative to mass motorization.

This criterion should be considered within the framework of the features of the system of compensation to carriers from the city government.

The maximum size of the transport tariff for the public urban passenger transport system

$$T_r^{max} = \frac{\%C * P}{Q_a}, \ (UAH./pass.), \quad (3)$$

T_r^{max} – the maximum size of the tariff for passenger transportation services on public city bus routes, which are carried out in the usual mode of movement, UAH./pass.;

$\%C$ – part of transportation costs of households in the structure of their total costs, %;

P – average per capita total monthly income of one household, UAH.;

Q_a – the average number of trips by urban passenger transport.

Figure 4.10 – Calculation of the maximum size of the transport tariff for the public urban passenger transport system

The system of compensation for carriers should be based on the fulfillment of a certain number of criteria that apply to market operators providing urban passenger transportation services, partially described in [8, p.23] and supplemented taking into account modern Ukrainian realities of the passenger transportation market in Fig. 4.11.

The conditions of the compensation policy for carriers should be based on the fulfillment of high-quality urban passenger transportation and the fulfillment of the set of requirements stated in Fig. 9. Failure to comply with the qualitative aspect entails a complex deterioration in the level of satisfaction of households with the services provided.

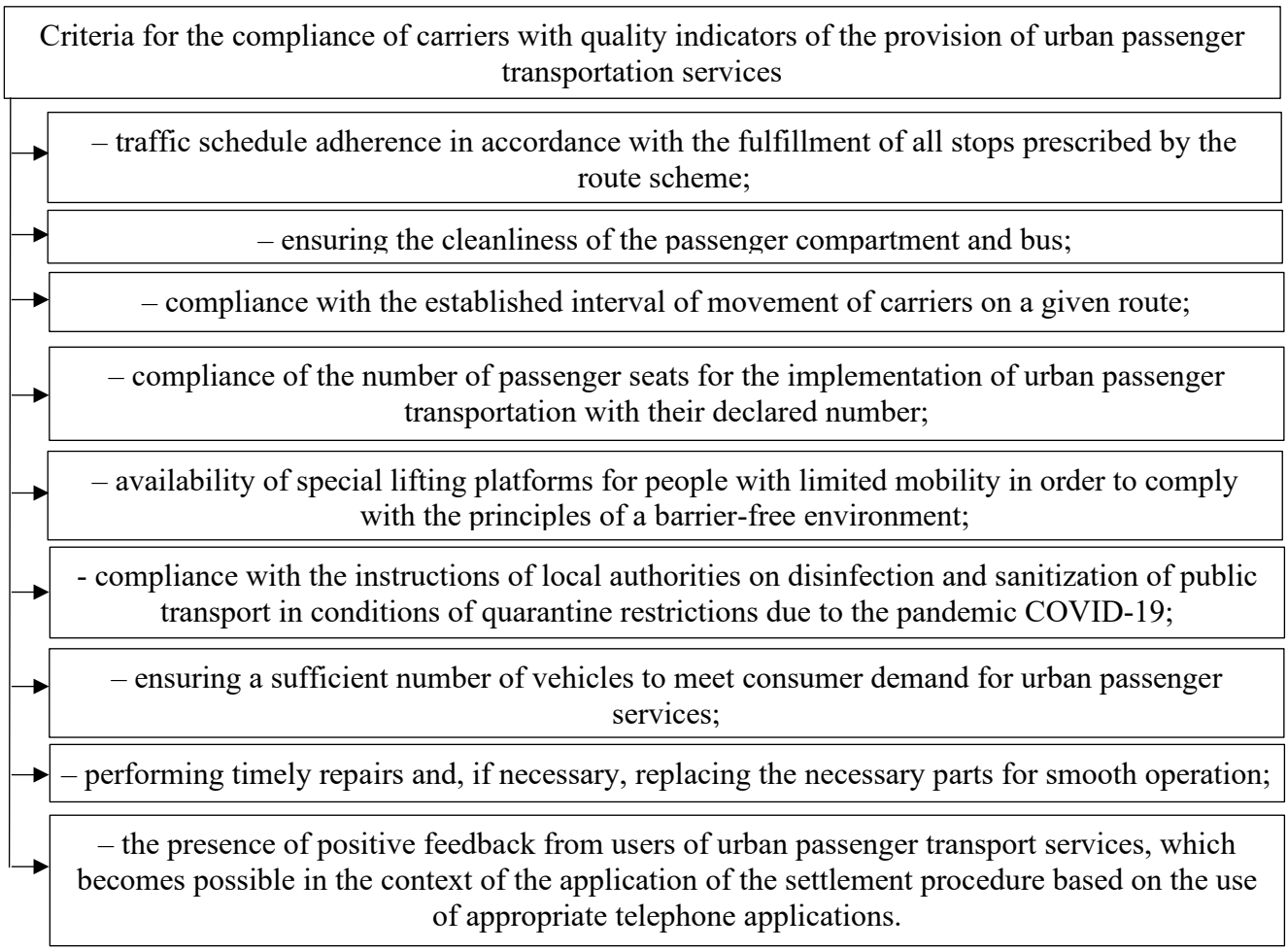

Figure 4.11 – Criteria for the compliance of carriers with quality indicators of the delivery of urban passenger transportation services

In matters of predictability of passenger traffic, it is necessary to deviate from the principles of annual planning stated in the Methodology for calculating tariffs for passenger road transport services, since this plan does not allow timely adjustments, which subsequently affect the cost and profit of carriers. Flexibility in the issue of compensations, planning the constituent elements of the transport tariff will allow forecasting for a quarter or a month.

The system of compensation for carriers should take into account the risks of non-compliance of the established quality indicators with the actual assessment of the level of services provided by urban passenger transportation to consumers.

The development of relationships with the market operator in such a plane presupposes the termination of cooperation and the announcement of a competition to replace the carrier on the vacant route. In this case, compensation should be provided for only the expenditure part (cost) within the framework of the transport tariff structure. This system will create motivational incentives for carriers, as well as maintain a certain level of competition in the industry, which will have a positive effect both on the satisfaction of households with passenger transportation services and on the development of the urban transport system in accordance with international standards.

The epidemiological situation in the country in the 1st and 2nd quarters of 2020 led to the introduction of an additional criterion for the quality of services provided by carriers, namely, the need to comply with the instructions of local authorities on disinfection and sanitization of public transport in conditions of quarantine restrictions due to the COVID-19 pandemic. In the context of a change in the concept of making a profit from urban passenger transportation, compensation to carriers for services provided by the city authorities is becoming a significant advantage. The assessment of passenger traffic under quarantine restrictions was carried out on the basis of a comparison of indicators with the data for the previous reporting period and made it possible to identify the following deviations in the volume of services provided for urban passenger transportation (Fig. 4.12).

Analysis of the dynamics of changes in passenger traffic under quarantine restrictions for the period January-April 2020 allows stating a decrease in the volume of passenger transportation services provided both in the context of all types of transport, and, in particular, road transport.

The decrease in passenger traffic in automobile transport amounted to 35.1% in January-April 2020 compared to the same period of the last reporting period. Compensation from local authorities under contracts concluded with carriers helps to reduce the financial burden and losses of owners in the field of transport under conditions of quarantine restrictions.

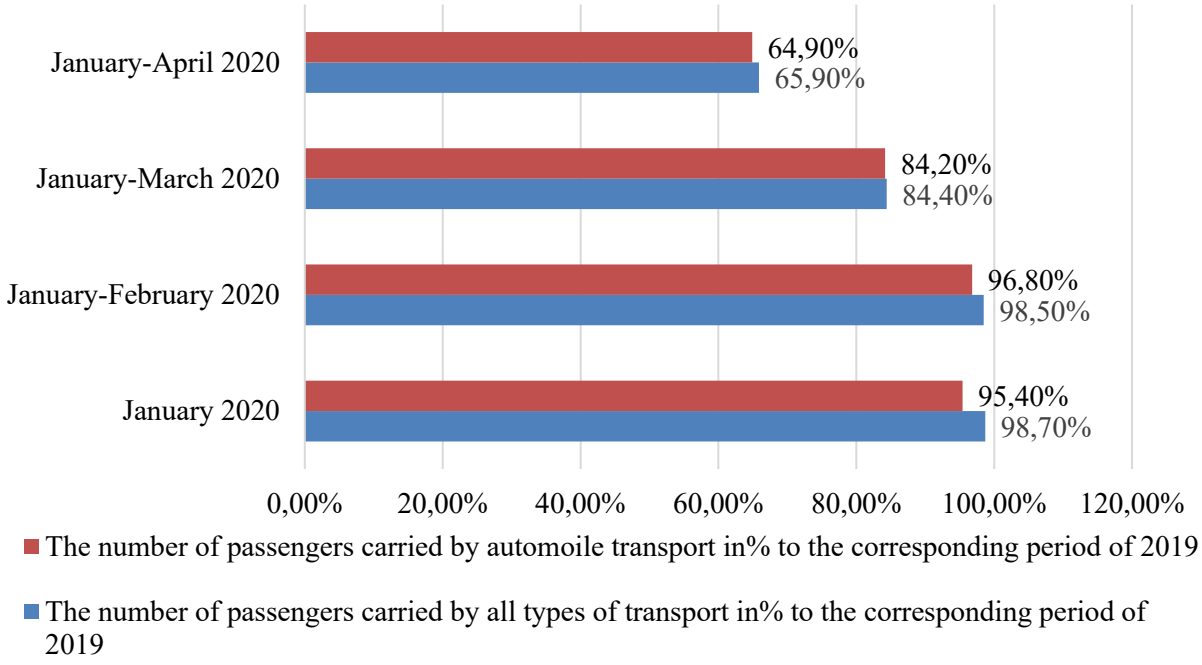

Figure 4.12 – Dynamics of changes in passenger traffic under quarantine restrictions for the period January-April 2020

Thus, when determining the income of carriers, the quality aspect of the services provided is in the first place, and not the indicator of the maximum vehicle occupancy. The system of compensation allows to ensure the financial stability of enterprises in the conditions of quarantine restrictions, supporting entrepreneurs in the urban passenger transportation sector, as well as helping to maintain competition in the industry.

The advantages of the implementation of the compensation system for carriers from the perspective of considering consumers of urban passenger transportation services are systematized (Fig. 4.13). The introduction of a compensation system to carriers for the provided services of urban passenger transportation allows to bring in line with the planning indicators of income from the services provided, the needs of the population in high-quality transport services and the level of service provided by market operators. The advantages of introducing a compensation system from the perspective of carriers that provide urban passenger transportation services are shown in Fig. 4.14.

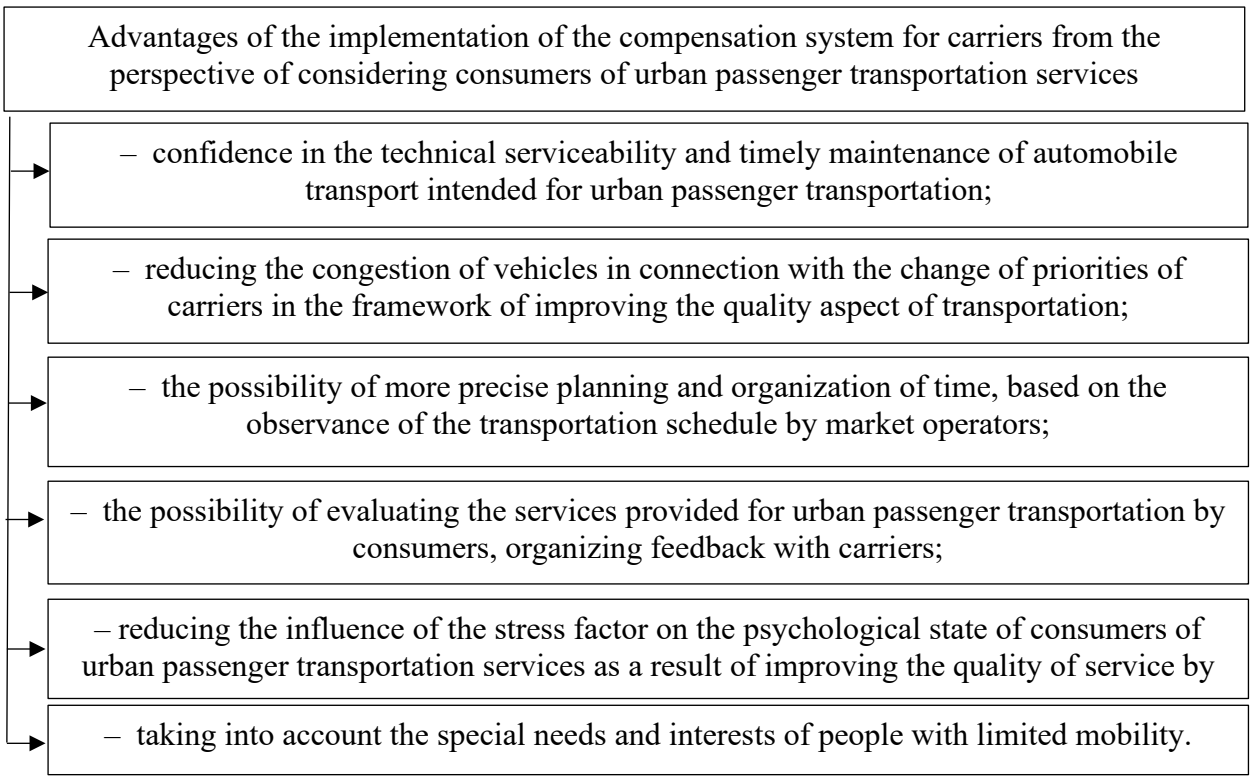

Figure 4.13 – Systematization of the benefits of the implementation of the compensation system for carriers from the point of view of consumers

