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Statement of Optimization Vehicle Routing Problems on Transport Network

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ABSTRACT: In the given article the notion of vehicle routing the transportation is discussed more widely, besides, the problem of vehicle routings of transport is put in generalized from. There shown the possibility of the using of such type of the problems in practice, considered the main varieties of the problem and the main approaches for decision of vehicle routing problems on transport is studied.

KEYWORDS: automobile transport, routing, point of departure, point of delivery, algorithm, rational, transportation, finely party.

I. INTRODUCTION

Determining the optimal (economic) transport networks and their development for a region without an appropriate science-based base is complex, but at the same time relevant. It is advisable to use a scientifically based methodology to improve the transport provision of the population of the region, to optimize the cargo flow in transport networks and to develop transport networks[1].

It is well known that the modernization and further development of production using logistic principles requires the expansion and increase of the efficiency of transportation of all elements, technical and technological means of the transport infrastructure - rail and road networks.

The concept of a route is important for addressing the management of freight or passenger traffic.

Cargo transportation routes are a set of departure points and destinations that make up the transportation process for a certain period of time (loading, unloading, equipment and technologies, roads and vehicles and methods) [2].

For each transport route, it is desirable to normalize the performance of vehicles. When transporting goods or passengers, the activity of the driver-vehicle system takes place along a specific route, and how this work is “heavy” or “light”, “costly”, etc., depends on specific indicators (length and conditions of the route’s roads, traffic management requirements) and many other factors.

Cargo transportation includes loading goods onto motor vehicles, transporting a loaded car from the sender to the recipient, unloading the goods and receiving them, as well as moving the car to the point of departure for the next flight.

Vehicle Routing Problems (VRP) is considered a fundamental problem that is widely used in practice by combinatorial optimization.

II. RELATED WORKS

George Danzig and John Ramser first applied routing of vehicles in 1959, and in recent years it has been widely developed [3]. The development of trade networks, the increase in the population in large cities, the development of transport infrastructure in Uzbekistan, especially in the southern regions, require the optimization of transport transportation, the development of new effective information and calculation technologies. Currently used information technology does not allow to efficiently solve the algorithms for planning transportation of goods. The

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development of new algorithms, their solutions will reduce the time and also improve the quality and reliability of the data received in a single time.

Vehicle Routing Problems (VRP) - a research operation with a large volume and the solution to this problem is engaged in transport logistics.

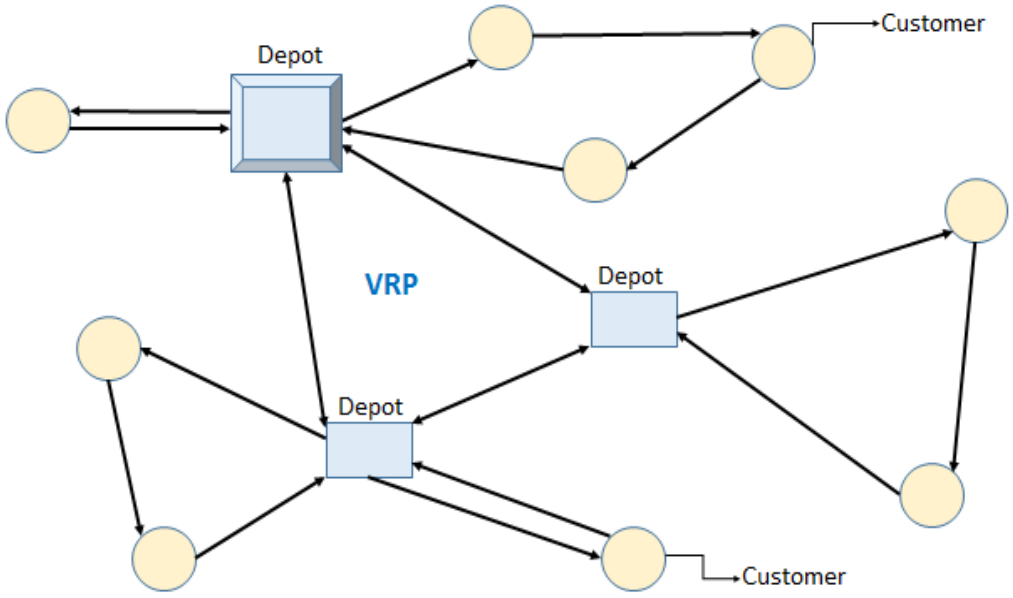
The object of this research is the transport and logistics process. The essence of the development of new algorithms is theoretical and practical research of transport problems and their solutions aimed at improving the efficiency of managing this process.

