TERMS OF REFERENCE
Data Scientist / Senior Data Analytics Specialist
KARACHI WATER & SEWERAGE SERVICES IMPROVEMENT PROJECT (KWSSIP-2)

1. Introduction

Karachi is Pakistan's largest city, main seaport and international trade hub. It encounters numerous challenges among which water supply and sewerage are the worst affected services, falling far short of the city's expanding needs. To mitigate this gap, develop these services for Karachi and strengthen the Karachi Water and Sewerage Corporation (KWSC) to become a financially viable and technically well performing water utility that ensures clean, safe drinking water and sewerage services to public, the Government of Sindh GoS / KWSC partnered with the World Bank Group through the Karachi Water and Sewerage Services Improvement Project (KWSSIP). The Karachi Water and Sewerage Services Improvement Project (KWSSIP) encompass a USD 1.6 billion reform-led investment program, to be implemented in four phases over a period of 12 years. Phase 1, with an investment portfolio of USD 100 million, was completed on 30 June 2026. Building on its achievements, the Project Implementation Unit (PIU) continues to support the implementation of KWSSIP-II. The Project Proposal Form (PC-1) for the Second Phase of KWSSIP amounting to US$600 Million has been approved by the Executive Committee of the National Economic Council(ECNEC). The project has been approved by the World Bank Board on 12th December 2024. The project is being implemented by the Government of Sindh (GoS) and the Karachi Water and Sewerage Corporation (KWSC) through multiple procurement processes, expected to occur within a short timeframe. The project activities aim to achieve key milestones, including addressing environmental aspects associated with the proposed project components.

The Project comprises the following components:

Component 1 – Operational & Enabling Environment Reform

a. Institutional Reforms and Capacity Building in Human Resource (HR)
b. Implementation of Communication Program & Capacity Development of Customer Relations Management (CRM)
c. Implementation of Gender Action Plan (GAP)
d. Capacity Building in Asset Management, GIS and Data Collection Strategy
e. Preparation and Implementation of Water Safety Plans
f. Outsourcing of Metering & Operation and Maintenance (O&M)
g. Advance Studies for the adaptation of Trenchless technology of Infrastructure development in Karachi Water and Sewerage Program
h. Financial Management improvement

Component 2 – Infrastructure Investments

a. Rehabilitating Water Supply and Sewerage in Selected Low-Income Communities
b. Priority Sewer Network Rehabilitation and Extension
c. Priority Water Network Rehabilitation including O&M equipment, meters & District Metered Areas (DMAs) to reduce Non-Revenue Water (NRW)
d. Priority Works for Reducing Energy Consumption
e. K-IV Augmentation and Downstream Allied Works
f. Rehabilitation of Existing Filtration Plants (NEK K-II, 100 MGD, Pipri JBIC 50 MGD)
g. Viability Gap Funding (VGF) to support Public Private Partnership (PPP) Interventions

Component 3 – Project Management and Studies

a. Design Review and Construction Supervision of the Proposed Sub-Projects of Phase-2:
b. Follow-up studies on energy audits
c. Preparation of KWSSIP -3, feasibility, E&S study, designing & PC-1, follow up study from the Master Plan Study

A Project Implementation Unit (PIU), led by a Project Director (as PIU Manager), has been established under KW&SC to provide specialized support for implementation of the Project. The PIU is responsible for the various aspects of project implementation, including technical and engineering services, project and contract management, safeguards management, procurement, finance, and monitoring. The PIU also recruits specialized talent required to achieve project objectives. The position covered by these Terms of Reference falls under the PIU.

KW&SC, including the activities financed by KWSSIP, generates large volumes of operational, financial, customer, engineering, commercial, GIS, SCADA, NRW, sewerage, tanker and project-related data; however, much of this information remains underutilized for strategic planning and evidence-based decision-making. To strengthen institutional performance and support data-driven governance, the Project intends to engage a highly qualified Data Scientist / Senior Data Analytics Specialist under the PIU, in accordance with the applicable rules, regulations and requirements of the Project, to establish advanced analytical capabilities and provide actionable insights to senior management — particularly the CEO — for evidence-based policy formulation and decision-making.

