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Smart Urban Water Management System for Surat City by SWOT Analysis

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Abstract: ***The total availability of water resources is currently under stress due to climatic changes, and continuous increase in water demand linked to the global population increase. A Smart Water management is a two-way real time network with sensors and devices that continuously and remotely monitor the water distribution system. Smart water meters can monitor many different parameters such as pressure, quality, flow rates, temperature, and others. Existing situation of water supply system of new north zone of Surat city is studied by collecting secondary data and analysis of it. Infrastructure leakage index was found for study area using benchleak software and SWOT analysis is performed for deriving strength weakness opportunity and strength of system.***

Keywords: Smart water management, Real time monitoring, Infrastructure Leakage Index, SWOT analysis.

I. INTRODUCTION

The first question arise is that _What is smart city?‘ The answer is, there is no globally accepted definition of a Smart City. It is different things to different people. The concept of Smart City varies from country to country and city to city, depending on the level of development, readiness to change and reform, resources and ambitions of the city residents A Smart City would have a different meaning in India than, say, Europe. Even in India, there is no one way of defining a Smart City.

Some specific boundaries are required to guide cities in the Mission. In the imagination of any urban citizen in India, the imagination of a Smart City contains a wish list of infrastructure and services that describes his or her level of desire. To provide for the desires and needs of the citizens, town planners should aim at developing the entire urban eco-system, which is represented by the four pillars of development — institutional, physical, social and economic infrastructure.

In the Smart Cities Mission approach, the objective should contain the provision of core infrastructure and give a decent quality of life to its people, sustainable environment and application of _Smart‘ Solutions. A Smart City is a well performing city built on the smart combination of endowments and activities of self-decisive, independent and aware citizens.(Gaffinger)



Figure 1 smart solutions

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A. *Smart water management*

Water Management is the most basic and crucial service imparted by the city administration to its citizens and business. Vast distribution networks are implemented over thousands of kilometer to meet the demands.

Rivers and ponds are the main key sources of water supply that most of the cities depend on. Most of the cities don‘t have ground water management system. Due to rise in population and increased population in urban areas the water resources are lessening over time. Only few cities are able to tap rain water up to the maximum potential. Measuring water consumption is not available to all the cities, which indirectly leads to irregular and irresponsible use of water. Foreg , in Surat , as much as 20-30 per cent of water is lost due to pipe leakages and many domestic homes go without water. In view of such issues ,India need an sophisticated approach for water and waste water management to provide a seamless supply of water to the citizens.

B. *Need for smart water management*

Innovation assumes an imperative part by giving perceivability sought supply to guarantee Smart Water Distribution and streamline vitality in immeasurable water circulation system. Detecting the non-revenue water leakage quicker and reducing theft by detecting ghost pipes. Smart meter technology shapes conduct of citizens and organizations by giving perceivability in utilization and reduces under recovery by exact metering. Water asset management and water management operations and customer services can be improved altogether by utilizing this technology.

Analytics

Data analytics is a productive and economical approach to improvise water administration systems. Water flow usage can be determined in real-time.Adequate supply could be forecast by understanding water availability patterns using predictive analytics.

Water Infrastructure Management

Geospatial-based water base administration (WIM) solution can provide all required details of a municipal or wastewater distribution or private water.Planning or conducting engineering analysis, designing work orders, mapping management,

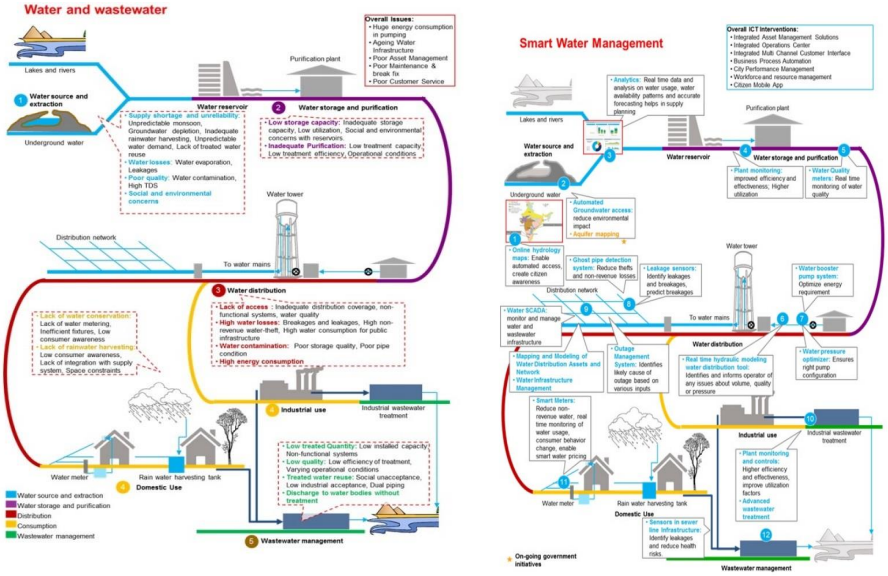


Figure 2: smart water management system

C. *Aim*

To prepare a planning proposal for smart water management system for Surat.