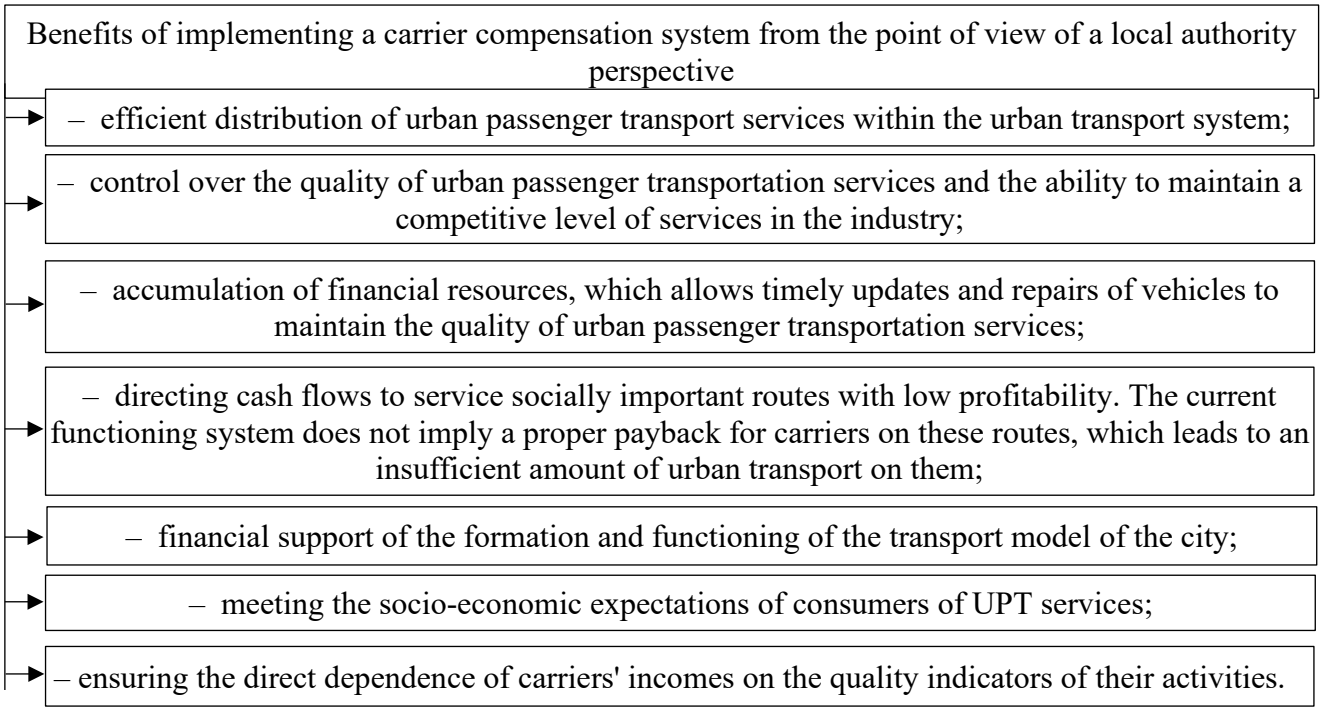

Figure 4.14 – Systematization of the benefits of the implementation of the compensation system for carriers from the perspective of local authorities

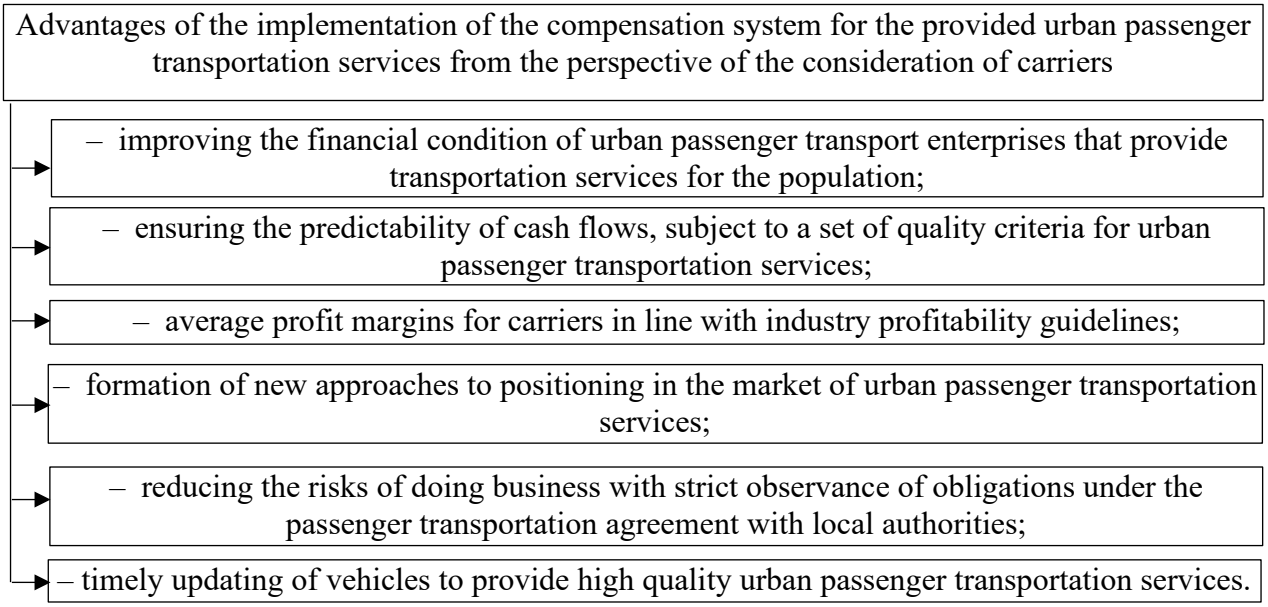

Figure 4.15 – Advantages of the implementation of the compensation system for the provided urban passenger transportation services from the position of market operators

In fig. 4.15 there are instructions on the need for market operators to adhere to the terms of the contract for providing urban passenger transportation services. The current model of interaction presupposes the existence of exclusively a system of compensation for transportation of privileged categories of the population. As part of the project for the implementation of a smart accounting system in urban passenger transport, a reallocation of financial flows is taking place, which secures the receipt of compensation payments to market operators depending on the total traffic volume.

As part of the proposed smart accounting system in urban passenger transport, the compensation system is based on the fulfillment of a number of indicators, the assessment of which is made on the basis of automated accounting of urban passenger transportation services:

a) the compliance of the number of round trips on the route declared in the contract with their actual amount;

b) the amount of expenses for the performed mileage of passenger traffic is taken into account during calculating the amount of compensation;

c) taking into account the average industry profitability of passenger transportation services when calculating compensation payments.

To create a positive perception among carriers of the new format for organizing passenger transportation and the compensation system, it is necessary to provide the possibility of indexing payments in the context of changing market conditions. The proposed model of compensation has become widespread in developed economic systems, which is named as the "Contract based on gross costs" [9, p. 4] (Fig. 4.16).

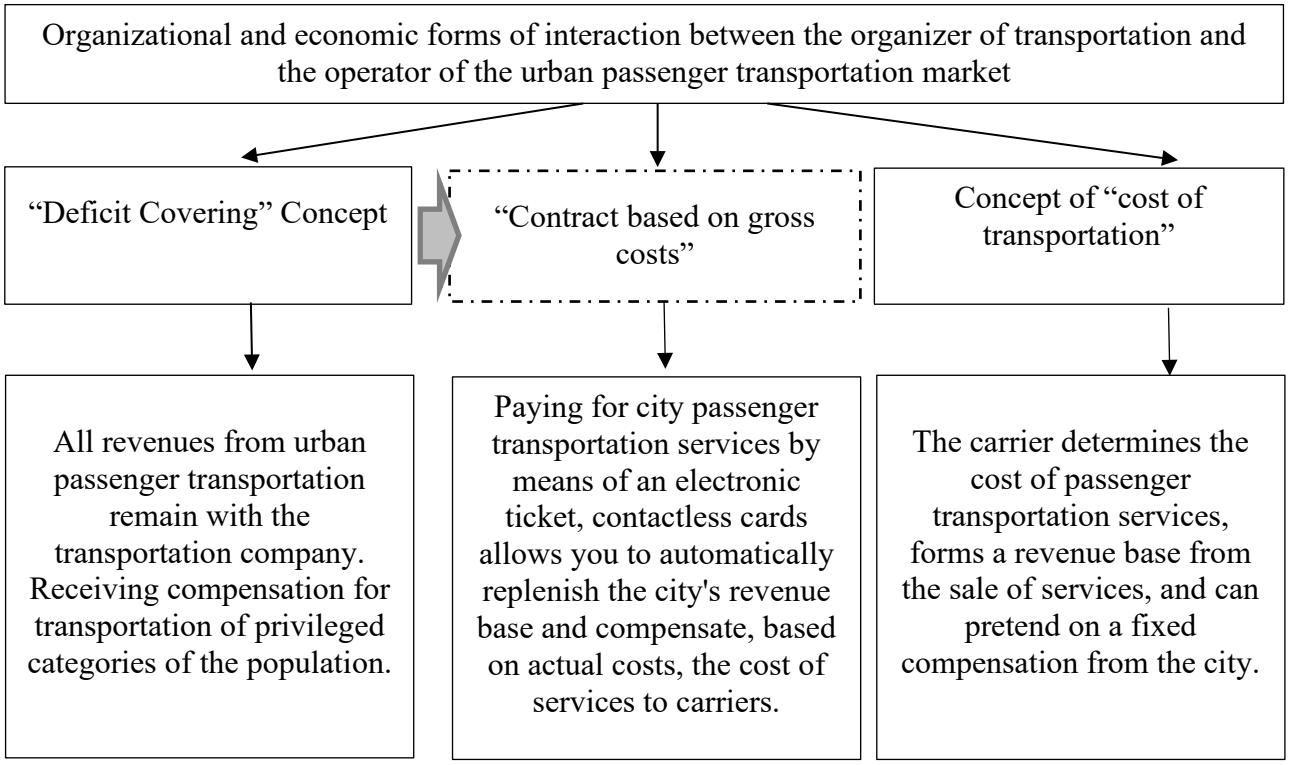

Figure 4.16 – Organizational and economic forms of interaction between the organizer of transportation and the operator of the urban passenger transportation market [9, p. 4]

Today there is a concept of "covering the deficit", which has a significant number of disadvantages in the field of urban passenger transportation services in Ukraine, that relate to:

– determination of the peculiarities of compensation for the carriage of passengers who are entitled to reduced fares;

– non-transparency of statistics about the volume of transportation of passengers who use the services of public urban passenger transport, the services of a route taxi;

– potential risks of physical injury to passengers, because the driver also performs the function of a cashier, which distracts him from driving a vehicle;

– underpayment of tax revenues to the budget due to incorrect calculation of passenger traffic and deliberate underestimation of the level of economic efficiency by carriers;

– insufficient coverage of routes with low profitability by private carriers, which negatively affects the satisfaction of transport service consumers.

The transition to the functioning of urban passenger transport according to the principle of “Contract based on gross costs” will create the basis for the formation of a transport model of the city, which meets the practice of developed economic systems, as well as form a flexible approach to tariffing - the establishment of "contractual prices" in the transport system.

The establishment of contractual prices may include, in addition to the proposals indicated in Fig. 5, binding tariffication to:

– the number of stops that a passenger passes by in urban passenger transport. So, in accordance with DBN B.2.2-12: 2018 “Planning and development of territories”, the distance between bus stops of public transport is 400 m in large cities [7, p.70];

– the duration of the trip and the number of transfers made under the conditions of the functioning of the city's transport model;

– the day of the week when the trip is carried out – a weekday, a day off or a public holiday;

– depending on the intersection of the designated areas of the city by the route, which implies its clear territorial zoning [1, p.22];

– the age division of consumers of urban passenger transport services.

The proposal for linking tariffication depending on the intersection of the designated areas of the city by the route, which implies its clear territorial zoning, has a number of disadvantages due to the complexity of calculating passenger traffic and their monitoring by the controllers along the route, insufficient coverage of transportation costs by revenues to the city budget within this tariff plan.

Thus, it is advisable to introduce tariffication on routes that pass along city-wide highways, depending on the duration of the trip and the number of transfers made, which implies the organization of transport hubs as an integral part of the functioning of the city's transport model.

The advantage for passengers will be the optimization of transport costs, since changing several types of transport in a limited period of time – payment will be charged once. To clarify the features of compensation, carriers should clearly define the conditions for the provision of urban passenger transportation services and the key principles of building relationships with contractors, which are summarized in a contract between the city administration and a business entity, the main activity of which, in accordance with the type of economic activity, is 49.31 Passenger land transport, urban and commuter connection.

The main points of the agreement between the city administration and carriers are shown in Fig. 4.17.

To calculate the amount of compensation to carriers, as well as the cost of a round trip, it is necessary to consider in more detail the structure of their expenses, set out in the Methodology for calculating tariffs for passenger road transport services [5; 15; 123].

Direct material costs include fuel costs for urban passenger transportation. With the transfer of a certain range of functions to the city administration and an increase in the amount of financial resources in circulation, a centralized purchase of fuel in bulk for the future is possible, which will allow fixing the cost of a round trip at a fixed level for a certain long period in this component part of it.

