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MATRIX MODEL TO ANALYSE FEASIBILITY OF SMART CITY IN GUWAHATI

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Abstract: *Smart City Mission was launched by the Government of India on 25th June 2015 with the aim to transform the selected 100 cities of the country into smart cities. Till date 100 cities have been selected to upgrade into smart city and they will receive funding from central and state government as well through the Public Private Partnership. The Guwahati city which is strategically located as the gateway to northeast India was selected in 17th position in first stage of selection for smart city. The major problems the Guwahati city facing today are traffic congestion, flash flood and inadequate number of Public Sanitation. The objective of the study is to analyse the feasibility of the smart city and to answer if the mission can solve the current mentioned problems in City. The methodology adopted for the study is Matrix model analysis. The parameters used for the model are availability of water facility, sanitation, street light, hospital, educational institution, flood problem, landslide problem, road connectivity and transportation, traffic congestion and electricity. The data has been collected from secondary source and by observation and questionnaire method. The technique of GIS was used to prepare the outcome map. The primary finding of the study is that northern ward of the city which lies near of the Brahmaputra River, except the Nilachal hills is highly feasible for the smart city and Dispur which is in the central part is also highly feasible for the smart city. The average of the Summation of Assessment point of the all the wards in the city is 73.09 and it indicate that city is feasible for foundation of smart city.*

Key words: Smart City, Matrix Model, Feasible and Flood, Assessment Point

Introduction

In the 21st century the development in the urban has led to the change of paradigm (Eremia et al., 2017). The concept of Smart City means different things to different people as there is no one fit universal definition of the Smart City. Its concept differs from city to city, regions to regions, nation to nation and country to country. The institute in California was first to focus on the use of ICT to make the communities and people smart in smart city (Alawadhi et al., 2012). Smart City introduces the Information Communication technology (ICT) to boost the living standard of the citizens, its growth and development. It improves the performance activities of the city by making optimum uses of the available resources and by dropping rate of consumption and its expenses. At their disposal Smart citizens have several ICT infrastructures, which permit them to enhance their day to day accomplishments (Lendak, 2016). The cities in India are focusing on the construction of the sustainable infrastructure to meet the growing demand of the growing population (Sen et al., 2016). The most important and central part of the successful implementation of the smart city is Infrastructure (Monzon, 2015).

The application of ICT encourages the actively engagements of the citizen with the government schemes, services and activities. Waste disposal problem is the main concern of hygiene in India, directly 22 diseases are caused due to improper management of urban waste (Anand, 2010). The ICT should be applied in the city to manage the waste, enhance the sector of transportation, water supply, energy and power supply, retail, disaster

management and various other sectors. In international policies and scientific literature, the concept of the smart city has been becoming very popular since last couple of decades (Albino et al., 2015). Smart city mission is the great step towards building the world class sustainable cities (Basumatary and Anand, 2016). The main aims and objectives of the Mission are to derive the growth in economic sector and to bring growth and development in citizen's life by enhancing ICT infrastructure. Based on the terms, context and nature of utilization Infrastructure has numerous meanings (Hadir and Rodzi, 2009). There is expectation that the sustainable environment and decent quality of life will be attained with the introduction of the Smart city mission in India. The Mission wants to create a replicable model which will act a light house to other aspiring cities (Ministry of Housing and Urban Affairs, 2017). The smart city concept is very recent phenomena in India, it was launched by the present government on 25th June 2015 (Roy, 2016). The opportunities of the mission should be availed by every section of the society. In India there are 13.8 million household of the slum dwellers, they should be not left out (Chandrasekhar and Venkatesh, 2014).

The Guwahati city is facing difficulty to match with the pace of escalating growing demands of the city services and its facilities. It suffers from flash flood, traffic congestion, shortfall in infrastructure, overcrowding, mushrooming of slum, lack of drinking water and sanitation. Apart from these frequent problems, some of the other major problems, the city facing are environment problems, disasters, social problem, health and crimes. Therefore, for the proper planning and management, the application of ICT to assist the city planners has become important. Introduction of the smart city mission is the step in this direction.

