Working Paper

TRANSPORTATION SYSTEM MODELING
IN THE SILISTRA REGION

Boris Mihailov

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WP-80-121

International Institute for Applied Systems Analysis
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INTRODUCTION

The transportation system has many different components and it represents in itself a large-scalesystem. For this reason the solving of the problem concerning the modeling of the internal transporation links within a unified transportation system will not only help to solve an unsolved (to date) problem, but will also give us the possibility of incorporating the transportation in the system of models for integrated regional development. That is why the pursued goal here at this stage is limited and has as its subject the internal components of the transportation system model.

This work is based on two accepted conditions: (1) the initial prospective value of the transportation system components and their interrelations within the region are balanced but not optimized. This value is determined by the assigned parameters on the side of the other subsystems and of the central planning body; and (2) the optimization of the transportation system has to be realized at the subsequent stages of an optimization cycle and this depends on the accepted approach for transportation system modeling.

The results computed here may be considered as intermediate and a deeper analysis of transportation system development should be made after obtaining the solution of the other subsystem models.

PROBLEM DESCRIPTION

The main goal of the regional transportation system is to carry out the required transportation services concerning freight and passenger traffic within the region and its connection with other regions with minimal total transportation costs.

The Silistra region transportation system has to ensure the performance of those functions depending on the transportation demands of long-term growth and structure, substantiated by the realization of the following models in the region:

-- agriculture model;
-- industry development model;
-- migration processes model;
-- human settlements model;
-- environmental protection model;
-- health care systems model.

On this basis a total balance of the freight and passenger traffic in the region is formed. The freight traffic total balance is divided into:

-- balance of produced lines of goods;
-- balance of goods not produced in the region, the demand of which is satisfied by imports from other regions.

The transportation production volume connected with freight traffic in the region is composed of:

-- traffic ensuring productive and non-productive consumption of goods within the region;
-- traffic ensuring the export of goods produced within the region;

-- traffic ensuring the import of goods for consumption into the region;
-- transit traffic.

The volume of transportation production in the passenger traffic is composed of:

-- traffic within the separate settlement system;
-- traffic among settlement systems in the region;
-- traffic ensuring connections with neighboring regions;
-- transit traffic.

This transportation production is completed by the transportation system of the region G_i as a combination of different transportation modes. Besides, the structure of G_i includes not only transportation modes now operational, but also principle new ones, the implementation of which will be possible in the future.

Within the existing and feasible conditions, the transportation system (G_i) in the Silistra region includes:

$$G_i = G_1 + G_2 + G_3 + G_4 + G_5 + G_6 \quad , \qquad (1)$$

where:

G_1 = railway transport;

G_2 = motor transport;

G_3 = river transport;

G_4 = air transport;

G_5 = pipeline transport;

G_6 = channel systems.

For the realization of the model, a regional rated transportation network is formed (see Appendix A) which comprises the main technical and economic indices of its components for the respective time period.

The dynamic characteristics of freight (and passenger) traffic flows are given, represented as two time functions, $Q_1(t)$ and $Q_2(t)$, respectively for both directions. Besides, $Q_1(t)$ and $Q_2(t)$ are considered as vector-functions determining not only the total freight (passenger) traffic flow, but also its structure (types of loads and passenger traffic categories).

Under given initial technical conditions of the regional transportation network, we can assign measures which will be possible in the future and consider network development and reconstruction including these for separate network sections.

Assuming this problem formulation and using the time functions $Q_1(t)$ and $Q_2(t)$, we can determine the time period (one year) $t_1, t_2, \ldots, t_n$, when it will be necessary to take due measures for development and reconstruction of the network. We can also calculate the capital investments and operating costs required.

The technical and technological development of the different types of transport is considered with the help of a technological development coefficient (d) dependent on the parameter t. For this purpose, we have to work out the following:

-- K_d - matrix comprising D_G technological modes for development and operation of the different types of transportation in the region dependent on the dynamics of Q(t);
-- N_d - vector of constraints for maximal possible intensity in using different technological modes.