D. *Objective*

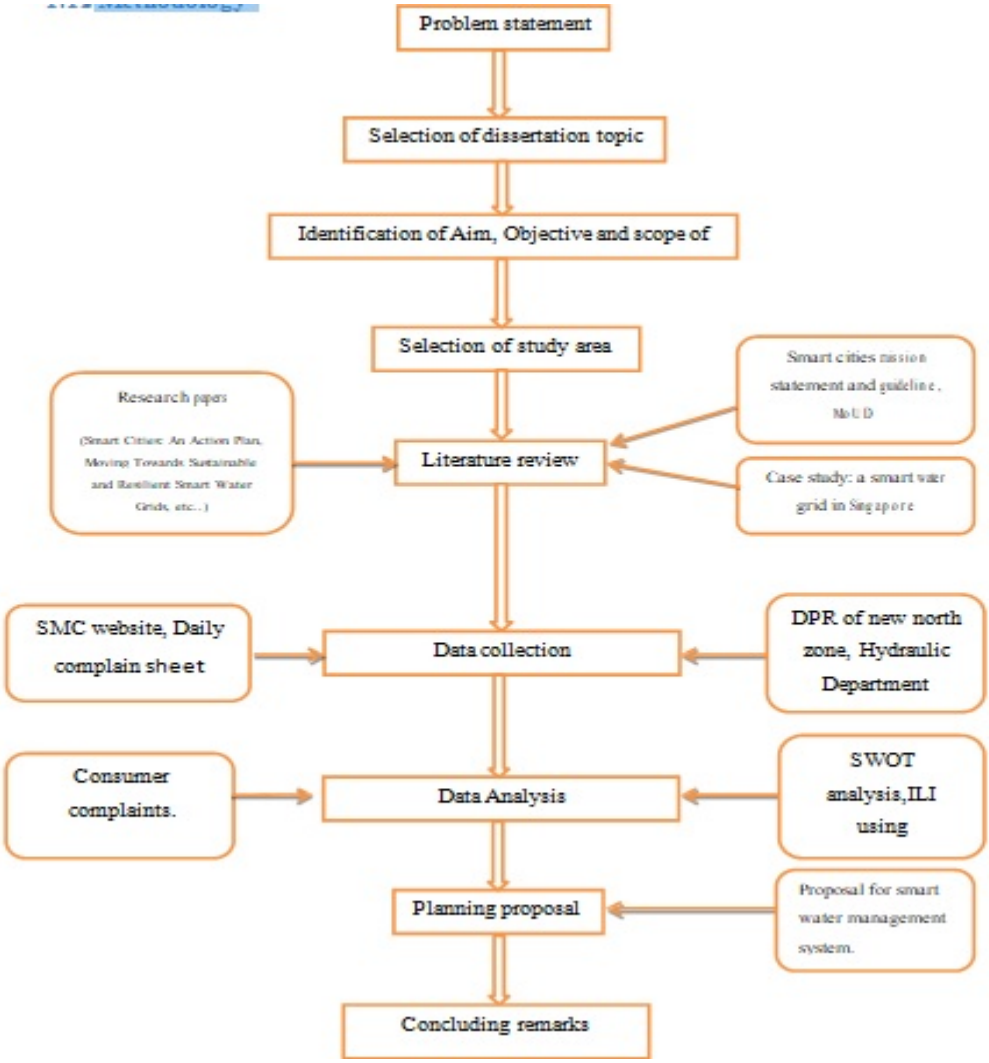
- To identify different smart solutions for smart water management system.
- To Analyse existing scenario of water supply system.
- To prepare a proposal for a smart water management system.

E. *Scope of work*

- The scope of study is limited to New North zone of SMC.

- Only secondary data is collected to study and analyze water supply system.
- BENCHLEAK software is used for finding infrastructure leakage index for new north zone.

F. Methodology



II. LITERATURE REVIEW

Environment: Green areas that promote bio-diversity, green areas (parks, forests) that act as carbon sinks, open spaces for citizens to interact with each other, clean air, creation and preservation of water bodies that collect rain water, recharge ground water and also act as sponges during heavy rains should all become the hallmark of smart cities.

Climate Change Resilience: Smart cities should be climate resilient. This means that right at the time of planning for smart cities, resilience to the impacts of climate change should be built in. In the water sector, for instance, this would include rainwater harvesting, recycling of wastewater, identifying multiple sources of water supply, recharge of aquifers, promoting water conservation, and so on. This would enable the city to cope with water shortages that are likely to result from climate change. Another example would be reducing the dependence on a single source of power by decentralizing power generation, e.g solar rooftops.

Disaster Risk Management: Multiple types of disasters are striking cities with regularity and this is likely to increase given the climate change projections. Smart cities need to be prepared for disaster management at all times. The disasters could be floods, earthquakes, fires, landslides etc. The smartness of the city will be put to test during the time of disasters and therefore, this aspect needs to be incorporated in planning for smart cities.

Reforms: Urban India needs to not only implement the reforms advocated under JNNURM, but needs to implement the next generation reforms that were put together for the next phase of JNNURM. Implementing reforms is the only way to sustain the changes and maintain infrastructure and services.

Governance is an extremely important part of managing cities well. The main difference between the developed and developing world is not just technology, but governance. Rules, regulations and their enforcement play a major role in how cities function. India has very good laws, rules and regulations in every sphere, but has had a very poor enforcement record. Smart cities will require strong governance.

1) Smart Cities: An Action Plan by IschaDohler, IgnasiVilajosana, XaviVilajosana, JordiLLosa

This paper looks into why business around Smart Cities has difficulties of taking off and thus runs short of projected potentials and proposes a clear roadmap and action plan on how to make Smart Cities finally happen. In this paper first review involved stakeholders and the eco-system. After that they proposed a viable approach to scale business within said eco-system. This paper also describe the available ICT technologies and finally exemplify all findings by means of a sustainable smart city application. There are two major observations which are seen to facilitate a sustainable smart city development. First, independent smart city departments need to emerge, much like today‘s well accepted IT departments, which clearly decouple the political element of the improved city servicing from the underlying technologies. And second, a coherent 3-phase smart city rollout is vital, where in phase-1 utility and revenues are generated; in phase-2 also only-utility service supported; and in phase-3 in addition a fun/leisure dimension permitted. They have also demonstrated one specific smart city application which obeys both technological as well as phase-1 smart city rollout requirements. It is World sensing‘s smart parking product, which was shown to yield dramatic financial as well as health gains. It was shown that with the use of this smart city technology, a city with about 10k regulated parking places, has annual gains of about 10 million Euros.

2) Understanding Smart City Business Models: A Comparison by Leonidas G. Anthopoulos and Panos Fitsilis(2015)

This paper addresses to answer the following research question: ―what smart city business models exist and are followed by major smart city cases?‖ In an attempt to answer the above question and to justify this hypothesis, this paper follows two research methods: literature review and findings from case studies. First, literature findings are explored regarding business modeling, their classification and patterns. Then existing smart city business models are demonstrated according to literature findings and the outcomes of interviews from case studies. Literature returned three business model types (web-based, network owner and e-commerce).

3) Evaluating the need for smart cities in India by M. F. Jawaid ,Saad A. Khan (2015)

This paper attempts to analyze and evaluate the need for the development and planning of smart city projects in the country in line with various ongoing projects and the government‘s proposal for development of the 100 smart cities throughout the country. For that Urbanisation scenario of country is studied and problems of unbanisation like infrastructure, governance and management, sustainability are discussed.

The analysis indicates that the cities are expanding and new cities are being formed mainly by transformation and growth from villages and towns due to rapid urbanization. But these cities lack basic infrastructural services and other amenities due to various reasons ranging from lack in administrative and service delivery mechanism to lack of proper planning vision, investment, management, and to some extent changing lifestyle, etc. Some green field development like GIFT, Lavasa, Kochi Smart city and Nano City have started but are far from satisfactory to cater to the demands of the sustainable cities and urban centres, hence there is an urgent need to plan for both green and brown field sustainable urban developments in form of ecocity or smart city or similar projects to bring out a balanced urban growth and development.

