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Published in:
Transportation Research Procedia

DOI (link to publication from Publisher):
10.1016/j.trpro.2018.09.007

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 30 (2018) 53–59

Transportation Research Procedia

www.elsevier.com/locate/procedia

EURO Mini Conference on "Advances in Freight Transportation and Logistics" (emc-ftl-2018)

Forecasting the release on the line of variously aged long haul vehicles in Russia

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Abstract

At the process of purchasing vehicles, carriers usually choose up between brand new and used vehicles. Essential delays on loading-unloading goods dramatically affect the intensity of long-haul transportation in Russia and in East European countries, stimulating carriers to purchase used vehicles, which generally need replacement on much frequent basis. In case of purchasing long-distance haulage vehicles, it is essential to have evidential information regarding its possibility for sustainable long-term usage, including maintenance constraints and possible financial loses. As an indicator of maximum number of days in operation per year, the potential coefficient of the released vehicles on the line is proposed. The coefficient was performed also in relation with dependence of truck age. As a practical result, for VOLVO tracks in Russia, the optimal 5-year exploitation period for vehicles has been determined.

Selection and peer-review under responsibility of the scientific committee of the EURO Mini Conference on “Advances in Freight Transportation and Logistics” (emc-ftl2018).

Keywords: long haul vehicles; potencial for use; fleet utilization; optimal exploitation period

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10.1016/j.trpro.2018.09.007

1. Introduction

At the stage of vehicle purchasing, carriers usually choose up between brand new and used vehicles. Essential delays on loading-unloading goods dramatically affect the intensity of long-haul transportation in Russia, stimulating carriers to purchase used vehicles. Frequently, there is a need of maintenance of the used vehicles. In case of purchasing vehicles for long-distance haulage, it is essential to have evidential information regarding its conditions for further transportation. Various aspects of this problem were covered by Hedvall et al. (2016, 2017), Ansaripoor et al. (2014), Vujanović et al. (2012), Parthanadee et al. (2012), Zheng and Chen (2016), Goryaev (2012). However, these studies do not take into account operating conditions along with specific countries regulations, For instance, East Europe and Russia in particular, which gives a considerable difference and high scientific interest for investigating.

2. Methodology

If we analyze the formula of annual vehicles productivity, it is obvious that the main characteristic, being dependent on age of transport, is truck availability rate. According to conditions in Russian Federation, the similar characteristic is called “coefficient of technical availability” and calculates as:

$$\alpha_{av} = \frac{D_{av}}{D_{bal}} \tag{1}$$

D_{av} – number of days in exploitation

D_{bal} – number of days when vehicle is under accountable condition (if it is the whole year, then the number is 365)

Another characteristic related to truck availability is “fleet utilization”. However, there is no use of such term in Russia, it is called “coefficient of transport released on the line” with the following formula:

$$\alpha_{rel} = \frac{D_{\exp}}{D_{bal}} \tag{2}$$

$D_{\exp}$ – the number of days being “on line” during one calendar year

If we denote "fleet utilization" as F_{ut}, the “coefficient of transport released on the line” can be calculated through:

$$\alpha_{rel} = \frac{F_{ut}}{\alpha_{av} \cdot 100\%} \tag{3}$$

Since “fleet utilization” calculates in percentage scale, the coefficient of transport released on the line could not be less than the truck availability rate as damaged vehicles could not be released on the line.

Traditionally in Russian Federation, the truck availability rate is meant to be a cross functional indicator, which shows the technical sustainability of vehicles and its further maintenance facilities. However, the current indicator is not objective, for example: serviceable vehicles have stayed without work for the whole calendar year that is, the truck availability rate equals 1, though we can’t come to any conclusion of its sustainability – it simply does not seem possible. Another example: in the company that work with seasonal type of business, during off-season transport is not used thus being under non-working condition and has low truck availability rate. However, by the start of the season it gets to technically approved condition and work effectively afterwards.

From above mentioned examples the dependence of an indicator seems clearer – the one characterizes the potential of vehicles released on the line, considering the intensity of its use. Also, it is obvious that such an indicator should consider truck availability rate as well as coefficient of transport released on the line.

For evaluation of effectiveness of vehicles usage Yakunin and Myachkova (2010) propose the coefficient of effectiveness, which is being calculated using ages of vehicles, total period of exploitation, truck availability rate and the coefficient of vehicles released on the line, using the following formula:

$$k_{ef} = \frac{k_{age} \cdot \alpha_{rel}}{\alpha_{av}} \tag{4}$$

k_{age} – a coefficient focused on fleet utilization and usage throughout time, also taking into account variable expenses – was confirmed in accordance with the correction factors in the Fuel Consumption Standards approved by the Russian Ministry of Transport.

