

VEHICLES DISCHARGING PROCESSES CONTROL OPTIMIZATION WITHIN PLANNING OF LOCAL DELIVERIES

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Abstract. The paper deals with local delivery process optimization problem. Paper's author investigates vehicle discharging time importance for local deliveries. Normally, it is indispensable to optimize not only car's moving time, but also its discharging time to organize a local circular route by optimal way. Paper's author recommends creating a special system, registering vehicle discharging time for the each object within the particular route. Often operators do not pay attention discharging time factor, though sometimes this parameter takes a half of the total delivery time within the particular route.

Key words: vehicle, delivery, discharging, process.

Introduction

Each company should satisfy its customers' needs and requirements. To achieve it, forwarder should organize fast and precise local deliveries. Sometimes deliveries planning process is not difficult at all, but in other situations it is a complex one. Traffic congestions in big cities are not constant; they may change on the particular hours or week's days. For instance, if an operator plans deliveries within Riga, he should pay an attention to the particular moment, when a vehicle achieves a customer.

Using of the mathematical methods often does not provide an effective solution of problem; because the number of forwarders simultaneously is being discharged by the particular customer may change depending on the day's hours. Generally, often it is impossible to forecast vehicle's wait time before discharging by the customer.

Delivery process planning problems for cities with intensive traffic

Habitually local delivery (connected a great amount of clients) planning is a complex process for cities like Riga, because there are many different ways how to complete it. Often operators make a typical mistake during the routing process, they try to minimize only vehicle's moving time, serving customers within the particular route.

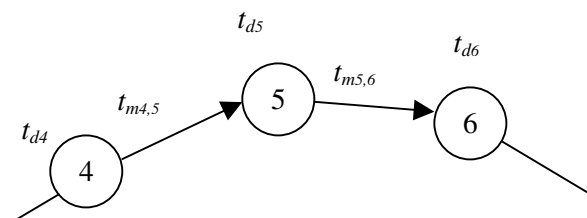


Fig. 1. Circular route fragment:

4, 5, 6 – numbers of customers; t_d – vehicle discharging time;
 t_m – vehicle moving time between customers

The total time of delivery within one route consists of the 2 main elements: vehicle moving time and vehicle discharging time (Fig. 1, Equation 1).

$$T_d = \sum_{i,j=1}^n t(m)_{ij} + \sum_{i=1}^m t(d)_i \quad (1)$$

where T_d – total delivery time;
 $T(m)_{ij}$ – Vehicle moving time between the route's points i and j ;
 $t(d)_i$ – Vehicle's discharging time for customer i .

It is very painfully to design a precise delivery time today because traffic congestions are not stable, they may be changed depending on days of the week or particular hours of the day [3]. The average vehicle's speed also changes (Fig. 2-4).

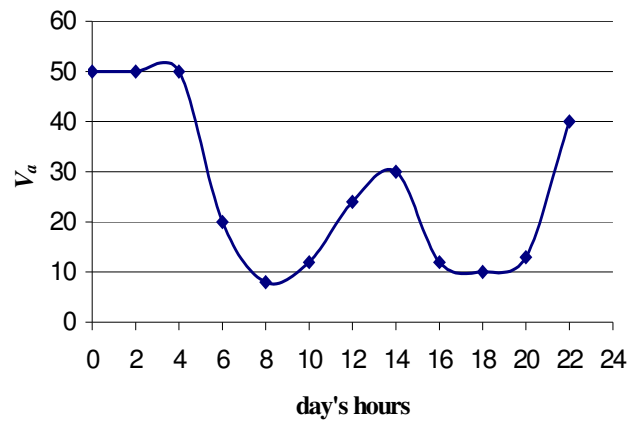


Fig. 2. The average vehicle's speed (V_a) changes for particular crossroad in Riga in particular day's hours (on Monday)

