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PROBLEMATICS OF MODELLING SYSTEMS FOR TECHNICAL SERVICE OF MEANS OF TRANSPORT

Paweł Gołda

Air Force Institute of Technology
Ksiecia Boleslawa Street 6, 01-494 Warszawa, Poland
tel.:+48 261 851 167
e-mail: pawel.golda@itwl.pl

Dariusz Pyza

Warsaw University of Technology, Faculty of Transport
Koszykowa Street 75, 00-662 Warszawa, Poland
tel.: +48 22 234 5854, fax: +48 22 234 1597
e-mail: dpz@wt.pw.edu.pl

Abstract

Exploitation of means of transport is an important decision issue for transport companies that perform transport tasks. The means of transport during their operation lose their functional properties, which mean that they require technical service and repairs. The components of operating costs of means of transport are expenditures incurred for servicing and expenditures incurred for repairs. As the first cost component increases, the other will decrease and vice versa. We obtain the optimal economic effect of the means of transport when the sum of costs reaches the minimum value. The article presents the problems of optimization of the technical service system. This required identification of technical services and basic parameters characterizing the operation system. On this basis, a mathematical approach to the problem of modelling the maintenance system is presented, including the decision variables, constraints and the criterion function. The identification of the problem of modelling the technical service system is presented in the case study for modelling the technical service of means of transport – buses in the company providing passenger transport services in public transport.

Keywords: *technical service, technical service system, modelling*

1. Introduction

The growing importance of the transport sector, which is the result of globalization processes in the economy, production specialization or the development of cooperation between trading partners, has resulted in an increase in the number of transport enterprises. Such a situation leads to the existence of competition between these enterprises and causes that currently in the struggle for the customer more and more often plays an important role not so much the service offer as the level and quality of transport services [3-5, 18, 20].

A specific group of transport companies are public transport companies. The basic purposes of their activities include [18, 23]:

- conducting collective transport in specific urban areas,
- exploitation of transport means of bus transport, while maintaining efficient and regular public transport and maintenance of technical efficiency of operated buses,
- activities related to the purchase, replacement and repair of rolling stock for the implementation of the statutory subject of the activity,
- initiating and implementing investment projects in the field of construction, extension and renovation of facilities, urban public transport devices.

One of the most important directions for ensuring the competitiveness of public transport is to increase the comfort of traveling for regular users and increase its attractiveness. Increasing the comfort of traveling can be done through efficient and regular communication, as well as by modernizing the existing rolling stock and renewing it, by purchasing means of transport with modern technical parameters [6, 11, 13, 16, 23-25].

Meeting the growing demands of customers is also associated with an efficient decision-making process implemented by the company's management. One of the factors determining the efficient management of a transport company is the possession of an appropriate number of means of transport used, adequate to the scope of tasks performed. The composition of the group of exploited means of transport of the company results from the nature of transport tasks performed by this Company and the rolling stock replacement policy. This group may consist of means of transport one or more types which differ in technical parameters. In turn, the number of transport tasks performed and the efficient technical service to which the funds are subjected determines the number of means of transport at the disposal of the company.

Maintaining a certain number of means of transport in a transport company determines the amount of costs related to their operation. These costs are in turn component costs of the company's overall logistics costs. Lowering the costs of maintaining a group of used transport means leads to a reduction of the overall logistics costs of the Company. It consequently affects the competitiveness of a given Company on the transport services market.

A significant impact on reducing the costs of exploitation of means of transport of the company is a reduction of their total number while maintaining the possibility of realizing given transport tasks [1, 2, 21, 23]. This is possible through the rational use of the company's technical back up or its modernization. The fulfilment of this condition is in turn dependent on the efficiency of the Technical Service System (TSS) owned by the company, whose task is to provide technical service used means of transport with minimum own costs.

