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Analysis of risk Contributors for Major Corridors of Urban traffic mobility

Dr. Awari Mahesh Babu
Professor, Civil Engineering Department,
Tirumala Engineering College, Hyderabad. A.P. India.
E-mail: maheshbabuawari@gmail.com

Abstract

Urban risk and congestion are the major issues which are influencing road user. This influence is carrying out on cost-effective travel, non substance of environment, psychological strains and a travel imbalance on traffic mobility. There is a need to indentify risk criterions for the phenomenal influence rendered in traffic. The risk criterions can be tracked with the attribute positioned on road with speed. The risk is generated with the above head is distributed with variable intensities and lead to the accident occurrence. These intensities are found that they are due to influence of certain characteristic influence from factors of land use, road geometric, and traffic and road network characteristics. This study is framed on with the multilevel influencing factors.

Principal Component Analysis is applied to risk contributors with the objective studying criterions and the links which leads to risk generation.

The present paper deals with the studying the risk contributors, and risk generated links for the Rajendranagar municipality area, Hyderabad AP., INDIA by using Principal Component Analysis (PCA).

Keywords: Risk generation; Road network characterization; Travel demand analysis; Desire line diagrams; User preferred paths; Principal component analysis, regression analysis

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Introduction

Rapid Urbanization causes disorganized and unplanned growth of urban centers which becomes more difficult with the fact that it must take place within the built up area. Urbanization operating in the fringe brings a number of Transportation problems of safety, congestion, accidents, parking, management and enforcement. **[7]**

The study is attempted, with reference to the geometric, traffic, utility and land use characteristics of the study area, to identify the major corridors with traffic characteristics as independent characteristics of congestion criterions as basis to identify the links leading to congestion.

Principal component analysis

The central idea of principal component analysis (PCA) is to reduce the dimensionality of a data set consisting of a large number of interrelated variables, while retaining as much as possible of the variation present in the data set. This is achieved by transforming to a new set of variables, the principal components (PCs), which are uncorrelated, and which are ordered so that the first few retain most of the variation present in all of the original variables. [8]

The PCA model can be represented by:

U_mx1= W_mxd X_dx1--------- (1)

Where *U*, an m-dimensional vector, is a projection of *X* - the original d-dimensional data vector (*m* << *d*). It can be shown that the m projection vectors that maximize the variance of *U*, called the principal axes, are given by the eigenvectors e1, e2, …, em of the data set’s covariance matrix S, corresponding to the m largest non-zero eigenvalues ë1, ë2, … ëm.

The data set’s covariance matrix S can be found from:

S= 1/(n-1) ∑_(t=1)^n= 〖(x_t-µ) (x_t-µ)^T 〗---------(2)

Where µ is the mean vector of *x*. The eigenvectors e_i can be found by solving
The set of equations:

(S-λ_i I) e_i=0 for i=1,2,…….d---------(3)

Where e_i are the eigen values of *S*. After calculating the eigenvectors, they are sorted by the magnitude of the corresponding eigen values. Then the m vectors with the largest eigen values are chosen. The PCA projection matrix is then calculated as: W=E^T ------ (4)

Where *E* has the m eigenvectors as its columns. Here *W* is an mxd matrix.

STUDY AREA

Rajendranagar municipality is part of Ranga Reddy district area. Major junctions and corridors are shown in the Fig 1. The land use activities are predominantly of mixed type constituting residential, commercial and industrial. Input data for attributes are collected satellite data by using GPS, GIS as supportive tool and field surveys, collected concerned municipal authorities.

ANALYSIS AND RESULTS

Design phase includes the standardization of the raw data for the analysis. The problem is analyzed by maximizing or minimizing a linear function of number of variables (Black W.R. 2003). Value function method of standardization for normalizing the data is adopted. The following method is used in assessing the value function. The main criterions with their objective functions which provide ideal values for risk are linked below.

