International Journal on
"Technical and Physical Problems of Engineering"
(IJTPE)
Published by International Organization of IOTPE

ISSN 2077-3528
IJTPE Journal
www.iotpe.com
ijtpe@iotpe.com

June 2016 | Issue 27 | Volume 8 | Number 2 | Pages 32-39

METHODS AND MODELS OF OPTIMIZATION OF TRANSPORT LOGISTICS

A.A. Allahverdiyev

Azerbaijan Technical University, Baku, Azerbaijan, afik_allahverdiev@mail.ru

Abstract- The article discusses the generalized methods, models and algorithms of interrelated tasks to optimize the road transport logistics elements, providing the indispensable fulfillment of customers' requirements and improve the efficiency of transport logistic. The methods and models in terms of sources of uncertainty can be divided into three groups: deterministic, probabilistic uncertainty and challenges fuzzy uncertainty. Within each group the task of developing methods, models and algorithms to ensure the optimization of elements of road transport logistics.

Keywords: Optimization, Range of PBX, Count Method, Linear Programming, Ranking of Local Criteria, Open Transport Problem.

I. INTRODUCTION

In the modern conditions, with the transition to market relations in the economy of an important character become problems of modeling and optimization of transport-term logistics (AL). Solving past experience focuses on priorities plan of the economy requires thoroughly be reviewed and revised. Previously, a fundamental requirement was put on the maximum load of all manufacture governmental resources. Today it should be considered in the first place: a high level of compliance with delivery dates; low stocks; minimum cost of shipping supplies.

However, road transport (AT) is currently the number of reasons not fully meet the needs of suppliers and consumers. This is due to many reasons, including: the lack of the systematic approach and the single coherent delivery technology goods, leading to the inconsistent goals and objectives of the models which is used; refusal of solutions to the problems of decision-making, which are mathematically poorly formalized.

The logistical approach to the management of material flows requires the integration of separate participants of logistical process in the single system that it can quickly and effectively deliver your requested product at the right place. The paper analyzes the traditional, statistical, technical and fundamental approaches to the planning elements of the road transport logistics, and it has been shown that these methods are not strong enough as well as are subjective, based on priori assumptions and do not meet today's requirements.

The conducted research founds that the solution of complex problems of the transport process (TP) necessitates the integration of logistics processes of planning and management, modeling and decision making methods in logistics contexts, taking into account the characteristics of the object and the conditions of their operation.

II. SETTING GOALS

The mentioned circumstances identifies the need for research of AL, the solving direction of the interconnected problems which is key-element of the road transport logistics-transport vehicle processes. The reference studies have established that the determination and optimization of the characteristics of AL problem in terms of sources of uncertainty can be divided into three groups: sufficient information; probabilistic uncertainty; and problems with fuzzy uncertainty.

In the first group, the universal of models ensure the optimization algorithms of the number of elements in the transport process, namely, a complete set of products and packaging saw the stone as "cube" [1, 2, 3]; for determining the shortest distance between the participants of the transportation process; ATS distribution routes of different lengths; optimization of the distribution of the transportation problem; and analyzing of ATS indicators to use the park.

In the second group, the models and algorithms are developed for determining elements of the transport process and having a random character. The proposed model allows to determine the speed of movement of the ATS with the influence of various factors, stochastic traffic, weather conditions and designing the parameters. Performance indicators shift-day planning and ATS management should be implemented within a single system.

As part of the third group, the models and algorithms for optimizing transport logistics elements are under uncertainty of choosing ATS, using a variety of preference factors; a decision in accordance with the alternative estimates of utility; routing of cargo transportation via the formalization of a set of rules based on expert assessments; decision of the transportation problem with the using of membership function based on the genetic algorithm developed by the method of the optimization of allocation resource.

The problems of increasing capacity utilization and rational choice of rolling stock are resolved to develop a model configuration and placement of products on the ATS platform. The proposed model is versatile, and providing a complete set of products based on a predetermined sequence for consideration of different ATS capacity. To improve the efficiency of traffic-cube stone, the use of a palette demon batch method of transportation is provided.

The problem of determining the shortest distance between the participants of the transportation process is achieved through the use of graph theory, based on the geometric parameters of roads and restrictions on travel axle loads of vehicles, which signs prohibiting freight traffic ATS, etc. The essence of the problem to be solved is to find the linked roads in the transport network, which have minimum length of the given destination. It was found that the use of different criteria for distribution of the ATS, as an effective option, determined on the basis of the purposes and consideration of possible situations.

