

COST CALCULATION IN ROAD FREIGHT TRANSPORT

Marjan Sternad

University of Maribor, Faculty of Logistics, Slovenia

E-mail: marjan.sternad@um.si

Received: May 21, 2019

Received revised: July 22, 2019

Accepted for publishing: July 25, 2019

Abstract

Cost management is important for every transport company. Increasing competition in road freight transport forces companies to cost-effectiveness, so they need to know their costs of carrying out the transport service. The article aims to illustrate the structure of costs in road freight transport and analyze the changes in fixed and variable costs for different annual kilometers traveled. Traditional accounting was used to calculate the total and average costs. In the research, we determined the changes in total and average costs for different annual kilometers, which are expected and comparable with other countries. From the transport company's point of view, the structure of costs is also important, and the finding that the highest of the costs are fuel, labor and toll costs. The research enables transport companies to understand the cost structure and provide opportunities for increasing competitiveness based on cost control. Further research is aimed at determining the cost structure of different types of transport vehicles and the changes of fixed and variable costs in the case of different mileage with using ABC costing methods.

Keywords: road freight transport, transport cost, total costs, average costs

1. INTRODUCTION

Road freight transport is an important factor in the economy of each country. Transport possibilities are one of major factors deemed to be of importance to multinational corporations in the decision-making processes followed when determining where to locate a logistics centre (Gajšek & Rosi, 2015). The production structure of GDP generates traffic and storage activity of more than 6% of added value, of which more than 50% is land transport, where road freight transport accounts for more than 80% (SORS, 2019).

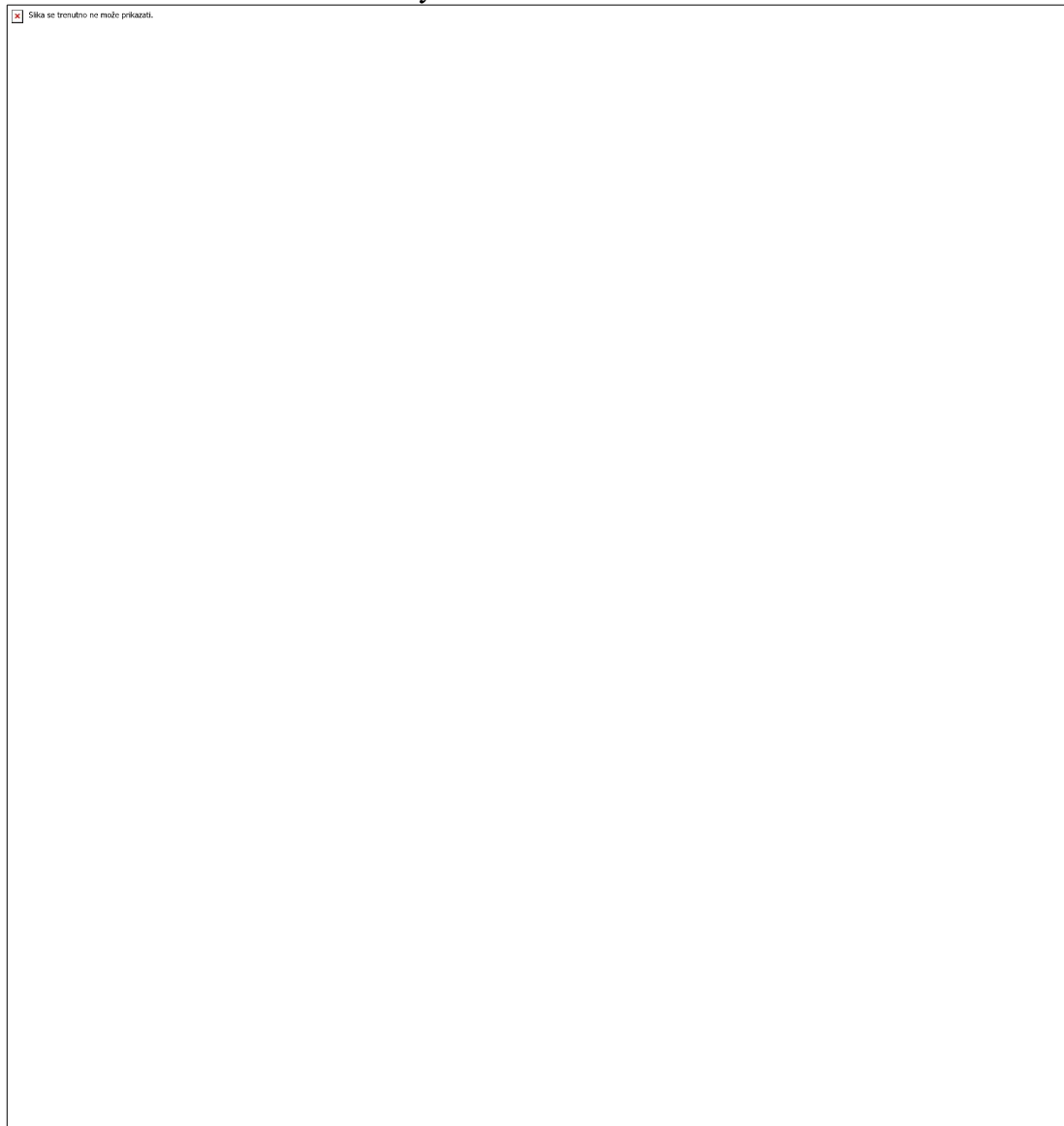
Theoretically, we divide the costs of the company on fixed and variable (eg. Rodrigue, 2017). The transport company usually incurs fixed costs even if the carrier does not carry out the transport work (Topolšek, Čižman, & Lipičnik, 2010). Fixed costs represent costs associated with the vehicle (depreciation, registration), and partly the costs associated with the driver. In addition, a fixed period is fixed also indirect costs of the company (for example, the costs of the company's management, financial services, commercials...) (e.g. Bokor & Markovits-Somogyi, 2015). From the point of