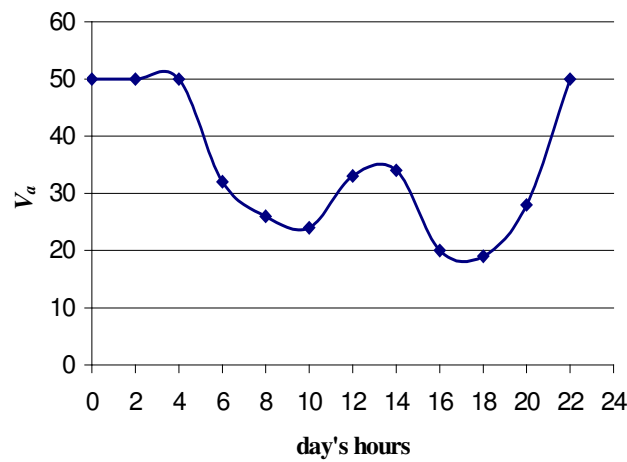


Fig. 3. The average vehicle's speed (V_a) changes for particular crossroad in Riga in particular day's hours (on Tuesday)

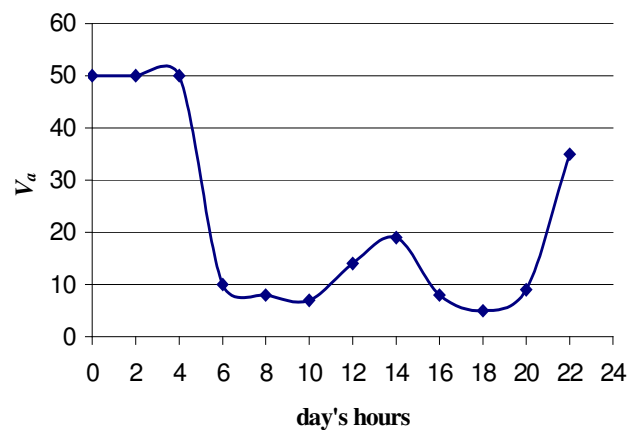


Fig. 4. The average vehicle's speed (V_a) changes for particular crossroad in Riga in particular day's hours (on Friday)

The average vehicle's speed in the particular stage of Riga's street is not stable; it changes not only at the particular hours, but also on the particular days of week. The highest speed is at night. This parameter changes on other days of the week (Fig. 3, 4).

Commonly, it is possible to solve vehicle's moving time problem, using the micro-elements method [3] (Fig. 5) to improve route planning in cities with intensive and traffic.

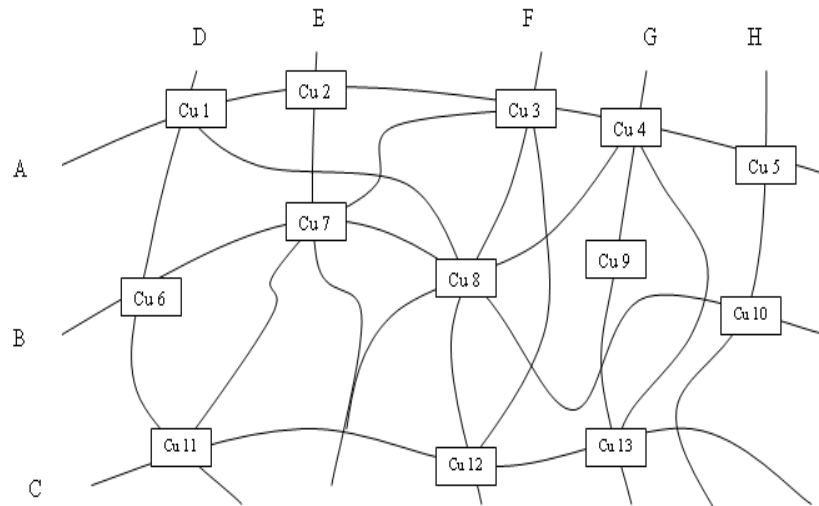


Fig. 5. Roads, divided into particular elements:
 A, B, C – main roads’ names; D, E, F, G, H – other roads names;
 Cu 1 – Cu 13 – customers’ names

Undoubtedly, it makes easier route planning process and helps to create the optimal delivery precisely. In this way it is possible to decrease vehicle moving time uncertainty, but it is not enough for delivery optimization in general. It is necessary also to plan vehicle’s unloading time for each customer.

Vehicles unloading processes time control optimization

According to Formula 1, to achieve the best delivery time planning, it is necessary to perfect planning of vehicle discharging time for each client. If there are 50 customers within the particular route and the operator is going wrong 5 minutes within planning of discharging time for each customer, the total mistake exceeds 4 hours (about one half of the total working hours). There are 2 possible alternatives in this case:

- vehicle’s driver serves all customer 4 hours earlier and returns to the depot. (Vehicle has 4 additional hours of idle time in this case);
- driver does not get in time serving customers during his working hours.

