



INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION AND MANAGEMENT

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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IDENTIFICATION OF POTENTIAL COMMERCIAL LOCATIONS IN PATNA URBAN AREA

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ABSTRACT

With the liberalization of Indian economic policies and the increase in expendable income of the urban population of India, there is tremendous growth in the organized retail sector since the turn of the century. The change in consumer buying behaviour, increase in purchasing power and exposure to organized retail formats has redefined the consumption pattern. As a result, retail projects have been mushrooming across even tier-II cities like Ahmedabad, Lucknow, Ludhiana, Nashik, Jaipur, Patna etc. Patna has been a wholesale trading centre long before independence. A large portion of wholesale trading activity is located in the old eastern part of Patna city. Like all Indian cities, retail trading is the means of livelihood to a large section of inhabitants of Patna Urban Area. In the recent years there has been a spurt in retail activities which is evident from mushrooming of large branded showrooms, large departmental store, hyper marts and shopping malls. The present research will determine the future commercial potential of locations in Patna Urban Area (PUA), based on the "Level of Urbanization" & "Image Perception of the citizens. It will benefit prospective retailers, business managers and market analysts, as well as urban planners who try to identify the potential commercial nodes within the Patna urban area.

KEYWORDS

Attractiveness Measures, Image Perception, Level of Urbanization, Spatial Interaction.

INTRODUCTION

Commercial activities form the backbone of a city's growth and development. In the urban scenario commercial activity occupies the prime locations where land values are very high. The recent emergence of the Corporate, Banking & Insurance, Retail & Wholesale sector, Hotels & Restaurants as the new growth segment in the B & C class cities has resulted in increased GDP and higher employment opportunities.

The real estate sector in India is growing bigger by the day. Industry experts believe that Indian real estate has huge demand potential in almost every concerned sector -- especially Retail. It is recognized that commercial development is necessary to provide for the needs of the city's growing residential population and to generate additional revenue to extend and maintain public facilities and services. The purpose of planning for commercial growth is to ensure well designed attractive development in appropriate locations of the city. The idea to demarcate commercial space within urban centres stems from the recent demand for real estate space generated by the retail sector. The urban development ministry has proposed that all states should notify at least 10-12% of the land fit for urbanization for commercial use.

The importance of retail in any city cannot be underestimated. It is one of the primary threads in the fabric of many outstanding cities throughout the world. The retail boom being witnessed in the past few years is bound have a significant impact in the commercial real estate sector. A large young working population (median age of 24 years), larger disposable income of the middle class, more nuclear families in urban areas, increased working-women population and emerging opportunities in the services sector are the key factors in the growth of the organized Retail sector in India. According to the latest AT Kearney study (2007), for the third year in a row, India leads the annual list of most attractive 'emerging markets' for retail investment followed by Russia and China.

The change in consumer buying behaviour, increase in purchasing power and exposure to organized retail formats has redefined the consumption pattern. As a result, retail projects have been mushrooming across even tier-II cities like Ahmedabad, Lucknow, Ludhiana, Nashik, Jaipur, Patna etc. Industry observers feel that this growth is facilitated by favorable demographics, existence of customer-friendly banks and finance companies, professionalism in real estate and reforms initiated by the Government to attract global investors. These factors have irrevocably changed commercial development patterns in the country. In the present context of market globalization and competition the importance of commercial planning is very significant. Moreover since most Indian cities are historic & organic in growth, with little planned area for expansion, careful retail & commercial planning become imperative.

NEED FOR THE STUDY

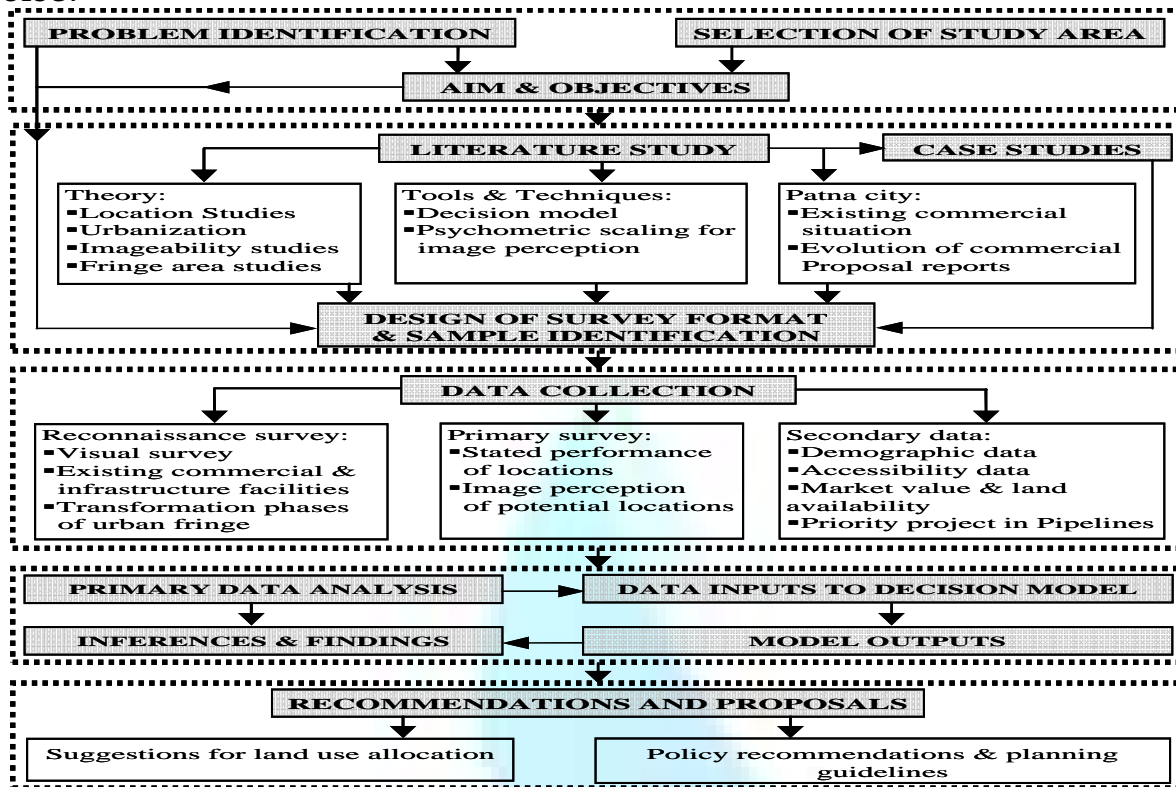
Patna Urban area (PUA) has emerged as a regional primate city of Bihar, with municipal area of 108.94 sq. km and population of 13.7 lakhs as per 2001 census with average population density of 125.43 pph. It is an important commercial centre due to its central position at the junction of the three rivers. It is well connected to NH2 and Delhi-Howrah rail line to its south and the East West expressway to its north, by appropriately bridging the Ganges.