MAIN STAGES OF THE TRANSPORTATION SYSTEM OPTIMIZATION CYCLE

Depending on the internal link formation of the basic transportation system components and on the possible interrelations with other subsystems in the region, we can formulate the following main stages of optimization of the transportation system:

Stage 1: Determination of the Initial Prospective Stage of the Transportation System

The following transportation system components referring to the prospective period may be balanced at the initial stage:

$$X^{1} = \sum_{i}\sum_{j}\sum_{k}\sum_{l}\sum_{d}\sum_{t} X^{1}_{ijkldt} \quad , \tag{2}$$

where:

X = total volume of the transportation production differentiated by loads (and passenger category) of type k from i-th productional center to j-th user's center by transportation mode of type l, and by technological mode d for t years of the planning period (1 is the stage number).

$$C^{1} = \sum_{i}\sum_{j}\sum_{k}\sum_{l}\sum_{d}\sum_{t} C^{1}_{ijkldt} \quad , \tag{3}$$

where:

C = volume of the current transportation costs differentiated by the same conditions.

$$\Phi^{1} = \sum_{i}\sum_{j}\sum_{k}\sum_{l}\sum_{d}\sum_{t} \Phi^{1}_{ijkldt} \quad , \tag{4}$$

where:

Φ = value of the productive funds installed and differentiated by the same conditions.

Of great significance for the above quantity of the main components of the transportation system is the necessity to define the productivity of each element referring to the concrete volume of the transportation production X, i.e. to derive the intensity coefficients q expressing the necessity of this element for unit of transportation production X:

$$q = \frac{N}{X} \quad , \tag{5}$$

where:

N = quantity of the productive element whence the quantity of relative elements for the transportation production needed at the initial stage will be:

$$N^1 = q \cdot X^1 \quad . \tag{6}$$

Since the separate elements must be comparable (viewed as current consumption elements in the transportation process) their value by prices $N^1 \cdot P = S^1$ will express the value of the transportation costs:

$$\Sigma\, C^1_{ijkldt} = S^1_{ijkldt} \cdot \Sigma\, X^1_{ijkldt} \quad . \tag{7}$$

Respectively, on the basis of the productive funds needs, one may derive the capital investment needed:

$$\Sigma\, K^1_{ijkldt} = b^1_{ijkldt} \cdot \Sigma\, X^1_{ijkldt} \quad . \tag{8}$$

In order to be commensurable, the current transportation costs with the capital investments, the latter have to be reduced to the first, using the coefficient α, reversed to the life of the productive funds (in the case that the productive funds' life is 15 years, $\alpha = \frac{1}{15} = 0,15$). In this sense, the reduced annual transportation costs F^1 at the initial stage will appear as follows:

$$F^1_{ijkldt} = \Sigma\, C^1_{ijkldt} + \alpha\, \Sigma\, K^1_{ijkldt} \quad . \tag{9}$$

Using the productive funds' life-term instead of the practially applied effectiveness coefficients which are a priori assigned, we approach this component to the required goal: the effectiveness has to be argued but not a priori assigned. The above accepted statement enables us to implement distributing type of model as a basic model for the prospective planning of the different kinds of transportation development unified in a transportation system.

Stage 2: Optimal Distribution of the Total Transportation Production Volume Among Different Kinds of Transports

The distribution of the total transportation production is realized on a computer RC4000 in Bulgaria (see Appendix B) using the following model:

$$\sum_i \sum_j \sum_k \sum_l \sum_d \sum_t F^2_{ijkldt} \cdot X^2_{ijkldt} \to \min \quad , \qquad (10)$$

where:

F^2 = reduced annual transportation costs at the second stage.

By means of the model one looks for such a distribution of transportation production k among l transportation modes and d technological modes in t years of the planning period in order to obtain the minimum value of the annual reduced transportation costs. The model is subject to:

$$\sum_i \sum_k \sum_l \sum_d \sum_t X_{ijkldt} = a_{ik} \quad , \qquad (11)$$

where:

$i = 139; \quad k = 17; \quad l = 6; \quad d = 1,\ldots,m; \quad t = 1,\ldots,T;$

i.e., the total transportation production volume should be equal to the freight (and respectively, passenger) volume k in the productional (forwarding) center i;

$$\sum_{j}\sum_{k}\sum_{l}\sum_{d}\sum_{t} X_{ijkldt} = r_{jk} \quad , \tag{12}$$

where:

$j = 139; \quad k = 17; \quad l = 6; \quad d = 1,\ldots,m; \quad t = 1,\ldots,T;$

i.e., the total transportation volume should be equal to the freight (passenger) volume K in the user's (receiving) center j; hence:

$$\sum_{i=139} a_{ik} = \sum_{j=139} r_{jk} \quad , \tag{13}$$

$$\sum X_{ijkldt} \geq 0 \quad , \tag{14}$$

non-negative conditions.