2. Problems of technical maintenance of means of transport in terms of their exploitation

Exploitation of means of transport is an important decision problem for transport companies providing transport services. The concept of exploitation in literature is variously defined. According to the authors Hebda M., Mazur T., Pelc H. [12], exploitation is a process that takes place from the moment the vehicle is manufactured until its liquidation (scrapping). The authors present a different approach to defining exploitation: Powierża L. [17] and Michalski R., Niziński S. [14]. According to Powierża [17], exploitation is a sequence of random events expressing the state of the object and their changes, i.e. a controlled random process of depleting the object's usable resource. Michalski R. and Niziński S. [14], define the exploitation as a total of all events, phenomena, and processes taking place in a given facility from the end of the manufacturing process until the liquidation.

In PN-82/N-04001 Operation of technical facilities. General terminology. Exploitation is defined as a set of targeted organizational, technical, and economic activities of people with a technical object and mutual relations occurring between them from the moment the object is accepted for use as intended until the liquidation. In this approach, the definition of exploitation captures the meaning of this concept in the organizational aspect. Still another approach to the concept of exploitation is presented by Niziński St., Żółtowski B. [15], who defines the concept of exploitation as the totality of all events, phenomena, and processes occurring in a given means of transport from the end of its production process until the liquidation.

Simplifying, we can say that mean of transport is operated if and only if it is used or is in service.

Technical state of mean of transport as a result of its operation changes continuously, which means that going from one state to another always passes through many intermediate states. In practice, in the operation of means of transport it is sufficient to use a finite number of states [19, 22].

The analysis of the exploitation process of means of transport over a longer period shows that the process of exploitation consists of particular types of time sections that are usually repeated in a specified order and characteristic for a given means of transport. Therefore, we can assume that the exploitation of a single mean of transport is a mapping of one of the possible implementations of its exploitation (Fig. 1).

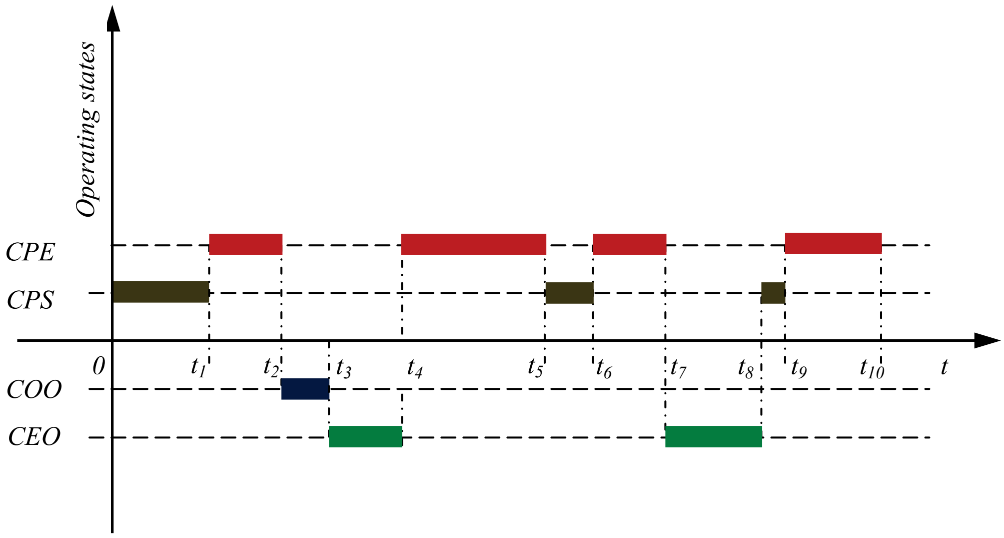

*Fig. 1. Operation of the statistical means of transport: CPE – time of effective work of mean of transport, CPS – stop time of an efficient means of transport, COO – waiting time for service, CEO – time of effective service (maintenance, repair, overhaul, etc.) of mean of transport [*source: own work]

Analysing a sufficiently large set of separate implementations of the process of exploitation of means of transport, one can notice many statistical regularities, on the basis of which we can determine a typical image of the exploitation of a statistical means of transport.

