SELECTION OF SUITABLE AREA FOR AUTOMOBILE MANUFAFCTURING HUB IN ANDHRA PRADESH STATE

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Abstract—This paper presents the selection of suitable area for automobile manufacturing hub by considering several criteria's such as location, land, labour, raw materials, manufacturing resources, transport, social and environmental conditions [2]. Analytical Hierarchy Process is employed for the selection procedure in finding a best area to establish an automobile manufacturing hub by taking four potential locations in Andhra Pradesh state namely Kurnool, Vijayawada, Nellore and Visakhapatnam. It is found that Nellore is the suitable location for establishing an automobile hub. The ranking evaluation will provide good guidance for the location selection of automobile manufacturing hub to the any industrialist.

Keywords— Automobile Hub, AHP, Eigen vectors, Consistency Index, Consistency Ratio, Random Consistency Indices

(1) INTRODUCTION

An industrial hubs refers to a geographically proximate group of interconnected industries and related governmental institutions in a particular locational area. It is an outstanding location which provides direct road and rail access to main transportation networks [3]. It is an area zoned and planned for the purpose of industrial development and to specifically promote sectors such as information technology and information technology enabled services, biotechnology, agro, marine, food processing, tourism, textiles and automotive industries. Connections among different hubs are provided through industrial corridors [4].

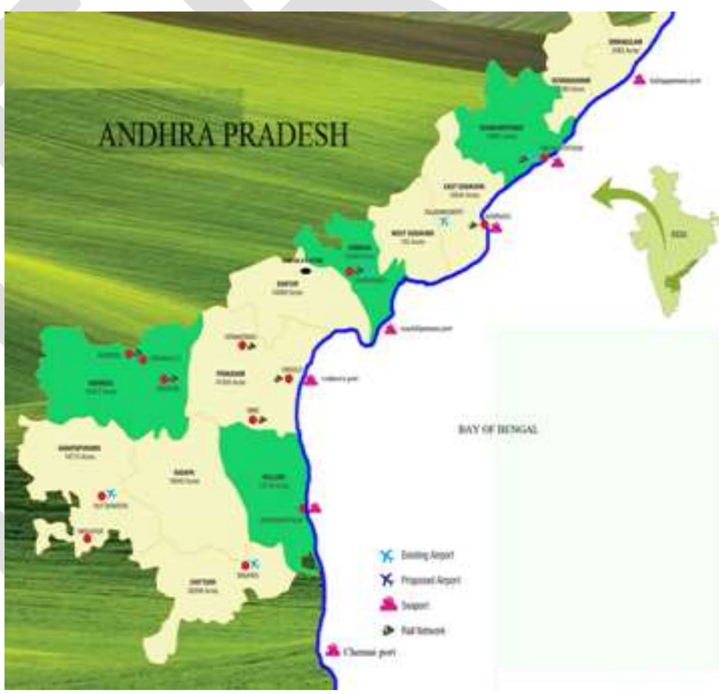

Fig. 1.1. Andhra Pradesh State

For Example, Andhra Pradesh state have potential industrial benefits and it is the market brimming with opportunities like, plenty of natural resources, second largest mineral store house of India, large scale of agriculture and horticulture production, second longest coastal corridor in India 972 kms, excellent infrastructure facilities, greenfield seaports and best power plants [5]. The A P government provides many special economic zones based on tax free industrial zones. It is the fastest growing base for IT and telecom sectors. A P state is the largest producer of cotton, vaccine, bulk drugs, paper, iron, steel, cement and food processing industries. Recent developments of Andhra Pradesh state, a need arises extensively to promote industrial investments. This paper is to provide suitable location for automobile industrial hub in Andhra Pradesh state.

(2) TYPES OF INDUSTRIAL HUBS:

Generally Industrial hubs are classified into two types, namely general purpose industrial hubs and functional industrial hubs.

2.1. General Purpose Industrial hubs

In this type of industrial hubs, different types of industries are encouraged except hazardous and highly polluting industries. The bulk of industries belong to this category.

2.2. Functional Industrial hubs

In this type of industrial hubs, only homogenous type of industries are encouraged. For example, only computer software industries are allotted in Hi-tech city at Hyderabad.