Making a value deciphering of the criterion "reduced freight and passenger traffic costs in the region" in combined transportation (i.e. using several types of transportation) we have to ensure, in advance, the comparability of current costs in the respective type of transportation.

Stage 3: Choice of Technological Modes of Transportation

The functioning of the separate transports has such features that different activities and subdivision work in it exists in a complex way. The link of these activities and subdivisions with the final transportation production is an indirect one. This necessitates separate tasks for each mode of transport to be solved. These tasks express different aspects of the given transport functioning and they have to be interlinked.

The classification of tasks may be as follows:

1. The first type of task is connected with the type of traction (for instance, diesel or electric traction in railway transport, different types of engine in motor transport, etc.). The result of this task solving is a new quantity of material, labor resources and productive capacities and respectively new transportation costs. In this respect the tasks can be linked with tasks of other classes.

   In outline, the tasks of the first type may be expressed as follows:

$$\hat{T} = \min \Sigma F^{31}_{ijkldt} , \qquad (15)$$

   where:

   31 is the number of this stage of the optimization cycle and task of the first type.

2. The second type of task is connected with the optimal capacities of the separate transports and their relative speeds (for instance, gross weight of train, ship loading capacity, etc. The outline of these tasks is:

$$\hat{Q} = \min \Sigma F^{32}_{ijkldt} . \qquad (16)$$

3. The third type of task refers to the optimal spatial distribution of the transport capacities and resources among the different sections. The determining factors for this distribution are the different transport conditions which cause different expenditures:

$$\hat{D} = \min \Sigma F^{33}_{ijkldt} . \qquad (17)$$

4. <u>The fourth type of task has a markedly dynamic character and determines the development strategy over time and more specifically defines the rational time to embed the possible actions</u>. If t_i is the year of the action implementation, ΔA = capital investments since the beginning of the period under analysis, T = final term, E = annual current costs gain, P_n^t = rate of the action productivity, the maximum total gain of cost will be:

$$G = (\Delta A - \Delta A \frac{1}{P_n^{t_i}}) + \sum_{t1}^{T} \Delta E \frac{1}{P_n^t} - \sum_{0}^{t_i} \Delta E \frac{1}{P_n^t} \rightarrow \max \quad , \qquad (18)$$

and the most rational time for embedding the action will be:

$$t_i = \frac{\Delta A_0 \cdot \lg Pn - (\Delta E_0 + \Delta A)}{\Delta E - \Delta A \lg Pn} \quad , \qquad (19)$$

or in outline, the fourth type of task is:

$$\hat{t} = \min \Sigma F^{34}_{ijkldt} \quad . \qquad (20)$$

The task arrangement within each transport permits its iterative linking. Therefore, in a direct line (depending on the task rank) for each subsequent task, the need for transport elements is calculated on the basis of their optimization in the previous task. In a reverse line, an iterative link exists between the last and the first ranking task. The right and reverse links between the different types of tasks will appear as follows:

$$\hat{T} = \min \Sigma F^{31}_{ijkldt} \; ; \; \hat{Q} = \min \Sigma F^{32}_{ijkldt} \; ; \; \hat{D} = \min \Sigma F^{33}_{ijkldt} \; ; \; \hat{t} = \min \Sigma F^{34}_{ijkldt} \; . \qquad (21)$$

This approach allows us to reduce the technological variants to an acceptable number, D_{ijklt}.

An iterative procedure is applied in order to overcome the difficulties coming from the nonlinear dependence of the total traffic volume and technological modes of transportation on the reduced annual costs. Having previously given (assigned) the values of X_{ijkldt} and F_{ijkldt}, this procedure allows the solving of the model for regional transportation network traffic distribution (initial plan) with the help of linear methods and then, determining new values of X^1_{ijkldt} we can calculate the reduced costs (F^1_{ijkldt}) etc.

Using the above approach, we have to determine the technical measures required for the development of the network--technological modes of transportation d, differentiated among different types of transportation l, traffic categories k and years of the long-term period t (D_{ijklt}) in every iterative procedure parallel with the project for traffic distribution in the regional transportation network, i.e. the third stage may be performed simultaneously with the second stage and they are conditionally divided.