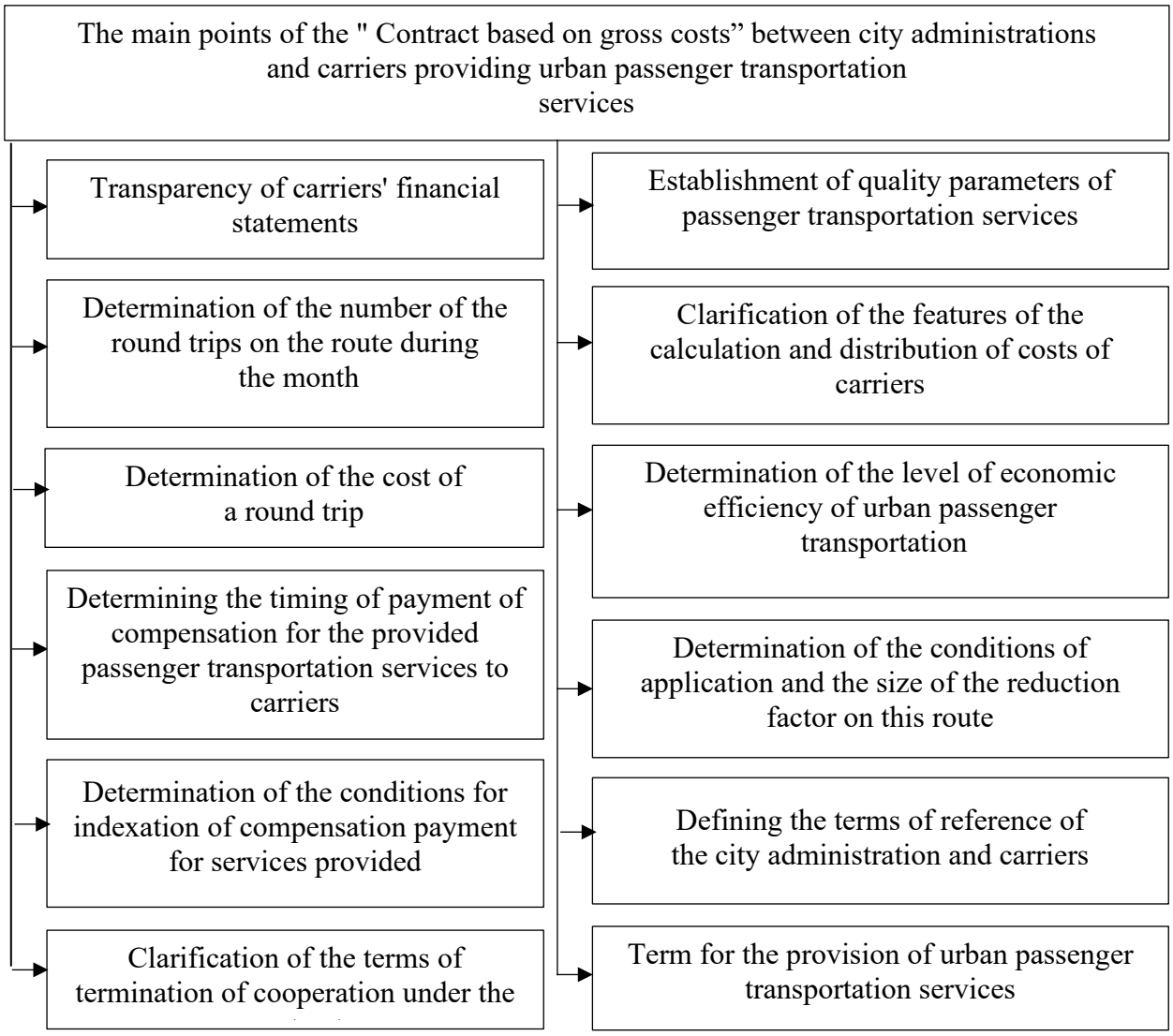

Figure 4.17 – The main points of the " Contract based on gross costs" between city administrations and carriers providing urban passenger transportation services

As part of direct labor costs for the carrier, the position of the conductor will be excluded in connection with the introduction of an electronic ticket and the transition to a non-cash form of payment. This position in the staffing table will be replaced by a controller on a specific route, whose responsibility will include monitoring the compliance of purchased tickets, depending on their type of declared duration and the final destination of the passenger's trip. In the proposed model, the city administration accumulates the total revenue, therefore it is advisable to introduce this personnel position into its subordination. Accordingly, among other direct costs, the structural element of charges for labor costs for conductors will also

undergo changes. The composition of the general production costs of the carrier in terms of the costs of making tickets for travel requires revision, since when purchasing an electronic ticket or smart card, this expense item must be taken into account by the city administration. The structure of the distribution of costs of carriers whose main activity is related to the providing of services according to KVED – 49.31 “Passenger land transport of urban and suburban connections” can be analyzed using the example of micro-enterprises. Statistical information on large enterprises of the industry is not disclosed in the reports of the State Statistics Service of Ukraine due to the need to comply with the requirements of the Law of Ukraine "On State Statistics" on the confidentiality of statistical information, for medium and small enterprises – data are partially published, which does not allow analyzing the dynamics of the expense item parts.

The analysis of the costs of micro-enterprises in the sphere of urban and suburban passenger transportation is summarized in Table 4.7 and Table 4.8.

The analysis of the structure of expenses of micro-enterprises in the sphere of urban and suburban passenger transportation indicates that material expenses and expenses for payment for services carried out in the course of their main activities account for the largest part of the costs of carriers. If in 2012 the share of material costs accounted for 56.01% in the total cost structure, then in 2018 – 68.1%.

Table 4.7 – Analysis of the cost structure of micro-enterprises in the sphere of urban and suburban passenger transportation

Carrier cost group	2012		2013		2014		2015		2016		2017		2018	
	mln. UAH	%	mln. UAH	%	mln. UAH	%	mln. UAH	%	mln. UAH	%	mln. UAH	%	mln. UAH	%
Material costs and costs of payment for services carried out in the course of the main activity	39,23	56,01%	107,87	74,84%	60,89	65,34%	79,83	72,47%	79,06	67,58%	76,70	58,14%	181,35	68,1%
Depreciation	2,8	4,00%	8,69	6,03%	5,10	5,48%	6,35	5,77%	5,80	4,96%	15,39	11,67%	18,20	6,8%
Labor costs	24,03	34,31%	19,39	13,45%	18,32	19,66%	16,16	14,67%	22,95	19,62%	23,74	18,00%	51,21	19,2%
Social spending	2,96	4,23%	7,07	4,90%	6,44	6,91%	5,82	5,28%	5,54	4,74%	5,64	4,27%	14,67	5,5%
Other expenses	1,02	1,45%	1,13	0,78%	2,44	2,62%	1,98	1,80%	3,63	3,10%	10,46	7,93%	0,97	0,4%
Total expenses for the implementation of services	70,04	100,00%	144,15	100,00%	93,19	100,00%	110,14	100,00%	116,98	100,00%	131,93	100,00%	266,40	100,0%

Table 4.8 – Analysis of the dynamics of micro-enterprises in the sphere of urban and suburban passenger transportation, mln. UAH

Carrier cost group	Period										
								2018/2017		2018/2012	
	2012	2013	2014	2015	2016	2017	2018	Absolute deviation, mln.UAH.	Relative deviation, %	Absolute deviation, mln.UAH.	Relative deviation, %
Material costs and costs of payment for services carried out in the course of the main activity	39,23	107,87	60,89	79,83	79,06	76,70	181,35	104,65	136,44 %	142,12	362,27 %
Depreciation	2,8	8,69	5,10	6,35	5,80	15,39	18,20	2,81	18,26 %	15,40	550,00 %
Labor costs	24,03	19,39	18,32	16,16	22,95	23,74	51,21	27,47	115,71 %	27,18	113,11 %
Social spending	2,96	7,07	6,44	5,82	5,54	5,64	14,67	9,03	160,11 %	11,71	395,61 %
Other expenses	1,02	1,13	2,44	1,98	3,63	10,46	0,97	-9,49	-90,73 %	-0,05	-4,90 %
Total expenses for the implementation of services	70,04	144,15	93,19	110,14	116,98	131,93	266,40	134,47	101,93 %	196,36	280,35 %

The main attention should be paid to direct material costs during calculating the amount of compensation by the city administration, and the possible indexing of its value.

Material and service costs incurred by carriers in the course of their core business increased by UAH 142.12 million or 4.6 times over the entire study period, which demonstrates a significant increase in the cost of materials and components used to directly ensure the implementation of passenger transportation and preparation of vehicles for operation in accordance with statement 2.6 of the Methodology for calculating tariffs for urban passenger transport services [5].

Total expenses for the implementation of urban passenger transportation services for 2012-2018 in total increased by UAH 196.36 million or 3.8 times and amounted to UAH 266.40 million at the end of the study period.

To determine the factors that need to be taken into account during the process of indexing the amount of compensation and which are key in calculating the cost of a round trip, in conditions of market uncertainty, it is relevant to apply one of the methods of economic and mathematical modeling – regression analysis.

Taking into account the factor of the change in the value of the national currency, we will analyze the influence of the Consumer Price Index, as well as examine the dynamics of the change in the cost of diesel fuel on the total amount of expenses of micro-enterprises in the sphere of urban and suburban passenger transportation. Thus, as a resultant indicator, we take the total costs of micro-enterprises in the sphere of urban and suburban passenger transportation, factors of arguments: Consumer price index and the cost of diesel fuel.

Using analytical data on the cost of diesel fuel and the Consumer Price Index, we will carry out economic and mathematical modeling of the dependence of the total costs of passenger transportation services on the selected factors, statistics for which are presented in Table. 6. To study the economic and mathematical relationship, we will consider the period from 2014, which will avoid distortion of calculations due to the fact that since 2014 data from the temporarily occupied ARC, the city of Sevastopol and part

of the occupied territories in Donetsk and Luhansk regions are not available, which significantly reduced the total costs of carriers in 2014 compared to 2013.

Table 4.9 – Statistical data for conducting regression analysis based on open statistical sources [3, 8]

Period	Total expenses for passenger transportation services, mln.UAH (У)	Price for 1 liter of diesel fuel, UAH (X1)	Consumer price index, % (X2)
2014	93,19	14,61	124,9
2015	110,14	17,27	143,3
2016	116,98	19,45	112,4
2017	131,93	23,78	113,7
2018	266,4	27,04	109,8

Based on formula (4), it is possible to visually express the interdependence of indicators in the economic and mathematical model:

$$Y_t = f(X_1; X_2)_t + \delta_t \quad (4)$$

In formula (4), the index t indicates the acceptance of different values by the elements of the regression model in the forecast planning periods. The δt component makes it possible to correct the result obtained for the probable error between the planned and actual values of carriers' expenses.

Regression analysis was carried out using the “Regression” function of MS Excel, the results of which are summarized in Fig. 16.

The multiple correlation coefficient takes a value of 0.86, which indicates the presence of a high correlation between the resulting factor and the factors-arguments. The R-squared value causes a 74% change in the total costs of carriers for the provision of passenger transportation services as a result of changes in the price of diesel fuel and the consumer price index.

Regression statistics						
Multiple R	0,859738121					
R-square	0,739149636					
Normalized R-square	0,478299272					
Standard error	50,54124813					
Observations	5					
Variance analysis						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	2	14476,47555	7238,237777	2,833615504	0,260850364	
Surplus	2	5108,835525	2554,417763			
Total	4	19585,31108				
	Factors	*Standard error*	*t-statistics*	*P-Value*	*Bottom 95%*	*Top 95%*
Y-intersection	-174,348746	400,892202	-0,434901814	0,706062841	-1899,248673	1550,55118
Variable X 1	12,85379443	6,76289636	1,900634543	0,197723892	-16,24460005	41,9521889
Variable X 2	0,459143567	2,441819222	0,188033399	0,868200202	-10,04715657	10,9654437

Figure 4.18 Conclusion of the results of regression analysis using MS Excel

Based on the results of the correlation-regression analysis, we express the algorithm for the dependence of the factors:

$$Yt = 12.85 * X1 + 0.46 * X2 – 174.35, \quad (5)$$

where Yt – total expenses for passenger transportation services, million UAH;

X1 – price for 1 liter of diesel fuel, UAH;

X2 – Consumer Price Index,%.

Both factors are in direct proportion to the amount of carriers' expenses, but factor X1 (the cost of one liter of diesel fuel) has a greater impact, due to the value of its coefficient (12.85). When predicting the cost of a round trip and the amount of compensation for the future, the influence of this factor on the carrier's costs must be considered at first.

The economic meaning of this correlation-regression model can be presented as follows: with an increase in the cost of diesel fuel and an increase in the Consumer Price Index, the total costs of the carrier for the provision of urban passenger transportation services will increase.It is necessary to improve the compensation model in terms of quarterly revision of the amount of compensation payments in relation to these factors, which will make it possible to take this sphere of economic activity out of the zone of losses and contribute to the efficient functioning of the transport model of the city.

It is recommended to use the methods of correlation-regression analysis on an ongoing basis when planning the cost of a round trip and indexing compensation payments to carriers.

4.3 Package "appeal" to the owners of minibuses with incentives to ensure the required amount of investment in rolling stock, production base and modern technology

Transport is one of the most important sectors of the economy, the effective functioning of which is a necessary condition for stabilization, structural transformation of the economy, development of foreign economic activity, meeting the needs of the population and social production in transportation, protection of Ukraine's economic interests.

In the conditions of radical reform of the economy of Ukraine, a balanced state transport policy is needed, which would take into account the peculiarities of the industry and its role in the processes of economic and social transformation.

The transport and road complex is a system of transport communications that unites all modern modes of transport.

In terms of location and structure, they are generally in line with the country's internal and external economic relations, but need to be improved and modernized to improve the quality of transport services, especially in international traffic.

In order to increase the economic efficiency of motor transport enterprises, an incentive mechanism is introduced to release excessive and inefficient production capacity and direct the saved funds to the development of investment and innovation activities of the industry.

State regulation of transport in market conditions should ensure a balance of national and corporate interests and be determined on the basis of the division of responsibilities for certain areas of transport between the state and enterprises.

The sphere of direct responsibility of the state includes:

- creation of a legal basis for transport activities and control over compliance with legislation;

- supervision over the safety of the transport process, environmental protection;
- strategic development of transport infrastructure;
- preservation of a single transport process in the country;
- financing of transport work performed for the special needs of the state and ensuring the availability of transport services for socially vulnerable groups;
- control and economic regulation of the market of transport services to ensure their accessibility, quality, social standards;
- implementation of non-discriminatory for other states measures to protect the interests of the state, national carriers;
- assistance in attracting investments;
- tariff regulation of monopolies.

The main forms of state regulation should be the laws of Ukraine and other regulations, targeted programs for transport development, licensing, certification and control mechanisms. For their effective operation should, as a rule, use tax, credit - financial, customs and other economic levers.

Road transport occupies an important place in the transport system of Ukraine, as it has the following advantages:

- has high maneuverability and mobility, which allows you to quickly concentrate vehicles in the right number and the right city;
- accepts goods directly at the place of their formation and delivers to the destination without overloading;
- the time of delivery of goods over short and medium distances is much shorter than by rail and water transport;
- requires less capital expenditure with low flows of passengers and goods, as in this case the construction of the highway can be significantly simplified and cheaper;
- has less than other modes of transport dependence on permanent roads;

– when transported over short distances is the most economical due to the elimination of multiple congestion with the participation of other modes of transport.

It is clear that road transport in many cases is inferior to other modes of transport through:

– use of more expensive fuel;
– insufficient use of technical capabilities of cars;
– low level of productivity of rolling stock due to low load capacity and short daily duration of cars;
– low mileage utilization of cars (significant empty mileage).