view of efficiency, fixed costs force us to ensure that transport companies carry out as much as possible productive work (as many ton-kilometers performed) as the increase in fixed-unit fixed costs increases.

However, it is important to emphasize that we are limited in this way with the capacities of production sources and legislation.

Variable costs with costs associated with increasing mileage. In the structure of variable costs, the most important are fuel costs, toll costs and labor costs (eg daily allowance, mileage surcharge). Fuel costs depend on the type of vehicle and the price of a liter of fuel. The cost of tolls differs between EU countries since various factors influence the setting of the price of tolls. For example, the toll in Germany includes the costs of air pollution, noise and infrastructure costs. The toll is also differentiated according to the emission classes of the engine and the permissible weight by vehicle classes.

Table 1. Toll classes in Germany from 1.1.2019



Source: Toll Collect

Total costs represent the sum of fixed and variable costs. Total costs increase with mileage, and the increase depends on the characteristics of variable costs, which can be rising, proportionate or decreasing (Rebernik & Širec, 2016).

From the point of view of business, the average cost of the completed kilometer is important, as they show the dependence of the total costs on the volume of operations. The average cost decreases with the volume of operations, which requires companies to maximize the utilization of the fleet. Cost control is not possible without knowing the full costs of the company (Sternad, 2018). For efficient operations, the company needs cost accounting that represents that part of the entire accounting system that monitors the costs for management decision-making and financial accounting (Hočevár, 2008). The incurrance of costs is always related to some purpose or cost driver (Bokor, 2009).

Cost allocation requires cost breakdowns at direct and indirect costs (Jacyna & Wasiak, 2015). The basic criterion for the breakdown of costs to direct and indirect (general) is whether these costs are in direct or indirect connection with the cost driver and are determined in accordance with the economy of operations.

Direct costs are those types of costs that can already be allocated to the cost driver at the time of their creation or the cost driver caused them (Reiche, 2017). Mostly, these costs are linked to carrying out transport activities and driving a freight vehicle. Indirect costs are those types of costs caused by two or more cost drivers. For indirect costs, it is primarily characteristic that they can not be directly allocated to an individual cost driver (Hočevár, 2008).