The above procedure may be expressed in the following way:

$$\Sigma\, F^2_{ijkldt} \cdot X^2_{ijkldt} \rightarrow \min$$

$$S^3_{ijkldt}\, \Sigma\, X^3_{ijkldt} = C^3_{ijkldt} \quad ; \quad b^3_{ijkldt}\, \Sigma\, X^3_{ijkldt} = \Sigma\, K^3_{ijkldt}$$

$$F^3_{ijkldt} = C^3_{ijkldt} + \alpha\, \Sigma\, K^3_{ijkldt} \quad .$$

(22) (22)

Stage 4: Impact of the Final Optimization on the Initial Parameters

As a result of the above, we may derive the total gain of the optimization procedure as the difference between the reduced costs at the initial and optimal plan:

$$\Sigma G_{ijkldt} = (\Sigma C^1_{ijkldt} + \alpha \Sigma K^1_{ijkldt}) - (\Sigma C^3_{ijkldt} + \alpha \Sigma K^3_{ijkldt}) \quad . \tag{23}$$

The total gain may be used in reverse line for changing the initial parameters of the transportation optimization model.

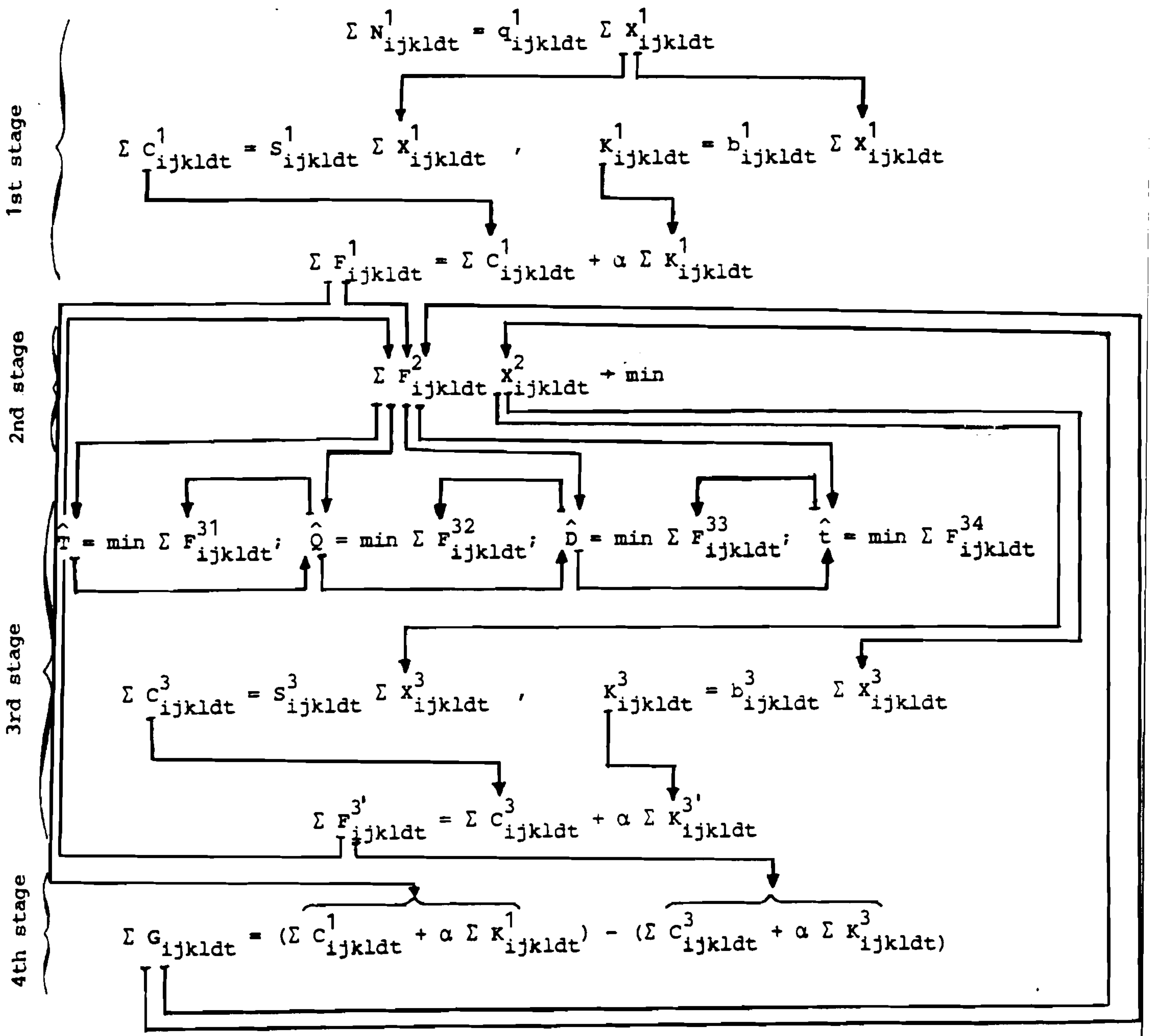
The above procedures may be repeated until the final solution is obtained. The full optimization cycle may be described as can be seen on page 13.

