DECISION-MAKING ANALYSIS OF COMMUNICATION SYSTEM IN LIAONING PROVINCE

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ABSTRACT

The decision-making analysis of communication system in Liaoning Province outlines the replica of the provincial communication system and its modelling process of investment analytic model by means of the point of view of system project and the method of systematic analysis. And, by way of man-machine dialogue, it makes prediction and decision-making analysis of transportation system of railway, highway, water navigation, aviation and tube transportation through the years from 1986 to 2000.

I. Preface

Communication-transportation is a complicated system consisting of transportation modes such as railway, highway, water navigation, aviation and tube transport. Liaoning's communication system has developed into a combined transport system with complete varieties that radiate in all directions and makes Liaoning one of the Provinces in China that communications have most developed.

The present article outlines the replica of the Provincial communications system and its modelling process of investment analytic model by using the point of view of system project and the systematically analytic method and, by way of man-machine dialogue, it provides the decision-making departments with predictions of more than twenty varieties of targets in communications system, plans for investment required to realize predicated target and their feasiablity analysis.

On the basis of the data on communications within the Province in 1985, screening some relevant historical data and using the above said method, the present article predicts and makes decision-making analysis of the transport systems of railway, highway, water navigation, aviation and tube transist from the year 1986 through to the year 2000 within Liaoning Province and its results have been adopted by departments concerned.

II. Status quo of Liaoning's Communications System

Liaoning is a multi-citied province with industry and agriculture much developed. Located at the vital communications line between the Northeast and the rest part of China west to the Shanhaiguan Pass, the province has large volumes of production and traffic flows. Running within the province are six major railway lines of Shenyang-Shanhaiguan, Changchun-Dalian and etc. and twenty-eight branches. Railway operative milage in 1985 is 3538 km, accounting for 7% of the country's total milage; while highway service milage is 33006 km, 4% of the nation's total; The coast line in the provice is 2178 km, with Dalian, Yingkou and other four sea ports. Wharf line in harbours is 16242m in length with 148 berths, among which, 28 are of 10,000 tonage, accounting for 14% of the country's total 10,000-ton berths. Dalian is the second sea port in China and there are four air ports for civil aviation in Shenyang and Dalian and other cities in the Province. 18 inland air lines and one international air line are opened in the Province with 22800 km of air service milage. In the Province, there are 1419.6 kms of oil pipeline, accouting for 12.1% of the nation's total length.

In 1985 the entire Province accomplished transportation of 235 million tons of various cargoes, accounting for 8.7% of the nation's total capacity; the cycling amount of cargo is 119.78% billion ton/km, 6.3% of the nation's total; passenger transport is 360 million people; 6.3% of the nation's' total; cycling capacity of travellers is 30.55 billion person/km, accounting for 7.1% of the nation's total; It's harbour's handling capacity is 50 million ton, 14.6% of the nation's coastal sea ports.

III. Modelling System of Decision-Making Analysis of Liaoning Provincial Communication System

The modelling system of decision-making analysis of Liaoning Provincial communications system contains of three models: LTSDM model, LTSAM model and LTEAM model. The relevant indicators in strategic plans for the entire province's economic development given by the provincial macro-economic model, such as production, speed and investment, etc. act as external variants of system input, while some indicators of the annual communication system with 1985 as base period are taken as input variants. They are put into LTSDM and LTSAM models respectively to predict the indicators for transport amount, cycling amount, investment, new equipments added, etc. in the total provincial communication system from 1986 through to the year 2000. Some feasiable plans were selected by means of screening according to the operator's intention through the dialogue between system analysis and the control panel (if no feasiable plans are available, system returns to imput end, correct input parameter, and go on with the above operation process). Indicators were put into LTEAM model, analysis and evaluation were conducted according to indicators and then good and bad plans were selected. Decision-making plans were determined through dialogue again between system analysis and control desk (if no optinmum plan is available, system returns and repeat the above said process). Then the plans were provided to decision-making department. Its process is as shown in Fig. 1.

a. LTSDM model

LTSDM model is the SD replica of Liaoning Provincial communication system, a system dynamic model consisting of 63 variants, 250 strong equations and transport modes including railway, highway, water navigation, aviation and simulates.

b. LTSAM Model

LTSAM Model is the analytic model set up by means of AHP for investment in Liaoning Provincial communication system. Its structure is shown in Fig. 3.

