Influential parameters calculation of vehicles fleet for distribution of beverages with heavy transportation road vehicles

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Abstract: Transportation of goods with vehicles is a complex logistic process about organization and management of companies that deal with transport and trade. Aim of this work is to present methodology of optimal planning and organization of transportation of goods in order to minimize expenses of distribution and transportation with heavy vehicles that follow predetermined travel routes. For this purpose has been studied and analyzed a case of Local Company that transports final products of liquid material – beer in period of 6 months, starting the distribution from production facility – factory to the 3 distant warehouses-distribution centers. The distribution is done based on customer requirements. The data of survey is based on long time measurements and information gathering, in cooperation with the company. Data of various parameters or indicators that are considered influential are collected. These parameters are: travel distances between distribution center, transportation velocities, time of travel, volume of goods transported, time of materials handling –loading and unloading, costs of process, etc. Results of these parameters will be presented graphically and Table form.

Keywords: Transportation, liquid goods, distribution, heavy transportation, influential parameters

1. INTRODUCTION

Development of technology and the advancement of transportation vehicles have increased volume of carried goods, cooperation between companies, fulfilled requirements of consumers as well as communication between people. These trends have put lot of challenges and demands to the logistic companies to offer better, faster, efficient and safer services. Therefore, their focus and requirement is to find best methodology of making this possible with purchase of better vehicles, selection of best routes, minimizing times, reducing costs and optimizing the process of distribution based on various conditions that exist in the market – domestic and international. The aim of transportation is not only reduction of costs and increase of speed of transportation, but also accomplishment, simplification and economical organization of transportation cycles in entire transportation path from producer-manufacturer to consumer [2], [5].

This study provides a information, definition and system architecture, participants and the bottlenecks of transport system of the beverages. Study also provides information on the current and future movement of goods, and the necessary actions to facilitate this movement. [4]. The distribution of goods at the malls by means of transport vehicles is a problem of organizing the work of production and trading companies, part of logistics and freight transport. It requires a good planning of travel routes, good organization of warehouses, good organization of vehicle fleet, qualified personnel, as well as good knowledge for calculation of expenses. [1], [10],[12]

2. INPUT PARAMETERS OF TRANSPORT

Based on measurements accomplished in the field, in local company, distribution is monitored and recorder for the period of 6 months. During this period is organized carrying of goods from the production facility of beer to three warehouses with same volume of load (cargo) carried. Transportation is done with 8 heavy transportation vehicles with carrying capacity of $q = 24$ *tons* (t) (Fig.2). Garage of vehicle fleet is situated in distance 25 km from production facility (Fig.1). Based on Table 1 and Figure 1, meaning of graph symbols is: G –garage; A – Production facility; B, C, D – warehouses. Other parameters are: Q (t) – Carried cargo in tons, γ - Static coefficient of vehicle utilization. Dotted routes means routes not used.

Routes	Distance (*km*)	Q (t)	γ
A – B	79	7000	0.92
B – D	228	1200	0.66
B – C	107	8000	0.63
C – D	121	-	-
D – A	107	-	-
D – B	228	-	-

Table 1. Input parameters of directions, distances and volume of goods transported

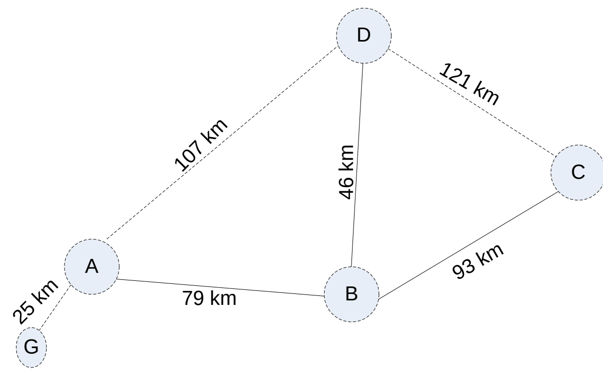

Figure 1. Graph of vehicle travel routes based on measurements and data collection in the field

Figure.2. Type of transportation vehicle-truck used for analysis

3. CALCULATION OF PARAMETERS FOR VEHICLES FLEET

Based on calculation of collected data necessary for usage of vehicles fleet, starting from necessary number of cycles for carrying goods, transport routes, various operational times, average speeds, number of possible routes during exploitation time, necessary number of vehicles, vehicle fleet days, vehicle fleet hours, and other characteristic parameters during the exploitation of vehicle fleet, calculations are processed for each coefficient and gained to results presented in *Table 2* [1],[3]. Data represents average values gained, based on numerous measurements and counting's in the field [7]:

Name of parameter	Result of calculation	Formula forcalculation
Inventory vehicle fleet days (days)	$AD_i = 1{,}098.00$	$AD_i = A_i \cdot D_i$
Vehicle fleet days in work (days)	$AD_r = 624$	$AD_r = A_r \cdot D_r$
Total length traveled (km)	$AK = 222{,}082.00$	$AK = AKt + AKp + Akn$
Total length traveled of vehicles with cargo (km)	$AKt = 109{,}108.00$	$AKt = z_{\lambda\overline{AB}} \cdot L_{\overline{AB}} + z_{\lambda\overline{BC}} \cdot L_{\overline{BC}} + z_{\lambda\overline{DB}} \cdot L_{\overline{DB}}$
Amount of carried (Transported) cargo (kg)	$Q = 27{,}004.56$	$Q = Q'_{\overline{AB}} + Q'_{\overline{BC}} + Q'_{\overline{DB}}$
Accomplished transportation work (kg·km)	$U = 1{,}848{,}949.44$	$U = Q_{\overline{AB}} \cdot L_{\overline{AB}} + Q_{\overline{BC}} \cdot L_{\overline{BC}} + Q_{\overline{DB}} \cdot L_{\overline{DB}}$
Inventory vehicle fleet hours for transportation vehicles (h)	$AH_i = 26{,}352.00$	$AH_i = 24 \cdot D_i$
Hours of work (h)	$AH_r = 9{,}707.35$	$AH_r = z_{\lambda I} \cdot T_{oI} + 2 \cdot \frac{L_{\overline{GA}}}{V_{sp}} \cdot n_{pI} + z_{\lambda II} \cdot T_{oII} + 2 \cdot \frac{L_{\overline{GA}} + L_{\overline{AB}}}{V_{sp}} \cdot n_{pII} + z_{\lambda III} \cdot T_{oIII} + 2 \cdot \frac{L_{\overline{GB}} + L_{\overline{BC}} - L_{\overline{DB}}}{V_{sp}} \cdot n_{pIII}$
Exploitation coefficient of vehicles fleet	$\alpha = 0.5683$	$\alpha = \frac{AD_r}{AD_i}$
Exploitation coefficient of vehicles fleet day	$\rho = 0.6481$	$\rho = \frac{AHr}{24 \cdot ADr}$
Exploitation coefficient of work time	$\delta = 0.5051$	$\delta = \frac{AHw}{AHr}$
Exploitation coefficient of travel distance	$\beta = 0.4912$	$\beta = \frac{AKt}{AK}$
Nulti coefficient of road travelled	$\omega = 0.0998$	$\omega = \frac{AKn}{AK}$
Exploitation speed (km/h)	$Ve = 22.87$	$Ve = \frac{AK}{AHr}$
Average travel speed (km/h)	$Vs = 45.28$	$Vs = \frac{AK}{AHw}$
Static coefficient of vehicle utilization	$\gamma = 0.701$	$\gamma = \frac{Q}{q \cdot Az_\lambda}$
Dynamic coefficient of vehicle utilization	$\varepsilon = 0.706$	$\varepsilon = \frac{U}{q \cdot AKt}$
Average transportation distance for 1 ton of cargo (km)	$Kst_t = 68.46$	$Kst_t = \frac{U}{Q}$
Average transportation distance with cargo (km)	$Kst_\lambda = 68.02$	$Kst_\lambda = \frac{AKt}{Az_\lambda}$
Average dailly road accomplished (km)	$Ksd = 355.90$	$Ksd = \frac{AK}{ADr}$
Time loss during travel with cargo (h/trav)	$td_\lambda = 2.994$	$td_\lambda = \frac{AHr - AHw}{Az_\lambda}$
Work productivity (t/hi)	$W_Q = 1.0247$	$W_Q = \frac{Q}{24 \cdot ADi}$
Travel work productiviy (tkm/h)	$W_U = 70.163$	$W_U = \frac{U}{24 \cdot ADi}$

Table 2. Values and formulas of influential parameters

3.1. Work productivity of vehicle fleet - W_Q and W_U

Work productivity is accomplished transport operation or the quantity of goods carried, accordingly the number of passengers carried by the working time unit (working hours). Based on this definition work productivity can be expressed through *t/h* (ton per hour) or *tkm/h* (ton kilometer per hour), which also known as *Travel work productivity*.

The formula for calculating the work productivity expressed in t/h is [2], [7]:

$$W_Q = \frac{Q}{24 \cdot ADi} \quad (t/h_i) \tag{1}$$

The formula for calculating the travel work productivity expressed in *tkm/h* is [2], [7]:

$$W_U = \frac{U}{24 \cdot ADi} \quad (tkm/h_i) \tag{2}$$

In Table 3 are presented values of work productivity calculated by the formula:

$$W_Q = \frac{\alpha \cdot \rho \cdot \gamma \cdot q}{\frac{Kst_\lambda}{\beta \cdot Vs} + td_\lambda} \quad (t/h_i) \tag{3}$$

3.1.1. Calculation and analysis of Work Productivity - W_Q

First parameter to be analyzed is Work Productivity W_Q. Results gained from formula (3) are shown in Table 2. For each influential parameter (or exploitation coefficient) we have appropriated 6 input values based from result gained and measurements in practice, and these values are implemented for calculation of W_Q, based in formula (3). Results are given in Table.3. Values of parameters in bold are values shown in Table.2, and other values are appropriated from experience and measurements in the field.