ALGORITHM FOR COMMODITIES DISTRIBUTION AMONG TWO KINDS OF TRANSPORTS

This algorithm is a modified Ford-Fulkerson's method for the shortest distance in a set, in which the transformed transportation costs are used instead of the transportation distance. For this purpose a set of commodity destinations serve as the basis to sketch the sections and crosspoints of the two transports. It is supposed that there is no friction limitation and the initial, final, surcharge and transit operation expenditures are assigned.

The starting points of this task are:

- -- the initial and final points of the commodities transported are known;
- -- an alternative for one of the two transports may be used;
- -- during the transportation process the commodities may be surcharged from one to another transport;
- -- it is necessary that the two transport participation be defined with the aim of obtaining minimum transformed costs.


1st stage
2nd stage
3rd stage
4th stage
Σ N¹ijkldt = q¹ijkldt Σ X¹ijkldt
Σ C¹ijkldt = S¹ijkldt Σ X¹ijkldt ,
K¹ijkldt = b¹ijkldt Σ X¹ijkldt
Σ F¹ijkldt = Σ C¹ijkldt + α Σ K¹ijkldt
Σ F²ijkldt X²ijkldt → min
T̂ = min Σ F³¹ijkldt;
Q̂ = min Σ F³²ijkldt;
D̂ = min Σ F³³ijkldt;
t̂ = min Σ F³⁴ijkldt
Σ C³ijkldt = S³ijkldt Σ X³ijkldt ,
K³ijkldt = b³ijkldt Σ X³ijkldt
Σ F³'ijkldt = Σ C³ijkldt + α Σ K³'ijkldt
Σ Gijkldt = (Σ C¹ijkldt + α Σ K¹ijkldt) - (Σ C³ijkldt + α Σ K³ijkldt)

For this purpose the following method for sketching the transportation set is chosen:

- each subregion of the region is subdivided into two crosspoints (expressing two kinds of transport);
- the sections between the different subregion crosspoints have a value equal to the transportation costs for one ton transported through the given section (i.e. by the given transport);
- the sections within the subregion (i.e. between the two transports) have a value equal to the surcharge costs from one to another transport.

The total volume of the commodities transported by the two transports is derived by means of sequent summing of separate commodities. The procedures are the following:

- The "distance" of the crosspoint is D_i (i is the crosspoint number; the initial crosspoint is $D_{io} = 0$).
- The following inequality has to be verified:

$$D_i + p_{ij} < D_j \quad , \tag{25}$$

where:

p_{ij} = "distance" of the sections between i and j.

In the case that this condition is satisfied, one can give a value of:

$$D_j = D_i + p_{ij} \quad ; \tag{26}$$

- The above condition has to be repeated until this inequality is fulfilled for all crosspoints.

This algorithm was fitted in Bulgaria at the Institute for Complex Transport Problems but in a different way: after each iteration, the following inequality was chosen:

$$A_j^{(m)} > A_i^{(m)} + P_{ij} \quad , \tag{27}$$

where:

$A_l^{(t)}$ = potential of l-th apex at t iteration;

P_{ij} = "price" of the section i, j.

At the initial iteration to all apexes (excepting io) is given potential $A_j = \infty$. If the above inequality is fulfilled at the following iteration for some apex j, one gives to this apex a potential:

$$A_j = A_i + P_{ij} \quad . \tag{28}$$

After all sections going out from the i-th apex are verified, its indication can be excluded. This process continues until such indications exist. In this sense the sections i, j taking part in (28) express the lowest expenditures of the transported commodities.

If the subsequent number of the apex on the line is i, it can be derived from the sequent denoted apexes, which have had potential $A_j = \infty$ and which are changed with (m_i) or the m-th apex, with i(m). Therefore, i(1) is always equal to io. These apex indications keep their place by the end of the task procedure.

The sequence of the apex review is the following: if the apex i with m_i indications is treated and some of the apex potentials jl are changed in this case the following apex to be treated is not i+1, but:

$$\beta = \min_{(jl)} [m(jl), m(i) + 1] \quad . \tag{29}$$

This procedure can be illustrated in the following way: let in the apex line under analysis, some of the apex potentials denoted with (^) be changed:

$$io, \ldots, \hat{in}, in+i, \ldots, \hat{il}, \ldots, \hat{ip}, ip+1, \ldots, \hat{is}, \ldots, ih \quad . \tag{30}$$

The solution is reached when $\beta = M + 1$.