Geometric characteristics

1. Roadway width (RW) – Minimum,
2. Carriageway width (CW) – Minimum,
3. Stopping sight distance (SSD) – Minimum,
4. Number of curves (NC) – Maximum,
5. Pavement Condition index(PCI)- - Minimum,

Traffic characteristics

1. Headway (H) – Minimum, 2.V/C Ratio (VCR) – Minimum,

3. Intensity of Parking, business activities and road side activities

(PBE) – Maximum, 4. Speed (V) – Minimum, 5. Delay (D) – Maximum,

Land use or Road side Characteristics

1. Number of access points on the link (NA) – Maximum,
2. Commercial area (CA) – Maximum,
3. Residential area (RA) – Maximum,
4. Semi Residential area (SRA) - Maximum,
5. Industrial area (IA) – Maximum,

Utility characteristics

1. Overlap size of the link from static analysis (OS) - Maximum
2. Minimization of Trip intensity on the link (TI) – Maximum

Analysis of contributors

Step 1: Determine the range over which the link is to be assessed (i.e., set the lower and upper bounds of the value scale) and assign a value of 0.0 to 1.0 to these end points, respectively. As the objective function is maximization, the maximum value in the range is the link which has the better values of risk generation. Hence this value will be assigned a value of 1.0 and the lowest value in the data will be assigned a value of 0.0. In the case of minimization, the minimum value in the range will be assigned a value of 1.0 whereas maximum value is assigned a value of 0. Input values are standardized by subtracting either the minimum value or maximum value from the respective characteristic vector and dividing it with the difference between maximum and minimum value.

Step-3: Calculation of the covariance matrix: The covariance of the above matrix is found using the Software MATLAB.

Step-4: Calculation of the eigenvectors and eigen value.

Step-5: Calculation of the Principal components

Step 6: Deriving new Dataset

The Final values are obtained by multiplication of the one Transposed matrix i.e. Principal components matrix and Standardized matrix. The final values obtained are the standardized values.

Step-7: Finding the congestion links: From new data set the final values of speed are compared with actual values. Therefore the risk generated links are found out.

CONCLUSION

In-order to reduce the congestion, it is very important to know where the risk has occurred and how it is distributed from one place to many

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places. All the geometric, traffic, land use and the utility characteristics are studied in the analysis. Speed is considered as the major contributors for risk.

The correlation parameters between the observed field data and prioritization observed from the model indicate that the critical links identified in the network through the analysis are the worst links with respect to geometric, traffic, land-use characteristics. This method of analysis is used for the development of the road links and the places where there is more congestion with limited budget constraints and it serves as a promising role for the road administrators and the govt. to implement at field level.

SCOPE FOR FURTHER RESEARCH

Prioritization of urban corridors for generating planning policies on urban infrastructure, land use policies and traffic management plans over a time and space. Apart from this study on a continuation of research, it is needed to analyze the total network on single entity and develop an approach with muilti-creteria framed levels of planning. The factors of influence on risk and congestion representation should be handled simultaneously as prioritize the planning policies on infrastructure and land use.

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Table 1. In put criterions of study area

Sno	**Link name**	**Link Id**	**Geometric characteristics**					**Traffic characteristics**					**Land use or Road side Characteristics**					**Utility characteristics**	
			RW in m	CW in m	SSD in m	NC	PCI	H in sec	VCR	PBE	V in kmph	D in sec	NA	CA in sq.km	RA in sq.km	SRA in sq. km	IA in sq.km	OS	TI
1	Hyderguda-Indirareddy	M1	20.7	15	38.2	3.07	4	5.4	1	5	27.1	6.96	1.15	0.006	0.003	0.005	0	35	18303
2	Indirareddy-RJNR	M2	13	7	41.3	4.38	3	6.3	0.9	5	28.6	6.30	0.31	0.012	0.001	0	0	77	10269
3	Indirareddy-Aramghar	M3	22	18	38.1	4.32	3	4.5	1.7	5	27.1	2.97	0.81	0.011	0.001	0.226	0	140	11091
4	Aramghar-NPA	M4	20.9	16.8	28.7	1.90	3	4.5	0.8	4	22.4	2.88	0.63	0.009	0.191	0.002	0	186	19166
5	Aramghar-Shamshabad	M5	20.9	16.9	40.7	4.21	1	5.6	0.8	8	28.3	4.15	1.72	0.007	0.000	0.000	0	129	30816
6	Aramghar-Durganagar	M6	20.9	16.9	39.6	2.08	3	6	0.8	4	27.8	4.51	0.34	0.006	0.001	0.001	0	306	33367
7	Durganagar-Bandlaguda	M7	20.9	16.9	37.9	10.66	2	5.5	0.9	7	27	7.64	2.22	0.0151	0.007	0.007	0.001	139	29072

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Table 2
Deriving New Dataset from principal component analysis