α	W_Q	ρ	W_Q	γ	W_Q	β	W_Q	q (t)	W_Q	Vs (km/h)	W_Q	Kst_λ (km)	W_Q	td_λ (h/trv)	W_Q
0.48	*0.865*	0.48	*0.759*	0.62	*0.894*	0.4	*0.921*	20	*0.880*	40	*0.961*	58	*1.321*	2.5	*1.099*
0.52	*0.938*	0.52	*0.822*	0.66	*0.952*	0.45	*0.982*	21	*0.924*	42.5	*0.933*	63	*1.280*	**3.0**	*1.02*
0.56	*1.02*	0.56	*0.885*	**0.7**	*1.02*	**0.49**	*1.02*	22	*0.968*	**45.2**	*1.022*	**68**	*1.242*	3.6	*0.934*
0.6	*1.082*	0.6	*0.949*	0.74	*1.067*	0.55	*1.086*	23	*1.012*	47.5	*1.05*	73	*1.206*	4.1	*0.869*
0.64	*1.154*	**0.64**	*1.02*	0.78	*1.125*	0.6	*1.13*	**24**	*1.056*	50	*1.077*	78	*1.171*	4.6	*0.812*
0.68	*1.226*	0.68	*1.075*	0.82	*1.183*	0.65	*1.171*	25	*1.100*	52.5	*1.102*	83	*1.139*	5.1	*0.762*

Table 3. Values of work productivity W_Q (t/h) in relation with various coefficients of exploitation of vehicles fleet

Results of gained coefficients gives a clearer view of where to make a change during the planning of the transport of goods in order to have the cost of transportation as less as possible [6].

In Figure 3 is given diagram of variation of *Total Productivity - W_Q* for each exploitation coefficient, based on Table 3, and curves are given based on the trend of these values.

In horizontal axes are given 6 values of each exploitation coefficient, and in vertical axes are results of W_Q. Dotted line A-A represents average value of total productivity W_Q (t/h), as given in Table.2. Based on Graphs in Figure.3 can be concluded:

a) Higher Exploitation coefficient of vehicles fleet (α) gives higher work productivity W_Q expressed in t/h ,
b) Higher Exploitation coefficient of travel distance (ß) gives higher work productivity W_Q,
c) Exploitation coefficient of vehicles fleet day (ρ) can be increased, if lost hours of work can decreased. This will lead to improved transportation processes,
d) If Static coefficient of vehicle utilization (γ) can be increased, work productivity W_Q can further increase,
e) Higher Useful carrying capacity of vehicle (q) gives higher work productivity W_Q,
f) During transportation, with higher average travel speed (V_s) will result in higher work productivity W_Q,
g) Higher Average transportation distance with cargo (**Kstλ**) will result in higher useful carry of vehicle,
h) Lost times during travel with cargo (**tdλ**) are in negative relation with productivity. Higher lost time decrease the work productivity W_Q.

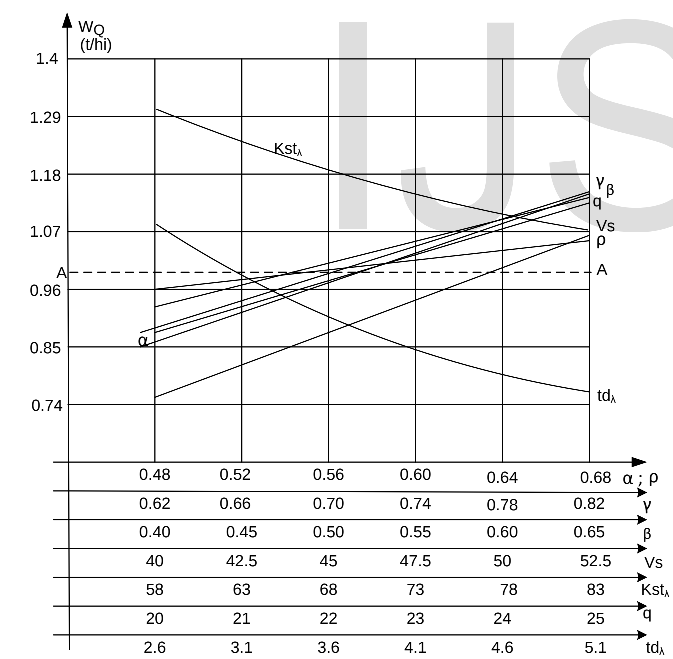

Figure 3. Diagram of Total productivity $\mathbf{W_Q}$ *in relation with exploitation coefficients of vehicles fleet*

Values 5 and 6 of exploitation coefficients give best results for W_Q. This concludes that transportation of cargo with this type of trucks (Q = 24 tons) should aim to these values for optimal transportation results.