Creterion stratum: Weights in total investment in communication and transportation in the five major transport departments from Z1 to Z5.

Sub-creterion stratum: the six influential factors that are: S1 to S5.

Stratum of plans: F1 to F10 is the orientation for major investment in construction of communication system. Scale that judges the matrix is determined by means of the combination of qualitative and quantitative methods. In quantitative method, historical data was used to obtain proportional relation between two factors in corresponding stratum and then, by means of qualitative method to ask for opinions form experts in decision making departments for modification. In investment in railway, for instance, the function of proportional relation with total investments in the whole province in every past year is easy to obtain. The proportion of relation function thus obtained is to be compared with the proportion obtained with LTSDM Model. Then we asked for opinions from expers concernedfor correction so as to determine a proper proportion. For the rest factors, this method is also used to determine the proportion to set up a ratio table of relations among factors. The table, then, was converted into table of difference among all factors by means of Thurstone method, and the scale table can be obtained by coverting the table of difference to some extent and the judging matrix is constructed.

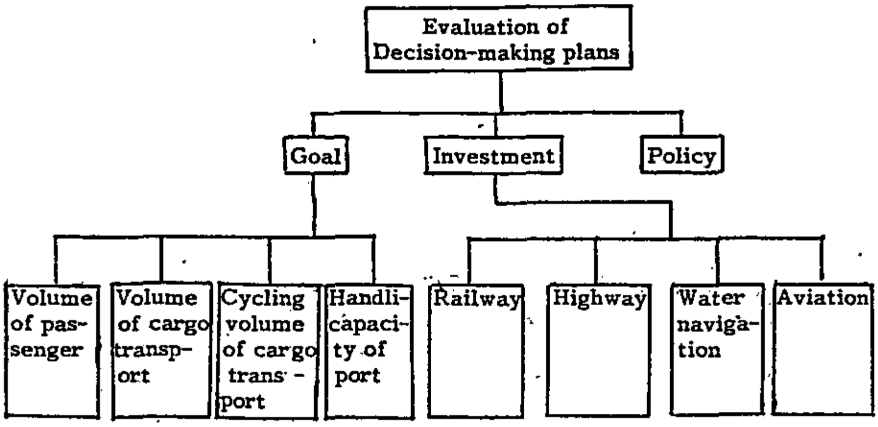

Fig. 3 LTEAM Model for Evaluation of Decision-Making Plans for Liaoning Provincial Communicatin System

c. LTEAM Model

The LTEAM Model is also a model set up by means of AHP method for stratum analysis of evaluation of the decision-making

The evaluation indicators and stratum are shown in Fig. 4. Determination of judging matrix is done in combination of analysis of historical data with experts' appraisal. Having been computed, the model is multiplied by a weighted number which, having been properly treated, is shown in Table 1 of the initial weighted values of evaluation indicators.

Evaluation of indicators in Table 1 is done by means of elastic coefficients which are:

$$\mathcal{E}_i = \frac{\Delta S_i}{\Delta M_i}$$

where $\mathcal{E}_i$ is the elastic coeffients in i lines of evaluation indicators,

ΔS_i is the annual growth of i lines of evaluation indicators,

ΔM is the annual growth of GNP.

According to historical quantitative level of $\mathcal{E}_i$, the optimum was selected as evaluation standard that is suitable for the provincial conditions. The highest sub-values are given as 9, with the rest progressively decreasing as 7, 5, 3, 2, 1. The standard values of our evaluation are given in table 2.

