Water Quality Monitoring for Sewage Treatment Plant Compliance

DETAILS

SECTOR | Water & Waste

STAGE | Planning, Operations and Maintenance

TECHNOLOGIES | Cloud Computing, Communications, Data Analytics, IoT (an integrated system of sensors, communications and analytics), Sensors, Integrated Command and Control Center

SUMMARY

This case study was submitted jointly by the World Economic Forum (WEF) and technology company Quantela

One of India's most prominent and longest river tributaries had reached critical levels of pollutants. In the interest of public health and at the intervention of the Supreme Court and the National Green Tribunal, a river revitalization mission was initiated with the participation of multiple states and government agencies. The Development Authority of an emerging smart city was mandated to follow the orders of the National Green Tribunal to control the levels of pollutants being discharged into a river through a drain within its jurisdiction, as part of the river revitalization program.

As part of this program, the levels of the effluents were to be measured at their discharge points from the Sewage Treatment Plants (STPs). Quantela's ICCC Solution has been deployed to integrate with the devices at all available STPs, monitor the overall operational status and the quality of treated water obtained by measuring parameters such as pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) etc., from the STPs, plot near real-time status on GIS map, automatically trigger SOPs in case of deviation of water parameter values and to provide insightful reports across the STPs for decision making. Limitations of the Case Study, a note: The information in this case study is an extract from an ongoing deployment. The details mentioned in the case study are factual and accurate insights from the implementation and are permitted to be used within the framework of this workshop. However, on account of our compliance to client confidentiality agreements in the associated implementation, the responses will not include the names of the project/deployment. Likewise, no further information can be provided to substantiate the case study.

The city's Development Authority is the custodian of the city's sewage system. The mandate by the National Green Tribunal (NGT) led by a Monitoring Committee was to control the pollution in the drains which were leading into a river.

- To adhere to NGT norms the city had to Build and operationalize adequate STPs to bridge the gaps between Existing Treatment Capacity Vs the Quantum of Sewage generated in the city.
- Constantly monitor the quality of the STP's effluent discharged into the canals to avoid the subsequent river pollution.

A solution was required to actively monitor and alert authorities on the operational and quality parameters' status. Quantela's Integrated Command and Control Centre (ICCC) solution was used by city authorities for this purpose. Quantela's ICCC solution integrated all STPs built with legacy and new technologies, created an

automated data pipeline, processed the data, provided near real-time monitoring dashboards measuring various KPIs and alerted authorities whenever STPs are non-functional and/or NGT norms for treated effluents are not followed. The solution also provided multiple insightful reports on the day-to-day trends of effluent parameters quality for each STP and overall trend in the city wastewater treatment.

Top drivers for this project:

1. Rapid deterioration of river ecosystem and ecology due to unchecked and untreated inflow of polluted effluents into the river
2. Long term consequences to public health and violation of the citizen's right to live in a healthy environment, as espoused by the intervention of the National Green Tribunal and the Supreme Court
3. Lack of monitoring systems to measure and report quality parameters to identify consistency of compliance or lack thereof for necessary interventions to attain the required quality standards

Desired outcome:

1. Quantela's ICCC solution is tasked to continuously monitor the quality levels of the effluents from the STPs against the benchmarks for the released volume of effluents into the canals and alert authorities on non-compliance across the following KPIs:

Key effluent parameters to monitor to determine sewage water discharge quality:

1. Biochemical Oxygen Demand (BOD) is an indicator of pollution levels in water that can decompose biologically—the higher the BOD level, the more polluted the water is which can kill aquatic flora and fauna due to depletion of oxygen levels.
2. Chemical Oxygen Demand (COD) is also an indicator of pollution levels and includes BOD and other organics which are not possible to decompose biologically. This is a parameter that determines the amount of oxygen which would be needed for all organic components to oxidise completely.
3. Total Suspended Solids (TSS) is the portion of fine particulate matter that remains in suspension in water. It measures a similar property to turbidity but provides an actual weight of particulate matter for a given volume of sample (usually mg/l).
4. pH of the environment has a profound effect on the rate of microbial growth. Abnormally high or low levels of pH adversely affect the survival of a majority of aquatic creatures in the river system. Most microorganisms do well within a pH range of 6.5 to 8.5. Extreme fluctuations in the pH levels are known to stress aquatic lifeforms, hatching and survival rates. In addition, extreme pH levels also increase the solubility of compounds and elements, making the toxic chemicals and metals which become mobile and are absorbed by aquatic life in the ecosystem and pose an extended threat to the human population in the proximity.

Desired outcomes of effluent quality parameters are consolidated below

S. No.	Parameters	NGT Standards
1	pH	5 to 9
2	Biochemical Oxygen Demand (BOD)	10
3	Total Suspended Solids (TSS)	20
4	Chemical Oxygen Demand (COD)	50
5	Nitrogen – Total	10
6	Phosphorus – Total (for discharge into ponds, lakes)	50
7	Fecal Coliform (FC) (Most Probable Number per 100ml)	50

Top barriers:

- The key barriers are
- Not having adequate STPs
- Non-functioning of the STPs
- STPs not meeting quality standards and discharging partially treated effluents

Planning for adequate STPs in required locations is in progress while the non-functional and effluents quality aspect of STPs has been addressed by monitoring and alerting authorities appropriately.