Reliable and efficient operation of urban passenger transport is an important component of economic stability of the city and the country as a whole. Such work of the enterprises of automobile passenger transport essentially influences effective functioning of the city enterprises, the organizations and establishments of all branches of economy. Transport processes, of course, continue to provide market relations of all sectors of the economy, its production and social infrastructure, production and social interregional ties, the turnover of goods and services. However, transport processes with their existing, but already outdated basic criteria of efficiency (performance of tasks on production indicators: planned indicators on the number of transported passengers and performed passenger-kilometers, inventory of rolling stock, level of profitability) occur against a significant reduction in industrial production the state of the country, the imperfections of the legal and regulatory framework, the rupture of already established transport and economic ties and tariff and tax policy, changes in people's minds about the concept of comfort and service, global information. There was no talk about any dynamics of the trucking company, competitiveness, and even more so, about the quality of transportation and comfort - only the implementation of the transportation plan. For the dynamics of a modern trucking company, it is necessary to determine the demand for transportation and

direct the work of the company to increase its competitiveness by improving the quality of passenger service. Quality management of urban passenger public road transport becomes more effective if a number of actual criteria are identified that affect the transportation process and its main indicators, as well as the existing dependences of process indicators on these criteria. This allows you to set the necessary direction in which to work for road transport companies engaged in efficient and high-quality operation of the enterprise, and also allows you to evaluate the results of the enterprise in units of output. Reliability and efficiency of urban transport is characterized by the quality of transport services (service transport flow), in which service providers seek to ensure maximum compliance with the conditions of transport services and the wishes of consumers and potential customers. It is the difference between these two conditions of maximum compliance and is a potential assessment of the quality of transport services. The most important parameters of service quality in relation to passenger transport services [95]:

- sensitivity (rolling stock, staff appearance, service monitoring, etc.);
- reliability - movement of vehicles necessarily according to schedules;
- responsibility - guarantees of accurate and safe performance of services;
- availability - necessary for the consumer services rolling stock services, the ability to fulfill group and individual orders for the service, etc .;
- safety - the probability of trouble-free operation of passenger transport, the absence of risks in the implementation of the transportation process;
- ethics of the relationship between the buyer and the provider of transport services.

In the logistics system of passenger transport for the movement of passengers in time and space, the service transport flow, which is the passenger services provided by passenger road transport enterprises to passengers, is characterized by the following factors [62]:

- non-stop travel;

- comfort of travel;
- filling of rolling stock;
- service of various social groups of the population;
- total time spent on travel (time for walking, time spent in transport);
- regularity of traffic;
- travel safety;
- information support of transport service (information service);
- the value of the transport tariff, etc.

When determining the level of quality of passenger road transport it is necessary to take into account the following factors:

- type of bus transportation: regular, to order;
- type of route: urban, suburban, intercity;
- content of transport service;
- the main requirements of consumers to the transportation process and service conditions in accordance with the current rules of passenger transportation.

Also, the quality of passenger road transport service is significantly influenced by the components of consumer perception of transport services, namely:

- use of comfortable rolling stock during transportation;
- a set of properties associated with the aesthetic feelings and views of consumers;
- available system of stops, information on the work of buses and taxis, etc.;
- rational assessment of the cost of the trip, the use of social and commercial tariffs;
- non-stop travel;
- speed of movement and speed of communication; -
- normal travel conditions (free cabin area, temperature, avoidance of noise and vibration);

- minimum time for pedestrian crossing to the stop and the shortest travel distance;
- timeliness of service provision, which is ensured by extending the working hours of buses and adherence to the schedule through the use of modern control information systems.

Currently, there are no formalized criteria that reflect the level of quality of passenger service on different types of passenger transport. For theoretical justifications of the quality of passenger traffic, there is a comprehensive indicator of the level of passenger service, which is synthetic and takes into account the above parameters of service quality. The level of quality of passenger traffic can also be assessed nominally by the fact of performed transport services, ie the basis for the optimal level of passenger service is the economic calculation of profit or loss of the transport company [60]. Also, the optimal level of passenger transport service can be determined as follows: the costs associated with the organization of passenger service, and the costs associated with non-compliance with the requirements of the service [77].

The investment policy in the market of suburban passenger transportation is determined, first of all, by own resources of the enterprises - carriers and physical persons of the businessmen working in the market of passenger transportations. These resources, in turn, depend on the technical and economic characteristics of the routes, the established level of prices and tariffs. Investments for the renewal of the middle-class bus fleet are expected to be made at the expense of enterprises' own funds and credit resources.

Investments in suburban bus routes at the expense of funds received from the maintenance of routes, even with a high level of compensation, are not possible in principle. The main source that allows to recoup the investment is the investment component, ie part of the profit from working on suburban bus routes in the modes of "express", "minibus".

For the efficient functioning of the passenger transportation system, infrastructure investments are important, first of all in the development, modernization and reconstruction of the production base of carriers. At the same time, investments aimed at upgrading rolling stock must ensure the achievement of a proportional ratio of buses by class and service life, as well as the purchase of the required number of rolling stock for the transportation of people with disabilities.

Given the high cost of new rolling stock used for suburban passenger traffic, as well as the long payback period of investment in the development of production and technical base, it is important for the development of suburban transport is a rational credit policy. As the acquisition of new rolling stock is usually in the form of leasing or credit, companies need to have long-term financial relationships with the relevant financial institutions based on guarantees from the district administration. The conclusion of such agreements will make it possible to reduce interest rates on loans and, accordingly, reduce the repayment period of fixed assets. Preference is given to the carrier, which has its own production base, as it can act as collateral when obtaining a loan.

To address the issue of consistency of costs and revenues, as well as improving the quality of passenger transport on urban trolleybus and public bus routes, the following methods are possible [78]:

1. Application of current tariffs for the service of passenger transportation on city trolleybus and public bus routes, buses on which operate in normal mode.

The method is not acceptable due to the fact that the current tariffs for passenger transportation services on urban trolleybus and public bus routes operating in normal mode, do not reimburse in full the economically justified costs of economic entities that provide these services in the city.

2. Settlement of the issue by reimbursing the city budget for the difference between the current tariffs and economically justified costs for their provision.

3. Adoption of new tariffs on the basis of economically justified indicators. The method is acceptable because it satisfies the interests of economic entities that provide passenger transportation services on public trolleybus and public bus routes in the city and allows the local government in a manner prescribed by law to achieve regulatory objectives.

Given that the possibility of providing passenger transportation services on public routes will take place with the involvement of a wide range of both legal entities - enterprises and natural persons-entrepreneurs, the proposed solution is the most acceptable.

The Commercial Code of Ukraine stipulates that economic activity of economic entities in the field of social production is carried out in order to obtain economic and social results and to make a profit. The cost of one-time tickets based on economically justified indicators for travel in trolleybuses, buses and minibuses will provide businesses with reimbursement of actual costs, as well as financial self-sufficiency, repair and renewal of rolling stock, stabilization of urban passenger transport, improving passenger safety, timeliness wages to employees.

The effectiveness of control over the work of road carriers, safety of passenger and cargo transportation, quality of transportation services depends on the coordinated work of regulatory authorities and the constant review and improvement of the regulatory framework in the field of motor transport.

The process of managing passenger traffic depends on such components as types of traffic, technical condition of vehicles and safety of transportation. Bus transport is the most common due to its maneuverability and high carrying capacity. In general, buses carry more than 60% of all passengers.

The implementation of the main directions of passenger transport development is carried out through the improvement of the mechanisms of the existing regulatory framework and on the basis of decisions of public authorities and local governments and the public aimed at regulating passenger traffic.

First, the bulk of passenger traffic on public routes is carried out in the mode of minibuses by buses of small and medium capacity, which does not allow to meet the full need for these services, especially remote areas of the city.

Secondly, the level of satisfaction of passengers' needs in public transport significantly depends on the number of required flights during "peak times". For a more complete and in-depth analysis of the functioning of passenger traffic in Chernihiv, it is necessary to conduct a more complete collection of necessary information and its analytical processing.

Third, the key issues that determine the economic basis for the functioning of public transport are still not regulated by law. This concerns the introduction of effective mechanisms for reimbursement of compensation for the carriage of passengers of privileged categories and a number of other differences that put carriers in different business conditions, which significantly hinders the creation of an efficient and balanced system of passenger traffic [76].

Ensuring the efficiency of passenger road transport by:

- creation of new organizational forms of cooperation - transport clusters, which will provide a new level of public-private partnership;

- inventory of the network of public bus routes, highways and transport infrastructure;

- study of passenger flows, substantiation of expediency of opening (closing) of bus routes (flights);

- renewal of rolling stock and optimization of its structure in accordance with the service life, purpose, passenger capacity, suitability for transportation of persons with disabilities;

- renewal of rolling stock used on public bus routes, together with the replacement of small-capacity buses with medium and large-capacity vehicles and the gradual decommissioning of buses on these routes, converted from vehicles intended for other functions;

- elaboration of the possibility of compensation to carriers for losses due to the introduction of a separate subvention (subsidy) from the budget when servicing socially important bus routes and on city electric transport;

- strengthening of control over the observance by motor carriers of various forms of ownership of the requirements of the legislation on the organization of passenger road transport;

- intensification of work with the broad involvement of regulatory authorities and law enforcement agencies to de-shadow the activities of passenger carriers;

- ensuring maximum transparency of the process of organizing passenger traffic on routes;

- wide involvement of public organizations and associations in the process of management and organization of passenger transportation by road, in particular, holding tenders for passenger transportation on public bus routes, working out the mechanism of their involvement in the competition committee to determine carriers on these routes;

- setting tariffs for the carriage of passengers and luggage in accordance with real costs;

- formation of a single coordination and logistics center of the cluster, which will carry out operational management of passenger traffic, and will be responsible for the quality of the transport process according to the approved transport network of the city;

- to develop and approve a system of flexible charging in the field of passenger transportation, which takes into account changes in the economy and protects the interests of carriers and passengers;

- introduction of modern management, accounting and control systems in the system of bus passenger transportation;

- to ensure the current collection of information on passenger flows on city routes using an automated ticketing system.

In modern market conditions, motor transport companies have not been able to find their niche in the market of motor transport services in most cases. This is largely due to the fact that enterprises were complex and highly specialized - by type of rolling stock or by type of transport services. Therefore, it is currently important for these companies to determine strategies for their further development.

When considering the methods of forming strategies for the development of motor transport enterprises, the following general shortcomings can be identified [92]:

– the compliance of the production and technical base of the enterprise with the cars to be purchased is not taken into account, as this may require attracting additional funds for the implementation of the development strategy;

– competition in the market of transport services is not taken into account, as in the final case on its basis the real general demand for transportation of the motor transport enterprise will be defined;

– the mathematical model of the choice of the most effective strategy of development at the enterprises of motor transport which is adequate enough to real economic conditions is not developed;

– in earlier studies, the choice of strategy of the motor transport enterprise was determined on the basis of indicators of efficiency of the planned-administrative economy, and therefore do not take into account modern market conditions.

Improving the efficiency of motor transport enterprises is possible on the basis of the formation and implementation of development strategies, which in turn requires the solution of a number of problems.

Note that the development of the formation and definition of the most effective strategies and options for the development of motor transport companies, taking into account the large number of variables and many links and constraints requires optimization, as well as finding the best options.

Developments for the development of motor transport enterprises consist of a number of interdependent stages.

Usually, the process of developing a methodology for choosing a development strategy is based on determining the goals and objectives of strategic development of the enterprise. Then it is necessary to determine the diagnostic parameters, as well as their quantification. The purpose of diagnosing the company is to assess the organizational and economic status of the available resources and opportunities.

In the further research of external and internal environment of the enterprise is carried out, its basic landmarks are defined. At the next step the results of the first and second stages are compared, possible variants of strategies are defined, one of variants is chosen and the strategy of the enterprise is formed.

Enterprise environment analysis is the process of identifying critical elements of the external and internal environment that may affect the company's ability to achieve its goals.

Analysis of the environment performs a number of important functions in the enterprise:

– in terms of strategic planning, improves the accounting of the most important factors affecting the economic organization and its future;

– in terms of enterprise policy, helps him to create the most favorable impression of himself;

– in terms of current activities, provides information that is necessary for the best performance of work functions.

If we talk about the importance of the external environment in the practice of development of Ukrainian economic organizations, then in the period of transition to the market it increases significantly. In a centrally managed economy, any connections in the external environment of the enterprise were carried out with the active participation of the state, which independently, without taking into account the interests of the organization, established its

suppliers and customers. The factor of competition in the economy of the planning period was virtually absent. The influence of contact audiences was very small.

After the analysis of the internal and external environment is made, the company determines the main guidelines of its activities, based on the results of the previous stage. Sometimes the definition of development goals precedes the analysis of the environment. This practice makes sense, the very existence of the organization implies that it has goals and motives.

It is very important to collect the necessary information. The collection of the necessary information is usually carried out by various services of the motor transport enterprise (planning and economic department, accounting, operational service). At the same time, this process is coordinated and controlled by management. Management, in addition, independently collects information, because it has the ability to enter various information channels.

Evaluation of information is the final stage of the analysis of the organizational environment. The results of the evaluation are used as a basis for identifying possible development strategies.

As a result, a certain set of options is formed in the context of each of the above development strategies. Among the strategies for the development of motor transport enterprises, it is necessary to choose those that will bring the maximum effect.

To select development strategies that may be most acceptable for a typical trucking company, we use the method of expert assessments. The expediency of using the method of expert assessments in this case is due to the fact that there are options, the implementation of which is ineffective even under the most favorable conditions. To determine the feasibility of implementing a particular strategy for the development of a typical trucking company, it is necessary to apply the method of expert survey, ie direct assessment.

The list of possible strategies for the development of motor transport enterprises of Ukraine at the present stage is presented below [76]:

1. Strategy aimed at the sale of vehicles, spare parts and materials for them.

2. Strategy related to the development of the transportation system.

3. Strategy aimed at the restoration and manufacture of individual elements of cars.

4. Strategy related to rolling stock re-equipment.

5. Strategy aimed at forwarding and warehousing services.

6. Strategy aimed at the development of production and technical base and related to the provision of services to ensure the efficiency of cars.

7. Strategy for the provision of rolling stock storage services.

To determine the strategies that, according to experts, are possible for implementation at a typical trucking company, a priori rank charts are constructed (Fig. 4.19).