Study Area
The study is confined to the area of the Guwahati Municipal Corporation of the Guwahati City which covers the total area of 176 sq. km. Due to its strategic location it is the commercial hub and gateway to North-east India (Mahadevia et al., 2014). Guwahati the major city of Assam is located at 26°10″ north latitudes and 92°49″ east longitudes. The city is horse shoe in shape and is situated in between the south banks of the Brahmaputra and Meghalaya Plateau in north (Deka, 2000). The land-use pattern of the city witnesses the multi-functional in character (Borah and Bhagabati, 2015).

Traffic jamming and flash flood are the two major problems in the city. With the reduction in the price of vehicles, due to Globalisation, people are purchasing them at high intensity, but the size of the roads are same as usual, so it has caused the traffic congestion. Majority of the city bus and transport facilities in Guwahati is privately owned and the main motive is to maximise the profit ignoring the public welfare that's why people prefer to travel in their own vehicles which cause influx of vehicle in the road and result into great traffic problem. Each monsoon, with slight rainfall, roads get floods with water, this cause great damage to properties and lives. The problem of traffic congestion needs to be tackled with the application of ICT in traffic department and encouraging the people to travel through public transportation to avoid traffic jam. For this government must give more emphasis on the development of public service and upgrading smart infrastructure. Before 1971 there was no such recorded flood problem in the city, so it clearly indicates that the flash problem in the city is due to unplanned development (Gogoi, 2013). This problem can be solved by adopting various smart method and techniques. The matrix model is applied to sort out the region/ward which is suitable for feasibility of the smart city mission.

Database and Methodology
The main objectives of the study are to analyse the feasibility of the smart city in Guwahati using Matrix Model and to answer if the mission can solve the current mentioned problems of

the city. Matrix Analysis Model is used to determine the feasibility of the smart city in each respective wards of the Guwahati Municipal Corporation area. The analysis is based on the primary field survey of the current situation of the City. The points assigned, range from 0 to 4, 4 being the highest positive remarks and 0 the lowest. This model is adopted to study the feasibility of the smart city in Guwahati. The point assigned for Approval/ Condition/ Situation of the parameters are 4 for highly satisfied, 3 for satisfied, 2 for neutral, 1 for dissatisfied and 0 for strongly dissatisfied (Table 1).

Table 01: Point Assigned for the Assessment for Matrix Analysis Model

#	Approval/Condition/ Situation	Point Assigned (PA)
1.	Highly Satisfied	4
2.	Satisfied	3
3.	Neutral	2
4.	Dissatisfied	1
5.	Strongly Dissatisfied	0

Source: Prepared by Authors, 2017

The parameters taken for the matrix analysis to determine the feasibility of the smart city are – 1) Availability of Water Facility, 2) Sanitation, 3) Street Light, 4) Hospital, 5) Educational Institution, 6) Flood Problem, 7) Landslide Problem, 8) Road Connectivity and Transportations, 9) Traffic Congestion and 10) Electricity. The weightages assigned for parameter to access the feasibility of smart city are 3 for highly feasible, 2 for medium and 1 for low. It means the parameters which are assigned 3 weightages are highly important factors responsible to consider the city as smart. Availability of water facility, sanitation, and street light and smart efficient management of flood problem, traffic congestion and electricity are assigned 3 weightage point as its presence and management is very important to consider the city as smart and sustainable. In the same manner according to their importance and significance presence of hospital, educational institution and road connectivity and transportation are assigned 2 point and management of landslide are assigned 1 weightage point (Table 2).

Table 02: Weightages Assigned to Parameters for the Smart City

#	Parameter to access the Feasibility of Smart City	Weightages Assigned (WA)
1.	Availability of Water Facility	3
2.	Sanitation	3
3.	Street Light	3
4.	Hospital	2
5.	Educational Institution	2
6.	Flood Problem	3
7.	Landslide Problem	1
8.	Road Connectivity and Transportations	2
9.	Traffic Congestion	3
10.	Electricity	3

Source: Prepared by the Authors, 2017

The formula to calculate the feasibility of smart city-
Feasibility Range=Summation of {Point Assigned (PA) X Weightages Assigned (WA)}

After assigning the approval point and Weightage point, to get the feasibility range, Approval Point assigned is multiplied with the Weightage point and summation of the result will be done to get the total. The range of the feasibility is from 0 to 100. The total value 100 is divided equally into five classes for final calculation and they are, 0-20, 21-40 and 41- 60,

61-80, 81-100 for Very low, Low, Average, High and Very High feasible respectively. For example, if the final summation of multiplication of PA and WA in particular ward is 88 then it, fall under the range of 81-100 and hence that ward will be highly feasible for the smart city, in the same manner if the point is 42 then it will fall within the range of 41-60 and that ward will be considered average feasible for the smart city.

