A Cost Calculation Model for Outsourcing in Parcel Pick-up and Delivery by Commercial Postal Services Operators

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Abstract – **The new challenging trends such as globalisation, liberalisation and privatisation of the postal sector, the emergence of the internet commerce, as well as the demands for high quality commercial postal services operators, create a new ambience for the ways business is conducted by commercial postal services operators which demands innovative approaches. The growing pressure regarding the costs of commercial postal services operators and the increase in volume for pick-up and delivery leads to changes from fixed into variable costs by means of different outsourcing models. This paper proposes a model of calculating the outsourcing services of the technological phases regarding parcel delivery and pick-up, while it is not focusing on the details of the partnership contract. For cost calculation, the model utilizes calculation factors based on the kilometres covered for different categories of vehicles that may take part in the parcel pick-up and delivery phases.**

Keywords – **outsourcing, model, costs, delivery.**

1. Introduction

The advancing development of techniques and technologies, as well as the new trends in selling good

goods, has a great impact on structural changes in the field of courier services. It is necessary for courier companies to enhance their efficiency and competitiveness, while at the same time they are reducing the resources in order to ensure sustainability on the contemporary technologies market. Different requirements and needs of users, the short life cycle of the product, as well as the new ways of trading, have brought to an enormous increase of parcels for courier companies.

The postal services market is generally divided into two parts. The first part is of special national interest, characterized by the so-called Universal Postal Service and is mainly performed by public operators under monopoly conditions. Furthermore, the second part is commercial, which is open to all potential operators who meet certain conditions. In further consideration, the paper deals with a market of a commercial character.

Commercial postal services operators are under growing pressure, due to the price of the services on the one hand, and on the other, due to the costs the new parcels produce. For that reason, the company's management is facing two different challenges: the need to eliminate unproductive costs, using increasing efficiency, and the demands for changes in the market and user requirements. It may be observed that the transportation prices are not growing proportionally with the new volume, while the costs are increasing faster than the profits gained [1].

Companies are trying to adapt to such challenges by means of reorganising delivery centres, revising business strategies, introducing contemporary techniques and technologies, through the management of outsourcing models, etc.

According to authors [2], the costs of express parcel delivery, on the global level, amounts to 70 billion Euros, of course without the pick-up costs, the linehole transport and the sorting costs which are not included. The German and the US markets especially stand out as the increase in delivery is expected to double in the following ten years.

A great majority of parcels generated through e-commerce is delivered to densely populated urban areas. When observing the technological phases of postal traffic, the greatest amount of costs is generated in exactly the pick-up and delivery phases.

These phases are one of the greatest challenges for researchers, especially in terms of organisation and cost management. The aim of each company, the postal company as well, is to gain the greatest possible profit, in the part of market outside the universal service. This is why it may be indirectly concluded that it is necessary to minimize the costs while maximizing revenue, without compromising the prescribed quality.

The need for postal services throughout the year varies, which is why it is particularly important to align the time-related variables, i.e. seasonal trends. These trends affect the capacities which are then directly producing the costs.

Companies focus on fixed costs in the delivery phase because the needs for transport capacities are different in different time periods. Outsourcing is one of the most commonly found management methods when turning fixed into variable costs in all branches of industry, including postal traffic as well.

According to research[3],companies which resorted to outsourcing reduced their costs for about 9%, improved the quality and the capacity by 15%.

There are only a few research studies on outsourcing services in the parcel delivery phase within courier services; the model and the principle may be found only in a few research studies published in indexed journals[1].

Based on the search on works published in the period from 1996-2017 in relevant international journals on outsourcing in the field of logistics, the supply chain, managing the supply chain, transport and distribution, it has been concluded that 41 papers were published, out of which only 6 papers are related to the reduction of costs and improving the services, qualities and delivery performance[4].

2. Aim

The paper aims are to briefly analyze the situation in the postal services market, and to propose a model of outsourcing costs for parcel pick-up and delivery. The calculation base is mileage covered per day by the delivery vehicle. The daily vehicle mileage is defined as the total time spent on the route.

3. Outsourcing

The basis and the most important economic advantage of outsourcing is that it allows companies to reduce their fixed costs such as vehicles, equipment, information technology, fixed salaries of the personnel employed, etc., and to transfer them into variable costs presented by means of the purchase and sale price the company pays[5], [6].

Such a method of reducing fixed costs is replaced by increasing variable costs in terms of purchase prices, and defined by a certain *outsourcing* model.

According to research [7], out of 165 surveyed companies from 24 world industries, 58% of participants gave the following reason for outsourcing: "turning fixed into variable costs".