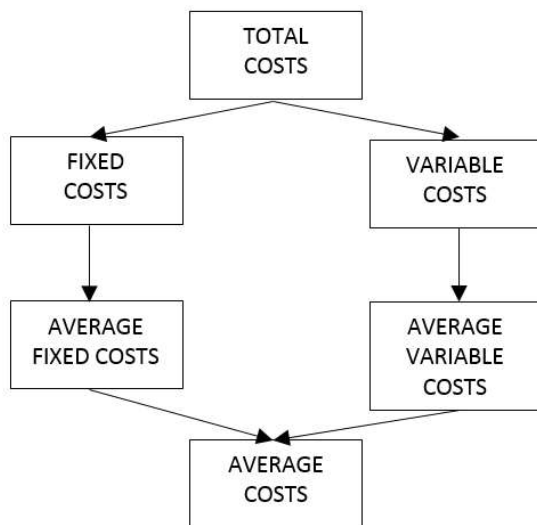
In addition to basic transportation, several transport companies perform other activities (storage, vehicle repair...). Therefore, it is necessary to determine the share of transport activity in the company. Also, transport companies have different fleets (by type of transport and capacity). If we determine the costs for a particular group of vehicles, indirect costs must be correctly allocated to individual vehicle groups (eg. Nurminen et al., 2009). The possible criteria for the division are the number of vehicles of each group or the annual kilometers performed if there are major differences between the vehicle groups.

In research, we focused on the analysis and structure of transport costs for trucks with a capacity of 24 tons. We simulated the change in the share of fixed and variable costs at various annual kilometers traveled.

2. METHODOLOGY

In the survey, we used the traditional cost estimation in Slovenia in accordance with the Slovenian Accounting Standards (hereinafter SAS, 2016). The research was conducted in 4 steps. Figure 1 shows the research model.

Figure 1. Research model



In the first step, we needed data on the vehicle (load capacity, average monthly transported mileage) and the number of vehicles in the company for the preparation of road freight transport calculations. Based on SORS data (2019) and relevant studies (Hočevár, 2008; Kot, 2015), we estimated the average monthly kilometers of 10.000 km. Different mileage scenarios were assumed for the analysis of cost changes: 8.000 km, 9.000 km, 10.000 km, 11.000 km and 12.000 km per month. We also assumed that the company has 10 identical vehicles with a capacity of 24 tons.

Costs in the calculation model are divided into direct costs related to the provision of transport services and indirect costs (e.g. Kovacs, 2017). Total vehicle costs over a period of one year are calculated using the equation:

$$TC = c_{dep} + c_{fuel} + c_{main} + c_{ins} + c_{reg} + c_{toll} + c_{sal} + c_{ind},$$

where are

- c_{dep} – annual depreciation costs,
- c_{fuel} – annual fuel costs,
- c_{main} – annual maintenance costs,
- c_{ins} – annual insurance costs,
- c_{reg} – annual registration costs,
- c_{toll} – annual toll costs,
- c_{sal} – annual driver's labor costs,
- c_{ind} – annual indirect costs.

Direct costs are divided into three categories of costs: costs associated with the vehicle, the transport route, and the driver.

Costs related to the vehicle are the cost of depreciation, fuel cost, maintenance cost, insurance cost, and registration fee.

The cost of depreciation represents the replacement value of the underlying asset. Fixed assets are vehicles and trailers. In accordance with the SAS (2016), the depreciation method, annual depreciation rate, and amortization basis are determined at the beginning of amortization. In the research, the method of straight-line depreciation was chosen. Annual depreciation rates were determined on the basis of

the depreciation period. In the calculation of our own transport price, we assumed a depreciation period of 7 years for vehicles and 7 years for trailers. The depreciation basis of vehicles and trailers is the purchase value of fixed assets. In the research, we used an average vehicle purchase value of 80.000 EUR and an average trailer purchase value of 25.000 EUR. When calculating the depreciation basis, we took into account that the vehicle has a further 20% of the value after the expiry of the amortization period. The depreciation cost is calculated using the equation:

$$\begin{aligned} DB_v &= PV_v - RV_v, \\ DB_t &= PV_t - RV_t, \\ c_{dep} &= \frac{DB_v}{DP_v} + \frac{DB_t}{DP_t}, \end{aligned}$$

where are

DB_v – depreciation basis for vehicles,
 DB_t – depreciation basis for trailers,
 PV_v – vehicle purchase value,
 PV_t – trailer purchase value,
 RV_v – vehicle rest value,
 RV_t – trailer rest value,
 c_{dep} – annual depreciation,
 DP_v – vehicles depreciation period,
 DP_t – trailer depreciation period.