The task of routing vehicles can be presented as the optimal plan (at a minimum cost) for the transportation of any product from the sender to the recipient (pic. 1). At the same time, additional restrictions are also provided, such as the number of vehicles engaged in transportation, the time of departure from the point of departure and arrival at the point of delivery, the vehicle's carrying capacity, route length, etc. The sum of the total costs of vehicles for transportation is a criterion for the effectiveness of the freight plan.

Routing of small-scale party (volumetric) traffic - the compilation of routes for the rational and consistent distribution or receipt of goods. From a mathematical point of view, this task is to determine the relationship pattern of several addresses, where there should be start and ends (depot) (warehouses), and you can drive through the rest of the points only once. In a simple form, this problem is reduced to the “salespeople” problem [4].

II.METHODS

Cargo must be transported from the point of departure v_0 to points v_{1-n} delivery.For each recipient, the quantity of cargo q_i must be delivered. For the transport of goods involved m the number of cars, $m = \{1, 2, ..., i, ..., m_0\}$.



Picture-1. An example of solving the routing problem.

For each vehicle i, its carrying capacity is known q_i $i \in \{1, 2, ..., m\}$. Car serial numbers are assigned so that the condition $q_1 \le q_2 \le ...q_m$.

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There is a known route i for each R_i car, with the order of cargo $\{V, v_1^i, v_2^i, ...v_s^i, V\}$ delivery $V, v \in R_i = \{V, v_1^i, v_2^i, ...v_s^i, V\}$.

For each i car, it is necessary to determine a route R_i in which the total amount of cargo delivered to the recipient should not exceed the car's carrying capacity, i.e.

$$\sum_{v \in R_i} Q \le q_i, \; i \in \{1, 2, ...m\}.$$

In this case, for all routes $\{R_i\}$ the following condition must be fulfilled:

- No recipient point should be included in two routes (for example, $(R_i$ *ва* $R_r)$ as well as intersecting R_i *ва* R_r, be free, i.e.

$$r \ne i \to R_i \bigcap R_r = \phi, \qquad r, i \in \{1, 2, ..., m\};$$

The route planning system should provide minimum (length of cargo transportation)

$$F_{VRP} = \sum C(R_i) \to MIN, \qquad i = 1, 2, ..., m \quad \bigcup_{i \in \{1 \div m\}} R_i = \{1, 2, ..., m\}$$

Where. $C(R_i)$ R is the sum of the length of the links in the route.

IV. RESULTS

The classification of the routing problem of vehicles can be in several ways [5].

Typically, real optimization problems arise when there are additional restrictions and variations, the main of which are accepted:

1. Routing with restriction on loading capacity (Capacitated VRP-CVRP).
2. Routing with a time limit (VRP with Time Windows, VRPTW).
3. Routing with multiple depots (Multiple Depot VRP, MDVRP).
4. Return Routing (VRP with Pick-Ups and Deliveries, VRPPD).
5. Routing with return of goods (VRP with Backhauls, VRPB).
6. Routing by various vehicle (Split Delivery VRP, SDVRP).
7. Periodic routing (Periodic VRP, PVRP).
8. Routing with random data (Stochastic VRP, SVRP).
9. Routingwith the possibility of additional loading (VRP with Satellite Facilities, VRPSF).

To date, algorithms for the exact solution of problems of optimizing the transportation route for the minimum time are missing. To solve this problem, there are a kind of difficulties, the main of which are:

- A lot of variation and long duration;
- Non-linear nature of the function of the cost of transportation and the volume of freight traffic;
- The need to solve the problem in dynamics;
- The complexity of determining the cost of freight between the compared modes of transport, etc.

In addition, the development of mathematical models for solving such problems is a complex process, since it is necessary to take into account the conditions of multi-factor transportation.

VI. CONCLUSION

In conclusion, it can be noted that in previous studies on the preparation of initial plans, insufficient attention was paid, and more attention was paid to its improvement. The possibility of adopting any plan as a basic one satisfying the boundary equations with positive variables is stated. However, if the basic plan is well drawn up, the number of

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iterations (change, improvement of the plan) will be equally smaller. Therefore, it is advisable to draw up a basic plan that is as close to optimal as possible.

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