Patna has been a wholesale trading centre long before independence. A large portion of wholesale trading activity is located in the old eastern part of Patna city. Like all Indian cities, retail trading is the means of livelihood to a large section of inhabitants of PUA. In the recent years there has been a spurt in retail activities which is evident from mushrooming of large branded showrooms, large departmental store, hyper marts and shopping malls.

Due to lack of planning and development guidelines and rapid urbanization the city has been found various problems in the in recent years. The old city, presently engaged in wholesale commercial activities, is congested with narrow lanes has crucial traffic congestion problems. Commercial land use is predominant ribbon development along the major road -- a typical organic growth in unplanned India cities. The anticipated growth of Patna needs more area under commercial land use. A recent initiative of preparing Master Plan 2021 and City Development Plan (CDP) has given new direction for growth of the city. Trade and commerce are identified as "strengths" in CDP of Patna.

This study is aimed to address how and where new commercial developments will come up in PUA and how it will change the image of the city. It attempts to determine the future commercial potential of various locations and predict new commercial locations; as well provide different sets of guidelines for sensitive, planned and regulated development.

METHODOLOGY



LITERATURE REVIEW

Literature study is essential for any study to know the theories, principles, practices, and background of the subject and it helps to formulate the methodology. The study of literature related to field of this project enables to gain capacity of thinking to provide better direction towards eminent result. Some of these are highlighted:

GEOGRAPHY OF LOCATION & LOCATION THEORIES

Principles of retail location, retail organization & retail techniques are important for any commercial planning exercise. Location theory rests on various classical & neo-classical theories. Clarkson et al. (1996) categorizes location theories as:

- Economic Theories
- Central Place Theories
- Land value Theories
- Spatial interaction Theories
- The principle of minimum differentiation

URBANIZATION STUDIES

The levels of urbanization of region are estimated from Census data, in a number of ways:-

- Urban population ratio
- Rural population served by urban centres
- Distance to the nearest town

IMAGEABILITY STUDIES

One of Kevin Lynch's innovations (1960) was the concept of place legibility, which is essentially the ease with which people understand the layout of a place. By introducing this idea, he was able to isolate distinct features of a city, and see what specifically is making it so vibrant, and attractive to people. To understand the layout of a city, people first and foremost create a mental map. Mental maps of a city are mental representations of what the city contains, and its layout according to the individual. These mental representations, along with the actual city, contain many unique elements, which are defined by Lynch as a network of paths, edges, districts, nodes, and landmarks.

RURAL-URBAN FRINGE STUDIES

The term "rural-urban fringe" is used to designate area where we have a mixture of rural and urban land use. Fringe area used as a new residential colonies, a considerable amount of vacant land, partially developed residential plots, few factories, commercial squatters on either side of the road, and further away from the city, warehouse, cold storage plants, timber yards, brick kiln, etc.

PREDICTION TECHNIQUES AND LOCATION MODELS

Some of the locations planning models used for location assessment are: Check list, Analogue, Financial analysis, Regression model & Gravity (Spatial interaction) model.

A) REILLY'S LAW OF RETAIL GRAVITATION (1931)

It states that the force of retail attraction between two cities is directly proportional to their respective populations inversely proportional to the square of the distances between them. The concept of determining the equilibrium point on a line between the two forces (competing markets) is then employed to establish the catchment area, from which point a consumer will be equally attracted to either of the market centers (breaking point). Mathematically expressed it as:

Where, T_A = Trade drawn to city "A" from an intermediate place

T_B = Trade drawn to city "B" from an intermediate place

P_A = Population of city "A"

P_B = Population of city "B"

D_A = Distance from city "A" to intermediate place

D_B = Distance from city "B" to intermediate place

$$\frac{T_A}{T_B} = \frac{P_A}{P_B} \left[\frac{D_B}{D_A} \right]^2$$

B) HUFF'S MODEL (1962)

D. L. Huff (1962), first attempted to bridge the gravity formulation and consumer behaviour, by suggesting an advanced model for expressing the probability of a consumer to travel to a particular store (trade zones), using two variables-store sizes (floor space and travel time). Huff suggested that, Probability (P_{ij}) of a given centre j being chosen from a set of centres by consumer at i is given by:

$$P_{ij} = U_j / \sum U_j$$

Where, U_j is the utility associated with centre j
 i = residential zone (demand),

j = shopping centres (supply)

This can be expanded as:

$$P_{ij} = (A_j/d_{ij}^2) / \sum (A_j/d_{ij}^2)$$

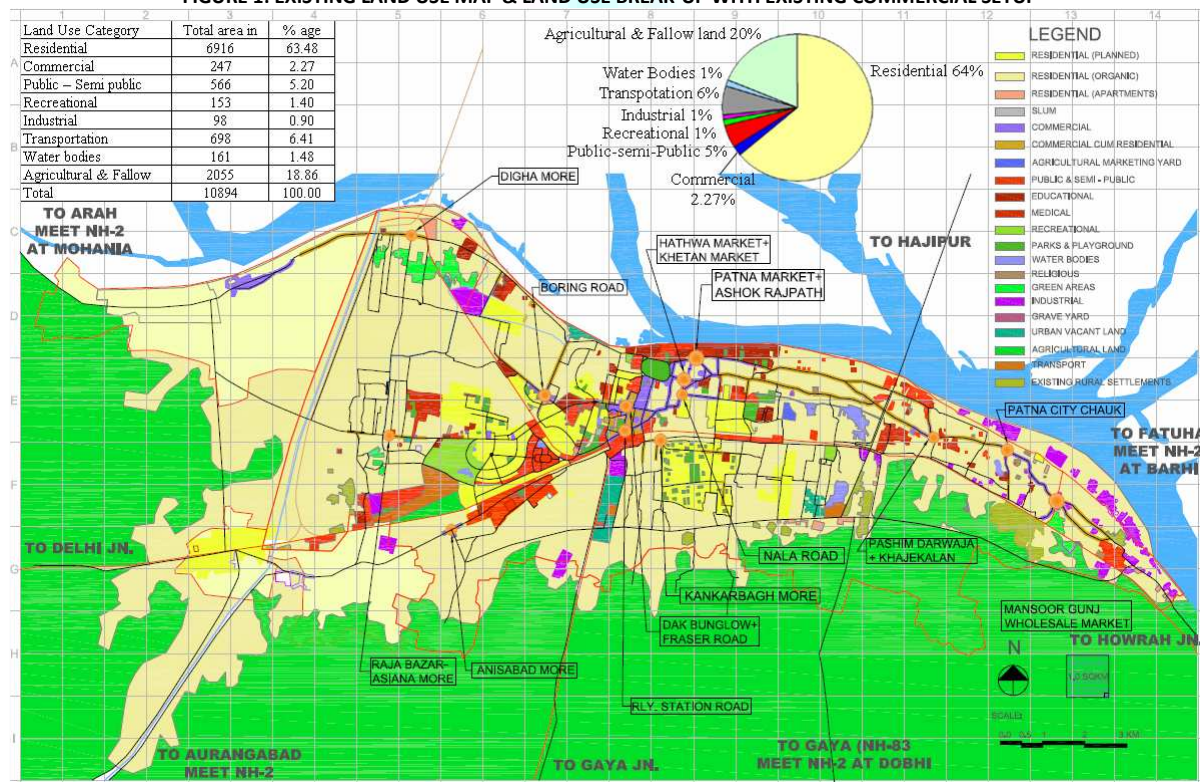
Where, A_j = the attractive power of the centre and
 d_{ij} = distance from zone i to centre j

OVERVIEW OF THE STUDY AREA - PATNA

INTRODUCTION & HISTORIC PERSPECTIVE OF PATNA

Patna is the capital of Bihar, with municipal area of 108.94 sq. km and population of 13.7 lakhs as per 2001 census with average population density of 125.43 pph. Patna is situated on the southern bank of river Ganges. Patna is one of the most ancient cities of India. It is a sacred spot visited by many and blessed by the Great Buddha as the capital of the first all-India Empire under the great ruler Ashoka.

FIGURE 1: EXISTING LAND USE MAP & LAND USE BREAK-UP WITH EXISTING COMMERCIAL SETUP



TOWN GROWTH AND IMAGE OF THE CITY PATNA

Patna is a linear city which has grown on either sides of a main road (Ashok Rajpath) running east to west on a ridge, almost parallel to the bank of the river Ganga. The eastern most zones, which is the old city and the ancient capital is full of rampant derelict buildings beaded along narrow lanes with obsolescence and unsanitary conditions. This zone contains one of the biggest centres of wholesale trade at Marufgunj and Mansurganj. The middle zone (central zone) which covers the area roughly between the Pashim Darwaza in the east and the Patna-Gaya road (now the Buddha Marg) in the west is the business and the commercial core of the city, also having bulk of the institutional, cultural and the district administration buildings. It is one of the most overcrowded zones of the city. The western zone, the new capital area, differs significantly from the other two zones. It comprises of monumental buildings and a well laid out ring and radial road pattern, with 200 feet Wide Avenue with the Secretariat and the Raj Bhawan forming its terminal features. However this zone is deficient in certain basic community facilities such as schools, shopping centres etc.

Patna has always been a great centre of trade and commerce. Patna today has a regional impact and draws a large number of people from throughout the state who come to the city for vocational requirements and for availing other services that the city offers. The general hospital, the many institutions of higher education and the offices of the state government, divisional and the district administration, all attract a large number of people to the city.

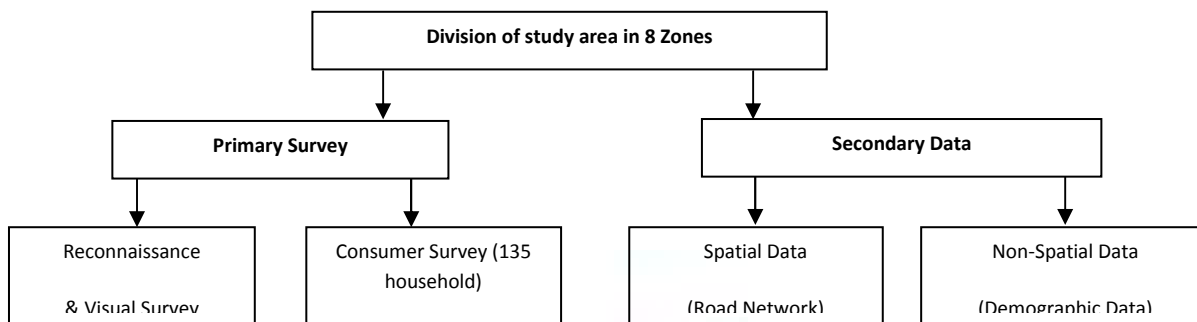
COMMERCIAL SETUP OF CITY PATNA

The spatial distribution of commercial activities in Patna is typical of old Indian cities. More than anything else it is the long shopping streets that dominate the city's urban scene. Almost all existing important roads in the central and the eastern zones of the city have commercial establishment on either side with intermittent breaks. One of the most important and busiest retail shopping areas of the city is spread over the southern flange of the Ashok Rajpath, right from Gandhi Maidan to NIT More. From NIT More, this road has retail shopping (ground floor) on both sides up to its junction with Sher Shah road. The commercial activity on this road in the central zone is mostly retail trade, whereas in the eastern zone it is both retail and whole sale. Other important roads in the central zone, (such as Rajendra path, Bari Path, Daryapur, Sabjibagh road, Station Road, Nala Road etc), all have retail commercial activities on both sides. There are some planned shopping centres in the city namely Patna market, Hathwa Market + Khetan market, Dak-Buglow Chauraha (Maurya lok + N P Centre + Abul Hai Commercial complex + Jai Praksh Bhawan + Maharaja Complex + Heera place etc).