4) GIS Steering Smart Future for Smart Indian Cities by AnujTiwari& Dr. Kamal Jain (2014)

The concept of a smart city is a new one. This paper describes the smart city projects in India namely LAVASA: SMART HILL CITY & GIFT: GUJARAT INTERNATIONAL FINANCE TEC-CITY. By 2050, the urbanization in India is expected to raise upto 70 percent compared to only 30 percent in 2011. According (Placeholder1)to the McKinsey Global Institute Analysis Report, India will have 68 cities with 1 million or even more than 1 million Populations, 13 cities with more than 4 million population & 6 megacities with population of 10 million or more by year 2030. A Smart City is the integration of technology into a strategic approach to sustainability. Smart city is a booming international phenomenon. According to the statics over 2000 smart city projects have been started or going on in Asia, Europe America & Africa. The three pillar basic smart city model is used in this research paper. The Three main dimensions of this model are Economy, Environment & Society.

GIS solutions can help the policy makers & planners for decision making purposes. Ultimately this paper helps to understand the use of GIS & its integration with various approaches to formulate, stimulate, interpret and validate the sustainable development of urban areas, steering a smart and sustainable future for smart cities.

5) "Comparative Study of Smart Cities in Europe and China"- White Paper by Kang Yanrong, Zang Lei, Chen Cai, GeYuming, Li Hao, Cui Ying (2014)

This white paper shows the comparative studies between 30 smart cities of Europe and china(15 from each). International smart city concept was discussed with the help of different definations. Global trends and development of smart cities was studied with the help of various reaserchinstitute's research. Various challenges for development of smart cities are discussed.

III. STUDY AREA

A. City area profile

Surat is situated on the banks of the Tapti river. The city is located at 21°10′N72°50′E. It has an average elevation of 13 meters. The Surat district is surrounded by the Bharuch, Narmada, Navsari, to the west is the Gulf of Cambay and the surrounding districts.

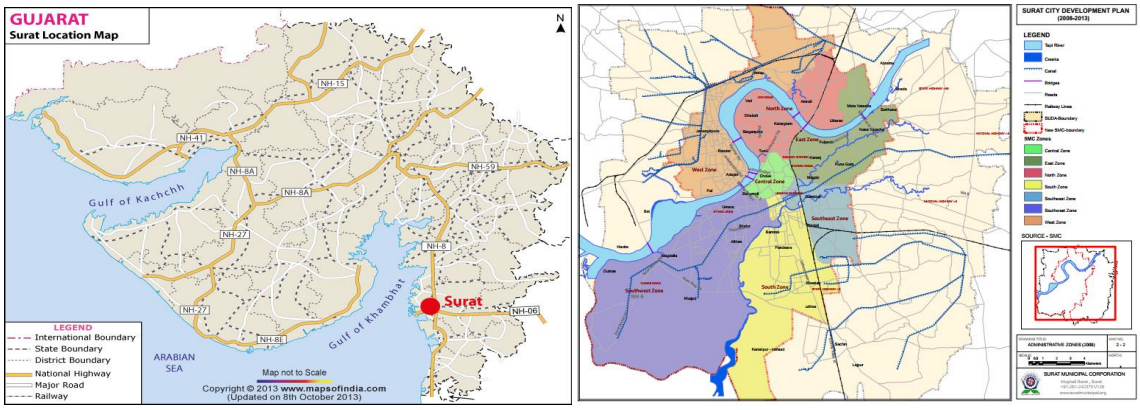


Figure 3.1 Study Area

TABLE 3.1 DEMOGRAPHIC PROFILE OF SURAT

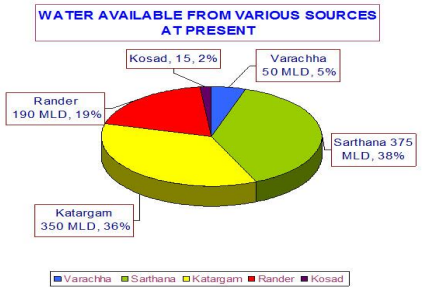
AREA	1981	1991	2001	2011
Surat Municipal Area				
Area (sq.km)	55.56	111.16	112.27	326.515
Population(lakhs)	776583	1498817	2433785	4462002
Decadal Growth Rate (%)	-	93%	62%	83%
Pop. Density (per sq.Km)	13977	13483	21678	13835
Surat Urban Development Area				
Population	985077	1786566	3090686	4,585,367
Decadal Growth Rate (%)	-	81%	73%	69%
Source: Census of India 2011				

B. water supply

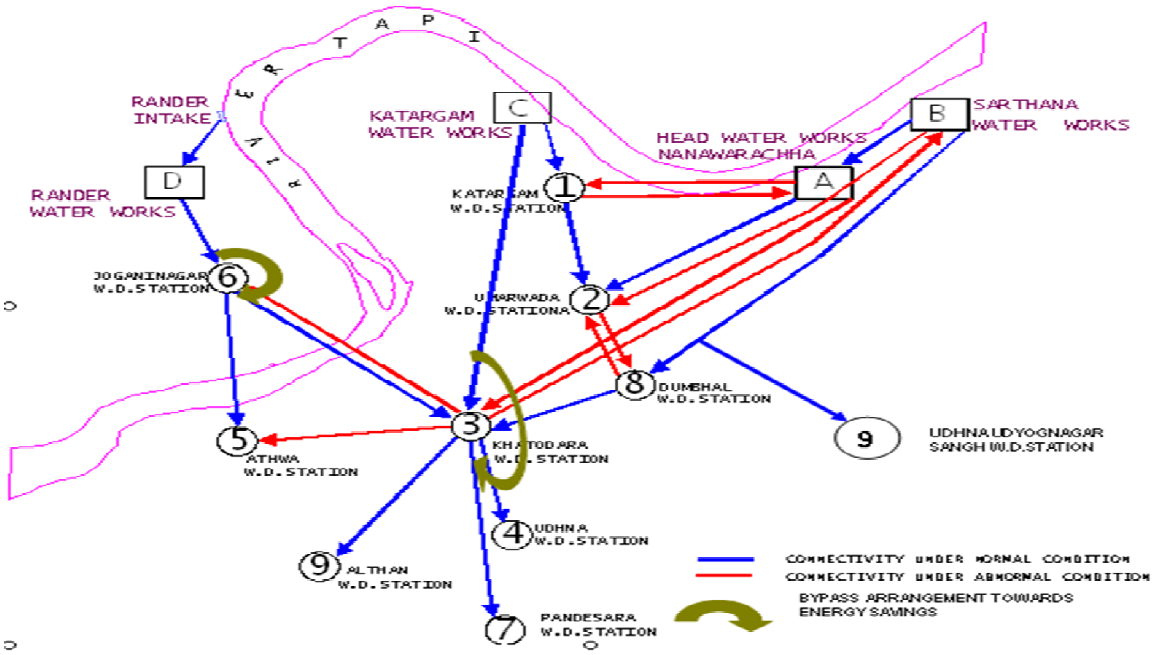
At present SMC is serving about 97 percent of its total populated area and 95 percent of its population

Population covered under piped network:- 95 %

Source of Water: River Tapi
Present installed capacity of Water Works (6 Nos.): 1300 MLD
Present gross daily average water supply: 980 MLD
Total storage capacity of all WDS & WW: 7076 Lacs Liters



C. LAYOUT



D. Water supply system

The layout of the distribution network is drawn based on the existing road pattern .Length of the pipe is taken as the road length. The diameter of the pipe is considered based on the purpose served by the pipe, such as main, sub main, branch pipes. Pipe roughness coefficient is taken 120, since Galvanized Iron pipes are used. The simulation period was set for 24 hours.