The formal description of this algorithm is as follows:

-- Notation:

l = number of the last apex in the line;

p(i) = number of the apex in the line, following the i-th apex;

q(j) = number of the crosspoint, preceeding the apex j in the shortest way;

δ(j) = indication of the apex;

i = number of the treated apex.

1. All apexes receive potentials:

$$A_i = \infty \quad \text{and} \quad \delta(i) := p(i) := 0 \quad .$$

2. $A_{io} := 0 \quad , \qquad i := l := il \quad .$

3. For the successive section (i,j) the equation (28) has to be verified. If it is breached, one can to go to point 8, otherwise to (28).

4. If $A_j = \infty$, hence $p(l) := j$ and $l := j$ and the transition is to point 6. If $A_j \neq \infty$, the transition is to point 5.

5. If $\delta(j) = 0$, hence $p(j) := p(i)$, $p(i) := j$ and the transition is to point 6. If $\delta(j) \neq 0$, the transition is to point 7.

6. $\delta(j) := 1$.

7. $A_j := A_i + P_{ij} \quad ; \qquad q(j) := i$.

8. If the section (i,j) is the last section, the transition is to point 9, otherwise, to point 3.

9. If $p(i) \neq 0$, hence $T := i$, $i := p(i)$, $p(s) := \delta(s) := 0$ and the transition is to point 3. If $p(i) = 0$, the procedure is ended.

In this algorithm, the annual transformed transportation costs are used as a measure for the transported commodities which makes two kinds of transports commensurable. The annual transformed transportation costs are calculated on the following methodological basis :

- -- the transportation costs are divided by main elements of the transportation process, referring to one ton for initial, final, surcharge and transit operations and referring to one ton per kilometer for movement operations;
- -- in the transformed costs, the current transportation costs and capital investments are included;
- -- the costs calculations are made by different commodities, taking into account their feature characteristics: the vehicle used, the carrying capacity, machinery used, etc.

The following step of the investigations in this direction could be to elaborate an algorithm for commodity distribution among more than two kinds of transports.

GENERAL CONCLUSIONS

The following general conclusions can be made on the basis of the proposed approach.

- -- The differentiation of the transport system optimization cycle and the usage of costs coefficients of the transport components have a great importance both for the transportation system optimization and its linking with the other subsystem models within the region.
- -- The convergence between the separate tasks within an unified system is realized by means of similar criteria, the task arrangement and right and reverse relations used.
- -- This approach enables traditional techniques for transportation indices calculation to be used as auxiliary ones and some of the tasks solved in practice as well, but submitted to the proposed optimization cycle.
- -- The described optimization cycle shows that the transportation system is a large-scale system and may be optimized on at least two levels: on the uniform

transportation system level and on separate kinds of transport level.

-- The transportation system modeled with regional aspects is a centralized system as well as with national aspects. But this does not mean that the regional management body can directly control the transportation system. This body may offer its concepts to the central planning body without the certainty that they will be be accepted.

-- The further improvement of the transportation system modeling is to be connected with the interrelations with other subsystem models.