In western zone Boring Road and Boring Canal Road are fully developed as commercial or mixed land use. Both sides of Bailey Road from Shekhpura More to Jagdeo Path are developed as shopping area. Maroofgunj and Mansoorgunj in the Eastern zone are the wholesale trade centres in grain, pulses, spices and other 'kirana' materials, the largest of its kind in Bihar. Wholesale trade in hosiery, cosmetics, general merchandise, utensils etc. are carried out in the Chowk Mohalla of Old city.

SURVEY PROCEDURE AND DATA COLLECTION

A Schematic overview of the survey design & data collection is provided here:



RECONNAISSANCE SURVEY

Primary reconnaissance survey was initially conducted at the city level to identify existing commercial nodes and candidate nodes for future commercial development. The major road intersections were identified along with the existing commercial locations, infrastructure facilities like road width and condition, pedestrian, parking provisions in shopping areas and recent retail developments, distribution of markets in the city (both traditional and new organized formats).

PRIMARY HOUSEHOLD SURVEY

Survey format were designed to know the shopping behaviour of customer and functional urban image suitability of zones & urban image of city. Primary consumer survey were conducted in the 135 households, identified by stratified random sampling in the 8 zones (self divided for convenience) and 57 wards of Patna Municipal area.

Primary data analysis is conducted to address five research questions:

How far is a customer willing to travel for shopping?

Where do consumers prefer to shop (location / format)?

What are the store and location attributes while deciding where to shop in?

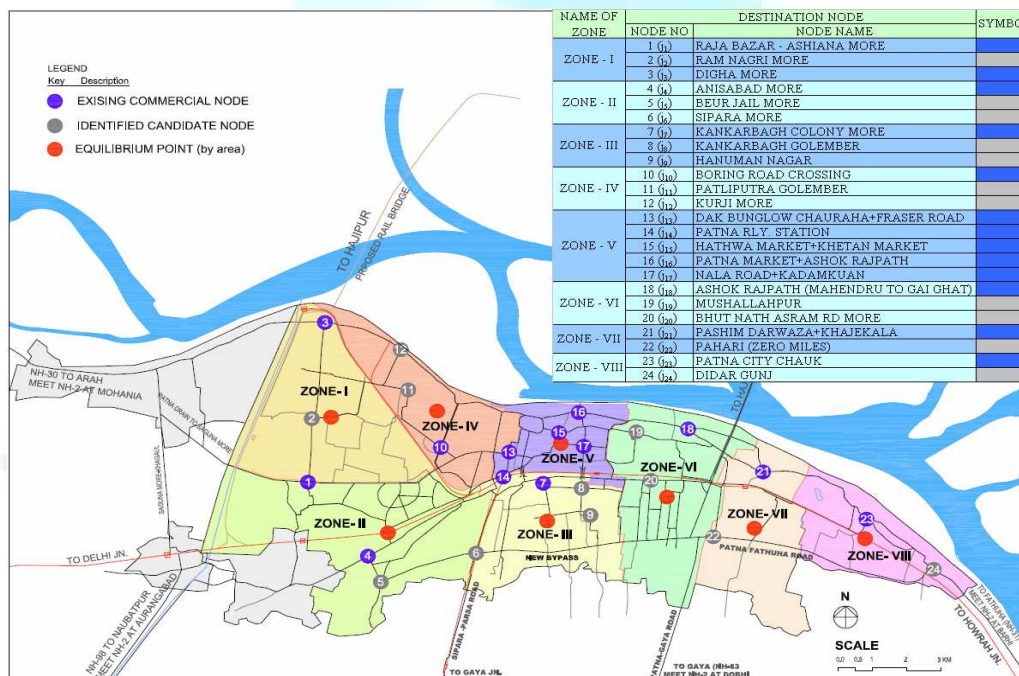
What perception does the citizen have regarding the image of the city and various zones of Patna?

Which zones are perceived to be "best suited" for various commercial functions?

SECONDARY DATA COLLECTION

The spatial data includes: (1) Census administrative & ward boundary map, (2) Road network map, (3) Existing land use map. The non-spatial data includes: (1) Ward wise population of 1991 and 2001, (2) Projected population for 2011 and 2021, (3) Socio-economic characteristic. Secondary data were collected from various documents (such as CDP & Master Plan) and organizations such as PMC, PRDA, BIRSAC, state statistical department, census office, various district office and town planning departments. Some of the data inputs are represented in figure 2.

Figure 2: Map Showing origin zones (i) & destination nodes (j) and equilibrium point of zone



DATA ANALYSIS

ANALYSIS & DESCRIPTIVE STATISTICS OF SHOPPING BEHAVIOUR

The analysis & descriptive statistics of consumer shopping behaviour is presented here under the six headings:

- Demographic statistics of sample:
 - Male-female composition (Male-55% & Female-45%) of total respondents is close to real aggregate situation of city (Male-54% & Female-46%).
 - Majority of the respondents were aged between 20-50 years (72% of sample). This compares favourably as real age distribution of Patna urban area.
 - The revealed monthly household income (MHI) of the sample fitted the basic standard distribution curve, with about 27% in the middle category of INR 15,000-20,000.
- Willingness to travel (distance & time) and preference of mode of travel:

- The majority of people (53%) are willing to travel less than 2 kms for general shopping trips and another 28% are willing to travel between 2-5 kms. About 19% people willing to travel between 5-10 kms.
 - About 62% of people are willing to spend 10-30 minutes of time for one-way shopping trip.
 - About 53% of people use private vehicle (car & 2-wheeler) for shopping trips.
3. Preference of shop format and Shopping Zones:
- The majority of people (64%) prefer organized format (branded showroom & departmental store/Mall) for general shopping.
 - The most preferred shopping zones are Patna Market, Hathwa Market, Dak Bunglow & Boring Road in PUA. The first two are traditionally & high-status market with high commercial image.
 - The relatively new locations showing high store attraction are Dak Bunglow Chauraha & Boring road Chauraha.