Based on the calculations obtained, optimal value of *Total productivity* is W_Q = 0.97 (t/h) shown with broken lines of axis A-A (Fig.5) [2], [9].

3.1.2. Calculation and analysis of Work Productivity – W_U

In Table 4 are presented values of travel work productivity W_u calculated by the formula:

$$W_U = \frac{\alpha \cdot \rho \cdot \varepsilon \cdot q}{\frac{1}{\beta \cdot Vs} + \frac{td_\lambda}{Kst_\lambda}} \ (tkm/h_i) \qquad (4)$$

Based on Formula (4) and methodology of analysis given above for W_Q, in Table.4 are given results of W_U *(tkm/h$_i$)*, in relation with each exploitation coefficient. For analysis purposes are appropriated also 6 values for each parameter. Results in Table.4 give us a clearer view of where we need to make a change when planning the transport of cargo in order to have the costs of transportation as less as possible. [11]

α	W_U	ρ	W_U	ε	W_U	β	W_U	q (t)	W_U	Vs (km/h)	W_U	Kst_λ (km)	W_U	td_λ (h/try)	W_U
0.48	59.73	0.48	52.38	0.62	61.944	0.40	63.767	20	59.100	40	66.452	58	65.268	2.5	75.871
0.52	64.71	0.52	56.747	0.66	65.406	0.45	67.962	21	62.055	42.5	68.619	63	68.160	**3.0**	69.712
0.56	69.69	0.56	61.112	**0.70**	69.937	**0.49**	71.738	22	65.010	**45.2**	70.667	**68**	70.838	3.6	64.478
0.60	74.67	0.60	65.478	0.74	73.933	0.55	75.154	23	67.965	47.5	72.607	73	73.325	4.1	59.976
0.64	79.64	**0.64**	69.843	0.78	77.929	0.60	78.260	**24**	70.920	50	74.445	78	75.639	4.6	56.061
0.68	84.62	0.68	74.208	0.82	81.926	0.65	81.095	25	73.875	52.5	76.191	83	77.799	5.1	52.626

Table 4. Values of travel work productivity W_U (tkm/h) in relation with exploitation coefficients of vehicles fleet

In Fig.4 are given diagrams of variation of *Total Productivity – W_U,* also based on results in Table 4, for 6 values of each of 8 exploitation coefficients, and curves are given based on the trend of these values.

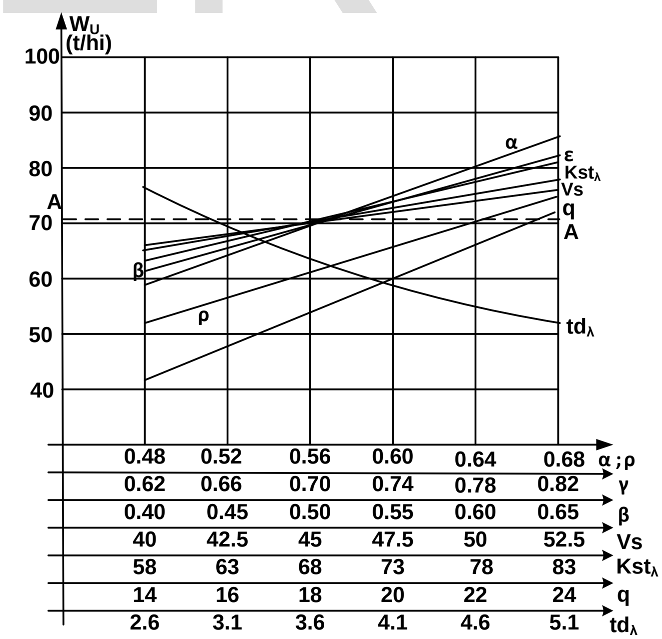

Figure 4. Diagram of various values of Total productivity $\mathbf{W_U}$ *in relation with exploitation coefficients of vehicles fleet*

Similar to conclusions in paragraph 3.1.1 and based on results in Table 4 and Figure 7, values 5 and 6 of parameters gives best results for W_U. This concludes that transportation of cargo with this type of trucks (Q = 24 tons) should aim to these values for optimal transportation results.

Based on calculations and graphs, the broken lines of axis A-A (Fig.7) is the average value of results of parameters. This is the optimal value of the Total Productivity W_U. It's value is W_U = 70.5 tkm/h [2], [9].