VALUE CREATED

While monitoring the quality levels of the effluents constantly, the platform provided consistent, timely and geospatial insights that enabled the stakeholders to:

ECONOMIC BENEFITS:

- City's economy: The city is an emerging smart city and an economic hub with existing and upcoming investments. By monitoring and containing the pollution of the lake and the accompanied pollution of ground water reserves, the most important resource of the city is being sustainably and effectively managed as a top priority. With sufficient reserves to meet the growth, the city can continue to host and add citizens, visitors, institutions and industries to sustain the economic activities.
- Avoid Cost Escalations: Avoid further deterioration of the river system and save substantial costs on delayed interventions at a larger scale

ENVIRONMENTAL BENEFITS:

- Avoid Environmental Deterioration: By monitoring the variations in quality levels and maintaining the levels below the threshold of permissible limits, the stakeholders can mitigate the harmful effects of pollution on the river ecology, aquatic live, associated habitats and wildlife.
- Localized initiatives as part of Global Water Conservation measures: Since water resources are linked to economy, poverty and development issues, water conservation is a Global concern as well as a responsibility. In this regard, for greater stability across the globe, International organizations harness cooperation among developing and developed nations to enable greater initiative and successful water conservation measures.

SOCIAL BENEFITS:

- Public Interest Dividends: By enabling efficient pollution monitoring systems to revitalize the river system, the stakeholders can avoid public health crisis in addition to ensuring a sustainable water source for the public.

POLICY TOOLS AND LEVERS

Legislation and regulation

In this case, a Monitoring Committee was mandated to monitor execution/compliance of the orders of the National Green Tribunal. The levels of pollutants in the discharge from the STPs were to be adhered to. While these levels were the objectives to be achieved by the STPs on a periodic progression, the same levels served as the parameters for analytics and Geospatial mapping to enable the monitoring at the ICCC.

Effective institutions

The need for the implementation was preceded by the establishment of a dedicated monitoring solution, a multi-state river revitalization mission and the National Green Tribunal dedicated to matters relevant to environmental conservation.

A future-enabled workforce

The solution has provided effective monitoring and alerting capabilities which helped authorities to take appropriate actions and ensure there was consistent progress in quality of effluent parameters. Authorities were empowered with granular and real-time information on functioning on each STP.

Funding and financing

A special purpose vehicle which is a part of the Smart City Project was influential in organizing the funding and financial tools for the implementation of the project. The funding has been driven by the state and central governments for setting up the ICCC solution to monitor digitized city urban infrastructure with a strategy of area-based development. Other resources for financing that have been proposed are

- User Charges
- Public-Private Partnerships (PPPs)
- Municipal bonds
- National Investment and Infrastructure Fund (NIIF)

IMPLEMENTATION

Ease of Implementation 	The criticality of the situation, the intervention of the judicial institutions and the priority on pollution control measures mandated by dedicated monitoring committee preceded the implementation. Quantela's solution incorporates structured as well as unstructured data, provides self-service capabilities, has a complex event processing engine for event management and provides configurable monitoring dashboards along with ready to use widgets for KPIs and automated SOPs makes implementation easier. As cities continue to focus on investments in environmental conservation and green initiatives, in the ecological projects, the ease of implementation is comparatively higher in zones where the levels of pollution have already reached critical levels.
Cost 	The solution CAPEX cost for STP monitoring can be considered to be in the medium range as the solution was setup for city overall and the same has been leveraged for STP purpose. The operating expenditure was well within the budget allocated for the project. In certain similar deployments, the operational expenditures are proportional to the proof of concept, stages and to the extent of results achieved in the particular stage. The solution OPEX cost for STP monitoring can be considered to be in the low range as the solution was setup for city overall and the same has been leveraged for STP purpose.
Country Readiness 	While most of the cities have STPs, effective monitoring and measurements isn't available in all these cities. However, the solution implementation can be considered for mid-range markets.

Technological Maturity

Quantela Solution provides end to end capabilities and is quite beyond a proof-of-concept stage and is well placed in a commercially available and widely adopted stage. The solution has already been implemented across 80 urban infrastructure projects globally.

Scalability

Quantela's solution is built on a scalable framework from a technology perspective and can be deployed on cloud, on-premises or hybrid. From a device onboarding perspective, any new devices added are automatically onboarded for monitoring. A similar solution can be setup in one city or across multiple cities in a multi-tenant architecture or even at a country level as an urban observatory.

RISKS AND MITIGATIONS

Implementation risk

Risk: The primary risk to our service delivery capability is the absence or disruption of incoming data due to various reasons related to the device malfunctions, reporting delays or streaming disruptions from the source. This risk is followed by the probability of inaccurate data feeding into the platform which make it challenging to sort the inaccuracies. Lack of consistency in the intervals in which the data comes into the platform also poses a substantial risk that may derail the generation of metrics and analytics designed to meet the objectives.

Mitigation: To ensure the risks are informed to authorities for actions, the solutions' Alert and SOP management system and associated SLA reports help in timely resolution

Social risk

The implementation objectives are to enhance the management of STPs and effluents into the river, the implementation is unlikely to pose social risks. On the contrary, by ensuring measured progress towards reviving water quality in the river, the project ensures a sustainable future for the city.

Safety and (Cyber)security risk

Implementing the solution helps to improve safety and is a proactive measure to ensure rules setup by NGT, Pollution Board and other similar entities are adhered to.