RELATIVE IMPORTANCE OF STORE ATTRIBUTES AND LOCATION ATTRIBUTES

The relative importance of 10 store attributes (Pricing strategy, Scope of bargaining, Quality of product, Image of Store, Customer Service, AC/Infrastructure, Interiors/shop ambience, Range of products mix, Advertisement, Location) to determine store attractiveness was rated by consumers.

The relative importance of 10 location attributes (Traveling distance / Time, Accessibility by public transport, Overall convenience in reaching store, Visibility of store frontage, No traffic Congestion/Pedestrian safety, Ease of parking in the area/store, Comparison options (similar shops), Complementary activities (eating/movie), Overall image of the shopping area, Utilities and infrastructure)

The four attributes with maximum importance are: (1) Quality of product, (2) Range of product, (3) Customer service, (4) Location of store

The four attributes with maximum importance are: (1) Overall image of shopping area, (2) Travel distance/time, (3) No traffic congestion/pedestrian, (4) Ease of Parking in shopping area

PREFERENCE FOR DIFFERENT TYPE OF COMMERCIAL ACTIVITIES IN UPCOMING ZONES

It is found that Bailey Road is most preferred upcoming zone for organized retail and corporate offices. Whereas for wholesale and unorganized retail South of new bypass is most preferred upcoming zone.

PERCEPTION OF THE IMAGE OF THE AREA

- Most respondents feel that new commercial developments are changing the commercial image and it is for better. Thus people are accepting and liking this image change over towards high-status organized retail
- Majority 92% of the respondents think Patna need more shopping malls since organized format shopping is presently not adequate and needs to be augmented.
- While trying to assess the overall pervading image of the city, respondents asked to rate the following urban function: Administrative, College/Hospital, Commercial, Residential, Industrial, Heritage/Religious, Recreation, Tourism, Agriculture. It is found that social infrastructure is 1st & commercial is the 2nd image of city Patna

CALCULATING THE COMMERCIAL POTENTIAL OF DIFFERENT NODES

Step-1: Computing the distance between all origin zones (i) & destination nodes (j)

Step-2: Calculating utility associated with destination node (j) for all origin zones (i)

Step-3: Finding the probability of a consumer to travel from origin zones (i) to the destination nodes (j)

Step-4: Comparison of "Actual" and "Potential" market shares of destination nodes

We formulate a simple step by step linear logic to arrive at the attractiveness of a store in a particular location. This is shown below:

Huff's states the probability (P_{ij}) of a customer originating from zone i to visit a shop at j is the ratio of the utility of shop j to the sum of utilities of all shops taken together.

$P_{ij} = U_j / \sum U_j$ Where, U_j is the utility associated with centre j

He uses store area & distance from store as the two attractive variables to calculate utility. However in the present study, we use two more sophisticated attractiveness variables namely, Level of Urbanization of the nodes & Commercial image of the nodes/zones.

$A_j = L_{ij} * U_{li}$, Where, L_{ij} = level of urbanization of the nodes, U_{li} = commercial image of the nodes

$P_{ij} = (L_{ij} * U_{li} / d_{ij}^2) / \sum (L_{ij} * U_{li} / d_{ij}^2)$, where d_{ij} = Distance from zone i to node

Step 1: Computing the distances between all origin zones (i) & destination nodes (D-nodes) (j)

Origin zones: The eight survey zones of delineated study area taken as origin zones (i)

Destination nodes: Based on the reconnaissance survey, 13 existing commercial nodes & 11 identified candidate nodes are taken as D-nodes (j).

The distance between all the 24 destination nodes and 8 origin zones has been calculated. For this, equilibrium points of all 8 zones are determined geometrically, as will be discussed in detail in the report.

Step 2: Calculating Utility associated with each destination node (j) for all origin zones

As mentioned earlier, we use two compound attractiveness variables namely, Level of Urbanization of the nodes & Commercial image of the nodes/zones for calculating utility.

The utility of commercial area (U_j) is defined as ratio of attractiveness power (level of urbanization of the nodes (L_{ij}) multiplied by commercial image (U_{li}) of the nodes) to the square of distance from the origin zone to the commercial node (d_{ij}) in km.

Thus, Utility of commercial node (j) is:

$$U_j = L_{ij} * U_{li} / d_{ij}^2$$

Where, L_{ij} = level of urbanization of the nodes

U_{li} = commercial image of the nodes

d_{ij} = Distance from zone i to node

(a) Calculating Level of Urbanization of destination nodes (j)

Ramachandran (1989) calculates level of urbanization by three measures: % of Urban population, Rural population served by urban centres, Maximum distance to the nearest urban centre.

In this present study, the "Level of Urbanization" of different nodes has been calculated by five modified measures:

Land Value (X1)	(Actual Value)
Accessibility (X2)	(Psychometric scale value by expert opinion)
Urban infrastructure (X3)	(Psychometric scale value by expert opinion)
Population Growth (X4)	(Actual Value converted in to scale)
Land availability (X5)	(Psychometric scale value by expert opinion)

All measures have been taken as equally important. The unit of all the measures is different, so standardized values (Z) for all measures is calculated. Only, the criterion land availability is inversely related to the level of urbanization. To overcome this problem the sign of the standard scores are corrected so that positive value indicates a high level of urbanization, while negative value indicated a low value. The standard score on all the criteria are the added together to give a composite index of level of urbanization.

$LU = X1+X2+X3+X4-X5$ (where, LU=level of urbanization)

This composite index of level of urbanization has been interpolated for model application by the formula:

$$LU_i = (LU - LU_{min}) / (LU_{max} - LU_{min})$$

b) Calculating Commercial Image of destination nodes (j)

Respondents from each zone were asked to rate the urban image suitability of that zone, in light of the urban functions: (Commercial (Retail), Public/Semi-public, Residential, College/Hospital, Recreational, Heritage/Religious, and Industrial). From the findings, the retail commercial image is used for the calculating the commercial image perception. This disaggregated data (on scale 1-5) is interpolated by following formula:

$U_{ij} = (U_{lj} - U_{lmin}) / (U_{lmax} - U_{lmin})$

The 1 (one) interpolated value of urban image for retail signifies fully conducive to retail commercial activity and 0 (zero) signifies not at all commercial.

