

A decision support system for ranking industries based on Saaty's AHP

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Abstract: This paper introduces a Decision Support System (DSS) which is built up on the basis of AHP and is now in use by the Planning Council of Guangzhou City municipal for key industries choice, which is significant to the forming and developing of an efficient local industry system. Described in detail are the background of its development, its main features, its structure and the functions of its main component modules.

Keywords: Decision Support System, AHP, Key industries

1. Introduction

The industry Economics is a newly emerging economic theory in which the object of research is industries. The theory reveals on the basis of a lot of evidential researches that the process of economical development is in fact the evolution of industrial structures. Therefore, in order to keep up with the developed countries, the developing countries must research their industrial structures and program them.

On the other hand, the Industry Economics points out for programming an industrial structure it is not feasible to plan the scale of every industry. the reasonable way is to choose the key industries in the district and, with their leading role, to promote the development of the economy as a whole.

Our country is large, for the national economy to progress rapidly and harmoniously the industry structure programming to a certain extent is necessary. As to the districts, the key industries choice is an important aspect of the industrial structure programming.

In the concrete procedure of choosing the key industries the traditional analysis methods do not work well. Because one industry may have some indicators higher and some lower than other industries. There hardly exists an industry with all indicators highest in all industries. So systems analysis methods are needed to give a synthetical evaluation to the industries. In many system methods we take AHP (the

Analytic Hierarchy Process) in which the qualitative analysis is supported by quantitative analysis as the suitable tool to deal with this problem.

However, it is not enough to only produce proper models and methods for key industries choice. There are two reasons. First, this job is not made just once, because in different programming periods the key industries may be different too. Even in the same programming period, if the situation changes, the model must be modified as well. All these make many-time choices necessary. Second, every time when the choice making is going a large amount of data to be dealt with, The repeated calculations cost much time of the decision makers.

In the above-mentioned background of practical needs, we developed the DSS "CX" to aid the decision of the half-structured problem, the choice of key industries. At present the DSS "CX" is in practical use by the Planning Council of Guangzhou municipal, which has solved two decision making issues with CX.

2. The designing principles and main features

The CX system is aimed at the convenient usage by non-computer-specialized persons to support the general multi-objective single/group decision making and the choosing of key industries/products.

Following are its main features.

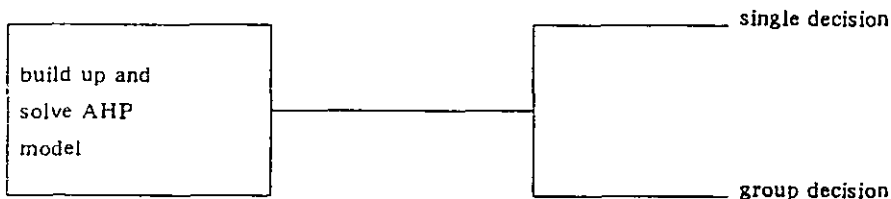
(a) The CX, according to the models built up by the decision maker following the prompts shown on the screen, resolves the whole decision making procedure into several simple steps. In each step the decision maker (single or group), based on his/their knowledge or experience, gives judges to the questions issued by the computer. And CX deals with the judges and derives the conclusion. In this way the decision maker, without the need to understand the details of models and algorithms used in the decision making process, can use them effectively and arrive the reasonable conclusions step by step.

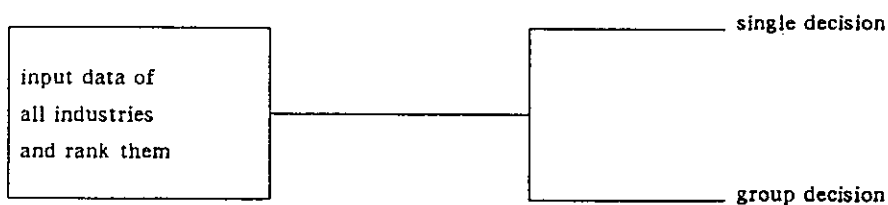
(b) CX includes the data storage function and data management system. The user can input and store the data or manage them conveniently.