The lifetime of mean of transport is the sum of the periods in which the means of transport is used or is in service. Thus, individual types of periods are usually repeated in a specified order and characteristic for a given mean of transport, showing a specific rhythm of exploitation. Formally, the lifetime of mean of transport can be written as:

$$TEST = TPE + \sum_{ot=1}^{OT} LO(ot) \cdot \vartheta(ot), \quad (1)$$

where:

TPE – time of effective work of mean of transport during its operation,
$LO(ot)$ – number of *ot*-th technical services,
$\vartheta(ot)$ – the average duration of maintenance of the *ot*-type.

Every means of transport, as a result of use, undergoes physical aging, which leads to a partial or total loss of its functional properties.

In order to reduce the intensity of the aging process, as well as to recreate the functional properties of the means of transport, activities referred to as technical maintenance are performed. Prevention is cheaper than removing the effects of failures; therefore, technical services are preventive in nature. The more often they are performed, the less often there is a need for corrective actions, and thus reduce the labour-intensity of the latter. Technical service is not an end in itself, and their cooperation with repairs should ensure maximum technical readiness of the means of transport for its use at the lowest possible cost.

The components of the operating costs of means of transport are expenditures incurred for service and expenditures incurred for repairs. As the first cost component increases, the other will decrease and vice versa. We obtain the optimal economic effect of the means of transport when the sum of costs reaches the minimum value.

Determination of the optimal value of costs is associated with the determination of the rational manner and scope of technical services of a preventive nature. Manufacturers for their types and brands of transport define such a range of technical services.

Under the term technical maintenance, we will understand all kinds of technological activities necessary to maintain the mechanisms of the means of transport in the state of being ready for use in the entire period of its operation.

The term "technical service" includes maintenance, diagnostics, preventive measures related to checking and adjusting individual elements and connections, and repairing means of transport in full, as well as washing and cleaning the means of transport. In terms of frequency and time of execution, we divide technical services into daily, periodic, seasonal, in the period of break-in and warranty service. Therefore, the handling of means of transport requires the adoption of an appropriate strategy, among which stands out strategies for corrective handling and prophylactic support [7-10].

Optimization of the operation process of means of transport requires the adoption of an appropriate assessment criterion, which should not only take into account the interests of technical service or only the interests of use. This criterion, referred to as the objective function, should reconcile both partners of the exploitation process from one general point of view, which is the interest of the company, which in general can almost always be identified with economic benefits. It is clear that the greater the benefits, the better the means of transport are operated. Having such a criterion, we can define the model process of exploitation of means of transport as the one that ensures maximum financial results under specific operating conditions and the possibilities of modernizing the technical service system. In this sense, the model process can be called the optimal process, and the system that guarantees such a course of the process the optimal system.

The transport company, ensuring the performance of transport tasks, has the appropriate number of means of transport operated N_{EX}, of which at the time t only part $N_{GT}(t)$ it is efficient and can carry out transport tasks. For comparative purposes in the analysis of the operating system, it is more convenient to use a relative value, which we call the technical readiness ratio $\xi(t)$ at time t, which we will write in the form:

$$\xi(t) = N_{GT}(t)/N_{EX}. \quad (2)$$

In practice, you can also use the average value of the technical readiness ratio, which has the form:

$$\bar{\xi} = \bar{N}_{GT}/N_{EX}, \quad (3)$$

whereby, $\bar{N}_{GT}$ is the average number of usable means of transport.