The advantages of the proposed algorithm for solving the transport problem of the distribution refers to lack of need for defining additional indexes, in connection with which reduces the complexity of calculations and reducing the number of iterations in comparison with the Me-Todd potential [4].

The current system of planning, accounting and analysis of motor company, using such vague notions as the days, the car-days, etc., as well as an assessment of its work only on re-executed result of the volume of traffic and transport work, without taking into account the level of quality indicators, disparate leads to erroneous results. The correct determination of these indicators offers sophisticated formula [10] and the automated system of calculation, which provides simplification and acceleration of planning and accounting indicators ATS Park.

The above makes the possibility to organize a comprehensive records management and analysis of the implementation plan for using of elegant time as the automatic telephone station, by brand ATS, convoys and on the road transport enterprises. The development of mathematical models of transport planning sets [7, 17] and effective introduction of optimization problems results, despite the large positive experience in development, are hampered by lack of uniform methodological basis of formalization conducted. The algorithm is developed by [6], to solve important problems of delivery kits at the appointed time.

For transportation of the ordered sets the ATS is selected using convolution local criteria. The proposed model is focused on the elucidation of essence of sets of transport planning tasks, which allows the optimization of the transport process, and ensures the effectiveness of ATS.

In order to solve a number of transport tasks it is required the using of probabilistic methods, as some parameters of initial data which are random in nature. ATS application efficiency depends on many parameters which specially take place the average speed of ATS. The speed of ATS in the stream is a random variable, which is depending on many factors. These factors include: design, travel, climatic, organizational parameters of the organization of transport and traffic.

Existing methods for calculating technical speeds in most cases do not take into account the random nature of the rate of change, a number of road, weather, and organizational factors. Therefore, the results of calculations have large errors and are not always appropriated, for assessing the underlying dynamics - the average rate of ATS. Consequently, there is a need to develop the methods for calculating average speed, taking into account the diversity of accidentally changing the real factors on the ATS movement.

The developed method for calculating average speeds is based on the study of influence of various factors, comparison of ATS features with the resistance value determined by the types and the road surface, which are characterized by the resistance movement by road. Thus, the average rate determines mainly features highlight sections of the route, which overcomes on a particular transmission.

Therefore, the developed method allows to determine the average speed, taking into account all variety of objective and subjective factors influencing its movement. Using the probabilistic methods in the study of the elements of the transport process, emphasizes that the method is more accurate and relatively simple mathematical model, which offers an affordable method of comparative evaluation of the various subsystems of the transportation process. This is indicated by the results of applying the developed model in dealing with the optimization of planning and organization of transportation, cube-stone, when probabilistic flow ATS implies a random time intervals between incoming ATS at loading points. Treatment of the initial data set that arriving at the loading points is a Poisson flow of ATS, and loading time obeys the exponential distribution law.

The developed mathematical model determines the quantitative values of the system parameters of performance - ATS and loading stations. The comparative evaluation of various combinations of the number of ATS and loading stations, as well as definition of indicators of the effectiveness of ATS and loading means as a queueing problem which is produced by the expectation queue of length, load factors posts and ATS downtime.

Most of real AL control problems associated with the need to address them in a greater or lesser degree of uncertainty. When the optimizing elements of transportation process, as well as decision-making under conditions of competition between alternative uses of classical mathematical methods is not possible due to the complexity and heterogeneity of the requirements of the large number of possible options. Therefore, the controller relies on the experience and intuition, bringing solutions to a number of local heuristic criteria, which leads to the inadequacy of the mathematical model of the real situation. The motor company management requires new methods and models for solution of some problems of the transport process which is characterized by vagueness.

The problem of selecting the effective ATS should be subjected to existing sets of preferences which is provided by the convolution of having the best possible evaluation of all factors (X, R_1, R_m), where X is set of alternative exchanges; R_j is preference relation on jth factor; and m is number of factors on which the choice is made the ATS.

$$\mu(x,y)=\sum_{j=1}^{m}\alpha_j\mu_j(x,y) \tag{1}$$

It is noted that the setting of such problem in traditional form of the maximization of objective function of the process is associated with considerable difficulties, since real number of factors change intervals are largely unclear, making it impossible to act in mathematical interpretation deterministic constraints as inequalities.

Using this model allows for rational choice of ATS to perform each considered haul delivery kits, and thus to ensure the optimization of the transportation planning process in terms of fuzzy decision-making.