Table 2 Standard values for ε selection

Evaluation indicators	value	Evaluation indicators.	value
Volume of passenger tr-nsport	1.0	Investment in highway	0.5
Volume of cargo transport	1.0	Investment in highway	0.7
Cycling volume of passenger transport	1.0	Investment in navigation	0.6
Cycling volume of cargo transport	0.9	Investment in aviation	0.5
Port han-dling capacity	0.9	Investment in tube transport	0.3

The weights of all evaluation indicators in Table 1 is to be multiplied respectively by corresponding value and, then to obtain tne total sum, which is:

$$N=\sum_{i=1}^{5} W_{1i}\varepsilon_{1i} + \sum_{j=1}^{5} W_{2j}\varepsilon_{2j}$$

where

N is the standard sub-value of the comprehensive evaluation of the decision-making plans,.

W_{1i} $_{1i}$ are respectively the weight and standard sub-value of the goal of decision-making (volume of passenger transport, ...)

W_{2j} $_{2j}$ are respectively tne weights and standard sub-value of investment plans for decision-making (railway, ...)

Policy factors are not quantitied. Condition for materilization of all plans and games respectively taken for them could only be determined by decision-making departments. Through above said steps, the evaluated mark points of plans calculated were their sub-value and, then, were provided to the decision-making department.

D. The Decision-making Analysis of Liaoning Provincial Communication System

Through calculation, Analysis and evaluation, the situation of Liaoning's communication and transportation in the year 2000 is as follows :

1. Transport lines and transport tools

Railway: milage of railroad service in the province will be as much as 4100Km, the modified and expanded electric railway being 500Km, with 1665 locomotives and 2368 passenger trains.

Highway: service milage will be 43669Km, with 1084Km of class A highway among it.

Society will have in possession 600,000 vehicles.

Port: along the coast there will be 204 berths, with 50 of them being 10,000-ton grade.

Aviation: there will be additional 20 inland airlines and 2 international airlines.

Tube transport: 500Km of oil pipeline will be constructed for oil final product.

2. Volume of cargo Transport and Passenger Transport

Volume of passenger transport: will be 1.02 billion people, 2.5 times that of 1985, annual growth being 6.4%. Among them, transport by railway will be 290 million people, 730 million by highway, 400,000 people by water navigation and 4 million by aviation.

Volume of cargo transport: will be 1.85 billion ton, 2.7 times that of 1985, annual growth being 6.8%. Among it, 220 million ton will be transported by railway, 1.57 billion ton by highway, 2 million ton by navigation and 60 million ton by tube.

3. Cycling volume of cargo and passenger transports

Passenger: will be 66.2 billion people. Km, 2.1 times that of 1985 with annual growth being 5%. Among it, 42.2 billion people. Km by railway, 19.8 billion people. Km by highway, 30 million people by water navigation and 4.2 billion people. Km by civil aviation.

Cargo: will be 269.2 billion ton. Km, 2.2 times that of 1985, annual growth being 5.5%. Among it, 191.5 billion ton/Km is done by railway, 47 billion ton/Km highway,2.47 billion ton/Km by water navigation, 70 million ton. Km by civil and 28.2 billion ton. Km by tube.

4. Sea port handling capacity

By the year 2000, harbour handling capacity of Province will be 130 million ton, 3 times that of 1985, with annual growth being 7.4%.

5. Investment

According to prediction, by the year 2000, the accumulated investment in capital construction of communication system will be 19.2 billion yuan (RBM) to meet the need of the sum, 3.1 billion will be in railway, 8.9 billion Yuan in highway, 4.5 billion for water navigation, 2.4 billion for aviation and 300 million yuan for tube.

6. The Feasibility analysis of plans

Through evaluation, mark points of the above plans are as high as 835 points, the highest among nearly one hundred plans.

Discussion of experts concerned concluded that to realize this plan investment must be increased, the existing transport administrative system be reformed, productivity hightened, technical transformation by enhanced and transport capacity and efficiency be raised, transportation system must be equiped with advanced technology and equipments and regulations and rules in communication and transportation must be set up and perfected. This plan will be realized easily so long as measurements are properly taken.

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