3.2. Price of cargo transportation per ton - ϑ_Q

The formula for calculating the transportation price of the goods per ton ϑ_Q is [2],[6]:

$$\vartheta_Q = \frac{1}{\gamma \cdot q}\left[\frac{\vartheta_s \cdot Kst_\lambda}{\alpha \cdot \rho \cdot \beta \cdot V_s} + \frac{\vartheta_s . td_\lambda}{\alpha \cdot \rho} + \frac{\vartheta_p \cdot Kst_\lambda}{\beta}\right] \qquad (€/t)$$

Coefficients in the formula are:

$\vartheta_s = 29.68$ *(€/hi)* - Cost in € per inventory hours

$\vartheta_p = 3.46$ (€/km) - Cost in € per kilometer

So far we have calculated influential indicators of the exploitation of the vehicles fleet. It is important that these results are also accounted for as a financial indicator, in which case we will see the possibility of economy in the case of transport of goods with the aim to reduce the cost as much as possible, and that the price of the goods is as small as possible, since it will have an effect on the final price of the goods when selling to the consumer.

In the six presented cases above, from the preliminary calculations for each coefficient of utilization of vehicles fleet, we separately obtained various results, and from the information we have achieved (from the transportation company), price of costs per inventory hour υ_s and the cost price per kilometer υp, we made the calculation based on formula (5). Results obtained are presented in Table 5, where we can see the value of the price for transported goods per ton υ_Q.

Table 5 shows the results of cost price (euro) for the transport of goods per ton (€ / t), based on the calculation by the formula (5), depending on the different values of the indicators - the coefficients of the exploitation of the vehicle fleet.

α	υ_Q	ρ	υ_Q	γ	υ_Q	β	υ_Q	q (t)	υ_Q	Vs (km/h)	υ_Q	Kst$_\lambda$ (km)	υ_Q	td$_\lambda$ (h/trv)	υ_Q
0.48	62.91	0.48	67.73	0.62	64.95	0.40	67.23	20	69.03	40	59.48	58	51.14	2.6	55.59
0.52	60.26	0.52	64.72	0.66	61.01	0.45	61.35	21	65.74	42.5	58.51	63	54.31	**3.0**	54.98
0.56	58.00	0.56	62.14	**0.7**	57.53	**0.49**	56.64	22	62.76	**45.2**	57.64	**68**	57.49	3.6	60.37
0.60	56.04	0.6	59.90	0.74	54.42	0.55	52.80	23	60.03	47.5	56.86	73	60.66	4.1	62.75
0.64	54.32	**0.64**	57.94	0.78	51.63	0.60	49.59	**24**	57.53	50	56.16	78	63.83	4.6	65.14
0.68	52.81	0.68	56.21	0.82	49.11	0.65	46.88	25	55.23	52.5	55.01	83	67.01	5.1	67.52

Table 5. Price per ton of transported cargo, depending on different values of the indicators - the coefficients of the exploitation of the vehicle fleet

In Fig. 5 is given the diagram of *price per ton of transported cargo* – $\boldsymbol{\upsilon_Q}$ (€/t) for 6 values of each influential indicator-coefficients of the exploitation, also based on results in Table 5, and curves are given based on the trend of these values.

According to results shown in Graphs of Fig.5, dotted line A-A represents average value of *Price per ton of transported cargo* - $\boldsymbol{\upsilon_Q}$, as given in Table.5.

Based on Table 5, Graphs in Fig.5 and methodology of analysis for $\boldsymbol{\upsilon_Q}$ (€/t), best results of $\boldsymbol{\upsilon_Q}$ are gained for values 4, and above 5 and 6 of coefficients of the exploitation.

In horizontal axes are given 6 values of each coefficient of the exploitation, and in vertical axe are results of $\boldsymbol{\upsilon_Q}$. Based on the calculations obtained, optimal value is $\boldsymbol{\upsilon_Q}$ = 57.5 (€/t), shown with broken line of axis A-A.