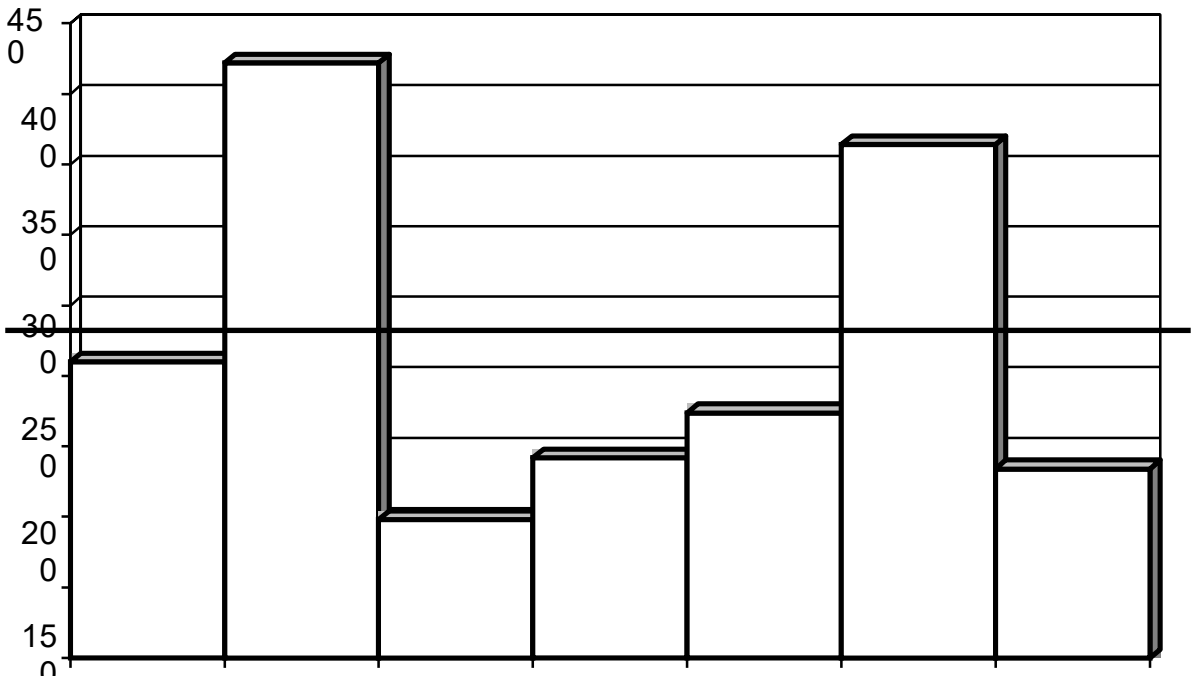

Figure 4.19 – A priori chart of ranks of choice of strategies of development of the typical motor transport enterprise [104]

The diagram shows that experts consider the most appropriate for the implementation of a typical trucking company two development strategies:

– strategy aimed at developing the production and technical base and related to the provision of services to ensure the efficiency of cars;

– strategy related to the development of the transportation system.

The strategy combines options that have common features, ie we can use the same formulas and economic dependencies to determine the profit, and also it is advisable to combine them when developing a methodology or program.

The strategy related to the development of the transportation system includes options that are related to the transportation process: passenger transportation (route urban transportation, passenger urban transportation in normal traffic, taxi transportation, international passenger traffic, intercity and suburban passenger transportation etc); freight transportation (transportation and production of construction mixtures in concrete mixers, transportation of flour by flour trucks, transportation of goods by light trucks, transportation of large consignments requiring special temperature conditions of transportation, transportation of fuel, transportation of dangerous goods, etc.).

The strategy, aimed at the development of the production and technical base and related to the provision of services to ensure the efficiency of cars, provides for the implementation of works on the basis of the motor transport company to restore the efficiency of cars. This means carrying out repair work on individual components and units (specialized service station) and the creation of a universal service station.

Ensuring the most efficient operation of the enterprise is possible provided that among the above strategies and options for the development of motor transport enterprises those that will bring maximum effect. To do this, you need to choose and justify the criterion of effectiveness.

The choice and justification of the criterion of efficiency is one of the most important conditions for determining the most effective strategies for the

development of motor transport enterprises. In most cases, the implementation of development strategies and options requires capital investment. Therefore, it is advisable to consider the implementation of strategies and development options as an investment project. Of great theoretical and practical interest is the method of determining the profitability of investment, which is used in developed countries with market economies and has not undergone significant changes for decades, which indicates, firstly, its deep scientific validity, and secondly, its confirmation in practice.

There are two methods of solving this problem, although they have much in common [95].

The first method involves comparing the amount of investment with the amount of income from their use by comparing the demand price with the supply price. The entrepreneur is interested in investing, ie in the acquisition of capital goods, only if the expected income from its use for a certain period is not less than the amount of investment.

The second method of determining the economic feasibility of investing is to compare the rate of return on investment with the interest rate or other similar criteria.

Along with the listed criteria in some cases it is possible to use a number of others: the ratio "profit - cost", return on investment, break-even point, and so on. But none of these criteria alone is sufficient to adopt a strategy.

Given the fact that all development strategies are aimed at maximizing profits, we take as the main criterion for selecting the maximum net discounted income, but with limited capital investment.

As the analysis of activity of motor transport enterprises has shown, there can be three variants of correspondence of capacity of production and technical base [106]:

– the capacity of the production and technical base meets the needs of the enterprise in the maintenance and repair of its own cars;

– the capacity of the production and technical base is insufficient for the enterprise;

– the capacity of the production and technical base exceeds the need.

If the existing production and technical base meets the needs of the enterprise, it is used for maintenance

and current repairs of own cars. When the capacity of the production and technical base is insufficient for the enterprise, it is possible either to improve the existing production and technical base, or to receive services for maintenance and current repairs outside.

As noted earlier for most modern trucking companies in Ukraine, which were formed after the privatization of existing ones, a typical option is when the capacity of the existing production and technical base exceeds the need for services for maintenance and repair of their own cars. As follows from fig. 4, in this case the following options are possible:

– demand for services from the outside corresponds to the excess capacity of the production and technical base of the trucking company;

– demand exceeds the capacity of the existing production and technical base;

– demand below the available capacity of the production and technical base.

In the second case, it is advisable to limit the provision of services to external customers by the excess capacity of the production and technical base, and in the third case, the volume of services to external customers will be limited by demand.

For variants of the strategy aimed at the development of production and technical base and related to the provision of services to ensure the efficiency of cars, it is advisable to consider not only the establishment of a service station, but also optimize its operation by specializing car repair stations.

Formalization of the problem of determining the rational level of specialization of production posts can be reduced to the following:

– the company has a number of repair posts, which by virtue of their capacity determine their capacity;

– depending on the area of the enterprise, operating conditions, technical condition and age of the rolling stock operated in this area, the incoming flow of requirements for various types of work is formed;

– the main indicators of performance of works by the enterprise are time of performance of works, losses of the enterprise because of refusals in service of cars owing to loading of repair posts, and also expenses as a result of idle time of posts;

– the organization of works requires an adequate management option, in which, taking into account the rational use of preliminary information, the operation of the enterprise will most fully meet the requirements for repairs and receive, in turn, the maximum profit.

So, let's have a system for fulfilling requests for maintenance and repair of cars, the performance of which is variable and time-dependent. It is known that the input flow of requirements is a function of time and is random. It is necessary to organize the process of system management so that at any time upon receipt of preliminary information about the nature of the input flow and production capacity of the repair area, it functioned with maximum efficiency in accordance with the accepted criterion of optimality.

When implementing a strategy related to the development of the transportation system, one of the first issues that needs to be addressed is to determine the appropriate number of vehicles that the company should purchase.

When considering the introduction of an option that involves the introduction of urban passenger transport, it is advisable to study how the number of buses at the company affects the economic performance of its work.

Therefore, when implementing a development strategy related to the development of the transportation system, it is necessary to determine in advance the demand for transportation, and only then determine the appropriate number of vehicles. Considering passenger traffic, it is advisable to study the demand in terms of a specific route, as the competition is usually exposed to the route as a whole.

To select a number of development options that may be most acceptable for trucking companies, we use the method of expert assessments. The expediency of using the method of expert assessments in this case is due to the fact that each region due to its geographical, natural or market opportunities may require completely different development options. It is fair to assume that there are options, the implementation of which is ineffective even under the most favorable conditions. To determine the degree of expediency of the implementation of development options in motor transport enterprises, the method of expert survey - direct assessment was used.

The list of options for which an expert survey can be conducted is given in table 4.10. To determine the options that, according to experts, are feasible and will bring the most profit.

Thus, the analysis of the activities of road transport companies showed that the most appropriate and possible for implementation are two development strategies: a strategy aimed at developing the production and technical base and related to the provision of services to ensure the efficiency of cars; strategy related to the development of the transportation system. Each strategy consists of a large number of development options, which are combined on a common basis, which allows you to simplify the calculation of projected profits from the implementation of a particular option and determine performance indicators.

It is proposed to build an algorithm for modeling variants of the strategy aimed at the development of production and technical base and related to the provision of services to ensure the efficiency of cars.

Table 4.10 – List of options for which an expert survey can be conducted

Development strategy	Development options
The strategy is aimed at developing the production and technical base and is related to the provision of support services efficiency of cars	1. Creation of a station for maintenance and repair of cars 2. Creation of a station to determine the technical condition of vehicles 3. Diagnosis, repair and maintenance of various units and components of the car 4. Tire installation and repair of car tires 5. Painting cars 6. Car wash
The strategy is related to the development of the transportation system	7. Urban passenger traffic 8. Taxi transportation 9. Transportation and manufacture of construction mixtures in concrete mixers 10. Transportation of flour flour by carts 11. Transportation of goods by light trucks 12. Transportation of goods that require special temperature conditions of transportation 13. International passenger traffic 14. Long-distance and suburban passenger traffic 15. Transportation of fuel 16. Transportation of dangerous goods

The algorithm provides an analysis of the structure of rolling stock in the region, determining the need for maintenance and repair services, determining the input flow of requirements for certain types of rolling stock repair work.

At the next stage, the analysis of the existing active and passive parts of the production and technical base, its capabilities, the need for its modernization and compliance of the existing production and technical base with the needs.

Also, an algorithm for modeling strategies related to the development of the transportation system is proposed, which involves studying the volume of traffic, capacity or passenger capacity and number of vehicles, determining costs and revenues from transportation, taking into account the need for production and technical base and the need for modernization. .

The progress made in the last few years in all aspects of computer technology has led to a significant expansion of the field of application of computers. An essential part of modern society is a variety of systems for collecting, processing and storing information, which are an integral part of modern scientific and technological progress. There are many good reasons to transfer existing information to a computer basis, because faster data processing and centralized storage provide easy access to the necessary information, saving significant money and time.

Currently, the collection of funds for travel is carried out in the following ways:

1) passengers purchase travel tickets at points of sale of travel tickets and, entering the transport, present them to the conductor;

2) passengers entitled to preferential travel receive documents confirming this right from the social security authorities, and present them to the conductor upon entering the vehicle. The costs of transportation of this category of citizens to the transport company must be reimbursed by the budget.

Thus, revenues from transportation consist of funds received from passengers in transport and points of sale of travel tickets, as well as funds transferred from the budget. This fundraising system has a number of disadvantages:

1) for the sale of travel tickets, it is necessary to maintain a network of points of sale;

2) it is necessary to print travel tickets for each month, and it is impossible to predict in advance the exact number of tickets that will be purchased in the next month;

3) travel tickets do not allow the transport company to clearly track the number of passenger trips;

4) a passenger traveling on a ticket does not have confirmation of the fact of travel on this vehicle at present;

5) the transport company must maintain a staff of conductors who will check the availability of travel and documents for the right of preferential travel, as well as issue tickets;

6) with a large vehicle, the conductor is unable to check and sell tickets to all passengers;

7) given that the conductors in this system work with cash, it is impossible to exclude the possibility of fraud on their part;

8) reimbursement of expenses for transportation of privileged categories of passengers is carried out according to theoretically calculated norms, and not for the number of actually transported passengers, which can lead both to losses of the transport enterprise and to overspending of budget funds.

The urgency of the problem in Ukraine at present has no exact mechanism for counting the number and structure of transported passengers and the authorities do not have the ability to adequately compensate companies for the associated costs. In addition, there is growing dissatisfaction among citizens due to the need for local authorities to resort to undesirable for the population increase in the cost of travel in public transport (ie, financing beneficiaries at the expense of other citizens). All this is due to untimely and incomplete compensation of the monetary equivalent for the services actually provided to transport companies. The introduction of automated fare payment systems provides an opportunity to fundamentally change the situation.

Now the tasks of rapid collection and processing of information, increasing the efficiency of management decisions and their compliance with the tasks are acute. Relevant systems form the foundation of information activities in all areas. The ultimate goal of their implementation is to improve the organization of production and management, which allows the company to achieve high results.

One of the most promising areas in terms of automation of data collection and processing is currently transport companies, for which information about

passenger traffic is vital for the successful operation of the company in today's market of automated data collection systems in public transport (which includes automated fare system) is a very promising area, which has found use in the subway and is currently being tested for the use of contactless data reading system and on land public transport.

The proposed system of automation of passenger traffic control and fare payment is designed to enable the transport company, as well as owners of minibuses to perform transportation as efficiently as possible.

Given the urgent need for city authorities and urban transport companies to create a citywide automated fare payment system, the first step is to decide on the choice of basic technology for the development of the latest socially oriented payment technology, which can be further improved.

As a basic technology to ensure the phased implementation of the system, it is proposed to use the technology and infrastructure of the National System of Mass Electronic Payments - NSMEP, with the possibility in the next stages of the system, the use of other payment technologies, such as Visa, MasterCard and more.

The automated fare payment system includes: contactless cards, turnstiles, validators, driver and controller terminals, devices for replenishing contactless cards, mobile transport servers.

A contactless card is a plastic card with a built-in microprocessor and antenna. The principle of the card is based on the exchange of information between the card and the reader on the radio channel. The card is a complex electronic device. The service life of a contactless card is several (up to ten) years and is limited almost exclusively by the mechanical strength of the card. The main areas of application of contactless cards are fare payment systems in public transport, access control, etc. [69].

Each contactless card has its own unique serial number. This number is set during card production and cannot be changed during the entire period of card

use. The card memory consists of 16 independent sectors. This memory structure allows you to use the card in various, unrelated applications. Other characteristics of the card [56]:

– data storage period in memory - not less than 10 years;

– number of recording cycles - not less than 100 thousand;

– working distance from the leader antenna to the card - up to 100 mm (depending on the type and size of the antenna).

– the ability to work with multiple cards;

– The time of a typical transaction for transport use is about 0.1 s., The user can simply hold the card near the leader's antenna, and this time will be enough for the transaction.

The electronic card as a means of payment for transport services can be used not only in the subway, buses, trams and trolleybuses, but also in taxis and minibuses. At the same time, the most acceptable technology for paying for taxis and minibuses is payments using non-prepaid specialized transport cards, namely cards with a bank payment application and a social application.

