Economic assessment of construction of the roadside service facilities

Olga Makovetskaya-Abramova[1], *Andrey* Ivanov[1], *Yuriy* Lazarev[1], *Mariya* Shakhova[1], *Artem* Rozov[1]

[1]Peter the Great St. Petersburg Polytechnic University, Polytechnicheskaya, 29, 195251, Saint Petersburg, Russia

Abstract. There is a strategy of the E-95 road «Pskov» infrastructure improvement and some practical recommendations for implementation of the plan in this work. The main purpose of the article is infrastructure improvement of the section of the Federal highway, for example, some new workplaces can be created, moreover, comfort and safety increasing can improve people's quality of life. Such objects as petrol-filling stations and service stations are essential elements for the modernization of the roadside infrastructure at this highway. It is offered to apply a typical business plan and calculate the cost of every type of such constructions taking into account the requirements of regulatory documents. There is a necessity for the construction of 2 new service stations and 9 new petrol-filling stations, in accordance with the analysis of the roadside infrastructure. Amount and nomenclature of technological equipment of stations are thoroughly worked out and calculated by the authors of the statement, moreover, writers calculate power and transportation and installation cost. The results of the survey have practical importance and they can be recommended for improving the roadside structure. The results of the survey are optimal service delivery project for the road users in case of the transport load on the section of the Federal highway.

1 Introduction

It is claimed to be a serious problem to create a worthy roadside service in our country nowadays. It is discussed widely by specialists, businessmen and mass media [1-5]. Existing roadside infrastructure facilities are analysed for compliance with international standards. The classifier and criteries have been developed for determination the frequency of location of the objects. Industry experts offer to make changes in the actual normative documents. Roadside service must provide comfort and safety [6 - 9] for all road users.

Positive experience of creating a quality service was thoroughly investigated by authors when they made calculations and made strategy for roadside infrastructure improvement. Despite the facts, there is a process that can eliminate any problems with the roadside service in our country. Legislative establishment are required to provide support to small and medium-sized businesses. So, there is a necessity to provide assistance to creation objects where truckers can have a rest and take some services and assistance. Obviously, drivers will drive a truck carefully and driver's attention will not dissipate due to fatigue if

they will have possibility to eat well, to get a good night's sleep, to read newspapers or watch a film [3].
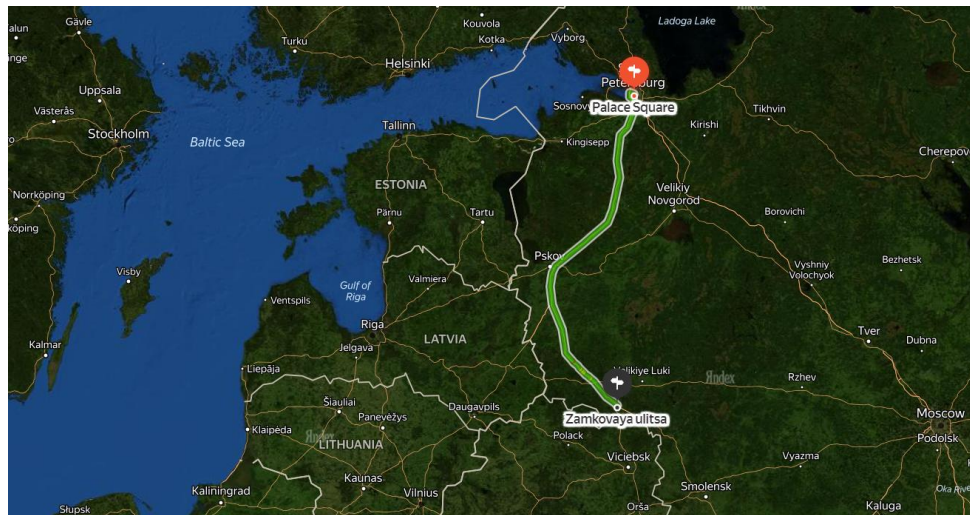
2 Methods

Fig. 1. Route E-95.

The hybrid road map is shown in the figure 1, taking into account the traffic intensity of cars. There is a necessity in a service station for 9 posts. ONTP 01-91 includes requirements for design service stations. According to these requirements, annual scope of work responds to the power of service station and equals to 40,000 person-hours. At the same time determination of the number of vehicles coming the service station in must consider the number of vehicles exiting the service station. This number depends on the distance between stations. There is a dependence between number of vehicles exits and a distance between stations in the table 1.