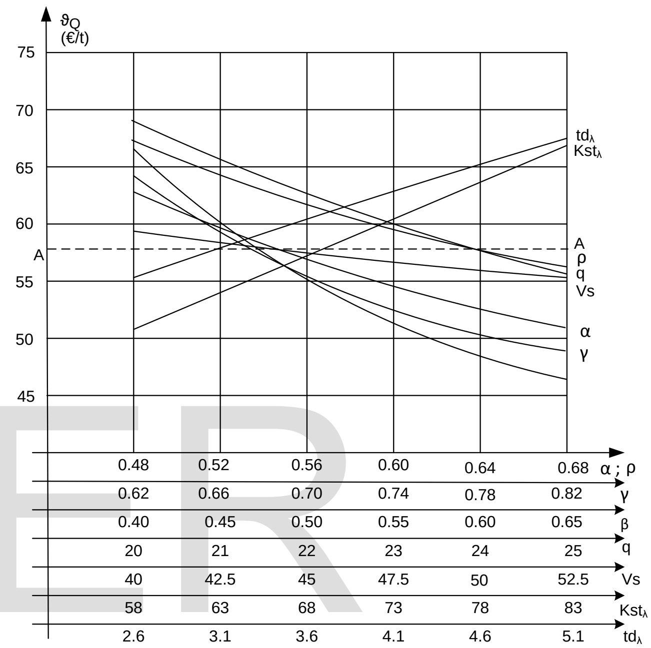

Figure 5. Variations of price per ton of transported cargo depending on on the change of the indicators of the exploitation of the vehicle fleet ϑ_Q

3.3. Price of cargo transportation per kilometer - ϑ_{AK}

The formula for calculating the transportation price of the goods per kilometer is [2], [6]:

$$\vartheta_{AK} = \frac{\vartheta_s}{\alpha \cdot \rho}\left[\frac{1}{V_s} + \frac{td_\lambda \cdot \beta}{Kst_\lambda}\right] + \vartheta_p \qquad (6)$$

Another indicator when examining the best use of the vehicles fleet is the finding of the price per kilometer of the trip ϑ_{AK} which is required by the transport service providers to be as small as possible, and it has an impact on the final product price which is offered to the customer.

Based on this, there are achieved many calculations and measurements in the field of the exploitation of the vehicles fleet provided by transportation providers. Therefore, based on what was said before, from the total of 6 reviewed cases, the values we have gained are used for the calculations based on formula (6).

By changing the values of vehicle utilization indicators we gain different values of ϑ_{AK} which enables us, after comparison and analysis, to choose methods - routes which will be more cost-effective. After calculations, the values obtained are presented in in tabular form in Table 6 and by diagram in Figure 6.

α	υ_{AK}	ρ	υ_{AK}	β	υ_{AK}	Vs (km/h)	υ_{AK}	Kst_λ (km)	υ_{AK}	td_λ (h/trv)	υ_{AK}
0.48	7.605	0.48	8.189	0.40	6.635	40	7.192	58	5.252	2.6	6.722
0.52	7.286	0.52	7.825	0.45	6.812	42.5	7.075	63	5.249	**3.0**	7.010
0.56	7.013	0.56	7.135	**0.49**	6.988	**45.2**	6.970	**68**	5.247	3.6	7.299
0.60	6.776	0.6	7.243	0.55	7.165	47.5	6.876	73	5.246	4.1	7.587
0.64	6.569	**0.64**	7.006	0.60	7.341	50	6.792	78	5.244	4.6	7.876
0.68	6.384	0.68	6.798	0.65	7.518	52.5	6.716	83	5.243	5.1	8.164

Table 6. Variations of price per kilometer of transported cargo depending on the change of the indicators of the exploitation of the vehicle fleet

In Fig.6 is given a diagram of of price per ton of transported cargo – υ_{AK} (€/km) as a summary of results presented in Table.6, for 6 values of each coefficient of the exploitation. In horizontal axes are given 6 values of each influential parameter, and in vertical axe are results of υ_{AK}. Based on the calculations obtained, optimal value is $\upsilon_Q \approx 7$ (€/km), shown with broken line of axis A-A.

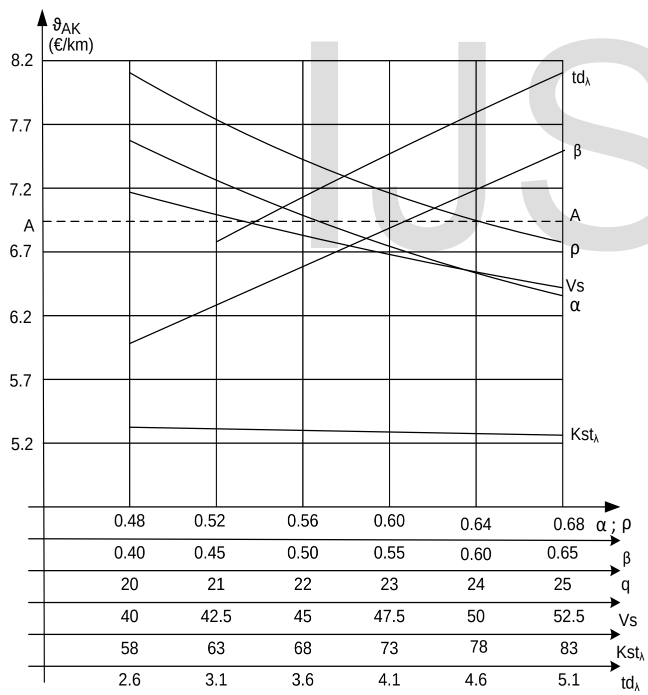

Figure 6. Variations of price per km of transported cargo depending on the change of the coefficients of exploitation of the vehicle fleet - ϑ_{AK}.