Such indicator evaluates mainly the effectiveness of vehicles usage. To calculate, we need to compare the number of days on the line with sum of days spent in maintenance and on the line, excluding the days of delay spent on organizational issues. If we evaluate the rate of days in exploitation and subtract the rate under maintenance from coefficient of technical availability, then the potential of vehicle released on the line can be evaluated with an indicator called “potential coefficient of released vehicles on the line” with the following formula:

$$\alpha_{rel}^{pot} = \frac{\alpha_{rel}}{\alpha_{rel} + (1 - \alpha_{av})} \tag{5}$$

Above mentioned formula has no usage in practice, whereas all the calculations are done through:

$$\alpha_{rel}^{pot} = \frac{D_{\exp}}{D_{\exp} + D_{rep}} \tag{6}$$

D_{rep}– number of days under maintenance.

The research was conducted for VOLVO fleet long-haul trucks, one of the most relative trucks segment on the Russian market. The study aimed on dependency of potential coefficient of released vehicles on the line and was done using data taken from “Tractor-Auto Ltd” in 2015-2016, which had up to 39 VOLVO long haul trucks along with SCHMITZ semitrailers-refrigerators. Long-haul trucks with exploitation in 2008-2011 were in equal circumstances, having slight changes in mileage, in average having 135 893 km each.

3. Results and Discussion

The initial data for analysis were the year of vehicle’s release, data in accordance with number of days in exploitation and under maintenance for considered trucks. Results with the potential coefficient of the released vehicles on the line are presented in table 1 and table 2 for years 2015 and 2016 respectively.

Table 1. Indicators of vehicles use in 2015.

Vehicle	Age	In use	Under maintenance	α_{rel}^{pot}
Р 003 ХА	2008	297	41	0,879
С 006 ВУ	2010	290	41	0,876
В 008 ХС	2011	298	33	0,9
К 008 ОН	2008	264	57	0,822
Р 008 ТР	2008	273	66	0,805
Р 009 ТР	2009	255	72	0,78
В 076 ВВ	2010	298	37	0,89
Р 111 ВУ	2010	303	40	0,883
В 141 ВВ	2010	279	64	0,813
Х 184 УЕ	2008	285	53	0,843
Е 200 ХК	2009	273	58	0,825
Н 208 УА	2008	286	47	0,859
Е 300 ХВ	2009	283	52	0,845
Н 300 ТН	2008	295	48	0,86
Т 333 РО	2008	284	51	0,848
Н 400 УС	2009	282	58	0,829
Н 444 УС	2009	232	109	0,68
Р 444 ВС	2010	255	81	0,759
С 444 УС	2008	267	55	0,829
М 500 УУ	2008	281	50	0,849
Н 500 ТУ	2008	298	41	0,879
О 590 АА	2010	278	50	0,848
О 591 АА	2011	281	49	0,851
С 600 ВУ	2010	291	49	0,856
Т 666 УА	2008	265	54	0,831
У 692 ХН	2009	270	46	0,854
Т 700 ХН	2010	299	37	0,89
В 800 ХС	2010	280	45	0,861
Е 800 ХК	2009	267	63	0,809
Т 800 ХН	2010	279	59	0,825
У 800 ХН	2009	286	35	0,891
В 888 УА	2008	280	57	0,831
А 900 УА	2008	279	54	0,838
В 900 ХС	2011	294	39	0,883
Р 900 ХА	2008	300	34	0,898
Р 900 ВС	2010	277	58	0,827
Р 900 ВУ	2010	291	50	0,853
У 928 ХН	2009	278	59	0,825
О 968 УУ	2008	282	50	0,849

Table 2. Indicators of vehicles use in 2016.