Fuel cost is a product of fuel consumption per kilometer and the price of fuel. We assumed that the average fuel consumption is 30 l / 100 km. The price of fuel on 25.4.2019 is EUR 1.04836 excluding VAT. We separately evaluated the average fuel consumption of AdBlue, which is 4 l / 1000 km. The average fuel price of AdBlue is 0.6 EUR excluding VAT.

$$c_{fuel} = \frac{FC}{100} \cdot P_{fuel} \cdot K,$$

where are

c_{fuel} – annual fuel cost,
 FC – fuel consumption,
 P_{fuel} – fuel price,
 K – annual kilometers.

Maintenance costs (c_{main}) include the cost of routine maintenance, repairs, cleaning and other costs associated with maintaining the fleet. The cost of maintenance was also included the cost of the tires. The cost of maintenance is increasing with mileage, which is why the study took into account the proportional increase in maintenance costs with kilometers traveled, therefore, the study suggested that the average maintenance cost for a transported monthly distance of 8.000 km amounts to 5.000 EUR and for a transported monthly distance of 12.000 km it is 7.000 EUR.

The cost of insurance (c_{ins}) includes the cost of basic insurance, casco insurance, carrier liability insurance and other costs associated with insurance of rolling stock. In the research, we took into account that the average value of the insurance was 3.500 EUR.

The registration fee (c_{reg}) for a vehicle includes the cost of the technical inspection, the annual levy, the renewal of registration and other costs associated with the registration of the rolling stock identified by the undertakings. The average registration fee is 800 EUR.

Costs related to the transport route are the cost of tolls, tunnels, parking and other costs arising on the transport route. The cost of tolls (c_{toll}) is increasing with the distance traveled, so we suggested in the research that the average annual cost for road vehicles at a monthly distance of 8.000 km is 22.000 EUR, and for a transported monthly distance of 12.000 km it is 30.000 EUR. The remaining costs in this group due to the minimal impact on the cost structure were not captured.

Driver-related costs include driver's gross salary, daily allowance, recourse, travel expenses, food and other costs (education, licenses, medical examinations ...). The labor cost (c_{sal}) was also divided into a fixed part, which is related to the existing legislation and the variable part, which is related to the kilometers traveled. The value of the fixed part of the salary is 12000 EUR, and the variable part is 0,125 EUR / km.

Indirect costs (c_{ind}) are costs incurred at the level of the whole enterprise. When an enterprise has only a transportation activity, all costs are directly related to the performance of the transport activity. We assumed that a company with 10 vehicles has an average of 150.000 EUR of indirect costs.

In the second step, we divided the costs into fixed and variables. On the basis of the relevant studies (Bokor & Markovits-Somogyi, 2015) and our own experience, we included depreciation, insurance, registration, part of labor costs and indirect costs among fixed costs. Among the variable costs, we included the costs of fuel, maintenance, tolls and part of labor costs, depending on the mileage.

In the third step we calculated the average fixed and average variable costs by means of the equations:

$$AFC = \frac{FC}{K},$$
$$AVC = \frac{VC}{K},$$
$$TC = FC + VC,$$

where are

AFC – average fix costs,

FC – fix costs,

AVC – average variable costs,

VC – variable costs,

TC – total costs,

K – annual kilometers.

