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AUTOMATIC METHOD OF INDEXES RECORDING OF CARRIAGE ROLLING STOCK

A.A. Allahverdiev

Azerbaijan Technical University, Baku, Azerbaijan, afik_allahverdiev@mail.ru

Abstract- In this paper a problem of estimation and recording of indexes of carriage rolling stock and the developed automated method of the indexes recording are considered. For solving this complex scientific and practical problem it is suggested to develop information database to a considerable degree allows increasing efficiency of automated recording of information system as a whole.

Keywords: Database, Indexes Recording, Indexes of Carriage Rolling Stock, Automated Method.

I. INTRODUCTION

The automated system of planning and the account of parameters of motor transport is the actual problem facing to workers of the car enterprises. From the decision of this scientific and practical problem, efficiency and quality of the automated information system as a whole appreciably depend is studied.

One of modern forms of organization of the information is the special image organizing of databanks, intended for maintenance of the centralized accumulation and collective multi-purpose use of these data. Designing of a control system by databases allows automating process of machining of the data.

Now three basic models of data including relational, network and hierarchical are developed. On the basis of these three approaches big number DBMS is constructed. For personal computers the relational approach has won. It differs simplicity of basic concepts and severity of mathematical bases. At the same time, introduction of computers during a daily life of motor transportation enterprises (MTE) forces to deal with problems of the organization of databases. It stills more not enough, in particular on motor transport. Interest to this rather than perspective area of computing technology continues to remain actual.

The basic preconditions of creation of databanks are that elements of transport process in complex interrelation among themselves. For maintenance of adequate display of transport process, the whole information base should represent uniform interconnected. Required information related to the participants of transport process, suppliers, consumers and the motor transportation enterprises are crossed, that results in significant duplication of the information. Therefore, creation of uniform information base serves reduction of redundancy of the stored data and maintenance of repeated reference to the same data, various participants of transport process.

II. STATEMENT OF PROBLEM

At the decision of various problems of transport process the general performance of data selection and representation are necessary. For performance of these functions the special system software is created.

The increase in mobility, flexibility of information system concerns to advantages of the developed database. Thus integrity, consistency of the data is easily supervised. It represents the unified data set shared by participants of transport process. Its problem includes storage of the data required for management in a uniform place, exception of redundancy of the data, and minimization of probability of preservation of the inconsistent data. The program is a part of a database provides software for creation, loadings of inquiry, updating of the data and dialogue with a database. In the developed database input of the information is made on a condition of car in settlement base daily.

III. SOLUTION METHODS

Calculations are conducted on the basis of two bases. In the first base the information on a condition of car is entered. For this purpose the information is represented in the ciphered kind. Codes are garage numbers of cars and organic numbers of drivers. The condition of car is ciphered in the following kind:

P is work on a line; *B* is the day off on the enterprise; *П* is holidays; *TO*-2 is maintenance service of No 2; *TP* is operating repair; *KP* is presence on major overhaul; *OP* is pending repair; *OC* is pending write-offs; *BB* is without driver condition; *Н3* as there are no applications for transportations; Recreation Center as idle times on road climatic conditions; *БТ* is without fuel; *БА* is without the accumulator; *БШ* is without the trunk; *ПС* is leaving of car.

A fragment of base for 15 days is submitted in the Table 1. In the second base, daily data on a planned and actual operating time of work of car is in Table 2.

