A MODEL FOR APPLICATION OF AHP TO ARRANGE THE REFORM-THROUGH-LABOUR SYSTEM POINTS IN ORDER ACCORDING TO REDUCTION

Wu Yun Chong
East China Institute Of Technology
Nanjing, China

ABSTRACT

This paper presents a new model for application of AHP to order, then it is usedto arrange the RTLS points in order. The paper is a part of the problem of a study for Reform-Through-Labor-System. According to the objective reality the hierarchy model is constructed. It gets the criteria matrices, and then the order of points about their total average marks have been gotten. By R.I. given by Saaty and R.I. given by Shubo Xu, the decision matrices are belived to satisfy the uniformity requirement.

I. INTRODUCTION

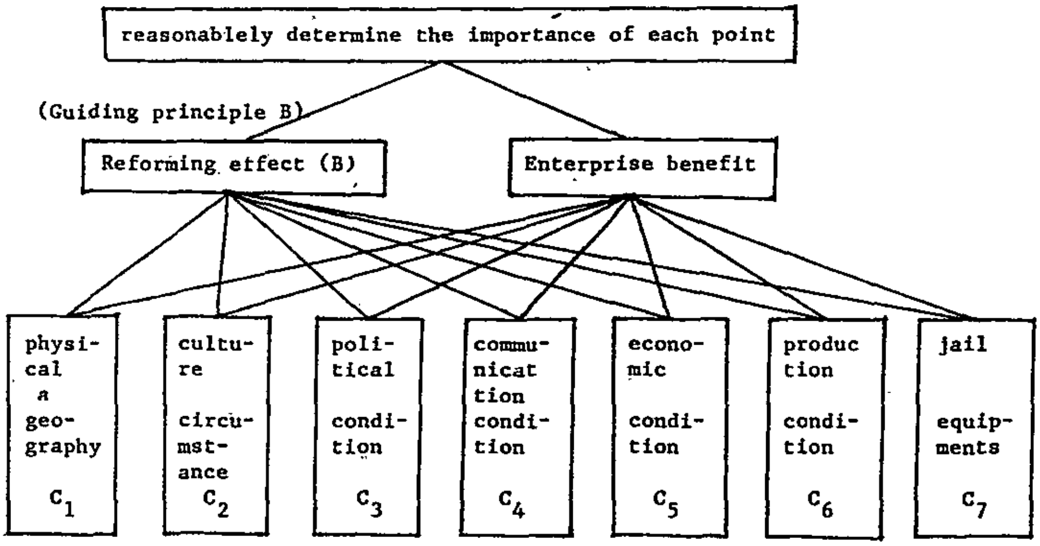
A reform-through-labour (RTL) system would consider the arrangement for itself, making medium term plans to reform the prisoners and to develop the enterprises of its own. Prisoners are required to learn some production techniques so that they can be reformed through labour and then be able to create some public wealth. It's necessary to the young presoners to require literacy so that they are capable making a living and become useful persons for the society after they are released, and then the possibility of recommiting a crime is reduced. So the RTLS need considering not noly the problems of the jail-equipments, the education improvement and the culture life but also the material production, the development for technology and the producing the well-quality items which fit to the market. As a result, the prisoners in RTLS will be effectly reformed and economic benefit of the enterprises will be improved. To see whether a RTLS is good or had, we should first know its effect of reforming such as the rate of escape etc., further more we should know the economic and social benefit the enterprises owed. If the reforming and the management are effective, the production activity of the workers, policemen and the prisoners will be enhanced. If the operating to the enterprise is good, the economic conditions will be improved, which is helpful to reform the prisoners smoothly. Because some of the profit can be used to improve the material and culture life of the workers and prisoners, it can also improve the jail's working conditions and replenish its equipments. Therefore, to RTLS the evaluation index should consist of the effect for reforming and benefit of the economics. Furthermore both aspects are considered as short and long term objective.