Industrial hubs having benefits like attractive business climate, accelerated investments in the state, increased infrastructure projects, increased economic growth, reduce regional disparities, attracts domestic as well as foreign investors, provides employment generation in the state and increases exports [5].

(3) FLOW CHART FOR SELECTION METHODOLOGY

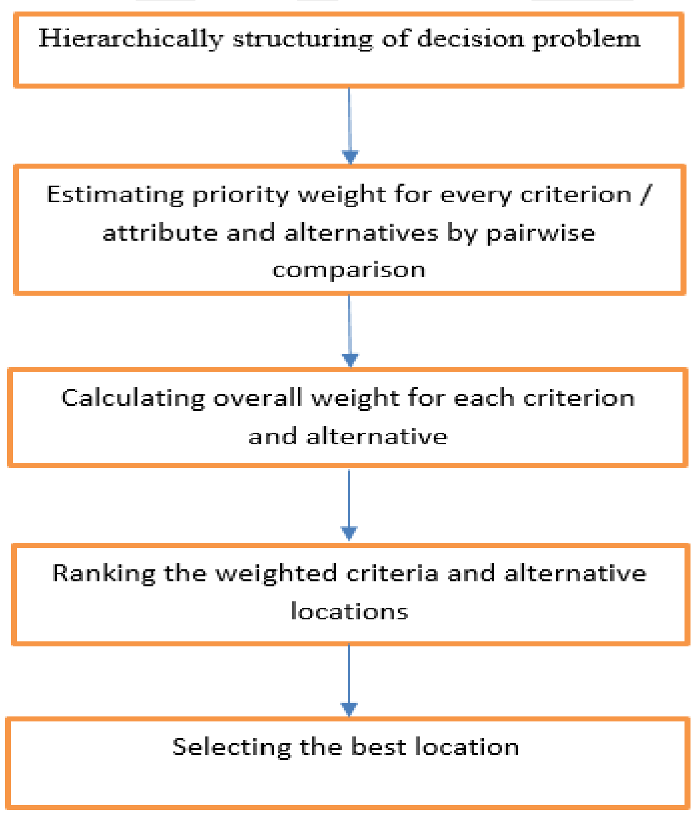

Fig. 3.1. Flow chart

(4) PROBLEM DESCRIPTION

It involves building the AHP hierarchy model. The developed AHP model, based on the identified criteria, contains four levels: such as the goal, the criteria's, sub-criteria's and generation of alternatives. Fig. 4.1 shows an illustrative four-level hierarchy for the industrial hub location selection. The goal is to select the suitable location in Andhra Pradesh for the automobile industrial hub. It is identified in the first level. The second, third and fourth level comprises of 8 criteria's, 24 sub-criteria's and 4 locational alternatives respectively as shown in the Fig. 4.1.