Result and Findings

After getting the summation of multiplication of PA and WA of each ward and comparing its point range the feasibility of smart city for each ward is determined. After knowing the feasibility point of each ward the feasibility of the smart city for the entire city was calculated by summation of feasibility point of each ward divided by total number of ward. After calculation it is found that all the ward of the city has potential to develop as the smart city (Table 3). Some wards have very high potential, some have high potential, and some are normal and average to develop as the smart city.

Table 03: Total Feasible Point of All the Wards

#.	Ward No.	Ward Name	Feasibility Assessment
1	1	Guwahati University	66
2	2	Pandu Port	89
3	3	North Jalukbari	92
4	4	Kamakhya Mandir	77
5	5	Maligaon	88
6	6	Ganeshpara	57
7	7	Pub Boragaon	49
8	8	Machkhowa	85
9	9	Chatribari	91
10	10	Guwahati Railway Station	91
11	11	Uzan Bazar	83
12	12	Nabagraha	61
13	13	Nehru Stadium	79
14	14	CRPF Battalion Outpost	83
15	15	Fatasil	72
16	16	Lokhra	61
17	17	Kahilipara	50
18	18	Rupnagar	79
19	19	GMC Hospital	84
20	20	Japorigog	75
21	21	Geetanagar	80
22	22	Noonmati	69
23	23	Bamunimaidan	74
24	24	Narengi	66
25	25	Hengrabari	64
26	26	Dispur	88
27	27	Sonaighuli	60
28	28	Basista Mandir	59
29	29	Hatigaon	70
30	30	Beltola	59
31	31	Khanapara	65

Source: Prepared by Authors

Very High Feasible Regions for Smart City

The above figure 1 indicate that the very high feasible wards for the smart city in Guwahati is spread in the two distinct regions, 1) Northern region and 2) Central region

Northern Region

This region is in the northern part of the city and just south of the mighty river Brahmaputra excluding the Kamakhya ward. These wards are considered highly feasible for the smart city

as these regions are one of the most developed regions of the city and it has and fulfil all the basic criteria for becoming the smart city such as availability of water facility, sanitation, street light, hospital, educational institution, efficient road connectivity, regular supply of electricity, efficient management of the flood problem, landslide and traffic congestion. This region is considered as the old Guwahati region as the region was developed early. Majority of the region was developed and planned during the British Administration and is in the high ground and plain region that's why occurrence of flood and landslide is very rare.

The region is the commercial hub of the city. The famous pan bazar is the educational hub and market of the city. The famous cotton college and handique college is in this region. The area is famous for the book market, Entire states of the northeast depends on pan bazar for the books. The area adjacent to the pan bazar is fancy bazaar and is famous for cloths market, Machkhwa is famous fresh vegetable and fish market and Laktokia is famous for electronic appliances. The benefits of this region are that it is located near the Brahmaputra river bank. To lessen and check the traffic congestion in this region all the important bus stop has been from the core city region to the outskirts of the city (Mission Smart Guwahati, 2015).