For adopting the unique solution in terms of competition between alternatives on the basis of local criteria multiplicative convolution in a minimum run without load and travel time, the excessive delays is set in the strict observance of prescribed time period of delivery of goods. Therefore, we use the convolution of the original relationship in another kind:

$$\mu_p(x,y)=\sum_{j=1}^{m}\alpha_j\mu_j(x,y) \tag{2}$$

In the proposed model of the transportation process, the particular organization is recreated in the computer in the form of a simulation model of the network of queuing systems. The challenge is to use the described model, and identify the best alternative. The set of all possible alternatives is denoted by A.

The elements of the universal set are chosen decision-maker according to some simple rules, such as: I = (very important, important, fairly important, not very important). This model allows to select of ATS based on the composition of fuzzy criterion of evaluation and heuristic arguments in the form of linguistic assessments utility. The usefulness for the evaluation of alternatives are summarized in Table 1. The utility values of alternatives in a simplified form are shown in Table 2.

Table 1. Usefulness for the evaluation of alternatives

Optimum Brand max. use. load capacity, max γ_c	Optimum Motor Company min empty run ATS, min l_{nop}	ATS waiting time in excess of t_A^o	Downtime unloading positions in anticipation of ATS $t_{\Pi P}^o$
Very high	Important	Important	Not very important
Vert important	Vert important	Important	Vert important
Quite Important	Quite Important	Vert important	Vert important

Table 2. Methods of the best optimizations

Alternative ATS	Motor Company	Building Company
A_1	Very high	Not very high
A_2	Fairly high	Very high
A_3	Middle	Fairly high

Based on these features, we can conclude that the best alternative is A_2 (with a maximum load capacity utilization factor, minimal empty runs, with little waiting time as excess ATS on the points of handling and a high level of compliance with the schedule of delivery of goods).

$$\mu_{AC}(\alpha)=\min(\mu_A(KR),\mu_C(KR)) \tag{3}$$

where A is model of company; C is building company; and KR is criterion.

Using of this method makes it possible to set a rational ATS to perform each considered haul delivery kits, and thus ensure the optimization of the transportation planning process in terms of fuzzy decision-making.

III. ROUTING CARGO TRANSPORTATION WITH FUZZY TERMS [19]

Routing solution of the problem of cargo transportation with fuzzy environment, as with great difficulty, is necessary to take into account a number of factors that have a random variable, in one degree or another associated with the uncertainty. It is effective that distribution of ATS with a large carrying capacity on route-you be small extent, but on routes with a small length - ATS with a large capacity (option A, and vice versa option B).

According to the research, there are many situations that cannot be guided by this principle. Since the change of technical speed and run-time loading and unloading exchanges are not clear, which it is impossible for deterministic interpretation of indicators.

Therefore, you cannot uniquely identify a preferred option. It is necessary to compare options A and B. After simple algebraic manipulations the comparison alternatives of expression can be represented in terms of traffic on the transport performed work.

$$\frac{q_{H_1}v_{l_1}}{q_{H_2}v_{l_1}} * \frac{(l_{o_1}+v_{l_1}t_{n-p_1})(l_{o_2}+v_{t_1}t_{n-p_1})}{(l_{o_1}+v_{l_2}t_{n-p_2})(l_{o_2}+v_{t_2}t_{n-p_2})} \tag{4}$$

and on the implementation of the transport operation

$$\frac{q_{H_1}t_{n-p_2}v_{t_1}^2}{q_{H_2}t_{n-p_2}v_{t_2}^2} * \frac{(l_{o_1}+v_{l_1}t_{n-p_1})(l_{o_2}+v_{t_1}t_{n-p_1})}{(l_{o_1}+v_{l_2}t_{n-p_2})(l_{o_2}+v_{t_2}t_{n-p_2})} \tag{5}$$

where the symbol * is depending on the comparison results may be set to > = or <. From the Equations (4) and (5) it is impossible to determine which sign connects the left and right sides. If the left side more than the right, preference should be given to option A, otherwise, preference should be given to variant B.

For the solution of this problem, the model based on fuzzy systems is constructed, for showing the relationship between the variables of performance and output of ATS in terms of linguistic rules. The linguistic fuzzy model generation of ATS has 6 inputs (speed length, capacity, utilization rate of ATS, technical speed, loading and unloading and waiting time of their implementation) and output (volume of traffic and transport operation).

For these linguistic variables, the corresponding fuzzy sets *M* is constructed with its carrier, which is defined on the basis of a study of expert assessments. Thus, under the odd carriers of X^* such that

$$X^* = \{x / \mu_m(x) > 0, x \in X^*\} \quad (6)$$

The results of the simulation stage are shown in Table 3.