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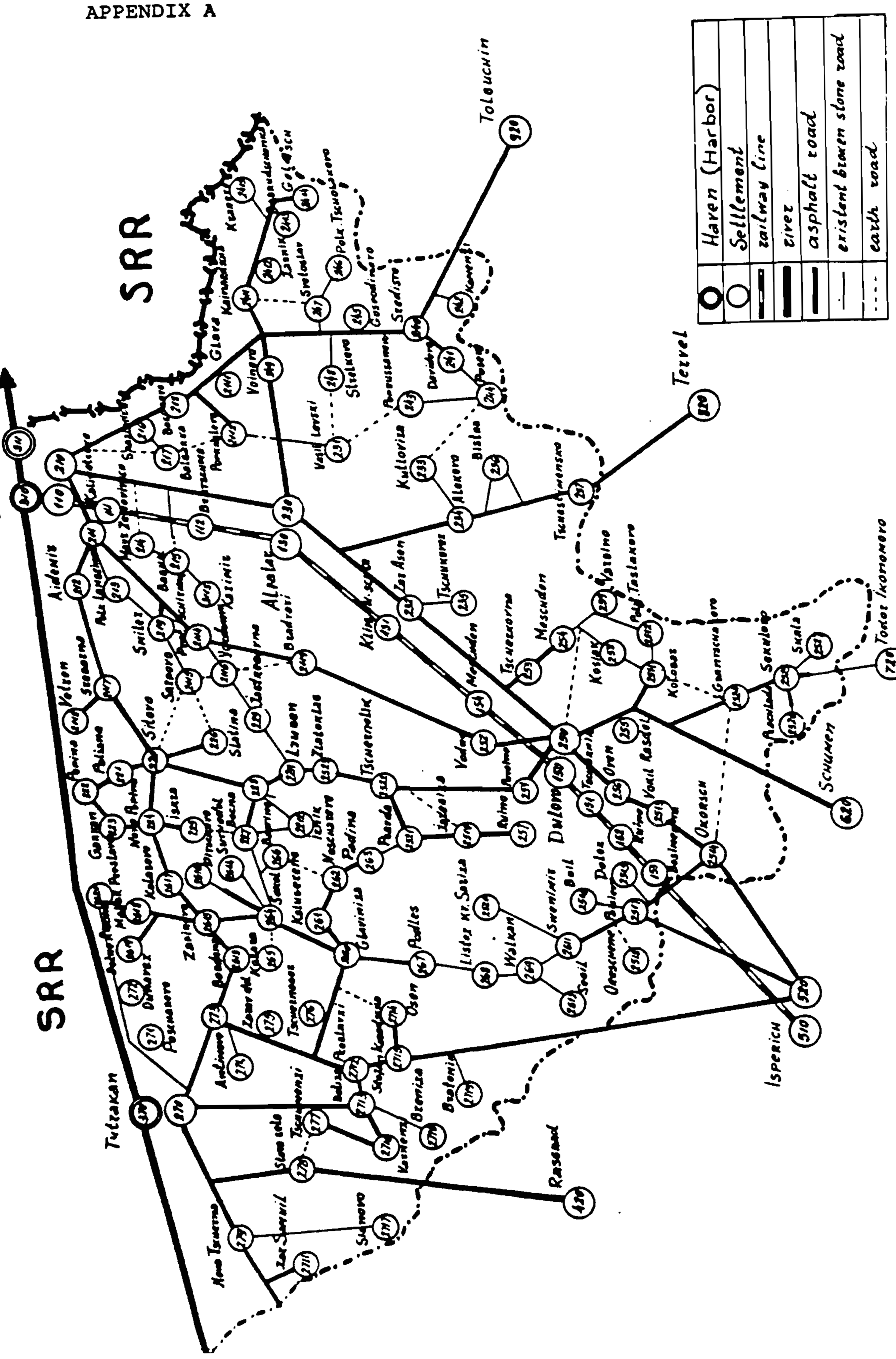
APPENDIX A



Map of Silistra Region - The Transportation Network

APPENDIX B:

ПЕЧАТ НА ПОКАЗАТЕЛИТЕ ЗА ТОВАР НОМЕР 1
Distribution of load no. 1

ПРЕМИНАЛИ ТОНОВЕ ПО УЧАСТЪЦИ
Transported tons by sections

A - motor transport
Ж - railway transport

ОТ from	ДО to	НАИМЕНОВАНИЕ sections		ХИЛ. ТОНА tons in thous.
250	251	ДУЛОВО-А	- ПОРОИНО-А	2
250	252	ДУЛОВО-А	- ВОДНО-А	15
250	2521	ДУЛОВО-А	- ПРАВДА-А	1
250	256	ДУЛОВО-А	- ОВЕН-А	1
250	255	ДУЛОВО-А	- РАЗДЕЛ-А	1
250	258	ДУЛОВО-А	- КОЗЯК-А	1
250	254	ДУЛОВО-А	- МЕЖДЕН-А	2
250	253	ДУЛОВО-А	- ЧЕРКОВНА-А	2
250	2514	ДУЛОВО-А	- КОЛОБАР-А	1
250	2515	ДУЛОВО-А	- ДОЛЕЦ-А	1
230	231	АЛФАТАР-А	- ВАСИЛ ЛЕВСКИ-А	2
230	232	АЛФАТАР-А	- ЦАР АСЕН-А	1
230	233	АЛФАТАР-А	- КУТЛОВИЦА-А	2
230	234	АЛФАТАР-А	- АЛЕКОВО-А	2
230	235	АЛФАТАР-А	- ЧУКОВЕЦ-А	15
230	249	АЛФАТАР-А	- ВОИНОВО-А	4
230	245	АЛФАТАР-А	- ГОСПОДИНОВО-А	3
230	2415	АЛФАТАР-А	- КРАНЕВО-А	1
230	2414	АЛФАТАР-А	- ГОЛЕШ-А	1
230	240	АЛФАТАР-А	- СРЕДИЩЕ-А	1
230	241	АЛФАТАР-А	- ДАВИДОВО-А	2
230	242	АЛФАТАР-А	- КАМЕНЦИ-А	2
210	211	СИЛИСТРА-А	- КАЛИПЕТРОВО-А	3