In the fourth step, we calculated the average cost per kilometer using the equation:

$$AC = AFC + AVC,$$

where is

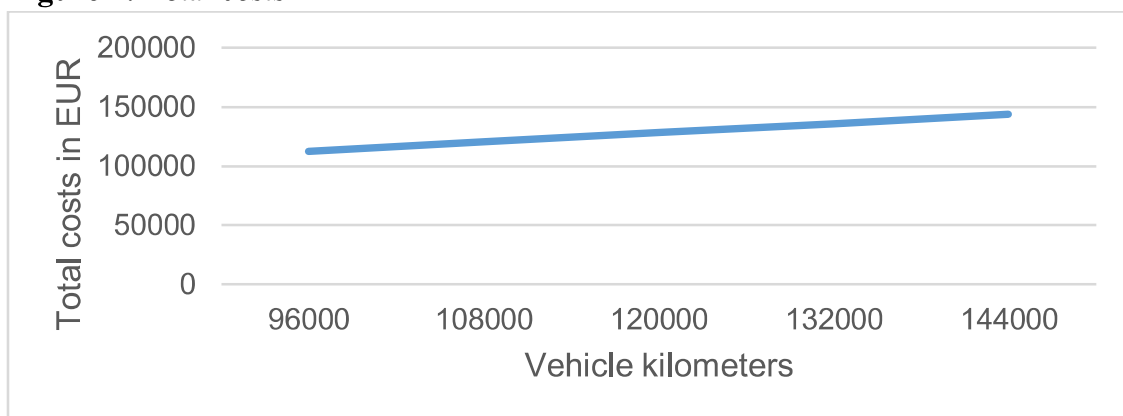
AC – average costs.

In the research, we also observed and graphically depicted the changes in costs in the case of different kilometers.

3. RESULTS

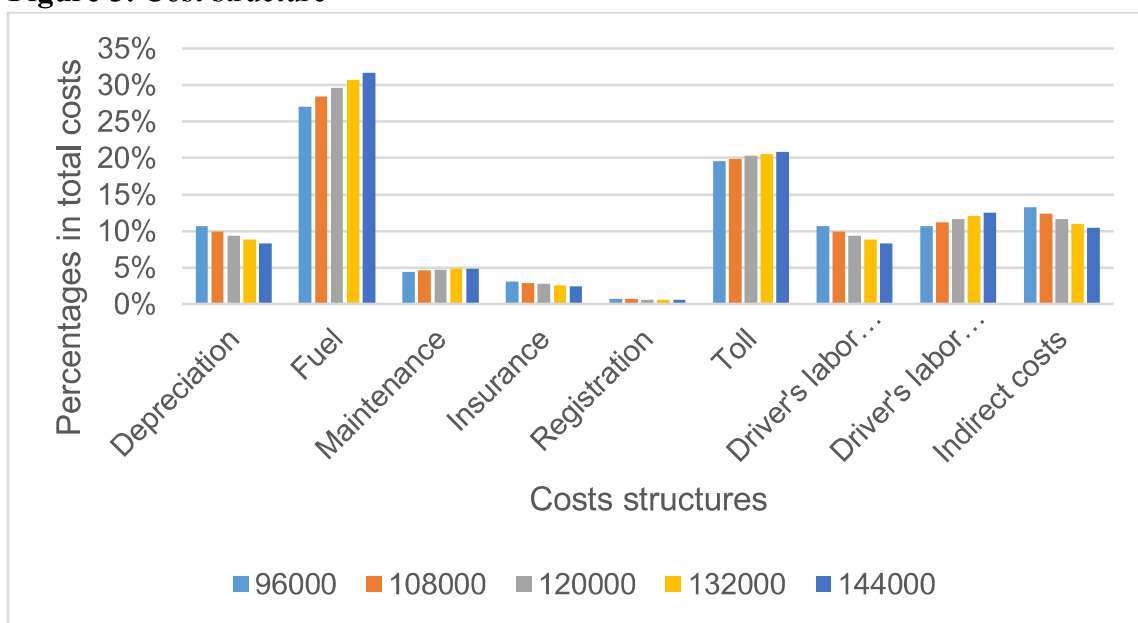
The total cost of freight transport increases with increasing distance. In the research, we assumed that costs were increasing evenly, but in practice, due to additional unforeseen costs, the costs may increase exponentially. Figure 2 shows an increase in total costs.