Due to the fact that during operation, some of means of transport are in service, to ensure the performance of transport tasks, each transport company, in addition to means of transport constantly performing specific tasks, must have some additional number of them N_{DOD}, which is equal to the number of means of transport staying on average use. Between the values N_{EX}, $\bar{N}_{GT}$ and N_{DOD} there is the following relationship:

$$N_{EX} = \bar{N}_{GT} + N_{DOD}. \quad (4)$$

The duration $\vartheta(ot)$ of $ot -$ type technical maintenance is the sum of the waiting times of the means of transport $\delta(ot)$ for the service of $ot -$ type and time $\eta(ot)$ of this service, which we will write in the form:

$$\vartheta(ot) = \delta(ot) + \eta(ot). \quad (5)$$

If means of transport undergoes various random damage, the total expected time of their removal over the entire period of operation is added to the sum of the expected times of planned services. The waiting time of the means of transport for servicing depends on the ratio of the nominal intensity of the $\mu(ot)$ demand for the ot – type service to the efficiency of the service system $\psi(ot)$ and the degree of regularity of transferring means of transport to service. Assuming that the means of transport are transferred to the service system on a regular basis and the efficiency of the service system is known, the intensity of the demand for ot – type service is determined by dependence:

$$\mu(ot) = LO(ot)/TEST \cdot N_{EX} \cdot \lambda, \tag{6}$$

whereby, $LO(ot)$ is the number of technical services of ot – type, whereas λ – is the intensity of use of the means of transport.

The intensity of requests for technical services expresses the number of means of transport that require this service per unit of time. The inverse of this quantity is the time interval between two consecutive service requests.

Meeting the regularity of technical service requests is in practice difficult to implement, and in systems where services are planned, it is simply impossible.

The theory of mass service deals with the issues of the influence of randomness of time intervals between successive requests for service and the randomness of the duration of service on the increase in the value of waiting time for service. It is obvious that if medium-intensity service requests are random, there are times when the service system, while waiting for means of transport, does not perform any service. In this situation, the actual use of the service system efficiency is less than the theoretical performance that the system can achieve when requests are regular. The impact of randomness in the operational processes of means of transport can be taken into account by lowering the efficiency of the service system to actually used maintenance efficiency, which can be estimated on the basis of statistical data.

3. Mathematical approach to the problem of modelling the technical service system

Modelling the technical service system of means of transport requires its parameterization and formal description.

This requires defining decision variables, constraints and the criterion function, which is a measure of the quality of the solution.

For the purposes of a formal description of the modelling of the maintenance system, we assume that the transport company has certain means of transport, which form a set of numbers of types of means of transport, with the form $\boldsymbol{M} = \{m: m = \overline{1, M}\}$. Used means of transport are subject to technical services, which form a set $\boldsymbol{OT} = \{ot: ot = \overline{1, OT}\}$ of types of technical services. Each ot type technical service consists of a number of basic activities, creating a specific service technology. An activity program implemented as part of a particular type of service creates a set $\boldsymbol{\Gamma}(ot)$ of maintenance activities that define the scope of service. Mutual relations and dependencies between these activities can be illustrated by a graph of interdependencies, commonly used in network methods of project implementation planning.

Due to uneven wear of various technical elements of means of transport, the ranges of successive services are different, so the sets $\boldsymbol{\Gamma}(ot)$ of maintenance activities are also different. The elements of the means of transport meet the multiple conditions, i.e.

$$P(ot + 1)/P(ot) = \xi, \xi = 1, 2, ..., \tag{7}$$

where $P(ot)$ is the inter-service course, between the sets $\boldsymbol{\Gamma}(ot)$ dependencies occur:

$$\boldsymbol{\Gamma}(ot - 1) \subset \boldsymbol{\Gamma}(ot), \tag{8}$$

$$\boldsymbol{\Gamma}(ot)/\boldsymbol{\Gamma}(ot - 1) = \boldsymbol{\Lambda}(ot) \neq \emptyset, \tag{9}$$

for $ot = \overline{1, OT - 1}$, where $\boldsymbol{\Lambda}(0) = \boldsymbol{\Gamma}(0) = \emptyset$; $\boldsymbol{\Gamma}(1) = \boldsymbol{\Lambda}(1)$.