(c) CX has a convenient man-machine interface; It uses chinese language for all input-output items, offers menu choices and dialog operations.

3. Structure outline and functions

The general structure of CX is shown as follows.





Following is the fundamental function of each part.

(a) To build up and solve AHP model:

This part is a computer-aided tool for general multi-objective single/group choice making.

1) First of all, decision maker draws up the criteria and subcriteria related to the object of decision and form his hierarchy model of the problem. Then he, following the prompts given by CX, inputs the hierarchy into computer. CX displays the hierarchy diagram automatically.

2) CX shows the prompts for one-to-one importance comparisons between the elements of every level. The decision maker gives his judges through choosing the proper adjectives shown on the screen. When the judge inputs are finished, judge matrices are formed in CX.

3) CX utilizes AHP algorithms to calculate the local and global weighting vectors from the judge matrices, makes the consistency examinations and outputs the final results of this part. Namely, with respect to the object of the decision the weighting values of relative importance of all criteria and subcriteria are produced and displayed.

4) In the "single decision" branch, decision maker input one judge matrix. Whereas in the "group decision" branch, a group of decision makers input all their matrices into the storage system of CX. The group of judge matrices are stored into the disk as data files and a special interface is set up to consult/supplement/modify them.

After reading—in the group of judge matrices from disk files, CX calculates importance ranking vectors of the criteria and subcriteria with arithmetical average weighting method. The weight of every judge-matrix is decided by decision maker through keyboard dialogs.

(b) To input data of industries and rank them

In this part the model built up in part (a) and its ranking results are utilized. On this basis the related data of the industries are input to rank them. There are also two alternatives, single decision and group decision in this part.

The mathematical models used in this part are simple hierarchy model and inner-dependent hierarchy model. The user can choose between them according to the condition of the case. The main functions of this part are as follows

1) Input names of the industries

The user, following guides on the screen, inputs series numbers and names of the industries. CX stores them into disk.

2) Input statistical tables of the industries

Commonly there are hundreds of thousands of numerals in a statistical table of the involved industries under the subcriteria. In CX, two methods for inputting these data are set up. One of them is an interface which let the user put all data in through keyboard, then CX forms data files and stores them into disk automatically. In the other way, the user can easily convert dBASE files into ASCII files in the re-

quired format which are to be read into the matrices in CX.

There are also interfaces in this part to consult/supplement/modify the data files.

3) CX sorts the values of all industries under the same indicator and displays them. At the same time CX asks the users to assort the industries into several categories by answering the prompts shown on the screen. Then one-to-one compare function is utilized to judge the relative importance between every two categories of industries. After this, a judged weight table is formulated, CX reads in the results of part (1) from disk and produces the weighting vector of importance for all industries with respect to general object of decision.

4) In "single decision" branch one decision maker inputs his assorting to the industries and makes one-to-one compares. Whereas in "group decision" branch a group of assort results and judge matrices are put in by an operation of data files inputing. The function of this operation is largely the same as its counterpart in part (a).

4. Applications

So far CX has been applied to two decision researches of key industries choice. They are "1985—1995 year key industries choice in Guangzhou" (single decision) and "1990—2000 year key industries choice in Guangzhou" (group decision). The results of these researches are in discussion and examination by an expert group now.

References

- [1] Saaty, T. L., *The Analytic Hierarchy Process*, McGraw—Hill, New York, 1980.
- [2] Malone, D. W., "An introduction to the application of interpretive structure modeling", *Proc. IEEE*, vol. 63(1875) 397—404.
- [3] Yang Jianmei et al, "Analysis of industrial structure of Guangdong in China — in comparison with Taiwan in China", *Proc. of 6th World Congress of the Econometrics society*, Barcelona(1990).