As the average distance between the planned stations equals to 100 km, so let's take the number of vehicles exits equal to 1.5 vehicles to 1,000 traffic intensity units. The traffic intensity equals to 22,158 vehicles a day on the route E-95, so we can calculate, how much vehicles will stop at the service station. Consequently, a number of vehicles exits and number of serviced cars will be equal to 33 vehicles a day. This number we will use for a payback period calculation.

Table 1. The number of vehicles exits, measure: in % of 1,000 traffic intensity units according to the distance between service stations.

Distance between service stations	Number of vehicles exits, % of traffic intensity units
50	1.0
100	1.5
150	2.0
200	2.5
250	3.0
300	3.5

The project of the service station requires some equipment for service and repair. Main equipment and its cost presented in the table 2.

Table 2. Main equipment.

Name	Amount, things	Unit price, EUR	Total price, EUR
Car lift П2-07 (P2-07)	7	1,525	10,675
Workbench ЛВ-1Т.05 (LV-1T.05)	8	175	1,400
Tire fitting machine Red Line Premium TCR26IT_220	1	1,098	1,098
Balancing machine RWB-120 Rudetrans	1	653	653
Diagnostic scanner-tester Bosch KTS 540	1	130	130
Toolbox ALK-8016F Licota	7	153	1,071
High pressure washer Karcher K 7 Compact 1.447-002	1	1,451	1,451
Amount			16,478

Some equipment require delivery and special installation, it will bring more costs of the enterprise. For example: car lift, tire mounting and balancing machine. The cost of the transportation and installation is 10% of the cost of the equipment. Consequently, the sum of the listed equipment will be equal to 1,242 EUR.

Let's use the formula (1) to identify the required area for the production room $F_{TO\&TR}$:

$$F_{TO\ и\ TR} = f_a \cdot x_R \cdot K_P, \tag{1}$$

where: f_a – the area occupied by the car, m^2;

x_R – the number of posts TO&TR for various types of work;

Kp – the density coefficient of equipment placement (it is equal to 4-5 for two-way placement of posts).

Consequently, area for the production room for the service station will be equal to:

$$F_{TO\&TR} = 9 \cdot 9 \cdot 5 = 405\ m^2;$$

Administrative and support facilities are also should be designed at the service station [10-11]. We will accept these rooms in accordance with individual requirements. Areas of these rooms are shown in the table 3.

Table 3. Areas of auxiliary rooms of the projected service station.

Room type	Room area, m^2
Client area	54
Cash area	7
Administrative premise	60
Toilet	3
Hall	13
Rest room	24
Sanitary unit	13
Cloakroom	15
Hall	5
Security post	9
Total area:	203

As a result, we need a 608 m^2 area for construction of the service station.

We should rent a land for our roadside service stations because this land cannot be sold as property, taking into account the requirements of legal documents. At present, the

average cost of renting land is 58 EUR per month per m^2 for roadside land. Consequently, we need 35,303 EUR per month for land rental.

Taking into account the cost of necessary construction materials, the cost of construction of 1 m^2 of the building is assumed to be equal 580 EUR per m^2. So, the cost of the whole building is assumed to be equal 353,027 EUR. In that way, 742,928 EUR is required for the construction of the new service station.

Let's calculate cost recovery for this object, so we need calculate estimated revenue per year from the service delivery. We need to multiply the annual amount of work by the cost of the standard hour. It is very important to provide correct price of standard hour not higher than other businesses to ensure competitiveness. The average price of standard hour is equal 28 EUR. Consequently, the income of the station can be equal 1,103,208 EUR per year.

There is a normal profitability near 25% for service stations. Let's calculate the cost per person-hour (S) with the formula (2):

$$S = C_{AV}/(1 + \frac{R}{100}),$$
(2)

where: C_{AV} – the average market price of labor costs for providing the service; 28 EUR;
R – profitability.
Consequently, the cost of a person-hour will be 22 EUR.

Further let's calculate the total current expenses for the year according to the formula (3):

$$P_{tot} = S \cdot T_{ser},$$
(3)

where: P_{tot} – total current expenses for the year, EUR;
T_{ser} – annual amount of work for the service, 40,000 person-hour.
Consequently, the total current expenses will be equal to 882,566 EUR.

Taking into account these conditions, the profit will be equal to 1,103,208 EUR – 882,566 EUR = 220,642 EUR.

Further, let's calculate payback period of this service station. So, we will use the formula (4):

$$T = C_{of}/P_R,$$
(4)

where: C_{of} – cost of construction;
P_R – profit from services.
T = 742,928 / 220,642 = 3.