Table 1. A fragment of base for 15 days

№	№ col	mark AT	St №	Park №	Cargo	wr	Driver	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2	zil130	10-ij-121	1	6	6	12	ТР	БА	БА	НЗ	Р	В	Р	ТО-2	Р	Р	Р	П	В	Р	В
2	2	zil130	10-ii-110	2	6	5	2	ББ	Р	Р	ТР	В	В	Р	ОР	ТР	Р	Р	П	В	ББ	Р
3	1	zil130	10-iu-154	3	6	5	22	НЗ	ТР	Р	Р	В	В	Р	Р	ТО-2	Р	Р	П	В	ОС	ББ
4	1	QAZ53a	10-ii-524	4	4	5	23	Р	Р	БТ	Р	В	В	ТО-2	ТР	Р	ОР	ТР	П	В	ТР	Р
5	1	zil130	10-ff-123	5	6	6	24	БА	ТР	Р	Р	Р	В	Р	ПП	ДК	Р	ТР	П	В	ТО-2	БШ
6	1	zil130	10-mm-584	6	6	7	44	ТР	Р	Р	Р	Р	ТР	Р	ОР	ТР	Р	Р	Р	Р	ББ	Р
7	1	zil130	10-gl-345	7	6	7	56	ТО-2	Р	Р	БА	БА	ТР	Р	Р	БА	Р	ТР	Р	Р	ОС	ОС
8	2	zil130	10-lb-905	8	6	7	34	ТР	БШ	Р	БТ	Р	ББ	ББ	ББ	ББ	Р	Р	БА	БА	Р	Р
9	2	zil130	10-rf-639	9	6	7	35	Р	БТ	Р	ТР	Р	П	ДК	Р	ТР	БШ	ТО-2	БТ	Р	ТР	БШ
10	2	zil130	10-tr-650	10	6	7	47	Р	Р	Р	НЗ	Р	ТО-2	ТР	Р	Р	В	В	ББ	ББ	ББ	ББ
11	1	QAZ53a	10-fb-005	11	4	7	87	ТО-2	БА	Р	НЗ	Р	Р	БШ	Р	ОР	ТР	Р	Р	В	Р	ОР
12	1	zil130	52-bc-888	12	6	7	55	Р	Р	Р	ТР	ТР	Р	БА	БА	ТО-2	НЗ	Р	П	ДК	Р	БА
13	2	QAZ53a	10-hg-777	13	4	5	19	ТР	ББ	Р	ТР	В	В	Р	Р	ПС	ДК	ДК	П	В	Р	БТ
14	2	QAZ53a	01-ab-555	14	4	5	60	Р	Р	ТР	Р	В	В	Р	Р	Р	ББ	Р	П	В	Р	ОР
15	1	QAZ53a	10-FB-474	25	4	5	40	Р	Р	Р	ТР	В	В	Р	Р	Р	Р	Р	П	В	В	ТО-2

Table 2. Daily data on a planned and actual operating time of work of car

№	1		2		3		4		5		6		7		8		9		10		11		12		13		14
	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р	Ф	Р
1	0	0	0	0	0	0	0	0	7	7	0	0	7	7	0	0	7	4,5	7	8	7	7,5	0	0	0	0	7
2	0	0	8,2	3	8,2	5	0	0	0	0	0	0	8,2	8,5	0	0	0	0	8,2	6	8,2	5,5	0	0	0	0	0
3	0	0	0	0	8,2	6	8,2	4	0	0	0	0	8,2	6,5	8,2	4,5	0	0	8,2	4,5	8,2	5,5	0	0	0	0	0
4	8,2	4	8,2	7,5	0	0	8,2	3,5	0	0	0	0	0	0	0	0	8,2	8	0	0	0	0	0	0	0	0	0
5	0	0	0	0	7	3	7	5,5	7	4,5	0	0	7	6,5	0	0	0	0	7	8	0	0	0	0	0	0	0
6	0	0	6	6	6	7,5	6	3,5	6	7	0	0	6	6	0	0	0	0	6	9	6	7,5	6	9	6	9,5	0
7	0	0	6	8,5	6	3	0	0	0	0	0	0	6	3	6	9,5	0	0	6	6	0	0	6	6,5	6	9	0
8	0	0	0	0	6	4	0	0	6	5	0	0	0	0	0	0	0	0	6	6,5	6	5,5	0	0	0	0	6
9	6	5	0	0	6	4	0	0	6	6,5	0	0	0	0	6	5	0	0	0	0	0	0	0	0	6	6,5	0
10	6	6,5	6	8,5	6	8,5	0	0	6	4	0	0	0	0	6	6,5	6	3	0	0	0	0	0	0	0	0	0
11	0	0	0	0	6	8	0	0	6	5	6	8	0	0	6	9,5	0	0	0	0	6	9	6	0,5	0	0	6
12	6	9	6	8,5	6	3,5	0	0	0	0	6	7,5	0	0	0	0	0	0	0	0	6	6,5	0	0	0	0	6
13	0	0	0	0	8,2	4	0	0	0	0	0	0	8,2	9,5	8,2	8	0	0	0	0	0	0	0	0	0	0	8,2
14	8,2	6	8,2	8,5	0	0	8,2	4	0	0	0	0	8,2	6,5	8,2	3	8,2	5,5	0	0	8,2	4,5	0	0	0	0	8,2
15	8,2	6,5	8,2	9	8,2	5	0	0	0	0	0	0	8,2	8,5	8,2	5	8,2	6	8,2	9,5	8,2	3,5	0	0	0	0	0