4. CALCULATION OF TRANSPORTATION COSTS

One of the many tasks of logistics is the calculation of transportation costs for the goods or travelers to be transported. This preliminary calculation based on the results obtained from the various characteristic indicators of the exploitation of the vehicle fleet enables us to have a more realistic view of the costs of transportation, and whether it is the optimal choice methodology or should be changed.

Based on the data obtained, results of calculations of the realized income per unit of transport can be achieved according to the formula [2], [7], [9]:

$$P = \vartheta_s \cdot 24 \cdot AD_i + \vartheta_p \cdot AK \ \ (€) \qquad (7)$$

After replacing the respective values, results of the income are:

$$P = 29.68 \cdot 24 \cdot 1098 + 3.46 \cdot 222082 = 1{,}550{,}531.08 \ (€) \qquad (8)$$

Based on this, calculations of data per unit of work can be done. This is obtained by calculating the ratio between the revenue and the indicator of the use of the vehicle fleet. Based on the following data can be presented the characteristic data depending on the indicator of the exploitation of the vehicle fleet expressed per unit of work in monetary value in Euro (€). Parameters (indicators) expressed in Euro (€) are:

- Inventory days expressed in Euro (€) - represents the ratio between the revenue and inventory days of the vehicle fleet. This is calculated according to the formula [2],[9]:

$$\vartheta_{AD_i} = \frac{P}{AD_i} \qquad (9)$$

- Work days expressed in Euro (€) – Represents the ratio between income and days capable of work of the vehicle fleet:

$$\vartheta_{AD_r} = \frac{P}{AD_r} \qquad (10)$$

- Kilometers per travel times expressed in Euro (€) - represents the ratio between the revenue and the total vehicle fleet route:

$$\vartheta_{AK} = \frac{P}{AK} \qquad (11)$$

- Kilometers per travel with cargo expressed in Euros (€) - represents the ratio between the revenue and the total vehicle fleet route with cargo. This is calculated according to the formula:

$$\vartheta_{AKt} = \frac{P}{AKt} \qquad (12)$$

- Tons per carried cargo expressed in Euro (€) - represents the ratio between the incomes and the entire load carried:

$$\vartheta_Q = \frac{P}{Q} \qquad (13)$$

- Tons per kilometer expressed in Euro (€) - represents the ratio between the income and the realized cargo transport work of the vehicle fleet:

$$\vartheta_U = \frac{P}{U} \qquad (14)$$

- Inventory hours expressed in Euro (€) - represents the ratio between the revenue and the inventory hours of the vehicle fleet.

$$\vartheta_{AH_i} = \frac{P}{AH_i} \quad (15)$$

- Work hours expressed in Euro (€) - represents the ratio between the revenue and the work hours of the vehicle fleet.

$$\vartheta_{AD_r} = \frac{P}{AD_r} \quad (16)$$

Based on the values obtained from the preliminary calculations, according to the respective formulas, can be obtained values of price of revenues of transportation service per work unit that are presented in the Table 7 below.

No.	Indicator	Price - (euro) €
1	Inventory days (ϑ_{AD_i})	**1,412.14**
2	Work days (ϑ_{AD_r})	**2,484.82**
3	Kilometers per travel time (ϑ_{AK})	**6.981**
4	Kilometers for travel with cargo (ϑ_{AKt})	**14.21**
5	Tons per carried cargo (load) (ϑ_Q)	**57.417**
6	Ton per kilometers (ϑ_U)	**0.838**
7	Inventory hours (ϑ_{AH_i})	**58.389**
8	Work hours (ϑ_{AD_r})	**159.727**

Table 7. Price of revenue for work unit

5. CONCLUSIONS

The case studied in this work deals with transport of goods from the production facility to three distribution centers. Authors have presented results for main influencing parameters of transport of beverages with heavy transportation vehicles. From results of selected parameters can be made analysis and give conclusions for optimization and improvement of transportation process of beverages depending on number of routes and number of vehicles in use. From the calculations shown in this work can be concluded that there is space for improvement of the transportation process in order to reduce costs.

Based on results, there is importance for increase of these parameters:

- Exploitation coefficient of vehicles fleet ***α = 0.5683*** is low. This means that not all vehicles are used daily for transportation of goods. It should be increased.

- Exploitation coefficient of travel distance ***β = 0.4912*** is low. It is possible to increase it by loading trucks during return trip.

- Exploitation coefficient of work time ***δ = 0.5051*** can increase with shortening the time of loading and unloading of trucks, and time of road travel.