Figure 2. Total costs



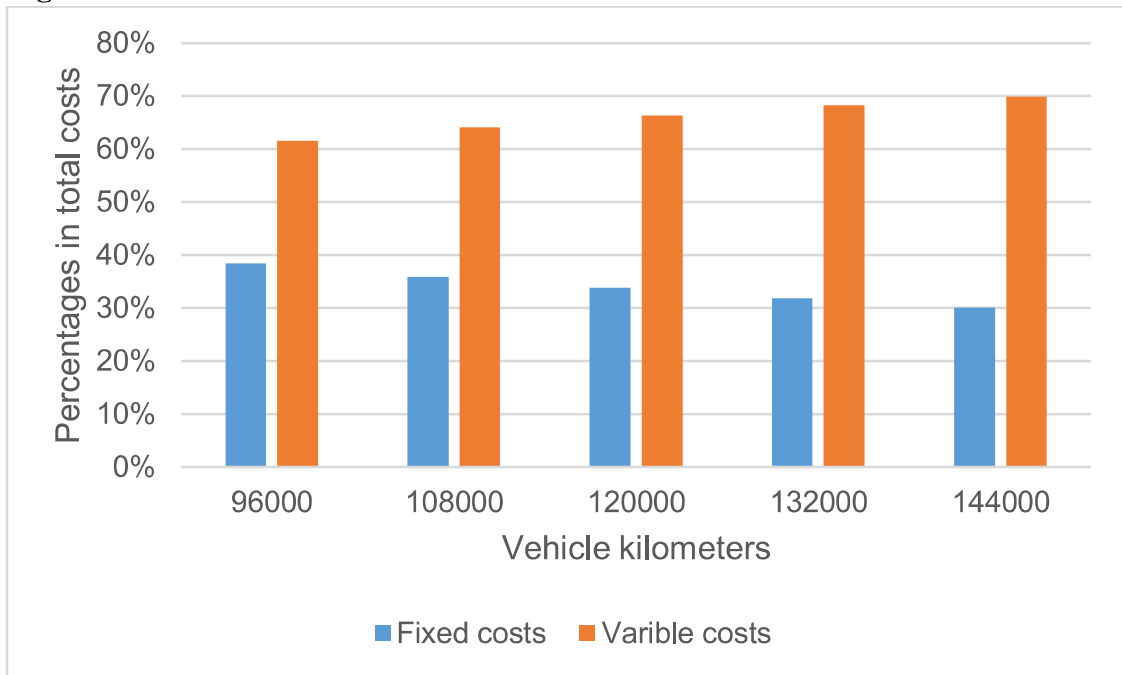
The largest share in the cost structure present fuel costs. With an annual mileage of 9.000 km, the fuel cost is 27% in total costs, and for the kilometers of 144.000 km, it is already 32%. The other highest cost is the cost of work divided into a fixed and variable part. With an annual mileage of 96.000 km, the total labor cost is 22% and for 144.000 km it is 21%, as the fixed part of the wage is falling faster than the variable increases. An important share in the cost structure represents a cost of tolls of around 20%. The lowest cost (1%) represents the cost of the registration fee. Figure 3 shows the changes in shares in the cost structure.

Figure 3. Cost structure



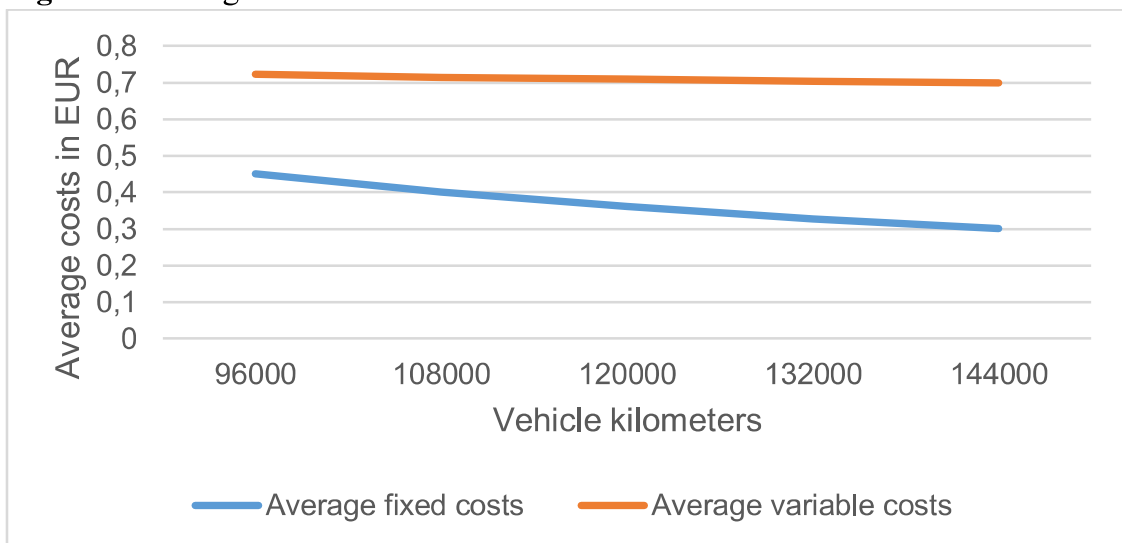
At 120.000 km, the share of the fixed costs is 34% and the variable is 66%. With less mileage, the share of fixed costs is increasing (at 96.000 km is a share of 38%), with higher mileage, the share of fixed costs is reduced to 30% at 144.000 km. Figure 4 shows the shares of fixed and variable costs in total costs.