Step 3: Finding the probability of a consumer to travel from origin zones (i) to the destination nodes (D-nodes) (j)

The probability of a customer patronizing a selected shopping destination is positively related (directly proportional) to the attractiveness (product of level of urbanization and commercial image of the node/zone) of the shopping area and negatively related (inversely proportional) to the square of the distance between the D-nodes (j) and origin zones (i)

Table 1 provides a sample data entry for all destination nodes from origin zone-I, with the respective distances, level of urbanization parameters, commercial image & calculated utility (attractiveness). Similar data is computed for all origin zones.

Table 1: Calculation of Utilities (Attractiveness of shopping nodes (j) (for zone – I only)

			dij	LEVEL OF URBANIZATION					Urban commercial image (on scale 1-5)	UTILITIES
NAME OF ZONE	NODE NO. (j)	DESTINATION NODE NAME	ZONE- I	Land Value (X1)	Accessi bility (X2)	Urban Infrastr ucture (X3)	Populati on Growth (X4)	Land Availa bility (X5)		ZONE-I
		MAXIMA		500000	4	4	4	1	5.00	
ZONE - I	1 (j ₁)	RAJA BAZAR - ASHIANA MORE	2.00	211000	4	3	4	2	3.75	0.1269
	2 (j ₂)	RAM NAGRI MORE	0.45	171925	3	3	4	3	3.75	2.1025
	3 (j ₃)	DIGHA MORE	2.75	158700	2	2	2	4	3.75	0.0322
ZONE - II	4 (j ₄)	ANISABAD MORE	4.33	145475	3	3	4	2	2.67	0.0144
	5 (j ₅)	BEUR JAIL MORE	5.16	132250	2	2	2	4	2.67	0.0053
	6 (j ₆)	SIPARA MORE	5.70	119025	2	2	2	4	2.67	0.0043
ZONE - III	7 (j ₇)	KANKARBAGH MORE	6.37	264500	4	3	3	1	3.79	0.0131
	8 (j ₈)	KANKARBAGH GOLEMBER	7.60	238050	3	3	3	2	3.79	0.0078
	9 (j ₉)	HANUMAN NAGAR	7.83	224825	3	3	4	4	3.79	0.0069
ZONE - IV	10 (j ₁₀)	BORING ROAD CROSSING	3.37	300000	4	4	2	1	3.74	0.0472
	11 (j ₁₁)	PATLIPUTRA GOLEMBER	2.47	264500	4	3	4	3	3.74	0.0811
	12 (j ₁₂)	KURJI MORE	2.90	200000	3	2	3	4	3.74	0.0392
ZONE - V	13 (j ₁₃)	DAK BUNGLOW CHAURAHA+FRASER ROAD	5.30	415000	4	4	2	1	4.87	0.0292
	14 (j ₁₄)	PATNA RLY. STATION	5.45	405000	4	4	2	1	4.87	0.0274
	15 (j ₁₅)	HATHWA MARKET+KHETAN MARKET	6.56	343850	4	4	2	1	4.87	0.0182
ZONE - VI	16 (j ₁₆)	PATNA MARKET+ASHOK RAJPATH	7.06	356500	4	4	2	1	4.87	0.0158
	17 (j ₁₇)	NALA ROAD+KADAMKUAN	7.00	304175	3	3	2	2	4.87	0.0125
	18 (j ₁₈)	ASHOK RAJPATH (MAHENDRU TO GAI GHAT)	9.89	225000	3	3	2	2	2.41	0.0021
ZONE - VII	19 (j ₁₉)	MUSHALLAHPUR	10.11	200000	2	2	2	2	2.41	0.0016
	20 (j ₂₀)	BHUT NATH ASRAM RD MORE	10.36	264500	2	2	4	4	2.41	0.0017
	21 (j ₂₁)	PASHIM DARWAZA+KHAJEKALA	12.61	227700	2	2	2	2	2.67	0.0013
ZONE - VIII	22 (j ₂₂)	PAHARI (ZERO MILES)	11.27	150000	2	2	1	4	2.67	0.0010
	23 (j ₂₃)	PATNA CITY CHAUK	15.05	230000	3	3	2	1	4.00	0.0021
	24 (j ₂₄)	DIDAR GUNJ	17.85	115000	1	1	2	3	4.00	0.0006
MINIMA				100000	0	0	0	4	1.00	
MEAN (X)				241037.50	2.88	2.73	2.54	2.42		2.5943279
STANDARD DEVIATION (S)				100756.84	1.07	1.00	1.07	1.24		

Step 4: Comparison of "Actual" and "Potential" market shares of D-nodes (j)

A theoretical understanding of "Actual Market Shares (AMS)" & "Potential Market Shares (PMS)" needs to be highlighted here. In the first case, we consider the actual size of existing market & their real geographical locations, but the population of wards is not considered. So, we assume that the urban area has a uniformly distributed population, i.e. identical sizes of origin zones, but differing size of D-zones. When the Huff's model is applied to this dataset we get the AMS.

In the second case, we consider the actual population living in different ward, but do not consider the actual size of existing market. So here, we assume that the existing market provision is done uniformly for all nodes, i.e. identical size of D-nodes (similar attractiveness), but differing size of origin nodes. When the Huff's model is applied to this dataset, we get the PMS.

For this, consumer probability (P_{ij}) in eight origin zones (i) with respect to 13 existing shopping nodes (j) was multiplied with the actual population (PA_j) going to that shopping node and to the potential population (PP_j) around each existing shopping and identified candidate nodes (j) to get the actual and potential market shares respectively.

The actual number of people going to each commercial node was identified based on the primary survey results. First the % of people going from each origin zone (i) to all the D-nodes (j) was identified and total population from each origin zone (i) to one particular D-nodes (j₁) was calculated and added up to find the actual population going to that particular D-nodes (j₁). Similar calculation for all other D-nodes (j) has done for finding actual population around each node. It is obvious that Identified candidate nodes (j) do not have actual population around.

The potential population is assumed to be located around every D-node (j). The potential population around the node (PP_j) is taken as the sum of population living in the wards around that node in approx 2 km radius based on the primary survey results of willingness to travel for shopping.

Actual Market Share (No. of actual trip from zone i to node j) = P_{ij} * PA_j

Potential Market Share (No. of expected trip from zone i to node j) = P_{ij} * PP_j

Where, P_{ij} = Probability that a consumer in zone i will visit node j.