The intermittent system may lead to some saving in water consumption due to losses occurring for lesser time and also a more vigilant use of water by the consumers, but this may create other acute problems like contamination of water in the pipes during non-supply hours, hygenic as well as sanitation problems due to inadequate use of water by certain group of people by utilizing minimum quantity of water. Besides, at majority of places, the intermittent supplies may not provide much savings of water because of the following reasons :

1) In intermittent supply system, water is generally stored by the consumers in tanks, drums, utensils etc. for use during non-supply hours. This stored water is usually thrown away by them, if unutilized, as soon as the fresh supply is restored. This increases the wastage and losses of water considerably.

2) The consumers have a general tendency to keep the water taps open during non-supply hours; so that they may come to know the restoration of the supply. However, in majority of cases, water goes on flowing to waste, unattended even after the supply is restored, thus resulting into a wastage of precious sweet and potable water.

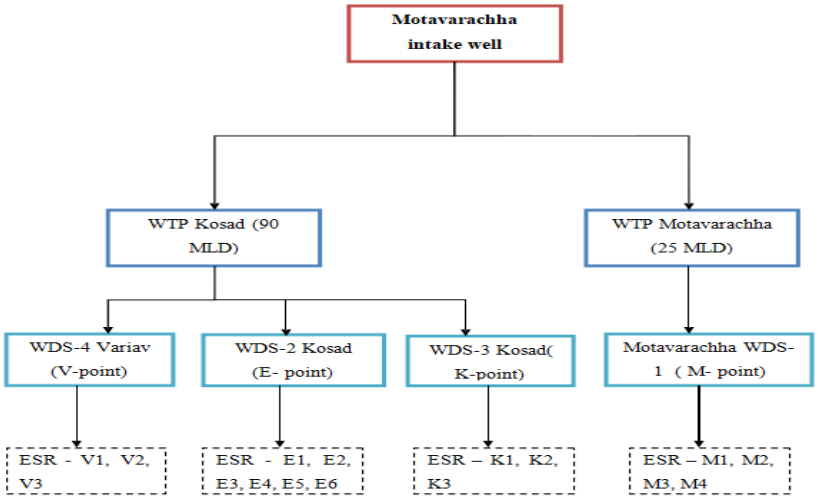
- Besides, this intermittent supply system causes great in convenience to consumers, keeping them on their toes for receiving and collecting water as soon as the supply is restored.
- Further, in this system, when the supply of water is stopped and the water from the pipe is withdrawn off, a partial vaccum may be created in the pipeline. This will induce suction through leaky joints and if the pipes are surrounded by dirt or ports of sullage or even sewage and other waste waters on the ground, the same may get entries into the pipes. This will contaminate the existing water available in pipes as well as incoming water in the pipelines, when the supply is restored.
- Number of sluice valves and control valves are required to be installed in the network of water distribution system. All these valves will have to be operated many times daily, while starting or closing supply. This will require additional operating staff along with high operating and maintenance cost.
- Intermittent system should not be continued on long term policy due to the following dis-advantages-

➢ The consumers have to store water for use during non-supply hours; which is likely to be contaminated. Some consumers may not have sufficient storage facilities; which may lead to insanitary conditions ultimately.
➢ It has been observed that the consumers leave their water taps open every time; which causes much wastage of water.
➢ If more storage of water is kept for the use during non-supply hours, it is being thrown away, causing wastage of water.
➢ If any incidents of fire-fighting occur during non-supply hours, no water is available; which may subsequently cause huge damages before the supply could be turned on.

- Inspite of all these limitations / disadvantages, the intermittent supply system is being mostly adopted in our towns and cities with certain benefits viz. this system helps in supplying water to high level areas with adequate pressures by zoning the project area. For improving the pressures, the entire city area is divided into number of zones and different zones are supplied with water during different hours of the day, thus obtaining better pressures. This system may also facilitate the repair works during non-supply hours of the day.
- However, the most of network of pipe distribution system of water supply of towns and cities are usually designed as continuous supply system , but after operated as an — intermittent‖ one.
- In view of above, the wafer is to be supplied through continuous system. This is the best system and the water is supplied for all the 24 hours a day. In this system, ample water is always available for fire fighting, or any break-down or emergencies, even by closing the supply of certain localities. Besides, due to continuous circulation, water always remains fresh, in the pipelines.
- Considering these, continuous supply of water around 24 hours a day is given in study area

E. Water distribution

Water is drawn from Tapi river through a intake well, provided on the bank of river Tapi, near MotaVarachha. This water drawn through this proposed intake works, is then pumped to the water treatment plants, one of 25 mLd capacity near MotaVarachha and another one of 90 mLd capacity near E-Point zone through pumping mains. The drawn water from Tapi river is then treated and disinfected in the above mentioned water treatment plants and stored in clear water sumps near water treatment plants. Then, the treated water from the clear water sumps is pumped into each of under ground sumps of each WDS. Thus the treated water stored in underground sumps of each WDS will then be pumped into each elevated service



IV. DATA COLLECTION AND ANALYSIS

Based on research problem and the literature review, data were collected to study the existing scenario of water management in study area i.e. New North zone, Surat. As per scope of the work only secondary data were collected from SMC website, Hydraulic department, and Consulting agency. Chapter contains data regarding Water supply system and distribution network, service connection, water demand and supply, various complains by consumers, leakage data, data regarding water loss.

The data collection plan, study area description, brief description of water supply and pipe network is mentioned in this chapter. The elementary analysis of data were carried out and presented to get the idea about realistic scenario of urban water sector.

Water Supply Infrastructure The following are the details of water supply infrastructure for supplying water for all 24 hours a day to the population of New North Area of SMC. New intake works on the bank of Tapiriver near MotaVaraccha for was constructed for supplying treated water to the population of New North Zone of SMC.