Turnstile - a device for admission to the cabin of rolling stock of passengers who have a valid contactless electronic card and registered it with a validator;

Validator - a device for reading or registering contactless electronic cards.

Mobile terminal of the driver, conductor - a device for printing one-time tickets, checking the status and replenishment of contactless electronic cards. Located with the driver and conductor;

The controller's mobile terminal is a device for checking contactless electronic cards and printing and accounting for penalty receipts. Is at the controller;

Card recorder - for self-service of ASOP users and paid access systems, namely: account replenishment, sale of the number of visits or trips and so on.

Mobile transport servers designed to manage the equipment network in the cabin, transmit reports to the central server and organize the management interface.

Passengers who have a contactless electronic card are boarded through the front doors and rear doors equipped with turnstiles. Passengers who do not have a contactless electronic card board only through the front door, paying in cash to the driver or conductor. After paying the fare, the driver or conductor unlocks the turnstile for the passenger to enter the cabin and issues a one-time ticket. It is possible to top up the account at the points of sale of contactless electronic cards, as well as to check the status and top up the card at the conductor.

Long-term travel tickets (contactless electronic card) for privileged categories of passengers (according to the list of privileged categories), which are personalized and cannot be transferred to another person, but the personalization has not been completed yet. They are valid on all types of land public transport provided they are registered in rolling stock.

Discount long-term travel tickets (student, student, professional, etc.) give the right to travel only if the passenger has a student (student) ticket or a certificate and is valid for the period specified on the card.

Long-term travel ticket (contactless electronic card), which gives the right to preferential travel in urban land transport, does not give the right to free luggage.

The main features of the system [68]:

1. precise control of passenger traffic, with the possibility of analysis by the number and categories of transported passengers, by routes and time of transportation;

2. issuance to the passenger of a ticket (control coupon) confirming the fact of travel in this vehicle at present;

3. change of route of the vehicle during change without return to park;

4. control of the number of transported passengers enjoying benefits (possibly with different types of benefits);

5. control of fare payment without the participation of conductors;

6. data transfer to a PC via a wireless interface;

7. travel registration is carried out by the passenger independently, without participation of the driver or the conductor.

Based on the information supplied by the system, the transport company will be able to plan the transportation process, reimburse the costs of transportation of privileged categories of citizens, improve the quality of service and reduce costs.

The system allows:

– take into account different fares in different modes of transport: tram, trolleybus, bus, minibus, suburban route (by writing off a certain fare);

– take into account different fares on different routes;

– take into account the possibility / impossibility of using one or another benefit for different types of transportation in different groups of transport enterprises;

– when paying for travel, the system allows you to provide various discounts.

Advantages and disadvantages of using purely accounting (registration) electronic cards.

Advantages:

– ease of making cards

– low cost of registration cards;

– simple process of issuing cards to beneficiaries (without contracts);

– a large number of places where such cards can be obtained by beneficiaries;

– simpler infrastructure than for payment cards;

– the possibility of organizing a simple social process;

– the appearance of the card and its number are determined by social authorities;

– a simple system of agreements and settlements between the participants in the process.

Disadvantages:

– limited use of the registration card;

– impossibility to provide monetized or combined benefits in the future, if there is a legal basis for this;

– the need to develop a significant amount of regulatory, technical, technological and administrative documentation required for the operation of a computerized accounting system;

– the need to create an appropriate infrastructure;

– the need to attract a significant amount of budget funds to create a system.

Advantages and disadvantages of using electronic accounting cards with the placement of various applications (cartoon cards).

Advantages:

– simpler than for payment process of making and issuing cards;

– simple process of issuing cards to beneficiaries;

– a large number of places where such cards can be obtained by beneficiaries;

– the appearance of the card and its number are determined by social authorities taking into account the requirements of payment systems;

– the possibility for the beneficiary to choose the applications that will be placed (or activated) on the cards;

– the possibility of gradual expansion of the scope of cards;

– a simple system of contracts and settlements.

Disadvantages:

– the need to develop a significant amount of regulatory, technical, technological and administrative documentation required for the operation of a computerized accounting system;

– the need to create infrastructure for the use of the social component of the card;

– the need to attract at the initial stage a significant amount of budget funds to create a system.

For passengers, the advantages of contactless cards are:

– ease of use of the travel ticket (the card can not be removed from the wallet or bag), reducing the cost of time to pay for travel

– no need to have small money (coins, tokens) to pay for travel;

– the possibility of using one ticket (one card) in different modes of transport;

– possibility of automatic (by means of automatic replenishment of a resource) and manual (in cash desks) of ways of replenishment of a resource on cards;

– the ability to personalize the card to ensure a refund in case of loss or theft of the card (the card is placed in the "stop list" and blocked);

– the possibility of obtaining a loan (within the collateral value) in case of need to make a trip with a rate higher than the balance of the resource on the card at the beginning of the trip.

For transport companies, the use of contactless cards allows to increase the service for passengers and get the following opportunities:

– significant reduction in equipment maintenance costs, as all devices that work with contactless cards require virtually no maintenance;

– reduction of costs for the issue and circulation of travel tickets due to the longer service life of the cards;

– the possibility of conducting a flexible tariff policy, as the introduction of new types of travel tickets or tariff tables is performed only by software. This

allows to increase the revenues of the transport company at a given level of tariffs by optimizing the structure and policy of fare;

– increase of incomes at the expense of the exact account of trips by passengers who have the right to preferential or free travel;

– increase revenue by eliminating counterfeit travel tickets based on contactless cards.

For the city authorities, the introduction of the system will reduce the shadow turnover of money in urban passenger transport, increase budget revenues through fuller taxation of transport companies, solve the problem of calculating the amount of budget compensation for the passage of privileged categories of passengers.

Therefore, the economic effect for owners of minibuses from the implementation of the system will consist of the following components:

– reduction of operating costs for fundraising for services provided (including for privileged categories of citizens);

– accurate accounting of services provided to beneficiaries;

– exclusion of travel or receipt of services on false documents;

– optimization of tariff structure, introduction of new types of services;

– introduction of a flexible charging system

– reduction of thefts and fraud due to the mass transition to non-cash payments;

– raising the level of payment culture for services;

– receiving additional income from multi-purpose use of contactless cards;

– increase the efficiency of payment control.

Introducing an advanced system in urban passenger transport can indeed yield several benefits for city authorities. Primarily, it addresses the issue of shadow turnover of money within the transportation sector. By implementing transparent and traceable electronic payment systems, authorities can significantly reduce or eliminate the underreported or untaxed revenue prevalent

in cash-based transactions. This not only enhances accountability but also ensures that all generated income is properly recorded and subject to taxation.

Moreover, the adoption of modernized systems allows for better oversight and regulation of transport companies' revenues. By integrating electronic payment methods, authorities can gain clearer insights into the financial transactions within the transport sector. This enhanced transparency enables more accurate taxation of transport companies, thereby increasing budget revenues for the city.

Another advantage lies in solving the challenge of accurately calculating budget compensation for privileged categories of passengers, such as seniors, students, or individuals with disabilities. Advanced systems can precisely track the usage of public transportation by these groups, facilitating a more efficient and fair distribution of budget compensation based on actual ridership data rather than estimations or unreliable reporting.

In essence, the introduction of sophisticated electronic payment and tracking systems not only curtails shadow economies within urban passenger transport but also bolsters budget revenues by ensuring comprehensive taxation. Additionally, it allows for more accurate calculations of budget compensation for privileged passenger categories, optimizing the allocation of resources within the transportation sector.

4.4 Determining the costs of implementing an improved urban passenger transport management system

Implementation and monitoring of the implementation of the Strategy is carried out within the powers of the Cabinet of Ministers of Ukraine, the Ministry of Infrastructure, other executive bodies, with the participation of public organizations and associations of entrepreneurs, international organizations. If

there is a need to make changes to the Strategy will be in accordance with applicable law.

In order to implement the Strategy, a Program (Strategic Action Plan) will be developed to implement the Strategy, which will include: identification of key tasks and activities; responsible body / executor; terms and connection between key tasks; main stages; implementation schedule; assessment of resources and costs; monitoring, evaluation and review mechanisms. A monitoring committee will also be set up, which will include representatives of interested state bodies, public organizations, business representatives, the media, etc. As part of the monitoring, the preparation and publication of an annual report on the status of implementation of the Program (Strategic Action Plan) for the implementation of the Strategy is envisaged.

Ensuring the effective implementation of the Program (Strategic Action Plan) will be implemented using appropriate tools to monitor key performance indicators and strengthen the institutional capacity of the Ministry of Infrastructure and other central authorities, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Infrastructure.

Implementation of this program is designed for 2 stages (Table 4.11)

Table 4.11 – Resource support of the Program

The amount of funds proposed to attract for the implementation of the program, thousand UAH	1 STAGE	2 STAGE		Total costs of the program (thousand UAH)
	2015-2019	2019	2020	
Total resources, including:	1774,3	21465,0	15405,0	38644,3
City budget	1674,3	0,0	1720,0	3394,3
Utility funds	100,0	75,0	75,0	250,0
Other funds	-	21390,0	13610,0	35000,0

The implementation of the program will contribute to:

– withdrawal of cash circulation in vehicles by at least 50%;

– 100% accounting of privileged categories of passengers, which will ensure the provision of reliable data for further reimbursement for actually provided transport services;

– providing complete, reliable and detailed information on the performed transport work to solve the problems of analysis and planning of passenger traffic.

Risks: lack of funding.

The program is financed within the funds provided in the budget for the year, as well as from other sources not prohibited by the legislation of Ukraine. The main administrator of budget funds for the implementation of this Program is the Department of Transport, Communications and Communications.

The responsible executors ensure the implementation of the measures defined by this program at the local level. Control over the implementation of the decision to put on the standing commission of the city council on economics, industry, transport and communications, control over the use of communal property, external relations, business, consumer protection and tourism.

Preliminary calculations of the project cost. The calculations take into account the cost of similar projects in EU countries. Equipment in vehicles per 1,000 units of public transport - € 4 million. Equipment of points of sale, sales and control terminals - € 3 million. Card issuance - € 0.425 million. Customer service centers, processing center, contact center, technical support system, software - € 1.61 million. Operating costs, testing, project management - € 0.465 million. Total costs - € 9.5 million. When conducting an international competition, the estimated cost of the project is expected to decrease by 10-15%. The cost of the e-ticket project in Budapest is € 90 million. The cost of the e-ticket project in Astana (population 814 thousand, 66 bus routes) is € 11 million. Vinnytsia - the preliminary cost of the project is € 8 million

Fare:

a) Contactless electronic payment card (type MIFARE +) - the main means of payment. Will allow the use of all basic tariffs.

b) Bank contactless payment card.

c) A mobile phone with NFC technology, or any other device that supports this technology.

d) Paper ticket purchased outside the vehicle.

e) Payment by SMS.

e) Support for further expansion of payment methods.

Types of tickets and season tickets:

– one-time paper ticket (60 minutes of travel to the GT with the possibility of free transfers);

– one-time electronic ticket (with the possibility of making free transfers within 40 minutes);

– short-term season tickets - for 1, 2, 3, 5 days without restrictions on the number of trips;

– long-term season tickets - for 1, 6, 12 months with a limited number of trips or without restrictions on the number of trips;

– various kinds of preferential personalized subscriptions (for free use of GT, for preferential use of GT - pupils, students).

Tariff policy at the second stage of ASAPT operation should ensure a gradual transition of passengers to use long-term electronic cards (Table 4.12).

Positive changes in the field of transport, in accordance with the proposed program:

– Improving the transparency and accuracy of accounting for actually provided passenger transportation services, including the privileged category.

– Elimination of the possibility of using fake means of payment.

– Improving road safety, reducing congestion on the road network.

– Increase of receipts in the city budget due to de-shadowing of payment of workers in the transport enterprises.

– Opportunity of the organizer of transportations to really influence qualitative structure of public transport at the expense of the higher payment for use on routes of new, modern transport.

Table 4.12 – Tariff policy at the second stage of operation of ASAPT

Type of tariff	Tariffing method	Amount, UAH
Single trip for 1 hour. public transport on a single ticket (basic fare)		5
Single trip for 1 hour. by public transport by electronic card (subject to a single purchase of a certain number of trips (10.20)	Minus 10-15 %	4,25-4,50
Short-term (tourist) card 1 day 2 days 3 days 5 days	6 trips per day minus% for more days	 30 40 50 75
Long-term card 1 month 3 months 6 months 1 year	2 trips per day minus% for a longer period	 200 500 800 1500

The proposed program brings forth several positive changes in the transport sector:

1. Enhanced Transparency and Accuracy in Accounting: The program's implementation improves the transparency and accuracy of accounting for passenger transportation services, especially for privileged categories. By integrating electronic payment systems and better tracking mechanisms, authorities gain precise insights into the actual usage of public transport,

allowing for more targeted and fair allocation of resources and subsidies for these groups.

2. Preventing Payment Fraud: The program aims to eliminate the possibility of using fake means of payment. This reduces fraudulent activities within the transport system, ensuring that revenues reflect genuine transactions. Such measures not only bolster financial integrity but also increase confidence among passengers and stakeholders in the system's reliability.

3. Improving Road Safety and Reducing Congestion: Efforts to enhance road safety and reduce congestion are integral parts of the program. By encouraging the use of public transport through more efficient systems and possibly incentivizing its use through fare structures or route optimizations, the program can contribute to reducing traffic congestion and subsequently enhance road safety in the city.

4. Increasing City Budget Revenues: De-shadowing payment methods within transport enterprises can lead to increased receipts in the city budget. By eliminating underreported revenues and ensuring comprehensive taxation, the city can capture previously unaccounted income, thereby increasing its budgetary resources for further urban development and improvement initiatives.

5. Encouraging Modernization of Transport Infrastructure: The program offers the organizer of transportation an opportunity to influence the quality of public transport services by allowing higher payments for the use of routes by new, modern transport. This incentivizes the adoption of modern transportation modes, potentially leading to a more efficient and advanced public transportation system that meets the evolving needs of the city's population.

Overall, these proposed changes aim to revolutionize the urban transport sector by promoting accountability, safety, efficiency, and innovation while bolstering budgetary resources for further urban development [125-135].

4.5 Expected economic effect from the improvement of the proposed system

The introduction of an integrated citywide automated fare payment system should be cost-effective for all stakeholders: citizens, transport companies, banks, city authorities, etc.

For citizens, the introduction of the system will increase the convenience of fare payment in public transport, receive social benefits and provide an opportunity to choose the most cost-effective type of fare for citizens who are not entitled to social benefits.