Service operations $\boldsymbol{\Lambda}(ot)$ from program $\boldsymbol{\Gamma}(ot)$ are not performed in any of the lower type of service. The sets $\boldsymbol{\Gamma}(ot)$ can be saved in the form:

$$\boldsymbol{\Gamma}(ot) = \{\boldsymbol{\Lambda}(ot): ot = \overline{1, ot}\}, for\ ot = \overline{1, OT - 1}. \tag{10}$$

OT service is defined by the program $\boldsymbol{\Gamma}(OT)$, which in this case takes the form:

$$\boldsymbol{\Gamma}(OT) = \{\boldsymbol{\Lambda}(OT): OT = \overline{1, OT}\}\ or\ \boldsymbol{\Gamma}(OT) = \boldsymbol{\Lambda}(OT). \tag{11}$$

The components $\boldsymbol{\Lambda}(ot)$ have an interpretation of the list of activities together with the element of the means of transport concerned by the given activity. Thus, the components $\boldsymbol{\Lambda}(ot)$ are vectors consisting of pairs: service activity – element of mean of transport. The manufacturers of means of transport in the operating instructions give the name of the activity and component of the means of transport concerned by the given activity.

Every technical service can be implemented according to a specific technology, creating a set of numbers of technologies $\boldsymbol{RT} = \{rt: rt = \overline{1, RT}\}$, while the technology is characterized by three parameters.

We assume that on the Cartesian product $\boldsymbol{OT} \times \boldsymbol{M} \times \boldsymbol{RT}$ mappings ϖ, ρ, ϱ are plotted carrying elements of this product into a set of positive real numbers, i.e.:

$$\varpi: \boldsymbol{OT} \times \boldsymbol{M} \times \boldsymbol{RT} \longrightarrow \Re^+,$$

$$\rho: \boldsymbol{OT} \times \boldsymbol{M} \times \boldsymbol{RT} \longrightarrow \Re^+,$$

$$\kappa: \boldsymbol{OT} \times \boldsymbol{M} \times \boldsymbol{RT} \longrightarrow \Re^+,$$

where:

- $\varpi(ot, m, rt) \in \Re^+$ is a number of the interpretation of the time of execution of $ot -$ type of technical service made on the $m -$ th type of mean of transport using the $rt -$ type of technology,
- $\rho(ot, m, rt) \in \Re^+$ is a number of the interpretation of the performance of a technological line that performs $ot -$ type of technical service made on the $m -$ th type of mean of transport using the $rt -$ type of technology,
- $\kappa(ot, m, rt) \in \Re^+$ is a number of the interpretation of the cost of maintaining a technological line that performs $ot -$ type of technical service made on the $m -$ th type of mean of transport using the $rt -$ type of technology.

Because any technology from the $\boldsymbol{RT}$, technology set can be used to provide technical service, each technology will be characterized by an ordered three in the form $\langle\varpi(ot, m, rt), \rho(ot, m, rt), \kappa(ot, m, rt)\rangle$. The characteristics of all types of servicing carried out on the means of transport can be presented in the form of three matrices with the dimensions $OT \times M \times RT$, i.e.: $\varpi = [\varpi(ot, m, rt)]_{OT\times M\times RT}$, $\rho = [\rho(ot, m, rt)]_{OT\times M\times RT}$, $\kappa = [\kappa(ot, m, rt)]_{OT\times M\times RT}$.

Parameters of the model

Parameter marking	*Interpretation of the parameter*
$CST(m)$	Price of the $m -$ th type of mean of transport, $m \in \boldsymbol{M}$
$\upsilon(m)$	The interest rate on funds spent on the purchase of $m -$ th type means of transport, $m \in \boldsymbol{M}$
$TPE(m)$	time of effective operation of the $m -$ th type of mean of transport during its operation, $m \in \boldsymbol{M}$
$N_{EX}(m)$	number of used $m -$ th type means of transport, $m \in \boldsymbol{M}$
$\eta(ot, m, rt)$	time of performing technical service of $ot -$ type on the means of transport of $m -$ type using $rt -$ type technology, $ot \in \boldsymbol{OT}$, $m \in \boldsymbol{M}$, $rt \in \boldsymbol{RT}$
$LO(l, m)$	the number of $l -$ th technical services provided on $m -$ th means of transport, $l \in \boldsymbol{RT}$, $m \in \boldsymbol{M}$
(...)	(...)