PA_j = Actual population going to each destination nodes (j).

PP_j = Potential population around each destination nodes (j).

Table 2: Calculation of Actual Market Share & Potential Market Share (zone –I only)

NAME OF ZONE	NODE NO. (j)	DESTINATION NODE NAME	(P _{ij}) ZONE-I	ACTUAL POPULATION GOING TO NODE (P _A)	ORIGIN ZONE (i) ZONE-I	POTENTIAL POPULATION AROUND THE NODE (P _p)	NO. OF EXPECTED SHOPPING TRIPS FROM (i) TO (j)	$\Sigma P_{ij} \cdot P_{A1}$ ZONE-I	ORIGIN ZONE (i) ZONE-I	$\Sigma P_{ij} \cdot P_{A1}$	NORMALISED POTENTIAL MARKET SHARE (%)
ZONE - I	1 (j ₁)	RAJA BAZAR - ASHIANA MORE	0.0489	25103	1228.1120	3996.8011	0.8776	165634.0000	8103.2359	26371.3927	3.8406
	2 (j ₂)	RAM NAGRI MORE	0.8104	0	0.0000	0.0000	0.0000	63000.0000	51056.5924	54889.4392	7.9939
	3 (j ₃)	DIGHA MORE	0.0124	10925	135.4201	368.5175	0.0809	36654.0000	454.3374	1236.3847	0.1801
ZONE - II	4 (j ₄)	ANISABAD MORE	0.0056	21789	121.2795	11172.5863	2.4532	110796.0000	616.7054	56812.5353	8.2739
	5 (j ₅)	BEUR JAIL MORE	0.0020	0	0.0000	0.0000	0.0000	15327.0000	31.3454	1237.3421	0.1802
	6 (j ₆)	SIPARA MORE	0.0016	0	0.0000	0.0000	0.0000	80558.0000	132.0875	3446.8119	0.5020
ZONE - III	7 (j ₇)	KANKARBAGH MORE	0.0050	38493	193.7669	9375.8439	2.0587	197259.0000	992.9770	48047.4062	6.9974
	8 (j ₈)	KANKARBAGH GOLEMBER	0.0030	0	0.0000	0.0000	0.0000	106981.0000	322.5575	27898.7790	4.0631
	9 (j ₉)	HANUMAN NAGAR	0.0026	0	0.0000	0.0000	0.0000	40951.0000	108.2065	20922.3222	3.0470
ZONE - IV	10 (j ₁₀)	BORING ROAD CROSSING	0.0182	134952	2458.9932	33531.1559	7.3624	105051.0000	1912.6041	26101.7512	3.8013
	11 (j ₁₁)	PATLIPUTRA GOLEMBER	0.0313	0	0.0000	0.0000	0.0000	39561.0000	1236.4125	26873.4829	3.9137
	12 (j ₁₂)	KURJI MORE	0.0151	0	0.0000	0.0000	0.0000	38561.0000	582.1337	3444.1313	0.5016
ZONE - V	13 (j ₁₃)	DAK BUNGLOW CHAURAHA+FRASER ROAD	0.0113	200993	2262.2602	48224.9858	10.5888	69948.0000	787.2941	16782.8825	2.4442
	14 (j ₁₄)	PATNA RLY. STATION	0.0106	78615	831.3275	20822.9729	4.5721	40531.0000	428.6011	10735.5402	1.5635
	15 (j ₁₅)	HATHWA MARKET+KHETAN MARKET	0.0070	293922	2058.7698	88903.9110	19.5206	39180.0000	274.4357	11850.9637	1.7259
	16 (j ₁₆)	PATNA MARKET+ASHOK RAJPATH	0.0061	323902	1975.8145	75900.2896	16.6654	50497.0000	308.0340	11833.0292	1.7233
	17 (j ₁₇)	NALA ROAD+KADAMKUAN	0.0048	35645	171.7141	33733.7784	7.4069	68348.0000	329.2517	64682.5489	9.4201
ZONE - VI	18 (j ₁₈)	ASHOK RAJPATH (MAHENDRU TO GAI GHAT)	0.0008	15586	12.7449	10135.1740	2.2254	92183.0000	75.3812	59945.4428	8.7302
	19 (j ₁₉)	MUSHALLAHPUR	0.0006	0	0.0000	0.0000	0.0000	84586.0000	52.4823	12309.6677	1.7927
	20 (j ₂₀)	BHUT NATH ASRAM RD MORE	0.0007	0	0.0000	0.0000	0.0000	45327.0000	29.6702	3644.3681	0.5308
ZONE - VII	21 (j ₂₁)	PASHIM DARWAZA+KHAJEKALA	0.0005	54880	26.7417	12620.0001	2.7710	90317.0000	44.0091	20768.8430	3.0247
	22 (j ₂₂)	PAHARI (ZERO MILES)	0.0004	0	0.0000	0.0000	0.0000	41978.0000	15.7357	9895.8158	1.4412
ZONE - VIII	23 (j ₂₃)	PATNA CITY CHAUK	0.0008	131640	107.0282	106649.9370	23.4171	196440.0000	159.7136	159149.0479	23.1778
	24 (j ₂₄)	DIDAR GUNJ	0.0002	0	0.0000	0.0000	0.0000	61086.0000	14.7726	7764.3226	1.1308
TOTAL			1.0000	1366444			100.0000			686644.2513	100.0000

By comparing the actual market share and potential market share we will infer about the future growth possibilities of all the existing commercial nodes. We calculate the difference between the potential market share and actual market share of all the existing shopping nodes.

If PMS – AMS = +ve, it means there is untapped market potential in a destination node.