For banks, the implementation of the system will provide an opportunity to expand the use of non-cash payments and card systems, in particular NSMEP or other payment systems.

For transport companies and enterprises that provide services to privileged categories of citizens, the implementation of the system will improve economic performance, automate financial and statistical accounting, the formation of analytical information for operational management, provide a high culture of service and favorable working conditions.

The economic effect of the implementation of the system will consist of the following components:

– reduction of operating costs for fundraising for services provided (including for privileged categories of citizens);

– accurate accounting of services provided to privileged categories of passengers;

– exclusion of travel or receipt of services on false documents;

– optimization of tariff structure, introduction of new types of services;

– introduction of a flexible system of tariffing of provided services;

– reduction of thefts and fraud due to the mass transition to non-cash payments;

– raising the general level of payment culture for services;

– receiving additional income from multi-purpose use of contactless cards;

– increase the efficiency of control over payment for services.

The exact calculation of economic efficiency should be performed at the stage of development of the feasibility study of the system.

For the city authorities, the introduction of the system will reduce the shadow turnover of money in urban passenger transport, increase budget revenues through fuller taxation of transport companies, solve the problem of calculating the amount of budget compensation for the passage of privileged categories of passengers.

Let's analyze the activity of the investment project according to the main efficiency indicators (Table 4.13).

Table 4.13 – The main indicators of efficiency of the investment project [136-146]

Indicator	Calculation formula	Necessity
Net discounted income (NPV)	$NPV=\sum_{t=0}^{t=T}\frac{CF_t}{(1+r)^t}-\sum_{t=0}^{t=T}\frac{(C_0)_t}{(1+r)^t}$	Allows you to get the absolute value of the effect of the project
Internal rate of return (IRR)	$\sum_{t=0}^{t=T}\frac{CF_t}{(1+IRR)^t}+\sum_{t=0}^{t=T}\frac{(C_0)t}{(1+IRR)^t}=0$	Shows the upper limit of the allowable level of the discount rate, exceeding which makes the project unprofitable
Modified internal rate of return (IRR)	$\sum\frac{(C_0)_t}{(1+r)^t}=\frac{\sum_{t=0}^{T}CF_t(1+r)^{T-t}}{(1+MIRR)^T}$	The modified Internal Rate of Return (MIRR) provides an internal rate of return that equates the current estimate of investment costs with the future value of the project's cash flow and is calculated at a fixed interest rate.

Profitability Index (PI)	$PI = \frac{\sum_{t=0}^{T} \frac{CF_t}{(1+r)^t} - \sum_{t=0}^{T} \frac{(C_0)_t}{(1+r)^t}}{\sum_{t=0}^{T} \frac{(C_0)_t}{(1+r)^t}}$	Allows you to get the relative magnitude of the effect of the project
Average rate of return (ARR,%)	$ARR = \frac{\sum_{t=0}^{T} CF_t}{T \times C_0}$	Shows the ratio between average annual income and initial investment
Payback period (PB)	$C_0 = \sum_{t=1}^{PB} CF_t$	Allows you to determine how long it takes to recoup the initial investment
Discounted payback period (VPB)	$C_0 = \sum_{t=1}^{BPB} \frac{CF_t}{(1+r)^t}$	Allows you to determine how much time is needed to recoup the initial investment based on time

NPV stands for Net Present Value. It's a financial metric used to evaluate an investment's profitability or the potential value of a project by comparing the present value of expected future cash flows to the initial investment cost.

The concept behind NPV is based on the time value of money, which states that the value of money changes over time due to factors like inflation and the potential to earn a return by investing money elsewhere.

The formula for calculating NPV is:

$$NPV = \sum \frac{CF_t}{(1+r)^t} - Initial\ Investment$$

where CFt – Cash flow at time t

r – Discount rate (the rate used to discount future cash flows)

t – Time period

∑ = Summation notation over the time periods

If the NPV is positive, it indicates that the projected earnings or cash flows from the investment exceed the initial cost, implying that the investment is potentially profitable and may add value.

When calculating the NPV and other indicators of project effectiveness in its implementation by a particular enterprise should take into account the following. Depending on the company, the project can be implemented in two ways.

1. Implementation of the project by an existing enterprise producing various types of products. The initial (at the time of calculations) balance sheet reflects the structure and value of own and borrowed funds of the enterprise, expressed in WACC (weighted average cost of capital). Then: NPV of the project = NPV of the enterprise with the project - NPV of the enterprise without the project (4) Calculations of flows for definition of NPV can be carried out:

a) without taking into account the sources of additional funding that will be required for the project:

– the FCF is calculated taking into account the return of previously received loans and interest thereon;

– the WACC indicator of the enterprise is used as a discount rate (because the project implementation should not lead to an increase in the cost of the company's capital).

The calculated NPV essentially reflects the assessment of the market value of the enterprise's business (with and without the project), carried out using an approach based on forecasting costs and profits generated by the object of assessment in the future.

b) taking into account the additional sources of funding required for the project:

– the components of the FCF stream are added to the additional own and borrowed funds received by the enterprise during the forecast period, and the return of borrowed funds and fees for their use is deducted. This flow will characterize the cash flow that remains at the disposal of shareholders;

– the discount rate must not be lower than the achieved level of ROE of the enterprise. The calculated NPV reflects the market value of the company's share capital.

2. Implementation of the project under the scheme of project financing with the creation of a special project company Special Purpose Vehicle (SPV) [147], the founders of which may be different interested in the project organization and enterprise:

a) calculations at the stage of creating a project company. Excluding sources of funding:

– the initial balance is zero;

– cash flow

– FCF;

– the discount rate is the same as when calculating the effectiveness of the project as a whole.

The calculated NPV reflects the cost of the project (business related to its implementation). Taking into account the sources of funding:

– the initial balance is zero;

– cash flow

– FCFE;

– the discount rate is not lower than the achieved level of ROE of enterprises in the same industry.

The calculated NPV reflects the value of the project company's share capital.

b) the T-year project is implemented by the project company (at the time of calculations, the project company's balance sheet reflects its assets and liabilities and takes into account the characteristics of all sources of funding used for T years).

Accordingly, an algorithm for comprehensive assessment of the effectiveness of the investment project for the development of social

infrastructure of electric transport, taking into account its impact on socio-economic development of the regions of Ukraine, and calculated an aggregate assessment of the effectiveness of the investment project for social infrastructure in general [148-153].

The algorithm allows to determine variable utility functions for cost estimation of social effect from realization of investment project on electric transport:

1. Assessment of the possible impact of the implementation of the investment project for the development of social infrastructure of electric transport on the state of the social complex of the region. It should be borne in mind that the implementation of some large-scale investment projects will run into a shortage of qualified personnel.

2. Substantiation of the list of indicators that will participate in the calculation of the social component of the integrated assessment of the effectiveness of the investment project for the development of social infrastructure of electric transport.

3. Determination on the basis of statistical data on the type of function of change of socially significant indicators of regional development, which were determined at the previous stage of the algorithm and will participate in calculating the socio-economic efficiency of the investment project of social transport infrastructure.

4. Identification of trends in socio-economic development of the region in comparison with the average values of indicators in the regions of Ukraine as a whole or in comparison with the target indicators of state target programs.

5. Definition of the utility function as the sum of increments of the functions of change of all indicators included in the calculation, calculation of the social efficiency of the investment project for the development of the social infrastructure of the organization of electric transport.

Aggregate assessment of the effectiveness of the investment project taking into account the weight of the social component.

Improving the proposed Smart Accounting System in Urban Passenger Transport can yield several expected economic effects:

Increased Revenue Generation: The implementation of a more efficient and transparent accounting system can lead to increased revenue collection due to better tracking of fares, reduced revenue leakage from fare evasion or fraud, and optimized pricing strategies.

Cost Savings: By streamlining operations, reducing manual processes, and improving efficiency in accounting, the system can result in cost savings for transportation authorities or companies. Automation of processes might lead to reduced labor costs and administrative expenses.

Enhanced Investment Attraction: A well-functioning smart accounting system can make urban passenger transport more appealing to potential investors. Greater transparency, efficient financial management, and demonstrated revenue potential could attract private sector investments or partnerships.

Improved Resource Allocation: Accurate data collection and analysis through the smart accounting system allow for better-informed decision-making. This can lead to more precise resource allocation, optimizing the use of funds and infrastructure based on actual demand and usage patterns.

Boosted Economic Activity: A well-operated urban transport system contributes to economic growth by facilitating smoother movement of people, goods, and services. Enhanced efficiency in transportation can positively impact businesses, employment, and productivity in urban areas.

Reduction in Traffic Congestion and Environmental Impact: A more efficient transport system could lead to reduced traffic congestion, lowering associated costs such as time lost in traffic jams and fuel wastage. Additionally, an optimized public transport system might encourage a shift from private

vehicles to public transit, contributing to lower carbon emissions and improved air quality [154; 155].

Stimulated Innovation and Technological Advancements: The adoption of a smart accounting system can encourage innovation in transportation technology. This could lead to the development of new solutions, further improving the efficiency and sustainability of urban passenger transport systems.

Improved Urban Livability: An efficient and reliable transportation system positively impacts the quality of life in urban areas, attracting residents and businesses, thereby contributing to the economic growth and attractiveness of the city.

In summary, the improvement of the proposed smart accounting system in urban passenger transport is expected to have a broad range of positive economic effects, impacting revenue generation, cost savings, investment attractiveness, resource allocation, environmental sustainability, and overall urban development.

MAIN RECOMMENDATIONS

Research has shown that the perception of the introduction of a smart accounting system (e-ticket) directly depends on the overall improvement in the field of UPT. Thus, our proposals will relate both to the direction of implementation of the smart accounting system and to general issues in the field of UPT, which have an indirect impact on the implementation of the smart accounting system.

To reduce the risk of public rejection:

- one of the negative factors is its load during rush hour. In order to unload public transport, we propose to use different fares, for example, from 8-9: 30 and 18-19: 30 there is an increased fare (there is no discounted fare for retirees);
- together with the cards to offer the population shielding protective plates, on which advertising images can be applied for their full payback;
- Introduce greater use of the smart accounting system by connecting additional services that can be paid for with money on the balance sheet. First of all, it should be introduced in school canteens: firstly, parents will be able to control what their child buys, and secondly, it will avoid cases of bullying related to extortion;
- use the smart accounting system as a targeted assistance tool, for example, under the programs "Affordable Medicines", "Monthly state support for the purchase of bakery products" and other city and national programs;
- connection with the application "Action" will provide even more opportunities due to the number of users of the application, its growing popularity, ease of use.

To reduce the risk of rejection by taxi owners. The study found that this is the "most difficult" category of smart accounting stakeholders: any implementation of an integrated continuous accounting system with a high share

of non-cash payments removes the conditions for the existence of current colossal corruption in the system and, consequently, meets enormous sabotage. This confirms the experience of introducing an electronic ticket in Khmelnytsky, where terminals are broken, they forget to bring them to the line and so on. The only tool to overcome this resistance is to show that the system will now work just like that - with strict accounting of both passengers, flights and cash flows. The second tool is the financial support of minibus owners on special terms to upgrade the fleet of vehicles, because this type of transport is the oldest in its total mass and technically unsuitable.

When using the subvention for compensation for concessional travel of certain categories of citizens, an effective mechanism will offer the Executive Committee of the Odessa City Council to strengthen the capacity of the Department of Transport of the Odessa City Council, the Department of Social Protection and Labor of the Odessa City Council and the Finance Department of the Odessa City Council. provision of services by carriers to privileged categories of passengers by making the necessary changes to their own regulations.

To management of a transport complex of the city of the Odessa city council to offer:

- to introduce an automated control system of the city transport complex with the use of modern technologies and ensuring proper remote control over the operation of each unit of urban passenger transport;
- to ensure the timely holding of tenders for the maintenance of urban routes, as well as the current control over the compliance of carriers with the conditions of the tender in the process of working on urban routes;
- to include in the composition of the tender commission to determine the enterprises-carriers of representatives of the bodies of self-organization of the population and public organizations working in the field of consumer protection.

- to ensure early informing of members of territorial communities of the city of Odessa about competitions on definition of the enterprises-carriers and free access to meeting of the competitive commission of representatives of bodies of self-organization of the population and the public organizations working in the field of consumer protection;
- to introduce special, stationary marking of vehicles used for transportation of privileged categories of passengers;
- to ensure proper control with the involvement of members of the public (public organizations and bodies of self-organization of the population) over the enterprises-carriers in terms of their compliance with the conditions under which they were recognized as winners of tenders for urban routes. In case of detection of such violations, to terminate the relevant contracts for the maintenance of city routes ahead of time, as well as to initiate the deprivation of violators of licenses for the provision of services for domestic transportation of passengers by buses.

To propose to the Department of Transport Complex of the City of Odessa City Council together with the Department of Social Protection of the Population and Labor of the Odessa City Council and the Department of Finance of the Odessa City Council:

- to ensure the payment of compensation for the transported beneficiaries to all carriers in proportion to the volume of services provided by them;
- to ensure constant control (including with the involvement of members of the public) over the enterprises-carriers, which carry out transportation of privileged categories of citizens, in order to avoid cases of falsification of the indicators of actually transported number of passengers.

To propose to the Department of Transport Complex of the City of Odessa City Council together with the Department of Information of the Odessa City Council and the editorial office of the newspaper of the Odessa City Council "Odessa Herald":

- to ensure proper informing of members of the territorial community of the city of Odessa through the official website of the city, as well as through the newspaper "Odessa Herald" about the schedule of public transport, which provides transportation of privileged categories of citizens;
- to carry out explanatory work among the population of the city about the mandatory need to obtain tickets from conductors and drivers of passenger transport when paying for travel in order to ensure the receipt of additional funds to the budget.

To offer to Management of a transport complex of the city of the Odessa city council and the Municipal enterprise "Odesmiskelektrotrans":

- to ensure the production and placement at all bus stops signs with information about the exact time of departure from each stop of each unit of public transport, which transports privileged categories of citizens, and the current telephone number of the dispatch service of the Department of Transport Complex of Odessa City Council.
- increase the number of controllers in order to ensure proper control over the receipt of funds in the budget for travel received from passengers by conductors and drivers of urban passenger transport.