Table 3. Results of the simulation

No	Indicators	Supports fuzzy set terms		
1	Rated Capacity	Small (s)	Middle (m)	Great (g)
2	The utilization of duty	5-10	10-20	0.8-1.0
3	Distance traffic	Small (s) 1-10	Middle (m) 10-30	Great (g) 30-50
4	Technical speed	Small (s)	Middle (m)	Great (g)
5	Timeout perform loaders discharge	Less normative	Normative	More normative
6	Development in tones	Small (s)	Middle (m)	Great (g)
		45-50	100-150	150-230

In the next step, we construct the set of rules for describing the dependence of the vehicle generation based on the variety of factors. The rules are of the form: If *A*=*N*, then *B*=*M*.

With the help of the constructed model, a set of rules has been resolved considered routing problem. We carried out a computer simulation shows that the work of ATS for option A is effective in 23% of the cases. In 17% there is equality of the compared alternatives, while 41% of the effective work of ATS are related to option *B*. Development the model using computer technology is an urgent task of enhancing the efficiency of AT.

For Analyzing the ATS performance in contrast to the existing reception used in chain productions, it is proposed to carry out on the basis of fuzzy systems using fuzzy logic package Fuzzy Logic Toolbox Matlab Mamdani system operator [18].

IV. EXPERTS RATE CALCULATION SYSTEM ATS [13, 14]

Creating an automated system for calculating the speed of ATS remains a poorly structured problem. To solve this problem, in the absence of the strict mathematical relationships and algorithms of decision-making, the use of the opportunity to create an expert system is required. The speed and fuel efficiency of the car, with fuzzy road and climatic conditions, may be integrally are evaluated by rolling resistance f and grip φ. They are appropriately formalized by means of linguistic variables and fuzzy relations.

To implement the fuzzy model for determining the coefficients f and φ, the fuzzy expert system ESPLAN is used. Entering knowledge in ESPLAN occurs in a dialogue mode. As a result, the entry procedure and interpretation of knowledge in-formed knowledge are base system. To express their expert knowledge, the related rules are used which provided in the form: if (condition) then (output), otherwise (output). The Fragment has the form:

1. If the type of coverage of the road-grit and intensity of rain, snow or small loose and a significant height vary 0.019 to 0.02, then the ranges will be 0 to 0.7.
2. If the type of road surfacing, asphalt concrete and rain-average intensity as well as the lack of snow and ice vary between 0.014-0.018 then the ranges will be 0.6- 0.8.

After filling the knowledge, the manager has the ability to set some initial data, and get a recommendation from the system results.

It should be noted that determination of validity of the velocity is largely dependent as formulation ATS, and the value of operational parameters, including fuel consumption and pollution. Efficient fuel consumption is calculated by

$$q_э = \frac{W}{Q_{v_t}} = \frac{Wt}{QS} = q_s t / Q \quad (7)$$

For the purposes of a comparative assessment of ATS, the sources of air pollution is used by exhaust gases as entered a conditional setting-toxicity index (T_S) ATS. This exponent is in the mass ratio of toxic components (in terms of CO) allocated to ATS

$$T_S = \frac{G_{CO}}{v_t} \quad \text{kg/km} \quad 8)$$

Setting the number of parameters in the equation for characterizing the working conditions of ATS, will causes more accurately reflect the effect of ATS on air pollution. Minimization of fuel consumption is almost identical to the requirements of CO (carbon monoxide) problem for determining the optimal fuel consumption which should be solved taking into account the rate of economically justified and necessary for the execution of the transport process.

Choosing the ATS efficiency of the transportation process, along with the technical and economic criteria, it is necessary to take into account and assess how the general toxicity of exhaust gases is changed in emission control which is based on removal of speed, load and adjusting engine operating modes.

V. TASK OF CHOOSING THE OPTIMAL CARGO OF ATS [12]

The method of calculation of economic efficiency and reduced costs requires minor time costs, which is unacceptable in operational planning. Suppose that the amount is earmarked for shipping and the distance of AB between points *A* and *B*.

The transportation can be made a variety of alternative of ATS. Each alternative has a number of indicators that can be used as a comparative selection criteria to expand the selection of optimal ATS problem which is based on combined criteria.

We propose the following algorithm to solve the problem:
1. Defines the set of valid alternative ATS, which satisfies certain number of organizational and technological constraints and criteria for choosing the best option;

2. From the condition of integrality rider to determine the necessary number for each alternative *i*, z_i , [Q / g_{HI}] and mileage for each alternative provide the export of goods;

$$L_i = I_{EГ} / \beta_e z_i \qquad (9)$$

Time spent on delivery of the total volume of cargo is determined by

$$T_{gi} = (t_g b_i + t_{n-p_i}) g_{HI} \qquad (10)$$

where $t_g b_i$ is the time spent on the movement of the *i*th of ATS per haul; and t_{n-p_i} is run-time loading and unloading haul for the *i*th of ATS.