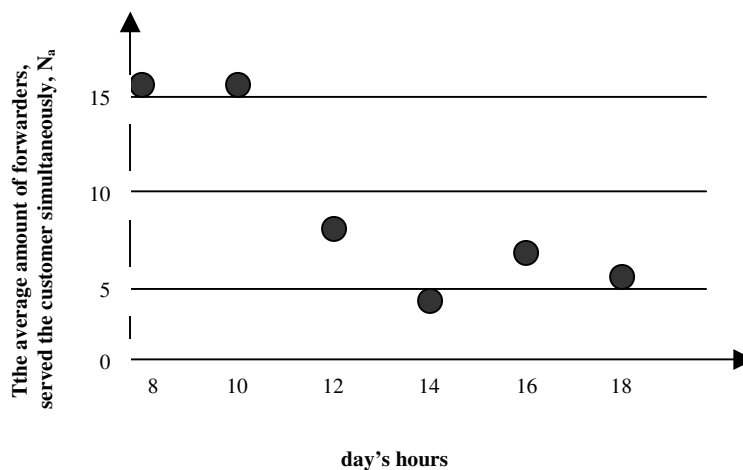


Fig. 6. The average amount of forwarders, served the customer simultaneously at the particular day’s hours

Both situations are not optimal for the operator; and it is necessary to improve vehicle’s discharging time control to satisfy company’s customers.

It is essential to create vehicle's discharging time system for all company's customers. First of all, may divide discharging process for separated elements. Discharging process consists of different elements, but the most problematic for planning is a wait time, while other forwarders are being discharged. To optimize discharging time planning it is essential to systematize company's customers.

Usually the average number of forwarders, serving the particular customer simultaneously, varies depending on particular hours of a day. Products with shelf life are usually delivered in the morning. Some warehouses' working time is being in progress day and night, but others works only till 5 or 6 p.m. Generally, caterers concentration is different for each customer depending on particular time of a day. First of all, it is necessary to investigate the average level of suppliers' concentration near the particular client. If this information is collected, it is essential to process it, creating a special system. It is possible to investigate wait time by the each customer (Fig. 6, Table 1) at the particular day's hours.

Table 1

**Wait time before the discharging process near company's customers
on the particular hours of a day**

Wait time	Hours of a day							
	8-9	9-10	10-11	11-12	12-14	14-15	15-16	16-17
5 min	Cu1, Cu2, Cu3	Cu1, Cu2, Cu3	Cu8, Cu7	Cu4, Cu5	Cu1, Cu2, Cu3	Cu1, Cu2, Cu3	Cu1, Cu2, Cu3	Cu7, Cu11, Cu12
5-10 min	Cu5, Cu8	-	Cu1, Cu2, Cu3	Cu6, Cu8	Cu7, Cu11, Cu12	Cu6, Cu8	Cu4, Cu5	-
10-15 min	Cu4	Cu6-Cu7	Cu6, Cu5, Cu12	Cu2, Cu9	Cu9	Cu7	Cu7	Cu4, Cu5
15-20 min	-	-	Cu11	-	Cu8	Cu10, Cu4	Cu11	Cu2, Cu9
> 20 min	-	-	-	-	Cu4	-	Cu13	-

Cu 1 – Cu 13 - customers' names (from Fig. 5)

After creating this database (Table 1), operator may minimize whole discharging process planning time as well as make the total delivery planning process more precisely. It is necessary to improve delivery service quality as well as to reduce delivery costs in general.

Conclusions

1. Delivery process for cities with unstable and intensive traffic consists of two elements: vehicle's moving time and vehicle's discharging time. Often operators pay an attention only the first element, but vehicle's discharging time also influences the total time of delivery.
2. Vehicle's discharging time consists of many elements, but the most problematic for planning and forecasting is wait time. Usually it is difficult to register this element of the delivery time because vehicle's wait (in a row) time may be different for each customer depending on the particular hours of a day.
3. Operator may create special database, dividing all customers into some groups, depending on the time, how much vehicle (driver) spends to serve the particular customer.

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