Thanks to the stability of our society, the development of production, decreasing of the influence in the cultural revolution, the tendency of the crime rate is generally decreased. And because of the policy of redressing the mishandted cases, the prisoners in jail are less and less. Using System Dynamic (SD) approach we forecast the amount of prisoners in the system to be a decreasing series. For this reason, we need order the points (RTLS) according to their different value (from views of refouming and production). In the following, we will use AHP as the means of ordering.

II. AHP System Model And Analysis

Suppose there are 10 points (RTLS) in the system denoted as Pi (i=1,2....,10) respectively, which are distributed over the system with different situation about physical geograpy, culture, politic, communications, economy and jail equipment. Through repeatly investigating and dialogue and the evalution given by experts, we obtain the importance for these factors to the effects of reforming and production . In addition, we had studied and constructed the following hierarchy model.

(Objective Layer A)



(condition Layer C)

The importance of the points is believed to consist of enterprise benefit and reforming effect which are in a proportion of 4 to 6. That is, to weight of the importance, ecomomic benefit is 40 percent while reforming effect is 60 percent. The criteria matrix for conditions C_j to B_1 and B_2 are respectively as following:

B1	C1	C2	C3	C5	C6	C7	weights	relative weights
C1	1	5	7	3	1/2	1/5	1.47973	0.18668
C2	1/5	1	2	1/3	1/2	1/7	0.46040	0.05809
C3	1/7	1/2	1	1/2	1/3	1/6	0.35433	0.04472
C5	1/3	3	2	1	1/2	1/3	0.83268	0.10501
C6	2	2	3	2	1	1/2	1.51309	0.19088
C7	5	7	6	3	2	1	3.28646	0.41459
Σ							7 92689	1

The importance index in the tables are corresponding to Saaty's creterion. Comparing the elements in raws with that in columns. Quantitating the relative importance, chosing 1,2,3,4,5,6,7,8,9 and taking their reciprocals as importance index (1). Taking the geometric average of the importance indexs in the raw as the weight for this raw's conditions and taking it as relative weight after standardization. The matrix of criteria for B_2 is

B2	C1	C2	C3	C4	C5	C6	C7	weights	relative weight
C1	1	2	2	1/2	1/3	1/4	5	0.97429	0.11059
C2	1/2	1	1	1/2	1/3	1/4	4	0.89061	0.10110
C3	1/2	1	1	1/2	1/3	1/4	4	0.66172	0.07511
C4	2	2	3	1	1/2	1/2	4	1.42616	0.16189
C5	3	3	3	2	1	1	4	2.15523	0.24465
C6	4	3	4	2	1	1	5	2.41565	0.27421
C7	1/5	1/4	1/4	1/4	1/4	1/5	1	0.28593	0.03245
Σ								8.80959	1

Now we compute the average relative weight for objective A. The results are listed in the following table:

	B1	B2	
	0.6	0.4	W_a
C1	0.18668	0.11059	0.15624
C2	0.05859	0.10110	0.07529
C3	0.04472	0.07511	0.05688
C4	0	0.16189	0.06476
C5	0.10504	0.024465	0.16088
C6	0.19088	0.27421	0.22421
C7	0.41459	0.03245	0.26174

Next, we will give the marks to points P_i (i= 1,2, ... ,10) about conditions C_j (j= 1,2,...,7). The marks are in 10 grades through 0 to 9, the worst is 0 and best is 9. Through investigating and inquiring to the experts, we get a mark table as following and the total average marks by computation.

	C1	C2	C3	C4	C5	C6	C7	Σ
P1	5	6	4	5	4	4	3	4.14584
P2	8	7	6	8	7	5	6	6.50796
P3	9	8	8	9	8	8	7	8.13026
P4	6	7	5	8	8	8	6	6.96311
P5	8	7	5	9	7	6	5	6.46931
P6	7	8	7	8	9	9	7	7.97323
P7	7	7	8	6	6	8	9	7.65053
P8	8	7	6	5	7	6	4	6.01441
P9	7	6	5	8	8	7	8	7.34333
P10	5	5	5	4	5	3	4	4.27008
WA	0.15624	0.07529	0.06588	0.06476	0.16088	0.22421	0.26174	