3 Results

Gas stations are an essential part of a modern technological society, but they also have a lot of risks and threats for employers and environment [12-14]. The calculation of the petrol-filling station construction on the exploring section of the road is proposed. It is rather difficult to compete with existing gas stations because the petrol-filing station network is quite developed. Therefore, the purchase of a gas station franchise is quite actual option. Generally, the cost of the franchise will be calculated individually for each case, however, the necessary financial expenses for opening the petrol-filling station are well known.

There is the information about the average cost of the fuel in 2018-2019 year from such electronic resources as the website of oil producing and processing companies. For example, let's consider such a famous Russian brand as Lukoil. First of all, it is necessary to pay a lump sum 6,817 EUR for the construction of a petrol-filling station under the brand

Lukoil on the federal highway. Thereafter, it will be possible to sell fuel under this brand. The process of construction of a petrol-filling stations includes several stages:

- Installation of gas station pumps;
- Construction of the petrol-filling station;
- Construction of a canopy;
- Purchase of an additional equipment for the petrol-filling station;
- Gentrification of the territory;
- Purchase and installation of billboards, flags and other advertising constructions.

These expenses become the responsibility of the franchisee as soon as the lump sum payment is made. First of all, it is necessary to invest 29,039 EUR for the purchasing and installation of gas stations. This operation consists of purchasing and installation of fuel distribution columns and fuel storage tanks. Secondly, it is necessary to invest 26,125 EUR for the construction of the petrol-filling station and for the installation of the canopies. The construction of the petrol-filling station building with the necessary premises will cost 18,868 EUR. There are strict rules on the appearance around the petrol-filling station. So, the gentrification of the territory will cost 4,354 EUR. And one more important thing: advertising structures will make the petrol-filling station recognizable. For this reason, it is necessary to invest 14,514 EUR for completing the petrol-filling station in accordance with the requirements of the franchisor.

Thus, sum of money required to open a petrol-filling station under the franchise is equal to 106,977 EUR. It is very important to keep in mind about the monthly royalties to the franchisor. They can be equal to 3,121 EUR or more, in case of location and profitability of the station. So, the first-year expenses will be equal to 144,428 EUR. At the same time, it is necessary to purchase fuel for sale. So, let's find out the cost price of different fuels. There are percentage of factors that can affect on the cost of the fuel according to the estimates of the Russian Fuel Union on the figure (2):
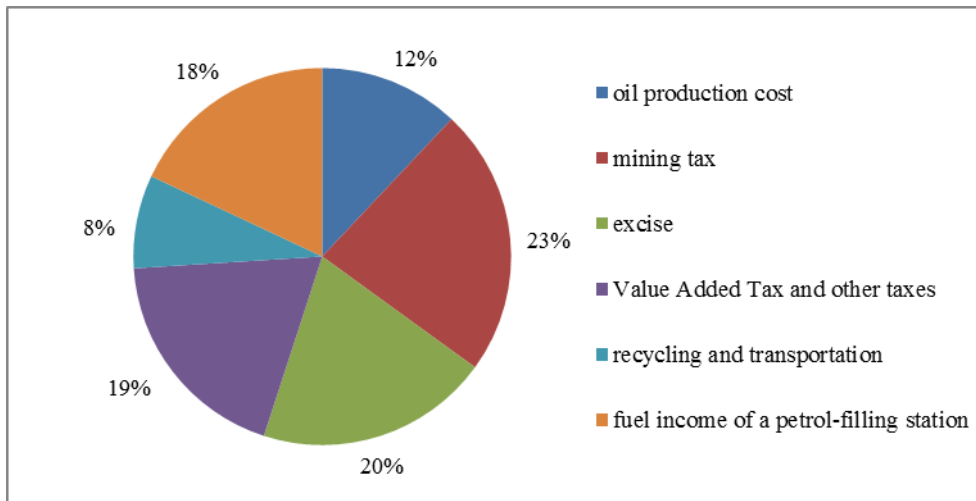

Fig. 2. Percentage of factors that can affect on the cost of the fuel.

At present, the average cost of various types of fuel in Saint-Petersburg at Lukoil's petrol-filling station is 0.56 EUR per liter for AI-92; 0.60 EUR per liter for AI-95; 0.72 EUR per liter for AI-98, 0.60 EUR per liter for DF. Consequently, the average cost of the fuel at the station is 0.62 EUR per liter. So, there are 0.11 EUR per liter that will go to the cash of the petrol-filling station.