Then to determine the costs of fuel $З_T$ to perform loading and unloading operations of $З_{n-p_i}$ is based on the driver's salary

$$З_{T_i} = L_i H_{T_i}$$
$$З_{n-p_i} = C^{1T}_{n-p_i} g_{H_i} \gamma_{C_i} z_i \qquad (11)$$

where, H_T is fuel consumption of *i*th vehicle at overcoming 1 km; $C^{1T}_{n-p_i}$ is cost of loading and unloading cargo of 1 t; and $C_{П}$ is hourly rate of the driver of *i*th ATS. Choosing the best ATS, the whole complex design parameters and operating costs are

$$W = f(g_H, v_t, R_П, t_{TOP}, N_{YD}, З_T, З_{n-p}, З_b, T_g, T_{n-p}) \qquad (12)$$

There are the following objectives: There are 5 alternative ATS $\{a_1, a_2, a_3, a_4, a_5\}$ for implementing of the transportation process, where a_1: ZIL-130, a_2: MAZ-500A, a_3 : KamAZ-5320, a_4 : KrAZ-257B$_1$ and a_5 : KrAZ-255B (auto-train).

Each alternative is characterized by 13 indicators $\{C_1, C_2, ..., C_{13}\}$, where C_1 is capacity, t; C_2 is maximal speed, km/h, C_3 is radius of turning, m; C_4 is controlling fuel consumption, km/h, l/100km; C_5 is vehicle length, m; C_6 is specific power, hp/t; factor.curb-weight; dynamic factor for cohesion, while $\varphi = 0.4$; C_9 is time spent loading and unloading operations, hour; C_{10} is the time required to perform the loading and unloading operations, hour; C_{11} is total mileage associated with the implementation of a given volume of traffic, km; C_{12} is the cost of fuel and lubricants, man.; and C_{13} is the value of vehicles, million man.

After determining the extent to each alternative $a_i = 1.5k$ criteria, the C_i is considered as fuzzy sets. The problem is to determine the alternatives of $\{a_1, a_2, a_3, a_4, a_5\}$, which are better than the other alternatives in terms of the criteria for the *i*th criterion which can be subjectively assessed in particular the method of peer review.

$$D = C_1 \cap C_2 \cap ... C_a \qquad (13)$$

As stated, the criteria C_i for evaluation of alternatives a_j may be expressed by $\mu_{ci}(a_j) \le [0,1]$, that through the function of grade solution which is reduced to the determination of

$$\mu_D(a^*) |= \max_{j=1,15} \min_{i=1,13} \mu_{c_i}(a_j) \qquad (14)$$

where a^* is optimal alternative.

VI. HEURISTIC APPROACH RANKING LOCAL CRITERIA [16]

To solve the problem, we propose a model of ranking of alternatives based on heuristic approach, which allows you to organize the composition of fuzzy evolution criteria and heuristic considerations as the linguistic assessments utility.

Each alternative is described by quality criteria $K_i^{i=\overline{1,n}}$. The domain of definition is represented as a Cartesian product of *n* sets $K_1^*, K_2^* ... K_n$. The adoption of a single decision on the criteria is applicable to all local multiplicative convolution of criteria in the form of

$$KP = KP_1^{a_1{}^*} KP_2^{a_2{}^*} ... KP_n^{a_n} \qquad (15)$$

where, KP_1 , KP_2 , KP_3 … KP_n are local criteria, and are characterized by the factors as: the extent of using of the ATS-duty, zero-mileage running with load, empty runs, excessive downtime while waiting for loading and unloading, deviation from the moment of delivery; α_1 , α_2 , α_3 … α_n are the values that characterize the "weight" of the local criterion.

We find out the value of the utility $P(A_i)$ using the ratio of utility *F*, to assess alternatives to each of the groups. The next step is setting the ranking of fuzzy sets and establishing a better alternative.

VII. A METHOD FOR SOLVING OPEN TRANSPORT PROBLEM USING GENETIC ALGORITHM [20, 22, 23]

The transport problem of linear programming with fuzzy objective, fuzzy constraints and fuzzy variables when demand exceeds supply, cannot be solved by traditional methods without entering a fictitious company. However, this approach uses assigned fictitious vendors which are not provided with the cargo.