Figure 4. Shares of fixed and variable costs



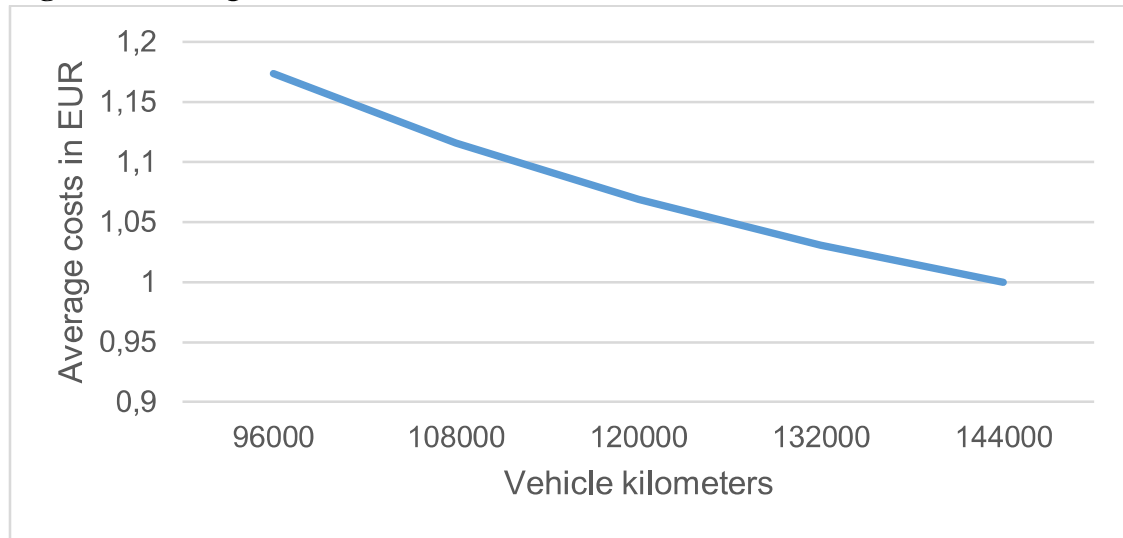
Since we assumed a proportionate increase in total costs, the average variable cost is around 0,70 EUR / km for different annual kilometers traveled. The average fixed costs are reduced from 0,40 EUR / km at 96.000 km to 0,30 EUR / km at 144.000 km. Graphically, the average fixed and variable costs are shown in Figure 5.

Figure 5. Average fixed and variable costs



From the perspective of a transport company, knowledge of average costs (cost per kilometer) is needed. The average cost is the basis for determining the sales price of the transport service. The average cost excluding the calculated profit margin varies from 1.15 EUR / km at 96.000 km, to 1 EUR / km at 144.000 km. Graph of average costs is shown in Figure 6.

Figure 6. Average costs



4. CONCLUSION

Cost management is becoming very important for all transport companies, and rational organization of freight transportation on time from point A to B must be at minimal cost (Topolšek, Čižiūnienė, & Cvahte Ojsteršek, 2018). Competition primarily from the eastern countries is growing, and therefore knowledge of the own price of the transport service represents the competitiveness in the market and the direction to the markets, where we can get the highest added value with our costs.