In order to define decision variables, we assume that on the Cartesian product $\boldsymbol{OT} \times \boldsymbol{M} \times \boldsymbol{RT}$ an x mapping is set, which carries elements of this product into the $\{0,1\}$ set, i.e.:

$$x: \boldsymbol{OT} \times \boldsymbol{M} \times \boldsymbol{RT} \longrightarrow \{0,1\},$$

where the size $x(ot, m, rt) = 1$, when the ot −type maintenance is carried out on the $m-$ type of the means of transport using the rt technology, otherwise $x(ot, m, rt) = 0$.

The mapping x can be represented as a matrix:

$$X = [x(ot, m, rt)]_{OT\times M\times RT}$$

with zero one variables.

For such saved model parameters, one should determine such values of the decision variable $x(ot, m, rt)$ that meet the following limitations:

- stationarity of the operation process of means of transport,
- constant intensity of economic effects brought by the used means of transport,
- constant intensity of technical maintenance needs,
- the intensity of $ot-$ type technical maintenance requirements is less than or equal to the performance of the maintenance system,
- balancing the demand for technical service and service capabilities of system components,,
- estimating the change coefficient for technological lines,
- estimation of the time of completion of all technical services, including their types and types of means of transport,
- the time of technical services carried out on means of transport does not exceed the time of effective operation of the maintenance system,
- performing technical maintenance using one technology from the set of technologies available for a given service,
- ...,
- binary decision variables,

which determine the minimum operating costs of the maintenance system, recorded as:

$$\mathcal{FK} = \sum_{m=1}^{M} F1(m) + F2(m) + F3(m) \rightarrow min, \tag{12}$$

where:

$$F1(m) = N_{EX}(m)\left(\frac{CST(m)\cdot v(m)}{TPE(m)+\sum_{ot=1}^{OT(m)}\sum_{rt=1}^{RT(ot)}\big(\eta(ot,m,rt)\cdot x(ot,m,rt)\big)\cdot\sum_{l=ot}^{OT(m)} LO(l,m)}\cdot \sum_{ot=1}^{OT(m)}\sum_{rt=1}^{RT(ot)}\big(\eta(ot,m,rt)\cdot x(ot,m,rt)\big)\cdot\sum_{l=ot}^{OT(m)} LO(l,m)\cdot\frac{\sum_{ot=1}^{OT(m)}\sum_{rt=1}^{RT(ot)}\kappa(ot,m,rt)\cdot x(ot,m,rt)}{\sum_{ot=1}^{OT(m)}\sum_{rt=1}^{RT(ot)}\rho(ot,m,rt)\cdot x(ot,m,rt)}\right), \tag{13}$$

$$F2(m) = CST(m)\cdot N_{EX}(m)\cdot v(m), \tag{14}$$

$$F3(m) = \frac{CST(m)\cdot N_{EX}(m)}{TPE(m)+\sum_{ot=1}^{OT(m)}\sum_{rt=1}^{RT(ot)}\big(\eta(ot,m,rt)\cdot x(ot,m,rt)\big)\cdot\sum_{l=ot}^{OT(m)} LO(l,m)}. \tag{15}$$

A detailed formal record of limitations and interpretation of the criteria function is presented in [3, 6, 18].

4. Case study for modelling the technical maintenance system

The problem concerns the modelling of the technical service of means of transport – buses in the enterprise providing passenger transport services in public transport. The subject of the transport company's activity is:

- public transport in the city using buses,
- maintaining efficient and regular public transport and maintaining technical efficiency of operated buses,
- operating in the field of bus purchase, replacement and repair for the implementation of the statutory subject of operation,
- initiating and implementing investment projects in the field of construction, extension and renovation of facilities, urban public transport devices.