On the basis of these databases of parameters the park of car is paid off. It is necessary to notice that a part of parameters of an estimation of quantity and quality is used. The result includes non-comparable and erroneous results. Correct definition of these parameters is the actual problem facing to motor transportation enterprises (MTE). In the submitted work results of the lead analysis of parameters of the account, concrete operating conditions of MTE are resulted and the specified formulas of their calculation are offered. On motor transport various parameters of an estimation of quantity and quality, both the vehicle, and the motor transportation enterprise are used.

The working system of MTE planning is accounted and analyzed only by results of the executed volume of transportations without taking into account a level of quality indicators which engaged in erroneous non-comparable results. For solving the problems of planning and management of transportation process, the great value has the concrete operating conditions using of correctly certain parameters and the accuracy.

The parameters to estimate a degree vehicles are used concern to: factor of technical readiness of car α_t, factor of car release on a line α_b, operating ratio of car park α_u, operating ratios of carrying capacity γ_c and run β, average length l_{ez} and average distance of transportation of a cargo l_{cp}, an idle time of car under loading/unloading t_{n-p}, time in the order T_H, technical speed of movement v_t and operational speed $v_э$.

To resulting the parameters of car working the related parameters include: number the volume of transportations Q, transport work P, run with a cargo $L_Г$ and the general run L_o, productivity of car - hour development in tons W_Q and kilometer-tons W_p.

Unfortunately, there is no uniform approach in questions of terminology and calculation techniques and economic parameters. So, for example, a number of authors [1, 2, 3] identify list and inventory number of the car consisting on balance MTE. Whereas, the structured list of park covers the car intended for performance of transportations under the established program. In addition, the inventory quantity of car includes special vehicles purpose, cars in the technical help, cranes, cars in the linear control, etc.

The structured list of park includes the conditions in operation $A_э$, current A_p, major overhaul $A_{кр}$ or pending it in all day, long maintenance service A_{TO} and in idle time A_n. The reasons of idle times can be absence in shipping requests, drivers, operational materials (the petroleum products, accumulators, and the trunk), bad road, climatic conditions, etc.

It is necessary to note that at definition of some parameters of park of car till now use such fuzzy concepts as: days, cars, etc. It results in completely deformed representations about use of car park for no clearness of physical essence understanding of considered laws. For example, factors of technical readiness, release and its use for work of car is estimated in days, and run as daily average, etc. The Concept day does not define the valid degree of work of car, therefore factors of release

and use of car do not reflect an essence of its use. It is connected that MTE in conditions of operation and different operating modes of calendar is used in the working days.

Using of park of cars exchange depends on quantity of cars suitable for transportation from operating mode MTE, i.e. quantity of day working for the certain period and business hours in day. Based on the experts understanding that day does not reflect the car hovered working and suggests operating ratio of park to apply instead of the term factor of car release on line. Logically such term is more correct, but it at all does not give an opportunity to judge about degree of use of park. Besides, it is necessary to note that the factor of technical readiness is excluded from official accounts as a parameter. Thus proceed from the assumption, that it as though automatically is included with operating ratio of park.

In our opinion to refuse the specified factors does not follow. As the factor of technical readiness, it is a major necessary factor for definition and maintenance of industrial programs in performance for all categories of maintenance, definition of the areas of zones, the equipment, calculation of expenses of work, etc.