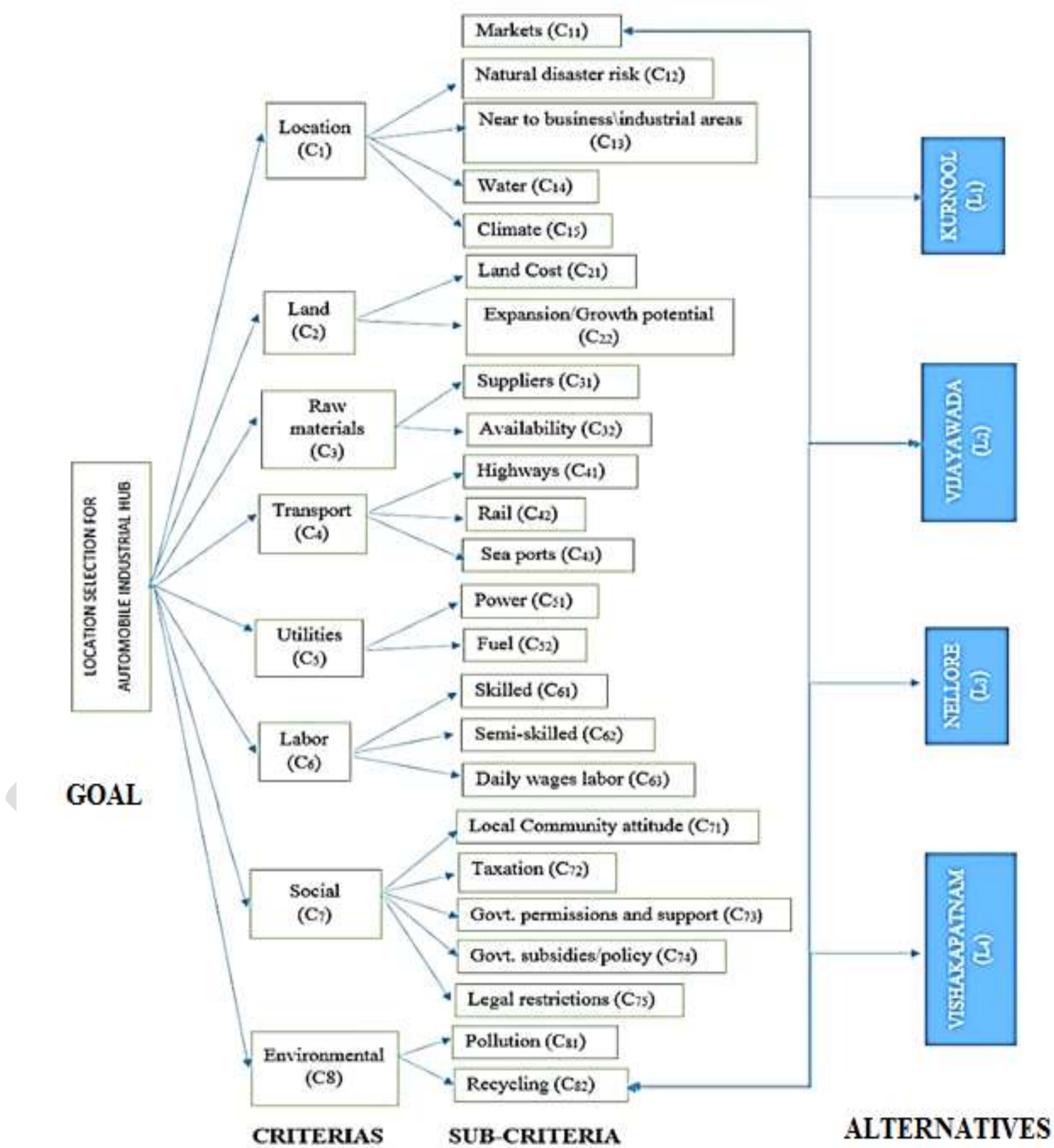

Fig. 4.1. Levels of parameters for automobile industry

4.2. Evaluating the Alternatives with Respect to Criteria's:

Step 1: Formulation of pair wise comparison matrix of criteria using AHP measurement scale is shown in Table 4.1.

Table 4.1. AHP measurement scale

Intensity of importance	Definition	Explanation
1	Equally preferred	Two activities contribute equally to the Objective
3	Moderately preferred	Experience and judgment slightly favor one activity over another
5	Moderately Strongly preferred	Experience and judgment strongly favor one activity over another
7	Very strongly preferred	An activity is favored very strongly over another; its dominance demonstrated in Practice.
9	Very strong and Extremely preferred	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	For compromise between the values	Sometimes one needs to interpolate a compromise judgment numerically because there is no good word to describe it
1/3,1/5,1/7,1/9	Reciprocals of the above quantities	If activity 'i' has one of the above quantity assigned to it when compared with activity `j' then j has reciprocal value when compared with 'i'

Table 4.2. Comparison Matrix of Criteria:

CRITERIA	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	Priority vector (PV)
C_1	1	2	2	2	2	2	2	2	0.2129
C_2	1/2	1	2	2	1	2	2	2	0.1679
C_3	1/2	1/2	1	1	2	2	2	2	0.1414
C_4	1/2	1/2	1	1	2	1	1	1	0.1087
C_5	1/2	1	1/2	½	1	1	2	1	0.1029
C_6	1/2	1/2	1/2	1	1	1	1	1	0.0890
C_7	1/2	1/2	1/2	1	1/2	1	1	2	0.0935
C_8	1/2	1/2	1/2	1	1	1	1/2	1	0.0836
COLUMN TOTAL (T_i)	4.50	6.50	8.00	9.50	10.50	11.00	11.50	12.00	