Water works and Water distribution station 32 MLD of water treatment plant at WDS M1 -1 near MotaVarachha and 90 MLD water treatment plant at E-point near Kosad is constructed for fulfilling the water demand of population water treated in WTP is transferred to four Water Distribution Station WDS -1 MotaVarachha (M-point), WDS 2 Kosad (E-point),WDS 3 Kosad (K-point) , WDS 4 Variyav (V-point). 15 ESR and 4 UGSR are instated to store water and supply at sufficient pressure to meet the variation in water demand. Storage capacity in lakh liters of various ESR and UGSR are shown below.

Sr. No.	Water works and Water distribution station	Storage capacity in lakh liters		
		ESR	UGSR	Total
1	MOTA VARACHHA-UTRAN WDS -1 & ESR – M2	18.00	88.00	106.00
2	KOSAD (MALDHARI PLOT) WDS - 2 & ESR - E4	21.00	139.00	160.00
3	KOSADWDS 3 & ESR K3	18.00	45.00	63.00
4	VARIAV WDS - 4 & ESR - V3	21.00	54.00	75.00
5	UTRAN ESR Ml	21.00	0.00	21.00
6	MOTA VARACHHA ESR-M3	21.00	0.00	21.00
7	MOTA VARACHHA ESR-M4	21.00	0.00	21.00
8	NEAR H5 EWS QUARII RS, KOSAD TSR-11	15.00	0.00	15.00
9	OPEN SPACE OF KOSAD G.H.B AREA ESR E3	15.00	0.00	15.00
10	KOSAD H - 2 ESR-E5	15.00	0.00	15.00
11	KOSAD G.H.B H 4 ESR E6	15.00	0.00	15.00
12	VARIYAV-KOSAD ESR-K1	15.00	0.00	15.00
13	VARIYAV-KOSAD ESR-K2	21.00	0.00	21.00
14	VARIAV ESR-V1	21.00	0.00	21.00
15	VARIAV ESR-V2	18.00	0.00	18.00
TOTA L	276.00	326.00	602.00	

TABLE 4.1 CAPACITY OF WW & WDS IN LAKH LITERS

1) Minimum Pipe Sizes

Minimum pipe size of 150 mm dia. as per recommendations in CPHEEO Manual, has been proposed for the distribution system under this project.

2) Staging height of elevated service reservoir

The elevation of the service reservoir is provided such as to maintain theminimum residual pressure in the distribution system. The staging height of RCC ESR is normally kept as 24.0 m. for this project.

3) Residual Pressure

CPHEEO ―Manual on water supply and treatment‖ - third edition (1999) has recommended that distribution system should not ordinarily be designed for residual pressures exceeding 22 meters. SMC has desired that the minimum residual pressure of 18 m. at ferrule pointshall be provided in the distributionsystem of new SMC area, which is being developed at the faster rate. Multi- storeyed buildings needing higher pressure, will be providing their individual underground storage tanks; from where, the water will be pumped to elevated storage tanks on such buildings for supply water to their consumers.

4) Diameter of the Pumping Mains and Length of pipe

When the source is separated by a long distance from the area of consumption, the conveyance of water over the distance involves the provision of a pressure main or free flow gravity main, entailing an appreciable capital expenditure. The most economical arrangements for the conveyance of water is therefore of importance.

The diameter of pumping mains can be reduced (for conveying a certain fixed volume of water) by increasing the velocity of water flow through pumping main. But, however, the increased velocity will lead to higher frictional losses and thus, will increase the cost of pumping. Here, although, the diameter and the cost of pipe can be reduced by choosing a higher flow velocity, the horse power of the pumping unit required will increase, thus increasing the cost of pumping. Therefore, for the optimum conditions, such a diameter of pipe must be chosen, which together with the pumping cost, will make the total annual expenditures the minimum. The diameter of pumping main which provides such optimum conditions is known as economical diameter of pumping main.

Therefore, if the diameter of pipeline chosen is less than the economical diameter, the cost of pipeline will be less, but the head loss will be high and the cost of pumping shall be much more than the resultant saving in the pipe cost. Similarly, if the diameter of pipeline chosen is more than the economical diameter, the cost of pumping will be less; but the increase in the cost of pipeline will be much more than the resultant savings obtained in the cost of pumping.

Sr. No.	Details	From intake well to Bifurcation point	B.F. point to WTP at MotaVarachha	B.F. point to WTP at E-Point
(a)	Diameter of pipe	1524 mm dia.	813 mm dia.	1422 mm dia.
(b)	Length of pipeline	2100 m	1100 m	4800 m

(1) Pumping main from WTP toWDS

(i) Pumping main from WTP at „E" Point to WDS at Kosad

a) Diameter of pipe : 864 mm MS

700 mm DI

b) Length of pipe: 1870 m

(ii) Pumping main from WTP to ‘E"point WDS at Variav

a) Diameter of pipe: 700 mm DI

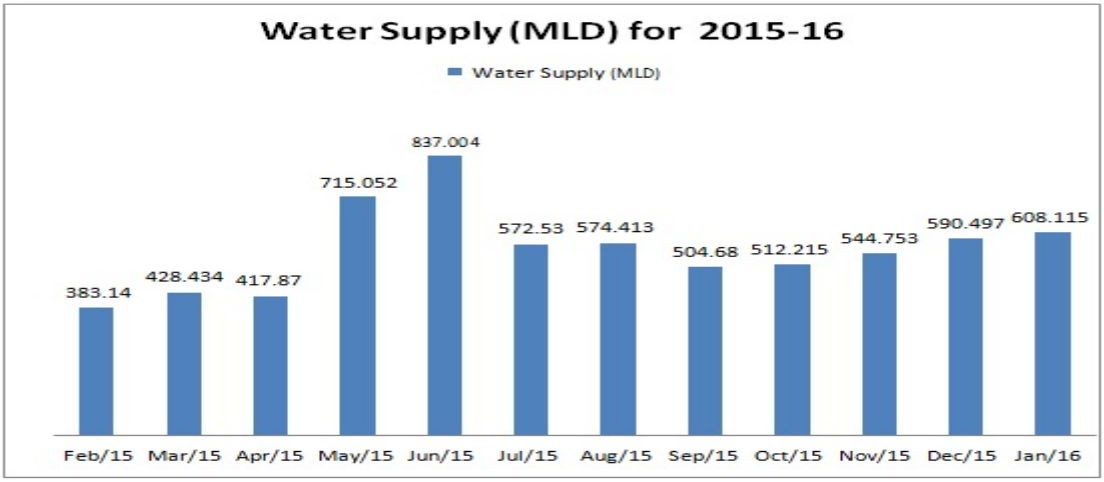
b) Length of pipe: 2780 m

(2) Pumping mains from WDS to ESRs

No.	Description	Diameter of pipe
(a)	From WDS-1 (MotaVarachha) *to* proposed ESRs	350 mm to 813 mm
(b)	From WDS-2 (E-Point) to proposed ESRs	350 mm to 864 mm