The proposed method is not clearly defined by the membership function. Searching for near optimal solution is based on the genetic algorithm which is developed by the author and a method of optimization of resource allocation. Application of genetic algorithm is demonstrated on a concrete example. Background information on the volume of supply and consumption is presented as a matrix of fuzzy numbers of triangular shape $\vec{\alpha}_i \;\; i = 1, n; j = 1, m$; and $\vec{x}_i \;\; i = 1, n; j = 1, m$.

The economic-mathematical model of optimal securing consumers for suppliers in the concise record is

$$\sum_{i=1}^{n} \sum_{j=1}^{m} Z_{ij} X_{ij} \to \min \qquad (16)$$

where Z_{ij} is the costs associated with the delivery 1 tons of cargo between *j*th supplier *i*th consumer; and X_{ij} is the volume of cargo transported by *i*th supplier and *j*th consumer.

The genetic algorithm for the specific task has the following scheme:

1. It amounts to "genetic" structure that represents the solution of the problem and constructs the validity function.
2. Emitted population is consisting of *k* chromosomes, which each chromosome consists of $n\times m$ gene, where *n* is number of rows and *m* is number of columns of the original matrix.
3. Appling genetic operators of mutation and crossing over the elements of the population.
4. Appling the operation selection of the best chromosome from the population. This is done taking into account the value of expiration function.
5. Leaving the population (*L*) and generate the best new chromosome (*K*-*L*). Continuing the process until the objective function is no longer to be improved.
6. If the number of N_u iterations, go to step 7, otherwise go to step 3.
7. Decoding the solution with the best chromosome from the population.

The task also introduces the clear limit to the possibility for varying degrees of satisfaction of customer demand. The structure of the individual, is called a chromosome, in the software implementation of the genetic algorithm (GA) is presented as a continuous "bit" lines. To evaluate the validity of each individual in the population, the genetic algorithm uses date function (DF).

For transportation tasks, the function *F* for any potential solutions $X^* = \{X_{ij}^*\}$ can be structured as follows

$$F = \begin{cases} 0, \text{ in case of violation of clear limitations on the decision} \\ P_{\max} - P\,(\mathrm{X}) + \varepsilon(1-\phi(X)), \text{ in other cases} \end{cases}$$

where $P(X)$ is the value of the costs associated with decision $X = \{X_y\}$, $P_{\max}$ is the value of the costs associated with decision-maximum possible value $P(X)$, $\phi(X)$ is the extent to which the fuzzy limits to regulate the desirability of order for various categories of customers, and ε is the scaling factor is needed to balance the contribution to the DF value of two components (part of the total flow and component performance fuzzy limits).

The individual chromosome for the above-mentioned problem can be made of household string that resembles the following individual *k*:

00010011, 00111001, 00……….10, 10010001, 11100011

The number of such individuals (different) equals to the size of the population (typically 50-100 for the average power of computers) as $k = 1,...K$. Finding the best solutions implement the GA on the skeleton generation in the evolution of new individuals (offspring) of the parental genes and assess their validity on the basis of DF.

Each pair of parental genes generates a pair of new genes on the basis of certain rules. The rules are:

1. The new individuals are formed to exchange some bits (genes) in the parental chromosomes (individuals crossing operation) with a certain probability.
2. New gene mutation individuals are formed (i.e. the replacement of some 0 to 1 or vice versa) in the parent chromosomes with a certain probability.
3. The probability of "connections" with the aim of creating new individuals is higher in genes with high value DF.
4. The size of the population must be maintained at a certain level in the process of evolution.

The probability of transition to the next generation is higher in individuals with high DF high value (and, accordingly, the likelihood of "death", i.e. discharge from population is higher in individuals with a low value DF).

The quality of the GA decision on each generation reaches the estimated maximum shelf function. The application of genetic algorithm to solve linear programming problems is demonstrated on the concrete example which it shows high efficiency of this approach.

VIII. CONCLUSIONS

1. Existing shortcomings in road transport and applied models and algorithms do not fully provide the requirements to be met by road transport. To improve the efficiency of transportation process optimization and the using of ATS related local elements of the transport process, it is required to develop new models and algorithms, taking into account the application of the systematic approach and the interaction of their technological coordination state of the environment, uncertain operating conditions.
2. The developed models and algorithms to optimize the related local deterministic elements of the transport process including: *complexion and packaging of goods; selection ATS of and rational allocation of their routes; select the shortest distance between the participants of the movement of the transportation process; transport distribution of tasks*, provide increased utilization duty ATS; optimizing the distribution of ATS routes; minimization runs and increase the efficiency of the transportation process, the application of a systematic approach and the interaction of technological harmonization.
3. The developed stochastic models and algorithms show that, compared with existing models provide: *determine the most reliable values theoretically possible and optimal ATS speed*, taking into account the random influence of different: traffic factors, climatic conditions and design parameters, the density distribution of slopes and road resistance and movement ATS in various programs, like in certain areas and at all route.
4. It is valuable to *determine the effectiveness of collaboration and ATS posts loading and queuing tasks*, taking into account accidentally entering the ATS and random service time. The calculated probability indicators are: ATS downtime ratios and loading stations, limiting the queue length and time of stay in the ATS

system capable of optimizing the combination of the number of ATS and post loading and a reduction in transport costs.