In the organizational structure of a transport company, a plant secures technical service and bus repairs.

The transport company operates three types of buses that form the set $\boldsymbol{M} = \{\overline{1,3}\}$. The type of technical services and their scope depends on the type of bus being used and their frequency from the intensity of their use.

Efficient implementation of transport in collective transport requires having appropriate types and number of technically efficient buses, i.e. $m = 1{:}\,754\,pcs$, $m = 1{:}\,214\,pcs$, $m = 1{:}\,265\,pcs$. Each type of technical service $OT = \{\overline{1,4}\}$ can be implemented according to a specific technology $RT = \{\overline{1,4}\}$, characterized by the time of service, the capacity of the technological line and the cost of maintaining it. It is possible to implement any technical service using four technologies that form matrices $\varpi = [\varpi(ot,m,rt)]_{4\times3\times4}$, $\rho = [\rho(ot,m,rt)]_{4\times3\times4}$, $\kappa = [\kappa(ot,m,rt)]_{4\times3\times4}$.

Other data necessary for modelling the transport company's technical service system is presented in Tab. 1.

Tab. 1. Characteristics of input data parameters for modelling the technical maintenance system (fragment of input data)

Parameter	**The parameter value**			**Unit of measure**
	$m = 1$	$m = 2$	$m = 3$	
Average intensity of bus use	62 274	62 274	62 274	[km/ year]
Total mileage of the bus	1 040 659	1 200 000	1 400 000	[km]
Inter-service mileage for service $ot = 1$	5 000	60 000	30 000	[km]
Inter-service mileage for service $ot = 2$	10 000	120 000	60 000	[km]
(…)	(…)	(…)	(…)	(…)
Number of buses in constant technical readiness	754	214	265	[pcs]
The price of a single bus	178 571.4	261 904.8	285 714.3	[EUR]
Interest rate on financial resources	0.04	0.04	0.04	[1/year]
Fixed costs of maintaining the service system	9 105 952	2 964 286	3 404 762	[EUR]
Inter-service time of effective work	0.08030	0.96348	0.48174	[year]
(…)	(…)	(…)	(…)	(…)
The total time of effective work	16.71	19.27	22.49	[year]
The number of servicing $LO(m,1)$	208	20	46	[pcs]
(…)	(…)	(…)	(…)	(…)
The number of servicing $LO(m,4)$	20	-	-	[pcs]

Source: own study based on the obtained data.

The solution was obtained using the LINDO Extended 9.0 computer program, which is an important element in the decision-making process, including modelling of technical service systems for means of transport.

This program is a commercial program of LINDO Systems Inc. LINDO 9.0 is used to solve linear, non-linear and integer optimization tasks. In addition, the package contains a rich language for writing optimization tasks, has an environment for formulating and editing optimization tasks and an inbuilt set of quick methods for solving appropriately formulated optimization tasks.

A properly formulated optimization task and the use of the optimization tool that is LINDO Extended 9.0, allowed obtaining a solution for the technical service system, which determines the effective operation of the system of used means of transport of the company. The results of calculations are presented in Fig. 1-4.