The priority task of local authorities should be to remove financial responsibility for social measures of the state from business entities by monetizing transport benefits directly from the budget. Limited financial resources of local budgets do not allow to transport all "beneficiaries" who are granted this right, so the number of beneficiaries should be reduced to a minimum of the poorest and most vulnerable. Significant unevenness of the number of preferential transportation in the regions of Ukraine shows that the declared reform of the social protection system, which provides for the monetization of benefits, can not be carried out solely from local budgets.

CONCLUSIONS

There are significant problems in the organization of the transport system of the city of Odesa, as well as in most cities of Ukraine. Their solution is carried out gradually. At the same time, it is worth taking into account the international experience in solving passenger transport problems. The solution of the issues revealed in the research is possible with the introduction of a single dispatching service of the common form of management.

Considering the tariff systems and compensation policy in public transport of foreign countries, we can see a bright contrast with the Ukrainian system, which has long become obsolete and does not meet the needs of citizens.

It is advisable to allow the possibility of increasing the fare in Odesa to 10-12 UAH. for a single ticket. This would be a kind of extra fee in the system, which would encourage not one-time, but frequent trips. However, a network of tariff plans should be developed that would allow locals and tourists to save, actively use public transport and have much lower actual travel costs. Such decisions will satisfy both the carrier and passengers.

Requirements for the professional level of specialists must be uniform for employees of enterprises of all forms of ownership and meet the requirements of state regulations.

The level of training of managers, specialists and drivers of transport companies should become one of the factors that are taken into account when conducting competitions for the right to work on city bus routes.

The conducted research and the obtained results made it possible to formulate conclusions of theoretical and practical nature, reflecting the solution of the tasks of the work, in accordance with the defined goal.

1. It is established that the transport of a "smart" city is based on technological innovations in the transport system, which provide for the

integration of operational management of all modes of transport and the ability to respond to events in real time. The practice of world transport operators shows that in the presence of an automated fare payment system, it is possible to increase revenue collection by one and a half to two times only due to a properly compiled timetable.

The main risks in the implementation of an automated accounting system are the risks of cybersystems, information risks, financial risks.

Thus, the theoretical and methodological approaches to the disclosure of the essence and basic provisions for: 1) the concept of "smart" city, 2) risk management of smart metering in urban public passenger transport and 3) the introduction of a single integrated intelligent transport system.

2. An analytical study of the transport industry of Ukraine and an analysis of the segment of public urban passenger transport. It should be noted that compared to the European transport system, Ukraine looks the opposite. In particular, in contrast to the European one, where road transport dominates, the domestic transport system is characterized by an expanded share of railways in the overall structure of freight turnover and a smaller role of other modes of transport. It should be noted that the structure of transportation in Ukraine is optimal in terms of European approaches, but the formation and innovative development of the transport industry depends on the introduction of new technologies in industry and, in fact, is an industrial process where Ukraine lags far behind developed countries. . Transport in the world is becoming a high-tech, science-intensive and multifunctional process. Today, modern global logistics includes elements of production, distribution and service activities. The key problem of road transport is the extremely low energy efficiency of vehicles, which is due to the high degree of physical wear and obsolescence of vehicles, insufficient rate of renewal of the fleet, which leads to inconsistency of technical and technological level with modern requirements for energy efficiency and environmental friendliness. 30% increase in fuel consumption and financial

resources for their maintenance, low level of comfort, quality and safety of transport services.

Thus, the tools for assessing and managing the realization of the potential of the route system of the modern city have been improved, which, unlike the existing ones, takes into account (1) the increase of urban territory and the requirements of constant increase of speed and comfort and (3) a unified methodological approach to the introduction of the electronic ticket.

3. The study showed that the most effective direction for the development of urban transport systems is the development and implementation of urban programs Smart City. In addition, it is proposed to improve the risk management of the introduction of a smart metering system in public urban passenger transport. As a result of the study, a methodological toolkit for identifying and classifying types of risks from the Smart City case was developed, according to which it is proposed to identify 5 types of risks of implementing a smart metering system in public passenger transport.

Thus, the prospect of implementing the electronic service "Electronic Ticket" is considered. We offer a single ticket for all types of public transport based on a contactless electronic plastic card. The purpose of this innovation is to simplify and make more transparent payment for travel in buses, minibuses, trolleybuses, trams and subways.

The result of the study is a substantiation of the modern conceptual scheme (model) of risk management of the smart accounting system in public urban passenger transport, based on detection, assessment and monitoring, as well as measures to reduce the risk of risks, which includes selected stages, with appropriate actions that are appropriate for each of these stages

The search for vectors for the realization of the potential for intellectualization of the urban passenger transport management system on the basis of targeted management is the direction of further scientific and practical research in the direction of this study.

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ANNEXES

LIST OF ABBREVIATIONS

ASAPT - Automated system of accounting for payment of transportation;

API – Application Programming Interface;

AV – Autonomous Vehicles;

BRT – Bus Rapid Transit;

BVG – Berlin Transport Company (Berliner Verkehrsbetriebe);

CRM – Customer Relationship Management;

DB – Deutsche Bahn;

EBRD – European Bank for Reconstruction and Development;

EMV – Europay, Mastercard, and Visa (chip card technology);

ETM – Electronic Ticketing Machine;

EV – Electric Vehicle;

FCF – Free Cash Flow;

FCFE – Free Cash Flow to Equity;

GPS – Global Positioning System;

ICT – Information and Communication Technologies;

IoT – Internet of Things;

ISIC – International Student Identity Card;

ITS – Intelligent Transportation Systems;

KPI – Key Performance Indicator;

LTE – Long-Term Evolution (a type of mobile communication technology);

MaaS – Mobility as a Service;

MFI – Ministry of Infrastructure of Ukraine;

ML – Machine Learning;

MT – Marketing Tools;

MTA – the Los Angeles County Metropolitan Transportation Authority;

NFC – Near Field Communication;

NPV – Net Present Value;

OCTA – the Orange County Transportation Authority;

PPP – Public-Private Partnership;

POO – Private Ownership and Operation;

POS – Point of Sale;

PTP – Public Transport Priority;

RER – (fr. Réseau Express Régional; Paris city transport);

RFID – Radio-Frequency Identification;

QR – Quick Response;

SANDAG – the San Diego Association of Governments;

S-Bahn – suburban trains;

SCAG – Southern California Association of Governments;

STI – Smart Technology Integration;

TfL – Transport for London;

TMS – Transportation Management System;

TSP – Transportation Service Provider;

U-Bahn – high-speed trams;

UPT – Urban Passenger Transport;

V2X – Vehicle-to-Everything;

V2V – Vehicle-to-Vehicle Communication;

V2I – Vehicle-to-Infrastructure Communication;

VPN – Virtual Private Network;

WACC – WEIGHTED AVERAGE COST of CAPITAL;

WLAN – Wireless Local Area Network.

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на № _____ від _____

007503

Директору Інституту бізнесу, економіки та інформаційних технологій д.е.н., проф. Філипповій С.В.

Шановна Світлана Валеріївно!

З метою забезпечення ефективного функціонування міського пасажирського транспорту, запровадження єдиної ефективної безготівкової системи оплати проїзду шляхом створення автоматизованої системи обліку оплати проїзду в міському пасажирському транспорті загального користування Одеською міською радою прийнято Рішення N 1780-VII від 15.03.2017 р. «Про впровадження автоматизованої системи обліку оплати проїзду в міському пасажирському транспорті загального користування м. Одеси».

Враховуючи попередні напрацювання молодих вчених Одеського національного політехнічного університету, Одеська міська рада підтримує проект «Управління ризиками впровадження системи смарт-обліку в міському пасажирському транспорті на основі інтеграції смарт-інновацій, інформаційних технологій та маркетингового інструментарію» (керівник к.е.н. Башинська І.О.) та виражає зацікавленість у результатах проекту.

З повагою
Заступник міського голови П.В. Вугельман

Вик. Тетюхін С.М.
705-46-08

ОНПУ
ВХІД. № 1700/01-05
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Вих. № 17/08-22/01 від «22» серпня 2017 року

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Враховуючи важливість і значущість роботи, підтримуємо проект молодих вчених Одеського національного політехнічного університету «Управління ризиками впровадження системи смарт-обліку в міському пасажирському транспорті на основі інтеграції смарт-інновацій, інформаційних технологій та маркетингового інструментарію» та сподіваємося на практичне впровадження результатів проекту.

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Одеса - 2017

ПУБЛІЧНЕ АКЦІОНЕРНЕ ТОВАРИСТВО «ЕКСІМНАФТОПРОДУКТ»
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ДОВІДКА № 20/17 від 29.11.2017

Довідка надана студентці Левинській Людмилі Олександрівні, групи ЗОФ-111, в тому, що дипломна робота на тему «Особливості управління економічними ризиками в системі фінансово-економічної безпеки підприємства транспорту (на прикладі ПАТ «ЕКСІМНАФТОПРОДУКТ»)» розроблена на замовлення підприємства ПАТ «ЕКСІМНАФТОПРОДУКТ».

Заходи щодо удосконалення методичного інструментарію управління економічними ризиками в системі фінансово-економічної безпеки підприємства, що запропоновані у дипломній роботі, розглянуті керівництвом та плануються до впровадження в діяльність, а саме: методика виявлення ризику, його оцінки та мінімізації негативного впливу.

Заст. Голови Правління
з економічних питань
ПАТ «ЕКСІМНАФТОПРОДУКТ» С.В. Батозський

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Вих. № 18-117 від 04.12.2018

ДОВІДКА

про використання результатів науково-дослідної розробки
«Управління ризиками впровадження системи смарт-обліку в міському пасажирському транспорті на основі інтеграції смарт-інновацій, інформаційних технологій та маркетингового інструментарію»
(керівник – к.е.н., доц. Башинська І.О.,
відповідальний виконавець – к.е.н. Філіппов В.Ю.)

Довідка видана в тому, що такі науково-практичні результати, отримані під час виконання науково-дослідної розробки «Управління ризиками впровадження системи смарт-обліку в міському пасажирському транспорті на основі інтеграції смарт-інновацій, інформаційних технологій та маркетингового інструментарію» були впроваджені в діяльність Благодійного Фонду «Карітас Одеса УГКЦ», який у партнерстві з Представництвом Міжнародної організації з міграції в Україні реалізує проект «Зміцнення самозабезпечення внутрішньо переміщених осіб та громад, що постраждали від конфлікту в Україні», зокрема:

– аналіз транспортної галузі у рамках соціально-економічного дослідження «Аналітичний огляд соціальноекономічної ситуації в одеському регіоні: стан, тенденції та перспективи» (Виконавець В.Ю. Філіппов).

Результати аналізу будуть сприяти визначенню перспектив розвитку бізнес-діяльності учасників програм самозайнятості та мікропідприємництва, враховуючи специфіку південного регіону, а також більш ефективному керуванню можливостей та проблем міграції в українському контексті та максимізації цих можливостей й зведення до мінімуму проблем, викликаних міграційними переміщеннями.

(підпис, МП)

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Вих. № 138 від 23 листопада 2018

ДОВІДКА

про використання результатів науково-дослідної розробки «Управління ризиками впровадження системи смарт-обліку в міському пасажирському транспорті на основі інтеграції смарт-інновацій, інформаційних технологій та маркетингового інструментарію» (керівник – к.е.н., доц. Башинська І.О., відповідальний виконавець – к.е.н. Філіппов В.Ю.)

Довідка видана в тому, що такі науково-практичні результати, які отримані під час виконання науково-дослідної розробки «Управління ризиками впровадження системи смарт-обліку в міському пасажирському транспорті на основі інтеграції смарт-інновацій, інформаційних технологій та маркетингового інструментарію» були впроваджені в діяльність Міжнародного Благодійного Фонду «Карітас України», а саме деякі положення:

- проекту оглядово-аналітичного документу світових досягнень у сфері смарт-інновацій, інформаційних технологій та маркетингового інструментарію;
- проекту оглядово-аналітичного документу міжнародного досвіду управління ризиками, положення яких були враховані під час розробки аналітичного звіту «Про регіональний розподіл трендів у сфері зайнятості в одеському регіоні на 2017-2018 роки (м. Одеса, м. Ізмаїл, м. Білгород-дністровський)» (Виконавець В.Ю. Філіппов), а його результати впроваджені в діяльність роботи проекту «Тривалий економічний підйом для миру».

Ці положення дозволять значно підвищити ефективність у питаннях бізнес-інкубації і акселерації та складанні критеріїв фінансових грантів для підприємців.

(підпис, МП)

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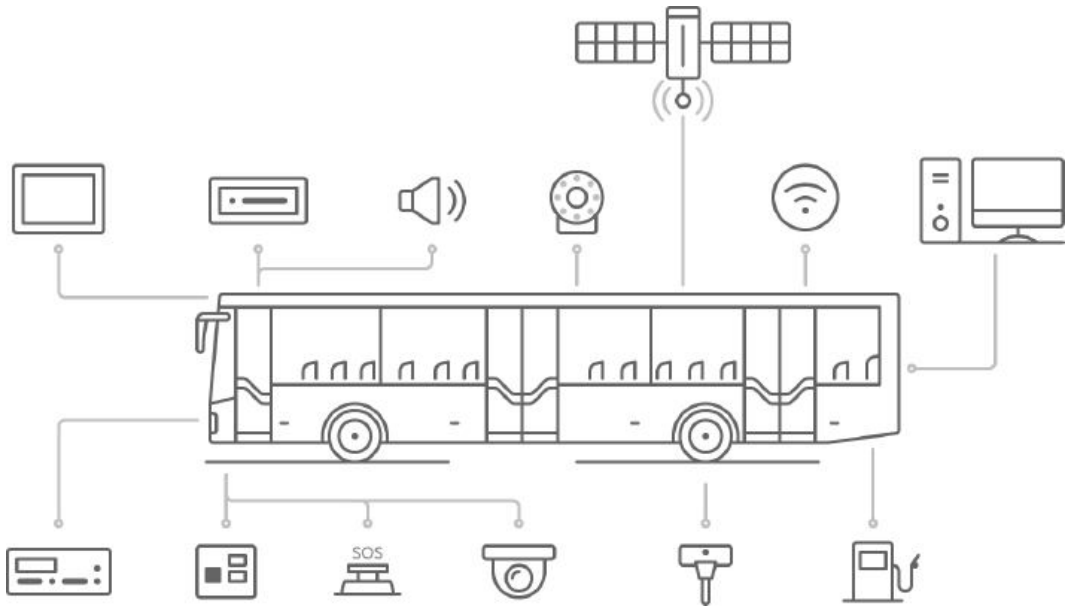

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