5. The first time developed models and algorithms in a fuzzy uncertainty indicators regarding to the results of calculations on the proposed mathematical models have higher adequacy, which allow using them to solve these practical problems:

• *routing cargo transportation* using an expert system that provides accounting impact of a number of factors that have a random variable, in one degree or another connected with uncertainty;

• *solution to the problem of shift-day planning* based on the compositions of fuzzy evaluation criteria and heuristic considerations Manager utility in the form of linguistic evaluation.

• *depending on the performance analysis of the ATS*, as distinct that is used existing reception chain productions, leading to distorted results, based on fuzzy logic package Fuzzy Logic Toolbox Matlab system and operator Mamdani.

• *delivery systems* in strictly defined intervals during the time of jewelry should be carried out taking into account: limitations on bandwidth posts handling and receiving certain ATS. The model provides solution to the problem by using the generated set of rules based on the multiplicative convolution of local criteria.

• *determining weights of local criteria*, in contrast to the direct export destination criteria weights, accompanied by a strong dependence on exports of subjectivity, which is proposed to produce a mathematically sound method of local criteria, and providing more adequate solutions as:

- *solution to the problem of choosing the optimal ATS* in competition on the basis of multiplicative convolution of local criteria;

- *the problem of interaction of road wheels and the road surface* under the influence of the various climatic and road conditions, allows for determining the rolling resistance coefficient of adhesion and, taking into account the formation of the rules of the system of export products in the form IF (condition) - THEN (conclusion);

- *decision to open the transportation problem when demand exceeds supply*, to ensure the customer satisfaction for demand presenting of fuzzy variables varying degrees. Search for near optimal solution is based on a genetic algorithm developed by the author and the method of optimization of resource allocation.

6. Using the developed mathematical models on the road transport provides a significant reduction in material cost and time when the process of optimization of the road transport logistics, as compared to the costly experimental studies of the processes discusses the road transport logistics.

7. The methodological basis of the developed models, methods and algorithms for optimization of the elements of AL, enable more deeply and comprehensively investigate of the processes. The developed application packages have been tested at a number of enterprises and indicators of efficiency and suitability for solving operational transport management process.

REFERENCES

[1] A.A. Allahverdiyev, "Effect of Complexion Product Management in House-Building Plant for Selection of the Optimal Rolling Stock", Collection of Scientific Works MADI (Improving the Management of Road Transport), Moscow, Russia, pp. 80-85, 1981.

[2] A.A. Allahverdiyev, "The Method of Optimizing the Product Structure Panel Construction, which Increases the Efficiency of Rolling Stock", Thematic Collection of Scientific Papers, Ministry of Higher and Secondary Education, Baku, Azerbaijan, pp. 26-34, 1984.

[3] A.A. Allahverdiyev, B.A. Huseynov, "Problem of Choosing ATS Size Optimization in Conflict Situations", Third International Conference on Emergency Situations Management Problems, Moscow, Russia, pp. 115-116, 1995.

[4] A.A. Allahverdiyev, "Iterative Method for Solving Transport Problem of Distribution", Proceedings of Institute of Cybernetics, Informatics and Control Problems, Azerbaijan National Academy of Sciences, No. 3, pp. 129-134, 2004.

[5] A.A. Allahverdiyev, "Automated System of Analysis and Accounting of Indicators Use the Car Park", International Conference on Problems of Cybernetics and Informatics, Azerbaijan National Academy of Sciences, Tom III, Baku, Azerbaijan, pp. 73-76, 1991.

[6] A.A. Allahverdiyev, "Complex Transportation Planning Algorithm", Proceedings of Azerbaijan Technical University, Baku, Azerbaijan, pp. 55-57, 2001.

[7] A.A. Allahverdiyev, "Model Kits of Transportation Planning", Proceedings of Azerbaijan Technical University, Baku, Azerbaijan, pp. 57-59, 2001.

[8] A.A. Allahverdiyev, Department of Road Transportation and Products Panel Construction, Ph.D. Thesis, Baku, Azerbaijan, p. 220, 1991.