There are 1,000 refills per day for the road under consideration. At the same time, there are very different vehicles: from cars to trucks that can refill at the gas station. Consequently, the average refueling receipt will be from 7.26 EUR to 102 EUR. As the road under consideration is quite large, it can be assumed that the average income from each car refueling will be equal to 54.4 EUR. At the same time the net benefit of the petrol-filling station will be equal to 18% or 9.8 EUR. So, maximum revenue available for a 1,000 deliveries per day and it will be equal to 9,800 EUR. But it is necessary to make some corrections taking into consideration that 1,000 refills per day is the maximum power of the gas station. The number of gas stations on the road under consideration will be equal to 66 units, if the roadside infrastructure will be brought into compliance with the requirements of the regulatory documents. In this case, the average amount of refills on the station will be equal to 336 units per day while traffic volume on the road will be equal to 22,158 vehicles per day. Then the revenue of the petrol-filling station will be equal to 3,292 EUR per day.

Now let's calculate the payback period of the petrol-filling station. Let's suggest that there are 2 cashiers and 2 petrol-filling station operators work at the station every day. The average cashier's salary is 29 EUR, so it is equal to 58 EUR for two people. The average petrol-filling station operator's salary is 21.5 EUR, so it is equal to 43 EUR for two people. So, the revenue of the gas station is equal to 3,205 EUR without salaries of workers. In this case, the monthly income for petrol-filling station will be equal to 96,153 EUR. At the same time, retailer takes only 18% of the whole sum. The rest part of the sum goes to the wholesale dealer or Lukoil in our case. Then it turns out that the income of the owner of the petrol-filling station will be equal to 17,307 EUR. At the same time there are 70% of incomes (12,115 EUR) goes for a paying for a land lease and gas station maintenance. In this case income will be equal to 5,192 per month.

Now let's calculate a payback period for the petrol-filling station by franchise with the formula (5):

$$T_{\text{аэс}} = 144{,}428 \,/\, 62{,}307 = 2.3 \qquad (5)$$

It is necessary to invest 3,528,636 EUR for construction of 3 service stations and 9 petrol-filling stations. The payback period is 2 years and 10 months.

4 Discussion

Results of the survey can be used for the roadside service infrastructure modernization of the road under consideration. At the same time, developed methodology can help to identify the necessity and the priority of modernization of any other roads.

There is a 3,528,641 EUR of total investment required for providing compliance of recommended events. Time of cost recovery of the project will be equal to 2-3 years. These payback periods are acceptable in the automotive industry [13-17], so construction of these objects is economically expedient.

References

1. G. Tokunova, Transport. Res. Proc., **36,** 754-758 (2018)
2. H. Chen, T. Onishi, F. Olalotiti-Lawal, A. Datta-Gupta, J. of Petr. Scien. and Eng. (2020)
A. Kar, P. V. Ilavarasan, M. P. Gupta, Y. Dwivedi, M. Mantymaki, M. Janssen, A. Simintiras, S. Al-Sharhan, I3E 2017 (2017)

3. S. Gibbons, T. Lyytikäinen, H. G. Overman, R. Sanchis-Guarner, J. of Urb. Econ. **110**, 35-50 (2019)

4. V. Okrepilov, M. Gravit, E. Nedviga, O. Dudnik, J. of Appl. Eng. Scien., **14**, 135-139 (2016)

5. T. Zero, *Ambitious Road Safety Targets and the Safe System Approach* (International Transport Forum, 2008)

6. K. Torfs, U. Meesmann, Transp. Res. Part F: Traf. Psych. and Beh., **63**, 144-152 (2019)

7. X. Zou, H. L. Vu, Accid. Anal. and Prev., **132** (2019)

8. M. Gravit, I. Dmitriev, Y. Lazarev, EMMFT 2018, **983**, 929–938 (2019)

9. M. Gravit, I. Dmitriev, K. Kuzenkov, M. Lunyakov, E3S Web of Conferences, **91** (2019)

10. S. Hammond, P. Bowen, K. Cattell, New Persp. Const. Devel. Coun., 166-181 (2012)

11. M. Ameri, I. Bargegol, J. UMP Soc. Scien. and Tech. Manag., **3,** 3 (2015)

12. S. H. Khahro, A. N. Matori, I. A. Chandio, M. Aftab, H. Talpur, IEDC (2013)

13. M. Gravit, I. Dmitriev, K. Kuzenkov, A. Shestakova, MATEC Web of Conf., **239** (2018)

14. Y. Li, W. Li, Y. Yu, L. Bao, Transp. Res. Proc., 4584–4592 (2017)

15. J. Zemitis, M. Terekh, EECE - 2018 (2018)

16. Z. Wei, K. Jia, Z. Sun, ECC - 2017, **682** (2018)