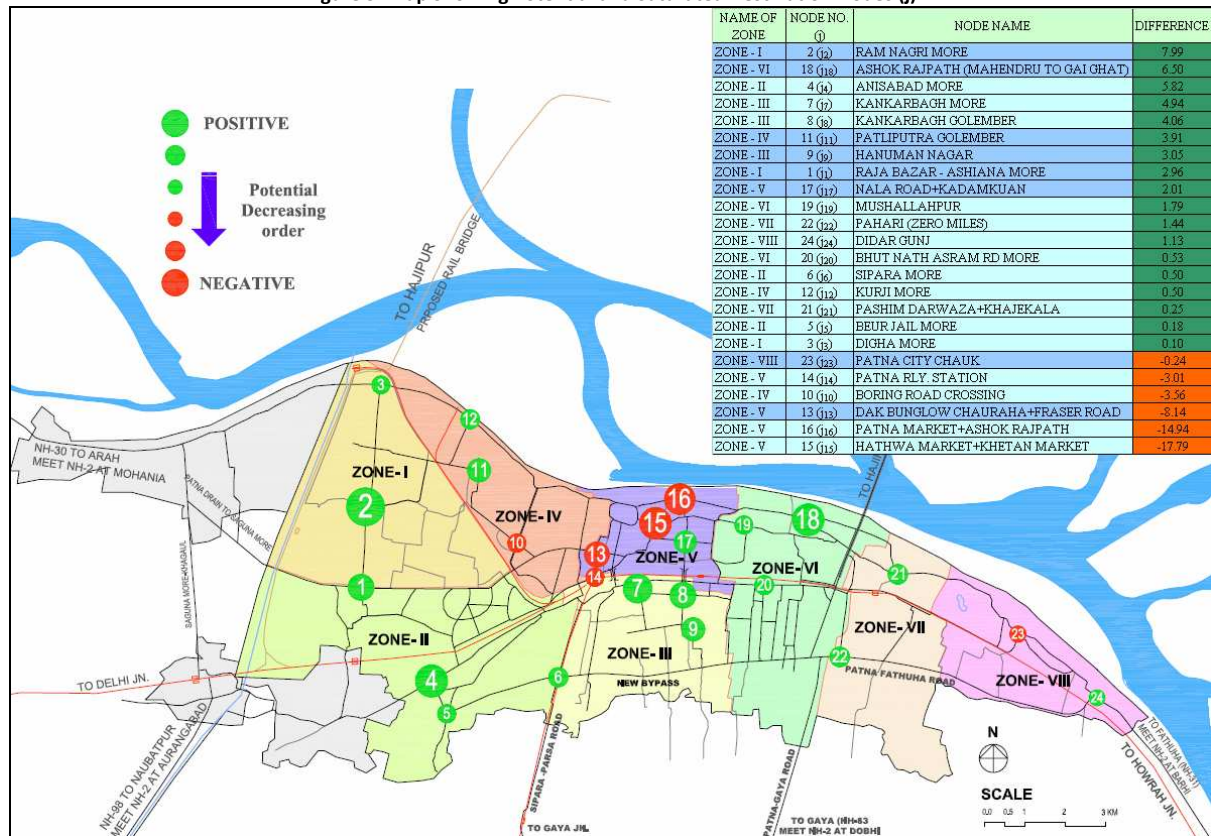
If PMS – AMS = -ve, it means area is oversaturated and not likely to grow.

Table 3 provides a summary of this (PMS –AMS) value, and is represented in a map in figure 3. This leads us to further recommendation and proposals, to be discussed in the next section.

Table 3: Comparison of “Actual Market Share & Potential Market Share” of all D-nodes

NAME OF ZONE	DESTINATION NODES		POTENTIAL MARKET SHARE (%)	ACTUAL MARKET SHARE (%)	DIFFERENCE
	NODE NO. (j)	NODE NAME			
ZONE - I	1 (j ₁)	RAJA BAZAR - ASHIANA MORE	3.84	0.88	2.96
	2 (j ₂)	RAM NAGRI MORE	7.99	0.00	7.99
	3 (j ₃)	DIGHA MORE	0.18	0.08	0.10
ZONE - II	4 (j ₄)	ANISABAD MORE	8.27	2.45	5.82
	5 (j ₅)	BEUR JAIL MORE	0.18	0.00	0.18
	6 (j ₆)	SIPARA MORE	0.50	0.00	0.50
ZONE - III	7 (j ₇)	KANKARBAGH MORE	7.00	2.06	4.94
	8 (j ₈)	KANKARBAGH GOLEMBER	4.06	0.00	4.06
	9 (j ₉)	HANUMAN NAGAR	3.05	0.00	3.05
ZONE - IV	10 (j ₁₀)	BORING ROAD CROSSING	3.80	7.36	-3.56
	11 (j ₁₁)	PATLIPUTRA GOLEMBER	3.91	0.00	3.91
	12 (j ₁₂)	KURJI MORE	0.50	0.00	0.50
ZONE - V	13 (j ₁₃)	DAK BUNGLOW CHAURAHA+FRASER ROAD	2.44	10.59	-8.14
	14 (j ₁₄)	PATNA RLY. STATION	1.56	4.57	-3.01
	15 (j ₁₅)	HATHWA MARKET+KHETAN MARKET	1.73	19.52	-17.79
	16 (j ₁₆)	PATNA MARKET+ASHOK RAJPATH	1.72	16.67	-14.94
	17 (j ₁₇)	NALA ROAD+KADAMKUAN	9.42	7.41	2.01
ZONE - VI	18 (j ₁₈)	ASHOK RAJPATH (MAHENDRU TO GAI GHAT)	8.73	2.23	6.50
	19 (j ₁₉)	MUSHALLAHPUR	1.79	0.00	1.79
	20 (j ₂₀)	BHUT NATH ASRAM RD MORE	0.53	0.00	0.53
ZONE - VII	21 (j ₂₁)	PASHIM DARWAZA+KHAJEKALA	3.02	2.77	0.25
	22 (j ₂₂)	PAHARI (ZERO MILES)	1.44	0.00	1.44
ZONE - VIII	23 (j ₂₃)	PATNA CITY CHAUK	23.18	23.42	-0.24
	24 (j ₂₄)	DIDAR GUNJ	1.13	0.00	1.13
Σ			100.00	100.00	

Figure 3: Map Showing Potential and Saturated Destination Nodes (j)



CONCLUSION

Based on this analysis, the oversaturated and the potentially growing commercial nodes are identified for Patna urban area. It is clear that the core area (Patna market + Ashok Rajpath, Hathwa market + Khatan market, Patna Railway Junction, Dak Bungalow Chauraha, Boring Road Chauraha and Patna city Chauk etc.) is saturated. Newer shopping locations away from the core are likely to grow in the near future are (Kankarbagh colony, Raja Bazar + Ashiana more etc).

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