Utilizing outsourcing has recently been marked as a positive trend increasing by 2% in 2018 when compared to 2017 [8].

The outsourcing process is far from simple which is why it is necessary to analyze in great detail its impact and benefits in the aspects such as:

- financial perspective,
- user perspective,
- perspective and impact on internal operations,
- long-term perspective and the courier company strategy.

A special reason why commercial postal services operators are resorting to outsourcing more frequently is transferring the parcel transport risks onto a third party.

General formulations by means of which it is possible to evaluate external costs may be found in papers [9], [10]. A somewhat simpler model has been implemented in paper [11]:

$$EC_{k,i} = f(D, M, E_i, v, c_k)$$

in which:

- $EC_{k,i}$ (€) is the cost of the *k-th* externality caused by the transport performed with the *i-th* transport mode,
- D (km) is the demand of freight transport, that is the total overall distance travelled by all the transport means adopted to delivery all parcels,
- M (ton) is the load transported,
- E_i (unit/ton·km) is the emission factor of the *i-th* transport mean adopted at a given transport speed,
- v (km/h) is the average speed of transport,
- c_k (€/unit) is the unit cost of the *k-th* externality.

The focus of the paper is defining cost calculation outsourcing model by providing an example. When forming an outsourcing contract, the cost of performing the service is separated from the performance, pick-up and delivery quality which may be defined as either rewarding or penalty points. For that reason, the paper discusses only the calculation of costs, whereas delivery quality and performance may be observed in the overall outsourcing contract as:

$$O_{pick,dely} = f\left(C_{pick,dely}, Q_{pick,dely}, P_{pick,dely}\right) \qquad (1)$$

in which:

- $O_{pick,dely}$ - is the outsourcing contract for pick-up and delivery,
- $C_{pick,dely}$ - pick-up and delivery costs,
- $Q_{pick,dely}$ - quality of activities performed,
- $P_{pick,dely}$ - pick-up and delivery performance.

Quality and performance may be observed through transit time performance, delivery performance, pick-up and delivery accuracy, the time needed for pick-up and delivery, etc.

4. A Proposal of the Calculation on the Basis of the Kilometres Covered

The model of calculating the outsourcing costs in the technological pick-up and delivery phase on the basis of the kilometres covered is often used in transport and logistics.

Defining the model

The courier company N in the geographical area G is performing technological parcel pick-up and delivery phases using certain categories of vehicles. The categories of vehicles include the deadweight of vehicles, which is why it is first necessary to define the categories of vehicles and allot certain cost coefficients for each category as illustrated in Table 1.

Table 1. Defining freight vehicles categories

Vehicle category	Vehicle cost coefficient (BAM/km)	Deadweight
N1	C_{N_1}	$\leq 3.5t$
N2	C_{N2}	$> 3.5t, \leq 12t$
N3	C_{N3}	$> 12t$

The cost coefficient contains costs for the particular vehicle category and includes the following costs: the driver costs and the vehicle costs. The vehicle costs include the costs of:

- petrol,
- spare parts,
- repair and maintenance,
- depreciation,
- tyres,
- insurance and registration,
- vehicle taxes,
- toll charges.

When designing the cost coefficients for vehicle categories, it is necessary to keep in mind that certain parameters depend on the market prices. In such conditions, one can define a range of prices and individual subfactors for the cost category, in order to meet all requirements of the parties in the outsourcing.

The N company in the geographical area G in the time period t has organized the technological parcel pick-up and delivery by means of n routes and i categories of vehicles (i=1,2,3) using a method illustrated in Table 2.

Table 2. Defining the routes in the geographical area G and the time period t

Route (r)	Vehicle category	Cost coefficient (BAM/km)	Distance covered
r_1	i_{r1}	C_{r1}	D_{r1}
r_2	i_{r2}	C_{r2}	D_{r2}
$\vdots$	$\vdots$	$\vdots$	$\vdots$
r_n	i_{r_n}	C_{r_n}	D_{rn}

The outsourcing cost of the technological phase of parcel pick-up and delivery for the geographical area G and the time period t is the sum of the cost within organised routes in the defined area.

The *route 1* (r_1) cost may be defined as:

$$C_{G,t,r_1} = C_{r1} \cdot D_{r1} \qquad (2)$$

in which:

- C_{G,t,r_1} - total outsourcing cost for *route 1* (r_1) for the geographical region G and the time period t.
- C_{r1} - cost coefficient for the selected vehicle category on route r_1 which serves a part of the geographical area G in the time period t. This coefficient includes the driver and the vehicle costs.
- D_{r1} - distance covered on route r_1 for the time period t.