Formulas of definition of the specified factors are not correct, because in the technically serviceable cars which are not used for the organizational reasons they are not taken into account. Besides, according to operating mode MTE, the period of time when technically serviceable cars is not issued on a line and not taken into account.

In [4] an estimation of parameters are used for car park limits considering to factor of technical readiness and operating ratio of the park and reflecting degree of use of car during calendar time. Hence, it is not deprived the above-stated lacks. Some authors assert that imperfections of release factor are used calendar instead of a rolling stock in the working days. The exception of days off and holidays at the rate of factor of release for those MTE where is organized only in the working days of week, creates to their collectives more favourable conditions.

There are also authors who consider that it is necessary to refuse factor of release because of its imperfection. In one they are right, the working technique of definition of factor of release is really obsolete and consequently demands carrying out of scientifically proved analysis. The existing design procedure of release factors cannot be recognized objective for non-reflecting a real condition of operational conditions. Namely, the completeness is stayed on time in each car and operating mode MTE by quantity of changes.

For this purpose and in our opinion, it is necessary to open essence and purpose of this factor. Firstly, it should show what part of motor pool MTE is issued for work on a line. Secondly, the factor should reflect and provide the operating time in a line. Meanwhile, it is known that duration the car in the working days changes in a wide range, practically from 1 till 24 o'clock, and it results in essential distortion of an actual state of affairs on comparability.

As it turns out, the cars in the order T_H within working days are involuntarily equated MTE with various finding time.

It is well-known that from duration of ordered time, with other things being equal, results of car work substantially depend on together with its volume of repairing and maintenance service. Hence, from duration of ordered time in direct dependence, there is also a quantity of work which is necessary for enclosing to collective MTE for the organization of satisfactory work of car on a line.

Thus, the factor of car release should take into account objectively in quantity and quality by collective for its achievement. Therefore, at an estimation of car using, it is necessary to sustain a condition of comparability and more precisely reflect intensity of their use. As a basis of comparability, the concretized common established size of concept the car such as day of work for all MTE or the resulted size can serve.

The factors are designed by a working technique reflect only for number of the cars which are released on a line. They do not reflect a situation of an outputof car with delay and premature returning in MTE. Besides under these formulas it is impossible to expect values for such MTE which works in two and three replaceable mode. If to count an output in each change, the number of car in operation will be more listing. Hence, the existing technique of estimation for a degree of car park cannot be recognized objective.

The factor of technical readiness determines an opportunity of car to make useful work. However technically serviceable cars can stand idle for operational and organizational technical reasons. These idle times are not planned, and are consequence not quite satisfactory work of departments of supply and operation of MTE.

Therefore it is offered to use two factors including factor of technical readiness for an assessment of technical service of MTE and factor of readiness of car in operation, i.e. to performance of transportations by means of which work is estimated, both technical service, and a department of supply.

Factor of technical readiness of car for D_K in calendar days:

$$\alpha_{TГ} = AD_{TГ} / AD_x \quad (1)$$

$$AD_{TГ} = AD_x - AD_{TO} - AD_{TP} - AD_{KP} \quad (2)$$

where $AD_{TГ}$ is days of technically serviceable cars; and the parameters $AD_x, AD_{TO}, AD_{TP}, AD_{KP}$ are days of stay in a facilities in the maintenance service current and major overhaul, respectively.

Factor of readiness of car in operation for a day is defined as:

$$\alpha_{ГЭ} = A_{ГЭ} / A_C \quad (3)$$

where $A_{ГЭ}$ is cars ready for operation.

$$A_{ГЭ} = A_c - A_{TO-2} - A_{TP} - A_{кр} - A_{мс} \quad (4)$$

$$A_C = A_Э + A_{TO-2} + A_{Tp} + A_{кр} + A_{мс} + A_{no} \quad (5)$$

where $A_{мс}$ is quantity the cars which are taking place in

idle time for the material reasons for the lack of the petroleum products, the trunk, accumulators; A_{no} is quantity of cars taking place in idle time, for the organizational reasons because of absence: drivers, applications for transportations and way-climatic conditions.