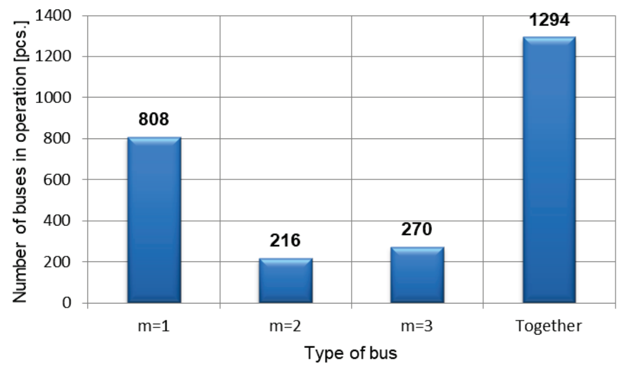

Fig. 1. Number of buses in operation

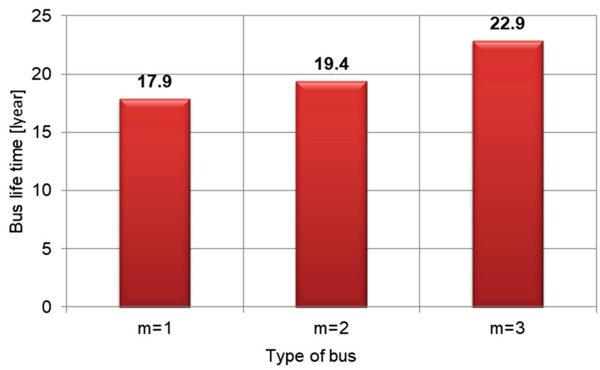

Fig. 2. Optimal time of bus operation

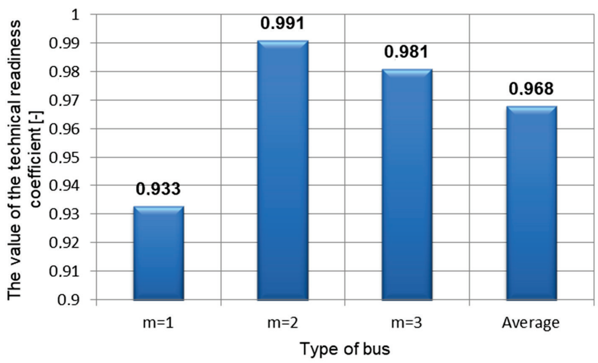

Fig. 3. Technical readiness coefficient

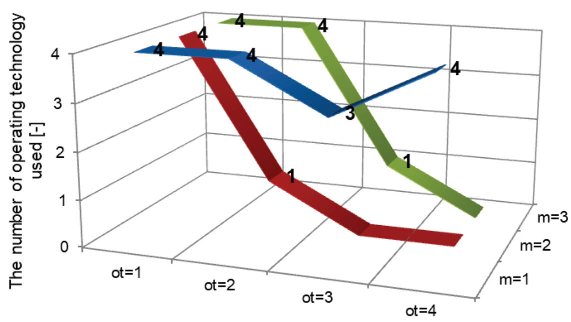

Fig. 4. Numbers of service technology

The calculations show that a transport company providing services in the field of passenger transport in public transport should have buses of the type *m = 1:808 pcs*, *m = 2:216 pcs*, *m = 3:270 pcs* (Fig. 1). The time of effective bus operation is in the range of *17.9 – 22.9 years* (Fig. 2). The value of the technical readiness coefficient ranges from 0.933 to 0.991, the detailed values for individual bus types, and the average coefficient are shown in Fig. 3. The implementation of individual types of service on different types of buses requires the use of various service technologies, e.g. the implementation of technical services performed on a $m = 1$ type bus requires the use of: service numbers 1, 2 and 4 – fourth technology, service No. 3 – third technology. The remaining choice of service technology for buses of $m = 2$ and $m = 3$ type is shown in Fig. 4. The operating system maintenance costs are 4.57E+07 EUR.

4. Summary

The issue of exploitation of means of transport is an important decision issue for transport companies. Transport enterprises carrying out transport tasks should include in their decisions the problem of the intensity of the use of means of transport, which affects their functional properties and the Technical Service System. It is therefore reasonable to adopt an appropriate strategy for managing the operation of means of transport, which would concern the resources of the exploitation system – human, financial, material and information resources. In addition, this strategy should include planning and decision-making, organizing, and controlling with the intention of achieving global and partial goals of the company. Such an approach should be focused on the effective functioning of the exploitation system of means of transport of the company, which purpose is both rational utilization – use of means of transport, as well as their maintenance in the state usability functional and task up state.

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