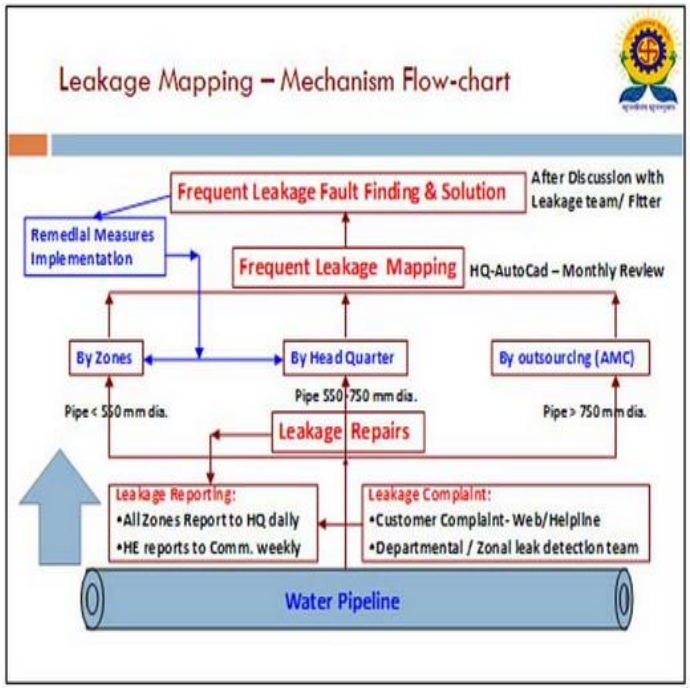
(c)	From WDS-3 (Kosad) to proposed ESRs	350 mm to 813 mm
(d)	From WDS-4 (Variav) to proposed ESRs	400 mm to 813 mm

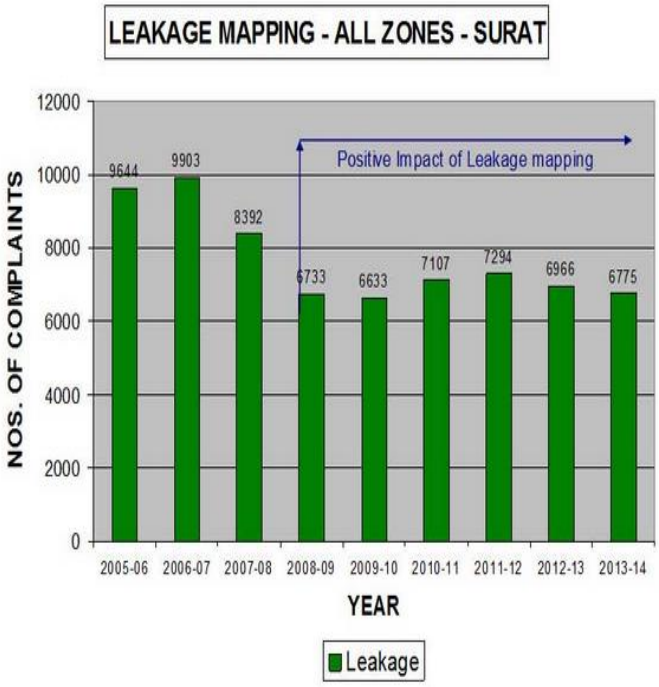
To meet the demand of water in area water is supplied from 4 WDS and then transmitted to the ESR. Total water supplied from ESR is recorded to know the variation in consumption of water. The following chart shows the water supplied from



As a part of to achieve the targeted benchmark of 15% losses, Non-Revenue Water (NRW) cell of Surat Municipal Corporation has started functioning from 2008-09.

 It has been observed that, after the Leakage Mapping initiative, the number of leakages in the central zone has reduced gradually. The same is evident for other zones as well. Thus, leakage mapping resulted in saving of precious potable water and also reduction in the probability of occurring water borne diseases. Positive impact of reduced number of leakages has been depicted well in the chart below:





Primary Details

Parameters used in calculating the pressure were readily available like number of service connection ,density of service connection , average operating pressure.

Input Description	Variable	Example Data	Actual Data	Units
Length of Mains (Transmission + Distribution)	Lm	1500	223	km
Number of Service Connections	Ns	60000	7502	Number
Density of Service Connections (per km of mains)	Ns/Lm	40	34	Per km
Percentage of time system is pressurised during year	T	100	100	%
Average operating pressure when system pressurised	P	45	18	meters
Population served by the supply system	Pop	100000	584313	Number

Components of Authorised Consumption	Example Data					Actual Data				
	Billed Metered 10^3 m^3/yr	Billed Unmetered 10^3 m^3/yr	Unbilled Metered 10^3 m^3/yr	Unbilled Unmetered 10^3 m^3/yr	Total 10^3 m^3/yr	Billed Metered 10^3 m^3/yr	Billed Unmetered 10^3 m^3/yr	Unbilled Metered 10^3 m^3/yr	Unbilled Unmetered 10^3 m^3/yr	Total 10^3 m^3/yr
Water Exported:	1500				1500					
Households:	24500	500			25000	4385				4385
Non-households:	6900	100			7000					
Standpipes:		500	10		510					
Firefighting:				100	100					
Mains Flushing:				100	100					
Building water:	1040				1040					
Other (specify):									1237	1237
Other (specify):										
TOTALS:	33940	1100	10	200	35250	**4385**				**5622**

: Non revenue water as a percentage by value of cost ofrunning system

Description of Unbilled Items	Example Result				Actual Result			
	Volume 10^3 m^3/yr	Unit Value R /m^3	Value 10^3 R/year	% of Annual Running Costs Costs	Volume 10^3 m^3/yr	Unit Value (R /m^3)	Value 10^3 R/year	% of Annual Running Costs Costs
Unbilled Consumption	210	2.70	567	1.26		4.50		
Apparent Losses:	550	2.70	1485	3.30	317	4.50	1429	1.24
Real Losses:	2200	0.15	330	0.73	1270	4.38	5562	4.84
Total Unbilled:	2960		**2382**	**5.29**	1587		6990	**6.08**

ILI as an Intervention Indicator

To address water supply systems in countries with high levels of leakage and correspondingly high ILI values, proposal was suggested by Liemberger (Liemberger,2005). The proposed approach is shown in table 17 and was first presented to the IWA Water Loss Task Force in February 2005. The approach was well received and was considered appropriate for use in both developed as well as developing countries.