Costs consist of fixed and variable costs. Fixed costs do not change with the kilometers traveled, and the achievement of lower average costs requires an annual score of as many kilometers as possible. Fixed costs range from 30 to 38%. Variable costs increase with mileage and represent up to 70% of total costs.

In the research, we determined the changes in total and average costs for different annual kilometers traveled, which are expected and comparable with other countries. From the transport company's point of view, the structure of costs is also important, and the finding that the bulk of the costs are fuel, labor and toll costs. Reducing fuel costs can be achieved by optimizing the truck's run and purchasing newer trucks that, in addition to saving on fuel costs, also allow for cost savings for tolls related to the type of engine (eg EURO 6). Due to the quality of transport services, savings in labor costs are almost impossible, but in practice (in Slovenia) drivers from other countries have significantly lower average wages than in Slovenia.

Further research is aimed at determining the cost structure of different types of transport vehicles and the changes of fixed and variable costs in the case of different

transported annual kilometers and using another accounting method (eg ABC costing).

5. REFERENCES

Bokor, Z. (2009). Implementation of activity-based costing in logistics. *Acta Technica Jaurinensis*, 2(3), p. 337-343.

Bokor, Z. & Markovits-Somogyi, R. (2015). Applying Activity-based Costing at Logistics Service Providers. *Transportation Engineering*, 43(2), p. 98-05.

Gajšek, B. & Rosi, B. (2015). Stakeholder differences in the understanding of inter-organizational concept content as a risk factor: The case for a logistics platform, *The International Journal of Logistics Management*, 26(1), p.107-127. DOI:10.1108/IJLM-06-2012-0040

Hočevar, M. (2008). Kalkulacija stroškov kamionskega tovornega prometa [available at: http://www.mzp.gov.si/fileadmin/mzp.gov.si/pageuploads/Razno/05_09_08_kalkulacije.pdf, access April 5, 2019]

Jasynaa, M. & Wasiak, M. (2015). Costs of road transport depending on the type of vehicles. *Combustion Engines*, 162(3), p. 85-90.

Kot, S. (2015). Cost structure in relation to the size of road transport enterprises. *Promet-Traffic&Transportation*, 27(5), p. 387-394.

Kovacs, G. (2017). First cost calculation methods for road freight transport activity, *Transport and Telecommunication*, 18(2), p. 107-117.

Nurminen, T., Korpunen, H. & Uusitalo, J. (2009). Applying the Activity-Based Costing to Cut-to-Lenght Timber Harvesting and Trucking. *Silva Fennica*, 43(5), p. 847-870.

Rebernik, M. & Širec, K. (2016). *Ekonomika podjetja*, 5th Edition, Ljubljana: IUS Software d.o.o.

Reiche, S. (2017). *A disaggregate freight transport model for Germany*. Springer.

Rodrigue, J. P. (2017). *The Geography of transport system*, 4th Edition, New York: Routledge.

Sternad, M. (2018). Metrics of logistics costs in Slovenian companies, *18th international scientific conference Business Logistics in Modern Management*, Davor Dujak (ed.) Faculty of Economics in Osijek, Osijek, 11 October 2018, p. 125-134.

SAS – Slovenian Accounting Standards 2016.

SORS – Statistical office of the Republic of Slovenia. 2019. Transport data [available at: <https://www.stat.si/StatWeb/en>, access April 15, 2019]

Topolšek, D., Čižiūnienė, K. & Cvahte Ojsteršek, T. (2018). Defining transport logistics: a literature review and practitioner opinion based approach. *Transport*, 33(5), p. 1196-1203.

Topolšek, D., Čižman, A., & Lipičnik, M. (2010). Collaborative behaviour as a facilitator of integration of logistic and marketing functions – the case of slovene retailers. *Promet*, 5(22), p. 353-362.

Tool Collect [available at: https://www.toll-collect.de/de/toll_collect/bezahlen/maut_tarife/maut_tarife.html, access April 15, 2019].