Factor of readiness of car to operation for $D_к$ calendar days is:

$$\alpha_{ГЭ} = AD_{ГЭ} / AD_x \quad (6)$$

For definition of car list number on MTE count number of days and stay at the enterprise of existing, acting and leaving car:

$$A_c = [A_н\ D_к\ + AD_{ПР} - AD_{Выб}] / D_x = AD_{Об} / D_x \quad (7)$$

where $A_н$ is number of car by the beginning of the considered planned period of unit; $D_к$ is Calendar number of days in the considered period; $AD_{ПР}, AD_{Выб}$ are the car days of stay on MTE accordingly again acting and written off car and $AD_{Об}$ is the general number of the car days of stay on MTE list park, in the considered period.

In view of the factor of time for definition of actual value factor of technical readiness, it is necessary to use the following formula for one car:

$$\alpha_T = \sum_{i=1}^{D_x} T_{TГi} / (24D_x) \quad (8)$$

where $T_{TГi}$ is time of service of car in *i*-day, hour and D_x is inventory days of stay of car in MTE.

For MTE for a day:

$$\alpha_T = \sum_{j=1}^{A_c} T_{TГj} q_{нj} / (24 A_C q_{нj}) \quad (9)$$

For MTE for D_x days:

$$\alpha_T = \sum_{j=1}^{A_C} \sum_{i=1}^{D_x} T_{TГij} q_j / (\sum_{j=1}^{A_C} 24 D_x q_j) \quad (10)$$

where D_x and AD_x are cars days of staying the car in a facility service, respectively.

The cars days of a presence that car in a facilities is determined by:

$$AD_x = \sum_{j=1}^{A_C} D_j \quad (11)$$

The factor of car release on a line is determined from $AD_э$ as the relation of the car working days and AD_x as days of car presence in facilities.

$$\alpha_в = \sum_{i=1}^{D_э} T_{ni} / (24 D_{xi} - D_{нпi}) \quad (12)$$

For group of car for a day:

$$\alpha_в = \alpha_u \sum_{j=1}^{A_э} T_{нj} / (24 A_u) \quad (13)$$

For group of car for $Dэ$ days:

$$\alpha_в = \sum_{j=1}^{A_э} \sum_{i=1}^{D_э} T_{нij} / \sum_{j=1}^{A_и} (24 D_x - D_{нпj}) \quad (14)$$

The degree of car using and all parks are estimated by operating ratios during calendar time, and working hours in factor of release. For separate car these factors should be determined for groups of car under the following formulas. For separate car

$$\alpha_u = \sum_{i=1}^{D_э} T_{Hi} / (24 D_x) \quad (15)$$

For group of car for $Dэ$ days:

$$\alpha_u = \sum_{j=1}^{A_э} \sum_{i=1}^{D_э} T_{нij} / \sum_{j=1}^{A_и} (24 D_x) \quad (16)$$

Average time of car staying in the order is determined from expression:

$$\overline{T}_н = A Ч_э / AD_э \sum_{s=1}^{n} AD_{эs} \overline{T}_{нs} \quad (17)$$

where $A Ч_э$ is the car hours of operation; $AD_э$ is total quantity days of car working and $\overline{T}_{нs}$ is operation time *s* (in hour) for groups of car on the average for a day.

In the conclusion, it is necessary to note that in the question of transportation process management, with the purpose of increasing the accepted decisions efficiency, the great value accuracy of determined technical-operational parameters is required. The suggested method allows solving the specified questions correctly. Results of calculations for suggested method are submitted in Table 3.