[9] A.A. Allahverdiyev, "The Method of Solving Shift-Day Planning", Training Notes, Azerbaijan Technical University, No. 3, pp. 153-157, 1992.

[10] A.A. Allahverdiyev, "The Specified Formula of Car Performance", Training Notes, Azerbaijan Technical University, pp. 110-115, 1993.

[11] A.A. Allahverdiyev, "The Method of Optimization and Automation of Shift-Day Planning of Delivery", Training Notes, Azerbaijan Technical University, No. 4, pp. 200-201, 1996.

[12] A.A. Allahverdiyev, "The Optimization of Road Haulage Process under Conditions of Decision Making", Third International Conference of Application of Fuzzy System and Soft Computing, Wiesbaden, Germany, pp. 288-293, 1998.

[13] A.A. Allahverdiyev, "The Heuristics Approach to Range Local Criteria by Optimization of Elements of Transportation Process", Word Conference on Intelligent System for International Automation (WCIS), Tashkent, Uzbekistan, pp. 359-360, September 14-16, 2000.

[14] A.A. Allahverdiyev, "Formation of Speed of Movement of the Automobile Parameters", Forth International Conference on Application of Fuzzy System and Soft Computing, Sigen, Germany, pp. 352-255, June 27-29, 2000.

[15] A.A. Allahverdiyev, "Fuzzy Decision Making for Selection of Vehicles", First International Conference of Soft Computing and Computing with Words in System Analyses, Decision and Control, Antalya, Turkey, pp. 232-242, June 6-8, 2001.
[16] A.A. Allahverdiyev, "Fuzzy Multi-Objective Optimization Problem of the Transportation Process", Proceedings of Azerbaijan Technical University, Baku, Azerbaijan, pp. 52-55, 2001.
[17] A.A. Allahverdiyev, "The Fuzzy Model is Replaceable-Daily of Planning of Transportation Process of Wall Materials", Fifth International Conference on Application of Fuzzy System and Soft Computing, Milan, Italy, pp. 203-234, 2002.
[18] A.A. Allahverdiyev, "Fuzzy Logic in Transport Logistic", Second International Conference of Soft Computing width Word System Analysis, Decision and Control, Antalya, Turkey, pp. 312-318, September 9-11, 2003.
[19] A.A. Allahverdiyev, "Cargo Transportation Routing under Fuzzy Conditions", Sixth International Conference and Application of Fuzzy System and Soft Computing (ICAFS), Barcelona, Spain, pp. 205-211, September 28-30, 2004.
[20] A.A. Allahverdiyev, "An Optimization Method of Transportation Problem under Conflations of Uncertainly", Third International Conference of Soft Computing with Words and Perceptions in System Analysis Decision and Control (ICSCCW), Antalya, Turkey, p. 205-210, September 1-2, 2005.
[21] A.A. Allahverdiyev, "Analysis of the Use of Car Park", Training Notes, Azerbaijan Technical University, Baku, Azerbaijan, pp. 24-27, 2006.
[22] A.A. Allahverdiyev, "Application of Generic Algorithm for Solving an Open Transportation", International Conference and Application of Fuzzy System and Soft Computing (ICAFS), Barcelona, Spain, pp. 24-27, 2006.
[23] A.A. Allahverdiyev, "The Method of Transportation Problem Solving with an Open View of Fuzzy Conditions" Proceedings of Institute of Informatics and Control Problems, Azerbaijan National Academy of Sciences, No. 2, Baku, Azerbaijan, pp. 96-101, 2006.

BIOGRAPHY

Afik Allahverdi Allahverdiyev was born in Azerbaijan, in 1937. He received the M.Sc. degree in the field of Road Transport Operation as a Mechanical Engineer from the Polytechnic Institute of Azerbaijan, Baku, Azerbaijan in 1960. He completed his doctoral thesis on "Development of methods and models for optimizing trucking logistics" and graduated in Ph.D. degree in Automation of the Experimental Study from Faculty Retraining Discounts for New, Promising Areas of Science and Technology from Moscow Car and Road Institute, Russian Academy of Sciences, Moscow, Russia in 1985. Currently, he is an Academic of the Republican International Academician Modern Sciences behalf of Lutfi Zadeh. He is a Doctor of Sciences, Professor and Academic of the International Academy of Ecoenergy, Baku, Azerbaijan. He became a correspondent for the public finished the Republican Council of People's University. He is also a member of the Union of Journalists of Azerbaijan. He is the author of 168 scientific papers. His research interests cover the areas of fuzzy control, development of methods and models for the optimization of road transport and logistics automation and process control industries.