Step 2: Eigen vectors (E.V) are computed for the above matrix to obtain good approximation of priorities using geometric mean method. This is done by multiplying the elements in each row and taking their *n*th root. Where n is number of criteria.

$$\text{E.V for } C_1 = \sqrt[8]{(1 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2)} = 1.8340$$

(Similarly calculate the Eigen Vectors values up to C_8)

TOTAL (sum of E.V values) = 1.8340 + 1.4142 + 1.2968 + 0.9170 + 0.8408 + 0.7711 + 0.7711 + 0.7071 = 8.5521

Calculation of Priority Values (P.V) $= \frac{\text{Eigen vector value}}{\text{Total sum of Eigen Vectors}}$

P.V for $C_1 = \frac{1.8340}{8.5521} = 0.2144$

(Similarly calculate the Priority Values up to C_8)

Step 3: Calculation of Principal Eigen value multiplying the column totals with the respective P.V of each row and then adding the results to obtain Principal Eigen value where

T_i = column totals $P.V_i$ = priority vector of each criteria

$\lambda_{max} = \sum_{i=1}^{n} Ti \times P.V_i$

$= 4.50\times0.2144 + 6.50\times0.1653 + 8\times0.1516 + 9.50\times0.1072 + 10.50\times0.0983 + 11\times0.0901 + 11.50\times0.0901 + 12\times0.0826$

$= 8.3210$

Step 4: Calculation of Consistency Index (C.I) Then consistency index is calculated using following equation we get

Table 4.3. Random Consistency Table

Size of matrix	1	2	3	4	5	6	7	8	9	10
Random consistency index	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

$$C.I = \frac{(\lambda_{max} - n)}{n-1} = \frac{(8.3210 - 8)}{(8-1)} = 0.045$$

Step 5: Random Consistency Indices (R.I) is then determined for each of the square matrices using formula from the Table 4.3. R.I = 1.41

Step 6: Calculation of Consistency Ratio (C.R)

C.R is obtained by dividing CI with R I for the same size matrix and the random consistency number is chosen from Tables. In this case R.I is 1.41 as the size of matrix is eight. The value of C.R should be around 10% to be acceptable.

$$C.R = \frac{C\,I}{R\,I} = \frac{0.045}{1.41}$$

Hence the C.R is less than 10%; therefore the pair wise comparison matrix is acceptable and the weightages for output responses as follows.

Step 7: Pairwise comparison matrices (D_i =1, 2 . . . n) for each criteria's are constructed. AHP scale is used to assign weight to these matrices. The P.V values, Principal Eigen values, C.I and R.I are then computed using the same logic as in steps 5 and 6.

Comparison Matrix of Sub-Criteria's:

Table 4.4. Comparison Matrix for Location Sub-Criteria

C_1	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	(PV)
C_{11}	1	5	3	2	3	0.308
C_{12}	1/5	1	1/2	1/5	1/3	0.065
C_{13}	1/3	2	1	¼	1/2	0.111
C_{14}	½	5	4	1	2	0.332
C_{15}	1/3	3	2	1/2	1	0.18
TOTAL	2.36	16	10.56	3.95	6.83	

Table 4.5. Comparison Matrix for Land Sub-Criteria

C_2	C_{21}	C_{22}	P V
C_{21}	1	7	0.8750
C_{22}	1/7	1	0.1250
TOTAL	1.1429	8	

Table 4.6. Comparison Matrix for Raw Material Sub-Criteria

C_3	C_{31}	C_{32}	P V
C_{31}	1	5	0.8333
C_{32}	1/5	1	0.1667
TOTAL	1.2	6	

(Similarly calculate comparison matrices between all the criteria's and sub-criteria's i.e. C_4, C_5, C_6, C_7 and C_8 using Table 4.1)