- Static coefficient of vehicle utilization ***γ=0.701*** and Dynamic coefficient of vehicle utilization ***ε=0.706*** can be increased for 10%. These coefficient means that vehicle is not loaded with its full loading space and capacity.

In the graphs presented in the work are shown which values of exploitation coefficients for each case should be selected in order to achieve optimal result of transportation of goods and optimal results of transportation costs.

This process can be reviewed by the offered methodology of the transport company, as this company is contracted by the Beer Factory. It should find transport methods in order to reduce the price of the supply for transport and thus influence in the formation of the best final price of this product. This is also the demand of the brewing factory.

Based on Conclusion about the necessity of increase of exploitation coefficients as influential parameters mentioned above, it is possible that transportation costs can be reduced, which could give positive effects in decrease of the price of beer delivered to final consumer.

This work can be extended also for bigger companies that have larger number of trucks and higher volume of goods transportation.

As a future work can considered the possibility of analyzing transportation of canned food and packed food based on parameters analyzed in this work.

NOMENCLATURE

Other parameters from Table1 and Table 2, are:

Q (t) – Carried cargo in tons,
Q – Carried cargo in kg,
γ - Static coefficient of vehicle utilization,
A_i – number of inventory vehicles of the vehicle fleet,
D_i – number of inventory days or calendar days of one inventory transportation unit in the vehicle fleet system or its subsystems,
A_r – number of vehicles in work,
D_r – number of working days ,
AKt- road traveled by all loaded trucks ,
AKp- road traveled by all trucks without load,
AKn - null kilometers,
q – useful carrying capacity of vehicle,
$z_{\lambda\overline{AB}}$ - Route A – B, number of turns for carrying load (goods)
$z_{\lambda\overline{BC}}$ - Route B – C, number of turns for carrying load (goods),
$z_{\lambda\overline{BD}}$ - Route B - D number of turns for carrying load (goods),
$Q'_{\overline{AB}}$ – Volume of goods carried in the route A-B,
$Q'_{\overline{BC}}$ – Volume of goods carried in the route B – C,
$Q'_{\overline{BD}}$ - Volume of goods carried in the route B – D,
AKn - nullti road traveled during one travel period ,
AK - Total travelled road during one travel period,
AHw – Time (vehicle hours) spent in motion by all vehicles (trucks),
AHr - Work time for all vehicles (trucks),
AKt- Total travelled road of trucks with load,
Az_λ- number of accomplished routes with load,
L – distance traveled,
T_{0I}, T_{0II}, T_{0III} – Time of travel cycle for transportation roads I, II or III,
$z_{\lambda I}$, $z_{\lambda II}$, $z_{\lambda II}$ – number of possible turns for transportation of goods in transportation roads I, II or III,

n_{pI}, n_{pII}, n_{pIII} – number of turn backs in garage during travel work of vehicles ,
V_{st} – average speeds of loaded vehicle,
V_{sp} – average speeds of empty vehicle,
L_{GA}, L_{AB}, L_{GD}, L_{BG}, L_{DB} – distance of particular routes.

REFERENCES

[1]. Doçi, I. (2008). Logjistika e transportit të mallrave (Logistics of goods transportation), Faculty of Mechanical Engineering, Prishtina.

[2]. Buçinca, Q. (2004). Organizimi dhe ekonomika në Komunikacion (Organization and economics in Traffic and transport), Faculty of Mechanical Engineering, Prishtina.

[3]. Langevin A., Riopel D. (2005). Logistics Systems, Design and optimization, Springer.

[4]. Taylor G.Don: Introduction to logistics engineering, CRC Press, 2009.

[5]. Smith J.M.(2002). Logistics & the out-bound suply chain, Penton Press.

[6]. Seiler Th.(2012). Operative Transportation, Planning, Solutions in Consumer Goods Supply Chains, Springer.

[7]. Buhler A.(2013). Performance measurement systems in logistics organizations: Design, usage, and impact on organizational capabilities and competitiveness, WHU – Otto Beisheim School of Management.

[8]. Gamme N. (2015), Johansson M.: Measuring supply chain performance through KPI identification and Evaluation, Master's thesis, Chalmers University of Technology, Gothenburg, Sweden.

[9]. Powell W.B., Bouzaïene-Ayari B., Simão H.P.(2007). Handbook of Operations Research- Transportation, Elsevier B.V.

[10]. The evolution of today's brewery supply chain, (2015). SpringTide Consulting Ltd.

[11]. John D. Sterman (2000). Supply chain dynamics, the "beer distribution game" and misperceptions in dynamic decision making, *MIT System Dynamics Group*, McGraw-Hill Companies, USA.

[12]. Veronica Ablordeppey B.Ed (2012). **T**he transportation problem of a beverage industry: A case study of Accra brewery limited. (abl), Institute Of Distance Learning .