Figure 10: Feasible Ward for Smart City in Guwahati
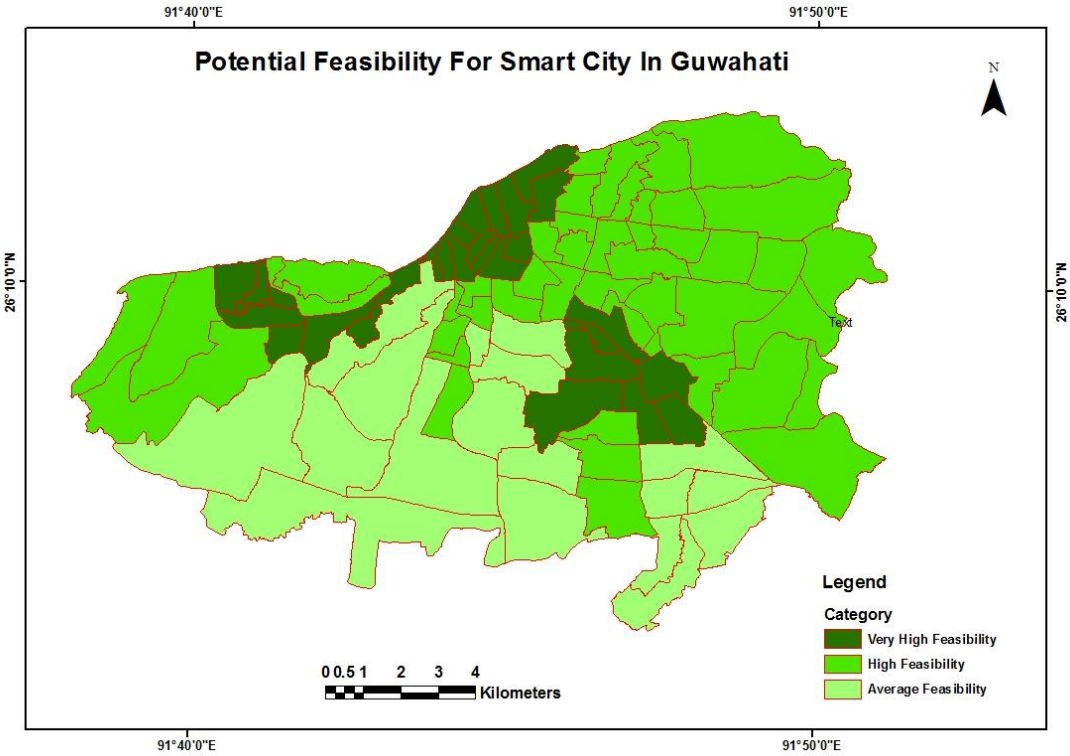
Source: Prepared by Author, 2017

Central Region

This region is in the central part of the city. Dispur the capital of the Assam state is located in this region. The region is one of the most developed areas of the city as it is planned to become the capital of the state. Assam central secretariat is located in this region. The entire important official residency is in this region. Ganesguri is considered as the commercial hub of the region. Beltola is famous for vegetable and cloth markets. The regions are famous as it is also located near the NH31 and adjacent to the Meghalaya.

High Feasible Regions for Smart City

Easter and western part of the city has the high potential to develop as the smart city. The growth of the city is restricted toward the north and south as the river Brahmaputra flows through the northern region of the city and Meghalaya plateau is located in the southern part

of the city. So the city has potential to expand and develop towards the eastern and western direction.

Eastern Region
In the eastern direction Bamunimaidan industrial belt is located. Famous Gauhati refinery is located in the Noonmati. The road to KV IOC Noonmati from the Guwahati refinery is badly affected by flash flood during the monsoon season. As northern part of this region is hills it is also very prone to landslide. The region is densely populated. The eastern most part of the region is used for agricultural purpose. It exhibits the rural character as it merges with the villages. Traffic congestion is not the major problem in this region, but the interior part faces the transportation problem as the connectivity is not well maintained. The hilly region faces the scarcity of the water.

Western Region
The city is expanding towards the western region. The region is famous for higher education institutions and industrial belt. Almost all the higher education centre of the city is located in this region for example Gauhati University, Assam Engineering College, Ayurvedic College and several other institutions. This region is newly developing area of the city. This region is developing due to availability of the open spaces and educational institutions and small scale industries along the NH 31. The region exhibits the suburban character as the city is merging with the villages and expanding.

Average Feasible Regions for the Smart City
The southern region of the city has the normal and average potential to develop as the smart city. The southernmost part of the city is restricted to growth and expands by the Shillong plateau. The Central and North eastern part of the region has numerous small hills. Agriculture is practiced in the southern part of the region. This region is considered as the newly developed and periphery region. To decongest the traffic in the main city region all the important trade centre, stadium and interstate and inter district bus terminus is shifted in this region.

About 1 lakh sq. km of an area in North east is vulnerable to landslide (Phukan et al., 2012). This region is no exception too. Sixty people have lost their lives in last 8 years due to landslide in Guwahati (Das et al., 2014). The flash flood problem is limited to some area. The National Highway 31 passes across the region. The interior part of the region is devoid of proper road connectivity and public transportation. The region in the hills and adjacent to hills face the scarcity of water during the period. The availability of the public sanitation and regular supply of electricity is not much satisfactory.