Comparison Matrix between Locations

Table- 4.7 comparison matrix between c_{12} and location

C_{11}	L_1	L_2	L_3	L_4	P V
L_1	1	1/4	1/3	1/8	0.0750
L_2	4	1	1/3	1/2	0.1945
L_3	3	3	1	1	0.3640
L_4	5	2	1	1	0.3625
TOTAL	13	6.25	2.6667	2.7	

Table 4.8. Comparison Matrix between C_{12} and Locations

C_{12}	L_1	L_2	L_3	L_4	P V
L_1	1	2	1	3	0.3472
L_2	1/2	1	1/3	1	0.1423
L_3	1	3	1	3	0.3829
L_4	1/3	1	1/3	1	0.1276
TOTAL	2.8333	7	2.6667	8	

Table 4.9. Global Matrix

CRITERIA	P V	SUB CRITERIA	P V	L_1	L_2	L_3	L_4
C_1	0.2129	C_{11}	0.308	0.0790	0.1945	0.3640	0.3625
		C_{12}	0.065	0.3472	0.1423	0.3829	0.1276
		C_{13}	0.111	0.0967	0.2516	0.5549	0.0967
		C_{14}	0.332	0.1896	0.0893	0.2328	0.4883
		C_{15}	0.180	0.1838	0.0485	0.3637	0.4040
C_2	0.1679	C_{21}	0.8750	0.1475	0.0611	0.4113	0.3800
		C_{22}	0.1250	0.1140	0.2734	0.3846	0.2280
C_3	0.1414	C_{31}	0.8333	0.3151	0.0648	0.2676	0.3522
		C_{32}	0.1667	0.1514	0.0789	0.5162	0.2535
C_4	0.1087	C_{41}	0.2395	0.2420	0.3690	0.1554	0.2336
		C_{42}	0.6232	0.2505	0.4214	0.2014	0.1260
		C_{43}	0.1373	0.1306	0.4495	0.1691	0.2508
C_5	0.1029	C_{51}	0.9000	0.0790	0.1945	0.3640	0.3625
		C_{52}	0.1000	0.2166	0.4786	0.1083	0.1966
C_6	0.0890	C_{61}	0.6333	0.1584	0.4775	0.2544	0.1097
		C_{62}	0.2605	0.0996	0.5021	0.2296	0.1687
		C_{63}	0.1062	0.3359	0.2734	0.1487	0.2421
C_7	0.0935	C_{71}	0.5028	0.1175	0.4288	0.2644	0.1894
		C_{72}	0.2602	0.0485	0.1631	0.5554	0.2330
		C_{73}	0.1344	0.14419	0.10013	0.58874	0.16693
		C_{74}	0.0678	0.48498	0.08019	0.2875	0.14726
		C_{75}	0.034	0.1109	0.4642	0.1205	0.3042
C_8	0.0836	C_{81}	0.8000	0.5368	0.1013	0.1049	0.2568
		C_{82}	0.2000	0.6311	0.1046	0.0849	0.1792
TOTAL WEIGHTAGE				0.2171	0.2421	0.2964	0.2439

(Similarly calculate comparison matrices between all the sub-criteria's and locations i.e. C_{13}, C_{14} and soon

Table 4.10. Priority Order

LOCATIONS	WEIGHT	RANK
L_1 (Kurnool)	21.7	4
L_2 (Vijayawada)	24.2	3
L_3 (Nellore)	29.6	1
L_4 (Vishakhapatnam)	24.3	2

up to C_{82} using Table 4.1. all the calculated P.V values are tabulated in the global matrix and summarised to find the final weightage of locations)

From Table 4.10 The highest total weight of the location (L_3) shows that it is the best location out of all considered locations i.e., Nellore is the suitable location to make it as automobile hub in the state of Andhra Pradesh.

(6) CONCLUSIONS

AHP is used to identify the suitable area for automobile manufacturing hub in Andhra Pradesh state. The ranking order of the locations are Nellore, Vishakhapatnam, Vijayawada and Kurnool. It is observed from the results that Nellore is the best suitable location for an automobile manufacturing hub with highest weightage of 0.2964. This work will give a clear view for domestic and foreign investors to select a suitable area in Andhra Pradesh state. This work is useful to attract MNC's (Multinational Companies) and Local automobile industries to establish companies.

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