The outsourcing costs for n routes serving a geographical area G in the time period t may be defined in the same way:

Cost for route r_1: $C_{G,t,r_1} = C_{r1} \cdot D_{r1}$

Cost for route r_2: $C_{G,t,r_2} = C_{r2} \cdot D_{r2}$

$$\vdots$$

Cost for route r_k: $C_{G,t,r_k} = C_{rk} \cdot D_{rk}$

$$\vdots$$

Cost for route r_n: $C_{G,t,r_n} = C_{rn} \cdot D_{rn}$

The overall outsourcing cost for the technological phases of parcel pick-up and delivery using the calculation model based on the kilometres covered for the geographical area G and the time period t may be written as:

$$C_{G,t} = \sum_{k=1}^{n} C_{G,t,r_k} \qquad (3)$$

In order for the model to be more transparent for the calculation, it is necessary for the vehicles to have inbuilt GPS devices. These devices would allow the movement of vehicles to be monitored along the route. Intelligent systems for managing parcel pick-up and delivery are based on geographical information systems [12],[13],[14]. Using these systems, it is possible to manage vehicle movement, and thus directly reduce the cost by means of reducing the kilometres covered per day.

An example of cost calculation using the model proposed

We have used data of a courier company from Bosnia and Herzegovina that covers the whole country. The data are from November 2019 for a part of a geographical area of the country.

The courier company A in the geographical region G_1 has performed pick-up and delivery by means of 4 vehicles, 3 of which are belonging to N_1 category and one to N_2 category.

For the period of November 2019, the cost coefficients in Bosnia and Herzegovina had average values as defined in Table 3.

Table 3. Cost coefficients by categories

Vehicle category	Vehicle cost coefficient (BAM/km)	Deadweight
N1	$C_{N_1} = 1,3$	$\leq 3.5t$
N2	$C_{N2} = 2,12$	$> 3.5t \leq 12t$

In the period of one month (t=21 days), the company has collected the data shown in Table 4:

Table 4. Data collected for the time period t=21 days and the covered geographical area G_1

Route (r)	Vehicle category	Vehicle cost coefficient (BAM/km)	Distance covered for the period of 21 working days (km)
r_1	$i_{r1} = N_1$	$C_{r1} = 1,3$	$D_{r1} = 3,195.00$
r_2	$i_{r2} = N_1$	$C_{r2} = 1,3$	$D_{r2} = 2,407.00$
r_3	$i_{r3} = N_1$	$C_{r3} = 1,3$	$D_{r3} = 2,751.00$
r_4	$i_{r4} = N_2$	$C_{r4} = 2,12$	$D_{r4} = 1,554.00$

It is necessary to calculate individual costs for each route and total outsourcing costs for the defined geographical area.

For the calculation of individual costs by routes, formula (2) is used and may be written as:

Cost for route r_1:
$$C_{G_1,t,r_1} = C_{r1} \cdot D_{r1} = 1,3 \cdot 3,195 = 4,153.00\, BAM$$

Cost for route r_2:
$$C_{G_1,t,r_2} = C_{r2} \cdot D_{r2} = 1,3 \cdot 2,407 = 3,129.00\, BAM$$

Cost for route r_3:
$$C_{G_1,t,r_3} = C_{r3} \cdot D_{r3} = 1,3 \cdot 2,751 = 3,576.30\, BAM$$

Cost for route r_4:
$$C_{G_1,t,r_4} = C_{r4} \cdot D_{r4} = 2,12 \cdot 1,554 = 3,294.48\, BAM$$

When individual costs per route are known, it is easy to provide the sum of individual costs, and obtain the total costs for outsourcing services of technological pick-up and delivery phases for the geographical area G_1 and the time period t=21 days, using formula (3):

$$C_{G,t} = \sum_{k=1}^{n} C_{G,t,r_k} = 4,153 + 3,129 + 3,576.3 + $$
$$+ 3,294.48 = 14,152.78\, BAM$$

The total cost calculated for the geographical area G_1 and the time period t=21 days is 14,152.78 BAM.

5. Conclusion

Based on the learned trends in the postal services market and the identified problems in the business of commercial postal service operators, the paper develops a model for calculating the costs of outsourcing pick-up and delivery packages. The model is based on the kilometres that are covered by individual vehicles performing pick-up and delivery within a territory. The model is possible to be implemented for various categories of vehicles, or one or more routes serving a certain area. The results obtained from the example provided illustrate that the costs of pick-up and delivery depend on the kilometres covered by the vehicle per day and the defined cost coefficient. Further research may be oriented towards detailed research and defining the cost coefficient, as well as the quality and performance as two other factors in outsourcing.

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