6.39	-20.37	29.22	4.71	6.70	4.25	1.81	10.62	27.07	8.69	1.81	0.007	0.17	0.26	0.000	283.9	59202
11.5	-17.48	24.71	7.24	6.87	3.77	1.42	10.48	23.04	6.65	0.68	0.009	0.26	0.35	0.000	385.4	70750
9.79	-18.12	35.72	7.23	5.84	4.40	1.23	8.27	23.18	8.212	1.137	0.008	0.007	0.23	0.001	97.97	53166
8.64	-11.47	37.62	5.397	6.32	3.71	2.24	12.24	23.70	12.02	0.30	0.007	0.057	0.27	0.00	288.8	4469
4.95	-14.89	31.49	4.65	6.9	4.38	1.23	7.27	28.45	11.47	1.292	0.009	0.183	0.35	0.001	438.5	53408
5.38	-17.12	24.56	3.81	8.57	4.18	1.55	9.79	26.4	11.10	0.69	0.01	0.04	0.27	0.000	383.0	55139
4.4	-11.02	23.36	12.85	4.67	5.03	1.16	9.77	28.03	9.97	1.60	0.011	0.24	0.31	0.001	342.7	42356

Table 3: Risk priority of Links leading to congestion

S.No	Link name	Link Id	Speed after analysis	Initial Speed	Difference	Risk priority
1	Hyderguda- Indirareddy	M1	27.07	27.1	-0.02	4
2	Indirareddy-RJNR	M2	23.04	28.6	-5.55	1
3	Indirareddy-Aramghar	M3	23.18	27.1	-3.91	2
4	Aramghar-NPA	M4	23.70	22.4	1.30	0
5	Aramghar-Shamshabad	M5	28.45	28.3	0.15	0
6	Aramghar-Durganagar	M6	26.43	27.8	-1.36	3
7	Durganagar-Bandlaguda	M7	28.03	27	1.03	0

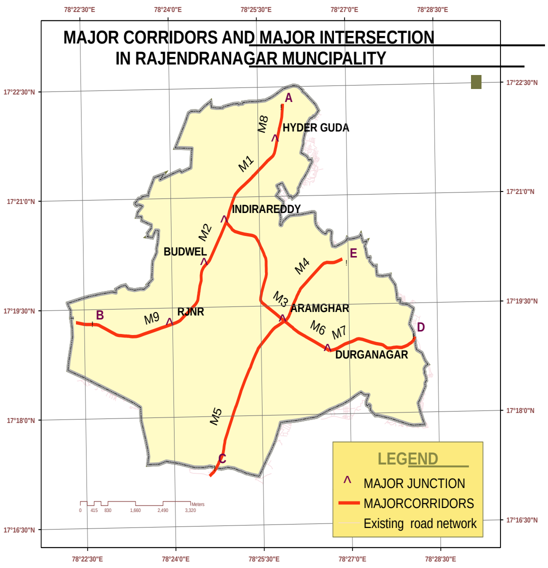

Fig. 1 Major Junctions & Corridors of Rajendranagar Municipality

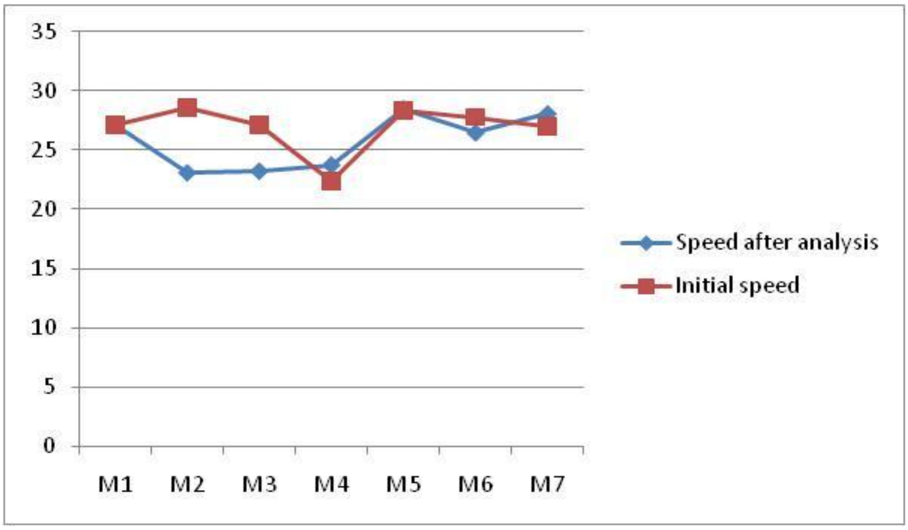

Fig. 2 Risk priority Graph