Table 3. Results of calculations for suggested method

№	№ col	mark AT	St №	Park №	Cargo AT	Wr.	Driver	Dэ	Dx	Dнп	Атг	Аге	Аи	Аип	Аиф	Ав	Ав(т)
1	2	zil130	10-jj-121	1	6	6	12	6	15	4	0,86	0,46	0,4	0,11	0,11	0,54	0,11
2	2	zil130	10-ii-110	2	6	5	2	6	15	4	0,8	0,4	0,4	0,13	0,08	0,54	0,13
3	1	zil130	10-iu-154	3	6	5	22	6	15	4	0,8	0,46	0,4	0,13	0,08	0,54	0,13
4	1	QAZ53a	10-ii-524	4	4	5	23	5	15	4	0,66	0,33	0,33	0,11	0,08	0,45	0,11
5	1	zil130	10-ff-123	5	6	6	24	5	15	3	0,8	0,4	0,33	0,09	0,07	0,41	0,09
6	1	zil130	10-mm-584	6	6	7	44	10	15	0	0,73	0,66	0,66	0,16	0,2	0,66	0,16
7	1	zil130	10-gf-345	7	6	7	56	7	15	0	0,66	0,46	0,46	0,11	0,12	0,46	0,11
8	2	zil130	10-lb-905	8	6	7	34	6	15	0	0,93	0,4	0,4	0,1	0,10	0,4	0,1
9	2	zil130	10-rf-639	9	6	7	35	5	15	1	0,73	0,33	0,33	0,08	0,07	0,35	0,08
10	2	zil130	10-tr-650	10	6	7	47	6	15	2	0,86	0,46	0,4	0,1	0,10	0,46	0,1
11	1	QAZ53a	10-lb-005	11	4	7	87	7	15	1	0,73	0,53	0,46	0,11	0,14	0,5	0,11
12	1	zil130	52-bc-888	12	6	7	55	6	15	1	0,8	0,46	0,4	0,1	0,12	0,42	0,1
13	2	QAZ53a	10-hg-777	13	4	5	19	4	14	4	0,85	0,28	0,28	0,09	0,08	0,4	0,09
14	2	QAZ53a	01-ab-555	14	4	5	60	8	15	4	0,86	0,53	0,53	0,18	0,12	0,72	0,18
15	1	QAZ53a	10-FB-474	25	4	5	40	8	15	5	0,86	0,53	0,53	0,18	0,14	0,8	0,18
							***	95	224	37	0,79	0,45	0,42	0,12	0,11	0,50	0,14

Application of daily automatic processing enables to determine the factors of technical and operational

readiness as well as the factors of release and use of car parking, to organize the detailed both all-round operative account and also analysis of performance of the plan of ordered time using as: on car, on marks of car, motorcades and on the motor transportation enterprise.

The database allows watching the organization of drivers working which consists in establishment of an operating mode and scheduling the output of working style considering the working hours. It is useful to carry out the requirements of the labour legislation for daily and monthly working duration hours. The daily accounting time fulfilled by the drivers in the established duration, but total time for a month should not be more than monthly working hours as 41 hours per five-day or six-day working per week.

IV. CONCLUSIONS

Summarizing the represented research makes the following conclusions.

1. The developed base alongside the automatic account, allows accepting the decision to watch a course of performance of planned targets on the basic technical-operational parameters, to reveal presence of losses and reserves, and, hence, is duly to take necessary measures in the current month.
2. The methods, information, program and technical base of the automatic systems of dispatching management are developed by technological processes of transportations of cargoes. Thus, the software of the developed automated control system is implied for three basic purposes have been put including the maximum simplification of accounting process; clearing the dispatcher of performance necessity of routine operations of car fixation condition, i.e. liberation of its intelligence and the maximum acceleration of planning process of the accounting and definition of parameters of car parking.
3. Due to application of computer facilities for deeper analysis of the information used for management it is provided in comparison with manual methods. Labour productivity of the workers is raised with processing of the information considerably. This paper is a fragment of the developed automatic system of dispatching management.

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BIOGRAPHY

Afiq (Allahverdi oglu) Allahverdiyev was born in Azerbaijan, 1937. He received the M.Sc. degree in the field of Operation Road Transport as Mechanical Engineer from Azerbaijan Polytechnic Institute (Baku, Azerbaijan) in 1960. He graduated to Ph.D. degree in automation of experimental research from Faculty Specials Retraining for New, Promising Areas of Science and Technology at the Moscow Car and Road Institute, Russian Academy of Sciences (Moscow, Russia) in 1985. Currently, he is the Associate Professor in the field of organization of road transport and road safety in Azerbaijan Technical University (Baku, Azerbaijan). He has authored 150 scientific papers. His research interests are in road transport of articles large-panel management, developing methods and models optimization in road transport logistics, and automation and process control and production.