Technical Performance		ILI	Liters/connection/day (when system is pressurized at a pressure of)				
			10 m	20 m	30 m	40 m	50 m
Developed countries	A	1-2		< 50	< 75	< 100	< 125
	B	2-4		50-100	75-150	100-200	125-250

	C	4-8		100-200	150-300	200-400	250-500
	D	> 8		> 200	> 300	> 400	> 500
	A	1-4	< 50	< 100	< 150	< 200	< 250
	B	4-8	50-100	100-200	150-300	200-400	250-500
	C	8- 16	100-200	200-400	300-600	400-800	500- 1000
	D	> 16	> 200	> 400	> 600	> 800	> 1000

Table of Acceptable limit of ILI

As can be seen from table , different ILI ranges have been provided for developing and developed countries attempts to classify the leakage levels within the Water Utilities into four categories based on the ILI value as follows:

- A = Excellent – no specific intervention required.
- B = Good – no urgent action required although should be monitored carefully.
- C = Poor – requires attention.
- D = Very Bad – requires immediate water loss reduction interventions.

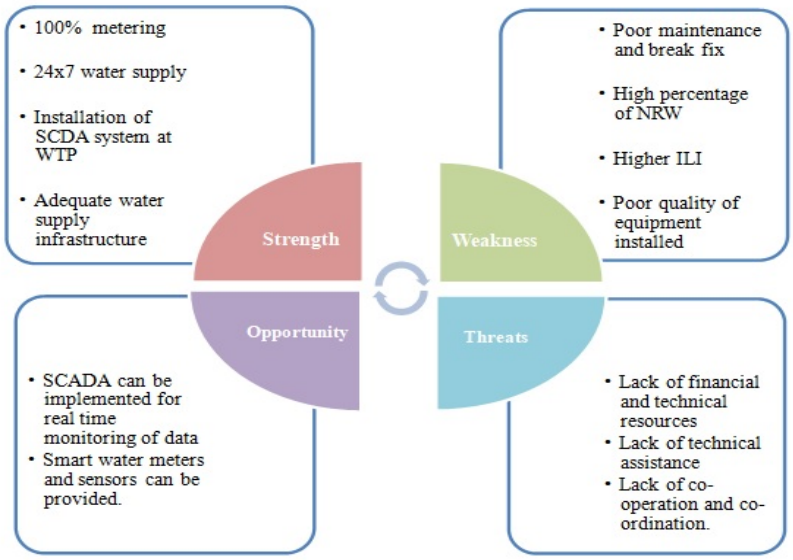
It should also be noted, that unlike the Australian recommendations, Liemberger does not attempt to define the water loss reduction interventions required. It is assumed that the leakage management specialist will first identify the key problem areas after which the most appropriate interventions will be established to provide the greatest returns for the available budget.

V. SWOT ANALYSIS

SWOT analysis is helpful tool for examine any ongoing water supply system and its environment. The abbreviation SWOT stands for strengths, weaknesses, opportunities, and threats. Strengths and weaknesses can be internal factors whereas opportunities and threats are external factors. The SWOT analysis gives the opportunity to advance a strategy which can help to block the weaknesses and threats. It can help to match resources and abilities to threats and opportunities in the competitive environment.

The SWOT analysis is performed to identify strengths and weaknesses in the water supply management system of new north zone of Surat city (as internal factors) and opportunities and treats (as external factors). In specific, strengths and weakness were identified based on an overall brainstorming about the situation of water management issues for the study area. Whereas Opportunity and threats were identified by analysisof water supply system.

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VI. RECOMMENDATION

Data collection and Analysis point out that there are numerous shortcomings in monitoring and accounting water losses in study area. Thus, shortcomings are surfacing in the area of inspection repair and maintenance of water network. Hence, this part gives recommendations to the Surat Municipal Corporation with respect to the shortcomings pointed out in the past two sections. These suggestions should be considered to achieve Economy, Efficiency and Effectiveness in water management system and reducing Infrastructure Leakage Index.

1) Monitoring and Accounting water loss

It should be ensured that level of Non-Revenue Water (NRW) should be bring down within an acceptable limit of 20%.This can be done by,

Establishment of special unit which works for NRW management.

Establishing DMA within distribution network for effective monitoring of water supply network.

Preparation of plan for collection of data, analysis and reporting.

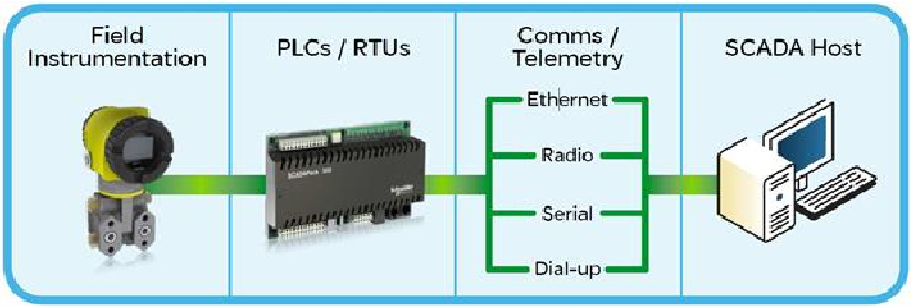
Manage Water pressure in the distribution networks in order to reduce water loss which results in bursting of pipes due to poor managed water pressure.

Provision of good quality of water supply infrastructure not to result in frequent breakage and cause leak.

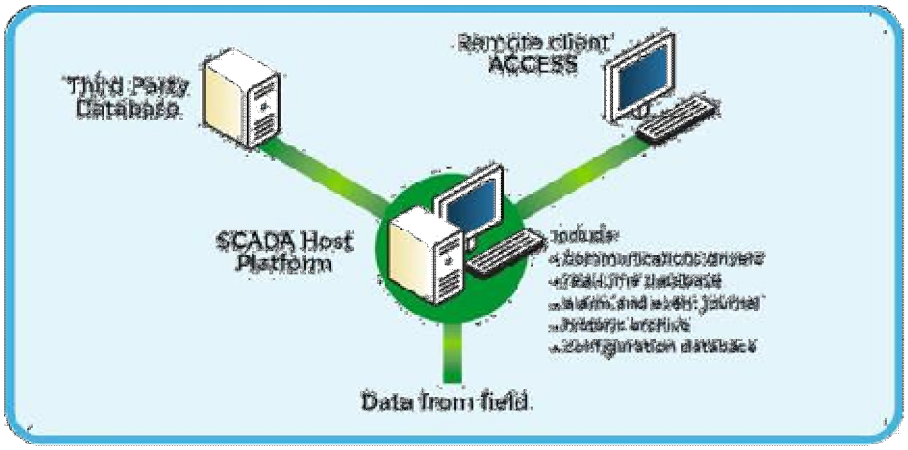
Co-ordination of various departments with hydraulic department to eliminate breakage of pipe due to any construction or excavation work by other department.

2) Inspection of Water Networks

Establishment of SCADA (Supervisory Control And Data Acquisition) system for entire water distribution network for real-time data collection and analysis.