Suggestions
The Guwahati city faces the traffic congestion due to road side parking. Nearly 40 per cent of the vehicles are parked in the road itself and it congests the road. This problem can be solved by construction of the enough underground parking facilities in the city. Majority of the city bus service in the city is privately owned and they are very profit oriented that's why they are very slow and won't move from the bus stop unless they got the required passenger. That's why majority of the commuter prefer to travel by the private means of transportation and in that way; it leads to increase of vehicle in the roads which lead to traffic congestion. So, it is important that government should regulate those city buses and if possible, private city bus should be replaced by the government city bus. The city does not have the separate lane for the bicycle rider and thus it doesn't encourage the bicycle rider. Many of the traffic congestion problem in the city is resolved by the construction of flyover and shifting of interstate and in inter district bus stop to the outskirt of the city. The city needs the fast and

efficient means of public transportation. Construction of metro is ideal for this purpose. Scarcity of water in the city can be solved in the city with the proper management of water supply system because the perennial river Brahmaputra passes though the city. The city can harness water from this river. At present time with the application of latest technology-based waste compositor it is possible to convert the waste of the city except glass into useful products. The waste product can be converted into source of energy, tar and organic manure. It has been observed that the cleaning of the sewage from the drain in the city is generally done by the contractor during the monsoon season only. It is of no use of cleaning it in monsoon season because during rainy season it is impossible to clean it so it is suggested that the cleaning of the drain should be done during January to March just before the arrival of Monsoon. Flash flood in the city is due to shrinking of wetlands, blockage of drain and unplanned growth of the city. So, it important that the restoration of wetland should be given priority and the growth and development of the city should be in planned way. To save the forest and wetland encroachment of that area should be prohibited. The success of the implementation of the smart city depends both on the implementation and building of ICT infrastructure and people participation, so skill development centre should be encouraging and taking the perception of the citizen is important. The smart city mission should look upon the interest of all sections of the society. The most important thing is before making it smart with the investment of the huge amount of capital it should be ensure that city is sustainable, and it has got all the basic facilities such as regular water supply, power supply, sanitation facilities, safety, education, health and proper disaster management.

Conclusion

The average of the summation of assessment point of all the wards in the city is 73.09. Hence, it clearly indicates that Guwahati City is highly feasible for the Smart City. During the detail ward wise assessment of the city, it is found that besides all other mentioned problem scarcity and hygiene of the sanitation facilities is also main problem in the city. The infrastructure for the sanitation in the city is very poorly developed. Under the Swachh Bharat Mission some portable mobile toilet was installed in the city but it was a big failure as those toilets didn't matched the standard of the city. Those toilets were so small and below standard and were not maintained properly after installation, that's why peoples prefer to do toilet just outside or near to it. The city has some paid and uses toilet facilities, but even though it is paid and uses one, the condition of the toilets is unhygienic and pathetic.

Next to Sanitation, Flash Flood and Landslide are the major problem during monsoon season from May to August. Though this problem is seasonal and for short period it causes the great loss of life and property in the city every monsoon season. With the increase of vehicles on the road traffic congestion is becoming one the problem in the city. Traffic congestion is mainly cause due to the unavailability of parking space in the city. Nearly 40 per cent of the road space is occupied by the street parking vehicles. The hilly part of the city suffers the scarcity of water during January to March, just before arrival of Monson but this problem can be solved by the piped water supply because the city has the potential to extract water from the Brahmaputra River. Though the city is 100 per cent electrified but the supply of electricity is irregular. The wire for supply of electricity are lying on the ground, so, whenever there is storm, strong winds and high intensity rain the power supply is disrupted.

As the concept of the smart city is very recent in Guwahati, the citizens are very curios, excited and eagerly hoping that the smart city mission can change the quality of the life by enhancing technology, enabling local area development, making the optimum use of the available resources. The citizens are ready to cooperate with the government schemes for the betterment and development of the city. For the successful implementation of the

smart city mission it is very important that along with the introduction of the funding, schemes, infrastructure, citizen engagement is also important. As all the factors are working parallel in the Guwahati it is very much reasonable to assert that city is feasible for the implementation of the smart city mission.

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