ПЕЧАТ НА ПОКАЗАТЕЛИТЕ ЗА ТОВАР НОМЕР 1
Distribution of load no. 1 (continued)

ПРЕМИНАЛИ ТОНОВЕ ПО УЧАСТЪЦИ
Transported tons by sections

ОТ from	ДО to	НАИМЕНОВАНИЕ sections		ХИЛ. ТОНА tons in thous.
210	212	СИЛИСТРА-А	- АЙДЕМИР-А	4
210	213	СИЛИСТРА-А	- ПОЛК.ЛАМБРИ.-А	1
210	214	СИЛИСТРА-А	- МАИР.ЦЕНОВИЧ-А	45
210	217	СИЛИСТРА-А	- БЪЛГАРКА-А	3
210	216	СИЛИСТРА-А	- СРАЦИМИР-А	2
210	219	СИЛИСТРА-А	- СМИЛЕЦ-А	1
210	218	СИЛИСТРА-А	- БОГОРОВО-А	2
210	220	СИЛИСТРА-А	- СИТОВО-А	15
210	226	СИЛИСТРА-А	- СЛАТИНА-А	1
210	221	СИЛИСТРА-А	- ПОЛЯНА-А	3
210	222	СИЛИСТРА-А	- ИСПИЧА-А	2
210	223	СИЛИСТРА-А	- ЯСТРЕБЪНА-А	1
210	228	СИЛИСТРА-А	- ДОБРОТИЦА-А	1
210	270	СИЛИСТРА-А	- ТУТРАКАН-А	2
210	260	СИЛИСТРА-А	- ГЛАВИНИЦА-А	1
270	274	ТУТРАКАН-А	- АНТИМОВО-А	25
270	271	ТУТРАКАН-А	- ПОЖАРЕВО-А	3
270	273	ТУТРАКАН-А	- ДУНАВЕЦ-А	1
270	275	ТУТРАКАН-А	- ЦАРЕВ ДОЛ-А	4
270	277	ТУТРАКАН-А	- ШУМЕНЦИ-А	1
270	276	ТУТРАКАН-А	- СТАРО СЕЛО-А	1
270	279	ТУТРАКАН-А	- НОВА ЧЕРНА-А	1
510	110	ИСПЕРИХ-Ж	- СИЛИСТРА-Ж	40
510	130	ИСПЕРИХ-Ж	- АЛФАТАР-Ж	15
510	150	ИСПЕРИХ-Ж	- ДУЛОВО-Ж	20

ПЕЧАТ НА ПОКАЗАТЕЛИТЕ ЗА ТОВАР НОМЕР 8
Distribution of load no. 8

ПРЕМИНАЛИ ТОНОВЕ ПО УЧАСТЪЦИ
Transported tons by sections

ОТ from	ДО to	НАИМЕНОВАНИЕ sections		ХИЛ. ТОНА tons in thous.
210	230	СИЛИСТРА-А	- АЛФАТАР-А	3
210	250	СИЛИСТРА-А	- ДУЛОВО-А	5
210	620	СИЛИСТРА-А	- ШУМЕН-А	10
210	520	СИЛИСТРА-А	- ИСПЕРИХ-А	20
210	920	СИЛИСТРА-А	- ТОЛБУХИН-А	2
520	250	ИСПЕРИХ-А	- ДУЛОВО-А	3
210	260	СИЛИСТРА-А	- ГЛАВИНИЦА-А	40
210	220	СИЛИСТРА-А	- СИТОВО-А	2
210	270	СИЛИСТРА-А	- ТУТРАКАН-А	2
210	250	СИЛИСТРА-А	- ДУЛОВО-А	5
210	240	СИЛИСТРА-А	- СРЕДИЩЕ-А	2
210	230	СИЛИСТРА-А	- АЛФАТАР-А	11
230	210	АЛФАТАР-А	- СИЛИСТРА-А	5
920	210	ТОЛБУХИН-А	- СИЛИСТРА-А	10