Ordering the points accorking to their total average marks we have

P_i	P_3	P_6	P_7	P_9	P_4	P_2	P_5	P_8	P_{10}	P_1
order	1	2	3	4	5	6	7	8	9	10
marks	8.03	7.97	7.65	7.34	6.96	6.51	6.47	6.01	4.27	4.15

Therefore the order for reducing points is P_1, P_{10}, P_8, P_2, P_4, P_9, P_7, P_6, P_3. That is, according to the amount of prisoners in jail, it's getting less while the given conditions have not changed. Corresponding to the order, we cancel P_1 at first, then P_{10} if necessary, then the other points in the table by same way. If the amount of prisoners is picking up, we would reset the point against the order.

In accordance with the rule of AHP, to know whether the ordering is valid, it is necessary to verify the uniforming requirement.

Uniforming for criteria matrix B_1-C and B_2-C are veritied as following:

First to find the maximum characteristic root of matrices. For the criteria matrix B_1-C, following the approximate formula (1) we get the maximum characteristic root of matrix B_2:

$$\lambda_{B_1} = (1/n) \sum_i (B_1 * WB_1)_i / (WB_1)_i \qquad (1)$$

where n=6, bycomputation, we get a matrix

$$B_1 * WB_1 = (1.284,\ 0.375,\ 0.286,\ 0.665,\ 0.720)^T$$
$$= [(B_1*WB_1)_1,\ (B_1*WB_1)_2,\ (B_1*WB_1)_3, \ldots, (B_1*WB_1)_6]^T$$

However

$$WB_1 = (\ 0.187,\ 0.058,\ 0.045,\ 0.015,\ 0.191,\ 0.415\ )^T$$
$$= [\ (WB_1)_1,\ (WB_1)_2,\ \ldots,\ (WB_1)_6]^T$$

Set the results into formula (1), we obtain the maximum characteristic root of matrix B_1

$$\lambda_{B_1} = 6.082$$

Analogously, the maximum characteristic root is

$$_{B_2} = 7.371 \qquad \text{while} \quad n=7$$

Therefore the unitormity index for matrix B1 and B2 are respectively

C. RB1=(B1-n)/(n-1)=(6.08151-6)/5=0.01630

C. RB2=(B2-n)/(n-1)=(7.37135-7)/6=0.06189

If we adopt R.I. given by Xu Shubo in universe-68 computer through 1000 random sample matrix, three are values when n=6 and n=7: 1.25 and 1.35. We obtain the unitormity criterions

C. RB1=(C.IB1)/1.25=0.01630/1.25=0.01304<10^{96}

C. RB2=(C.IB2)/1.35=0.06189/1.35=0.04684<10^{96}

Thus both matrix B1-C and B2-C are believed to satisfy the uniformity requirement.

If we use the R.I. given by Satty, which is respectively 1.24 and 1.32 when n=6 and n=7

C. RB1=0.01630/1.24=0.01315<10^{96}

C. RB2=0.06189/1.32=0.04689<10^{96}

It can also be demonstrated that the two matrixs are satisfactory to the uniformity requirement.

Acknowledgement

The point reducing model this paper discussed is to select an appropriate permulation for 10 points. As we know, the total permuation of which is 10!=3,628,800. It's almost impossible to discuss the projects more than 3.6 million one by one. It might be rather difficult even if the morden computers are used. If we use the approach of mathematic programming to deal with this multi-objective, nonsingle constrained problem. Though the solution can be found out from theory, both modeling and compution are very troublesome, and the optimal solution is not always the optimal one because of the approximation methods that seem to be unaviöded in the modeling procedure. The results given above by using AHP is available. Its compution is much simpler and paied sufficient attention to the functions of intuition. The author believes that AHP will be adopted more widely in the coming days.

The reason that this paper use the term "model" is that not noly for RTL system, even for all the point-reducing (increasing) problems, the frame work presented in this paper is valid to deal with.

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