Vehicle	Age	in use	in repaire	α_{rel}^{pot}
Р 003 ХА	2008	262	51	0,837
С 006 ВУ	2010	264	55	0,828
В 008 ХС	2011	283	42	0,871
К 008 ОН	2008	242	58	0,807
Р 008 ТР	2008	245	58	0,809
Р 009 ТР	2009	230	70	0,767
В 076 ВВ	2010	257	61	0,808
Р 111 ВУ	2010	269	52	0,838
В 141 ВВ	2010	215	97	0,689
Х 184 УЕ	2008	276	44	0,863
Е 200 ХК	2009	252	65	0,795
Н 208 УА	2008	233	75	0,756
Е 300 ХВ	2009	250	60	0,806
Н 300 ТН	2008	272	58	0,824
Т 333 РО	2008	257	68	0,791
Н 400 УС	2009	276	51	0,844
Н 444 УС	2009	248	70	0,78
Р 444 ВС	2010	274	45	0,859
С 444 УС	2008	240	78	0,755
М 500 УУ	2008	252	67	0,79
Н 500 ТУ	2008	166	155	0,517
О 590 АА	2010	239	87	0,733
О 591 АА	2011	276	50	0,846
С 600 ВУ	2010	253	57	0,816
Т 666 УА	2008	249	75	0,769
У 692 ХН	2009	248	63	0,798
Т 700 ХН	2010	260	56	0,823
В 800 ХС	2010	259	60	0,812
Е 800 ХК	2009	285	44	0,866
Т 800 ХН	2010	250	68	0,786
У 800 ХН	2009	267	54	0,832
В 888 УА	2008	255	67	0,792
А 900 УА	2008	258	65	0,799
В 900 ХС	2011	268	58	0,822
Р 900 ХА	2008	270	51	0,841
Р 900 ВС	2010	261	58	0,818
Р 900 ВУ	2010	222	65	0,774
У 928 ХН	2009	242	71	0,773
О 968 УУ	2008	238	77	0,756

The results of the potential coefficient of released vehicles on the line by year are presented in table 3, and the dependence of the coefficient on the vehicle's age are shown in Fig. 1.

Table 3. The results of the analysis of the potential coefficient of released vehicles on the line.

Vehicles age	α_{rel}^{pot} in 2015	α_{rel}^{pot} in 2016	α_{rel}^{pot} in average
8	–	0,780 (15)	0,780 (15)
7	0,848 (15)*	0,807 (9)	0,833 (24)
6	0,815 (9)	0,799 (12)	0,806 (21)
5	0,848 (12)	0,846 (3)	0,848 (15)
4	0,878 (3)	–	0,878 (3)

* the number of vehicles of this age is indicated in brackets

There is a scientifically important sequence found from the gained data. That is, a sharp decline (Fig. 1) in potential coefficient of released vehicles on the line for VOLVO trucks 6 years old in 2015.

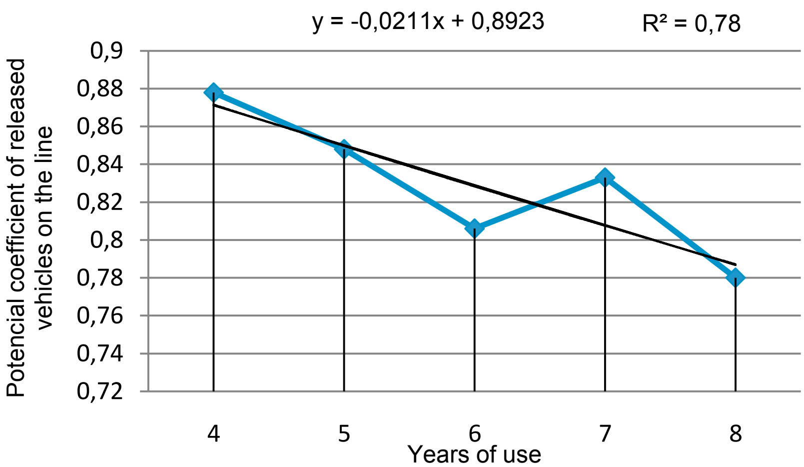

Fig. 1. Dependence of potential coefficient of released vehicles to their age

Furthermore, the same tendency is shown in 2016 for trucks made in 2010. It indicates that maintenance-free exploitation approximately goes to such a period of operation of 6 and 8 years. This is certified by data taken from one of the biggest carriers in Russia – «LORRY», which exploits nearly 800 VOLVO trucks, having average age of fleet of 2 years. Following that, «LORRY» prefers to sell its fleet when vehicles reach 5 years of exploitation.

Similar results were obtained by Redmer (2009), which indicate universality of the regularities for different truck operating conditions.

4. Conclusion

Gained results come to a discussion, that for VOLVO long haul trucks the proposed "potential coefficient of released vehicles on the line" tends to decrease the coefficient on average 0,0211 per year. Taking it into account, for VOLVO long haul trucks, table 4 illustrate the forecast of vehicles on the line in accordance to exploitation in Russia.

Table 4. Forecasting the release on the line of variously aged VOLVO long haul trucks.

Age of trucks	3	4	5	6	7	8	9	10
Days on the line	303	295	287	279	272	264	256	249

For more accurate evaluation and correlation analysis it is needed to gain additional data regarding exploitation of such type of vehicles.

Shown dependencies is vital to keep in mind while counting the terms of recoupment of vehicles in terms of loans or leasing, also considering the expected income from company's main product as well as above mentioned "sharp decline", because such decrease can lead to overall decline of all volumes of transportation work in certain amount of time and an increase in repair's costs.

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