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SCADA is installed at all WTP in Surat but it is not installed in distribution network. Installation of SCADA in distribution network will allow acquisition of information from remote devices such as pumps, valves, transmitters, and others. Moreover it will also enable us for automatic operation of pumps, valves and other components.
Regular updating network map.

3) Repair of Water Networks

It is observed that in study area that any repair work in case of leakage authority is taking about 48 hours, which results in ample amount of water loss. So it should be decreased as much as possible.
Make proper plans to ensure that pipes and other leak fixing materials and equipment are readily available when need arise. This can be achieved through arrangements such as framework contracts with suppliers.

4) Preventive Maintenance of Water Networks

Preparation of a separate adequate budget and implementation plans for preventive maintenance.
Enhance monitoring functions ensure that the plans are implemented.
To broaden the concept of Maintenance include Replacement (Reinvestment) as a means to avoid leaks in a more value for money way and in the long-term perspective serve customers with more reliable water supply.
Deployment of sensor nodes in distribution network which enables pre- detection of leakage and preventive steps can be taken.
Provision of smart water meters which allows monitoring some key parameters such as flow, pressure, temperature, quality, consumption, and energy usage.

VII. RESULTS AND DISCUSSIONS

This report deals with following objectives. 1. To identify different smart solutions for smart water management system. 2. To Analyse existing scenario of water supply system. 3. To prepare a proposal for a smart water management system. From this report it can be concluded that there are many technologies available in market for smart water management like smart meters, sensors, SCADA, Smart pumps which can enable us for real-time monitoring and analysis of data so that water management practice can be made much efficient and it can help in conservation of one of the most crucial natural resource i.e. water.
It is found in study and analysis of existing situation of water supply that New north zone of Surat city is only zone till date which provides 24*7 water supply. All the connection in study area are with provision of water meter. This can somehow reduce the unnecessary use of water. But still it is found that about 22% of the total supplied water in area is NRW which should be bring down to the acceptable limit of
20 percent. During 2015-16 905 complaints were registered by consumers and 75-
88% of them were about leakage. Leakage was mainly because of breakage of ball valve, breakage in main line and connection pipe. Infrastructure Leakage Index which was calculated using BEANCHLEAK software was found high as 19.30 which results in 22.02% of NRW and 6% loss of total running cost.
Concept of smart water grid is given. Which includes creation of DMA for efficient monitoring of actual consumption of water and it helps in reduction of NRW.

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Proposal is given for deployment of sensors and SCADA for real-time monitoring, collection and analysis of data. Concept of smart water grid can have numbers of advantages like water conservation, energy conservation, network visibility and damage prevention and other financial benefits.

VIII. RECOMMENDATIONS

Work can be conducted for different zones of city and existing situation of water supply system can be figured out and according to that concept of smart water grid can be applied. Smart water management also includes conservation of water and reuse of water. Work can be done in that direction also. By considering and studying various smart technologies available in market feasibility of various options can befigured out on the basis of estimation

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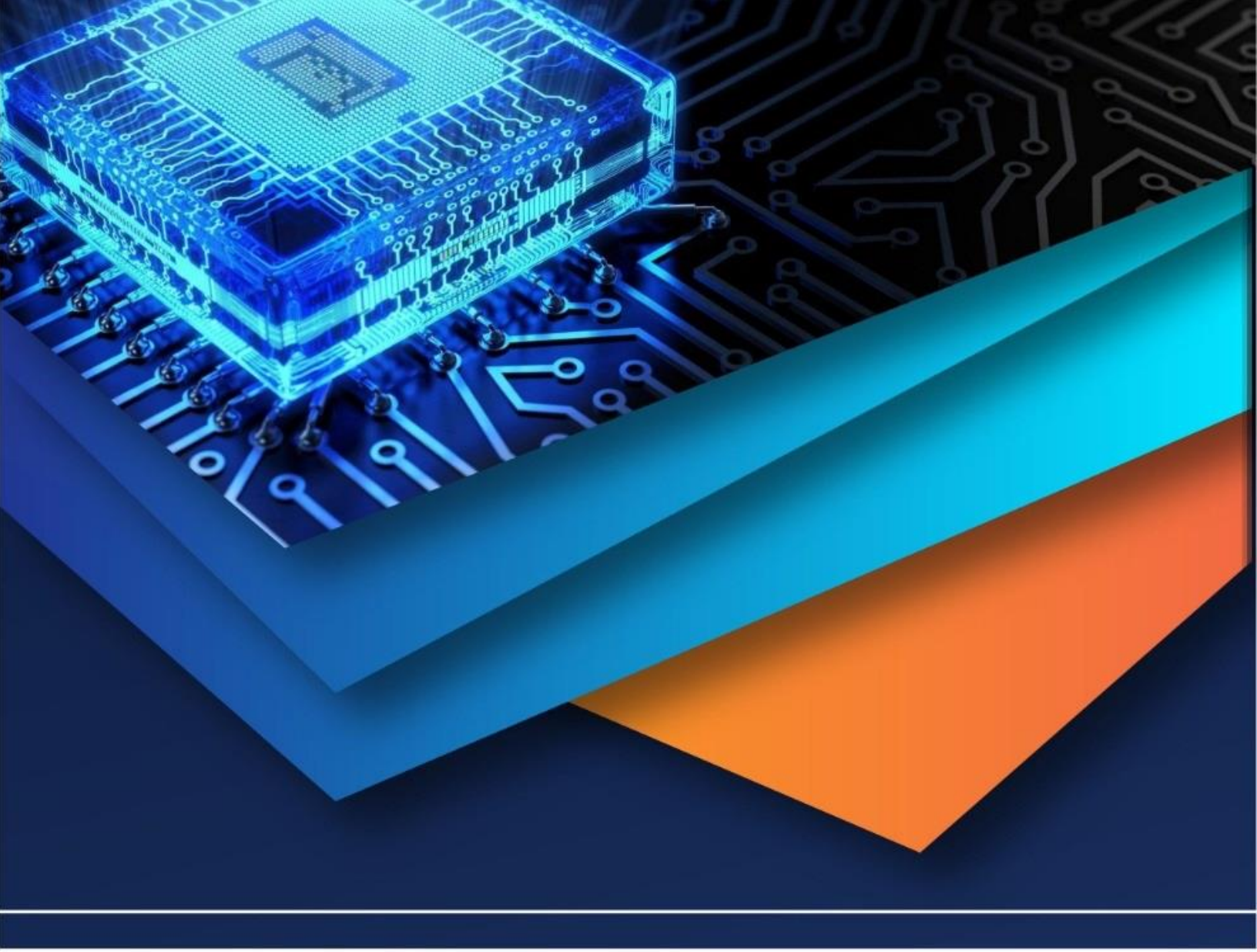
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