2. Key Duties, Functions and Responsibilities

The primary purpose of this assignment is to establish a sustainable, evidence-based decision-support capability within KW&SC to meet the Project Development Objectives of KWSSIP, especially improved financial and operational performance. The Data Scientist / Senior Data Analytics Specialist shall transform raw organizational data into actionable intelligence; consolidate and govern data drawn from KW&SC's multiple systems and departments; develop predictive and prescriptive analytical models and executive dashboards; and prepare analytical products that support policy formulation, operational efficiency and service-delivery improvement. The Specialist shall also build institutional capacity in data analytics and data governance, transferring knowledge to designated KW&SC personnel so that analytical capability is retained beyond the assignment. The assignment is intended to establish a sustainable Evidence-Based Decision Support Unit within KW&SC, enabling the CEO and senior management to make timely, data-driven and policy-informed decisions for improving water and sewerage service delivery across Karachi.

3. Scope of Work

Under the overall supervision of the Managing Director / CEO of KW&SC, the Data Scientist / Senior Data Analytics Specialist shall perform, but not be limited to, the following tasks, clustered under the applicable functional areas:

3.1 Data Integration, Governance and Management

- Consolidate data from KW&SC's multiple systems and departments into integrated, analysis-ready datasets.

- Develop data warehouses and centralized databases.
- Design data-governance protocols, standards and stewardship arrangements.
- Ensure data quality, integrity, consistency and security across analytical workflows.

3.2 Data Analysis, Modelling and Forecasting

- Analyse operational, financial, customer, project and infrastructure datasets.
- Apply statistical techniques and machine-learning algorithms to identify trends and patterns.
- Conduct predictive, diagnostic and prescriptive analytics.
- Develop forecasting models for water demand, revenue collection, Non-Revenue Water (NRW), asset failures, sewerage overflows, complaint patterns, tanker demand and energy consumption.

3.3 Decision-Support Systems and Executive Dashboards

- Develop executive dashboards and KPI-monitoring systems.
- Establish real-time monitoring and alert systems.
- Design decision-support tools tailored to the needs of senior management.

3.4 Policy and Geospatial Analytics

- Conduct policy impact assessments and scenario and sensitivity analyses.
- Develop evidence-based policy recommendations and analytical reports for strategic planning and reform initiatives.
- Integrate GIS data with operational datasets and conduct spatial analysis for service coverage, leak detection, sewerage hotspots and infrastructure planning.
- Develop geo-enabled decision-support applications.

3.5 Artificial Intelligence and Advanced Analytics

- Apply AI and machine-learning techniques to improve operational performance.
- Develop anomaly-detection systems and implement predictive-maintenance models.
- Explore the use of Generative AI and Natural Language Processing (NLP) for customer services and management reporting.

3.6 Capacity Building and Knowledge Transfer

- Train KW&SC staff in data-analytics tools and methodologies.
- Develop analytical frameworks and standard operating procedures.
- Transfer knowledge to designated KW&SC personnel to ensure sustainability of the analytics function.

3.7 Key Deliverables

The Specialist shall produce the following deliverables (each to be accepted by the supervisor against an agreed delivery schedule):

1. Enterprise Data Analytics Strategy for KW&SC.
2. Centralized Data Repository / Data Warehouse.
3. CEO Executive Dashboard.
4. KPI Monitoring Framework.

5. Predictive Analytics Models.
6. NRW Analytics Dashboard.
7. Sewerage Incident Prediction Model.
8. Revenue and Billing Analytics System.
9. GIS-based Decision-Support System.
10. Monthly Analytical Reports.
11. Quarterly Policy Briefs.
12. Annual State of KW&SC Performance Report.
13. Capacity-Building and Training Programme.

3.8 Other Responsibilities

- Maintain strict confidentiality of all organizational information; all data, reports, models, software, algorithms, dashboards and analytical outputs developed under the assignment shall remain the exclusive property of KW&SC.
- Perform any other relevant duties as assigned by the Managing Director / CEO or the Project Director.

3.9 Performance Indicators

Performance shall be assessed against:

- Number of analytical models developed.
- Accuracy of forecasting models.
- Reduction in decision-making time.
- Improvement in operational KPIs.
- Quality of dashboards and reporting systems.
- Adoption of analytical outputs by management.
- Capacity-building outcomes.

4. Qualification and Experience

4.1 Education

Master's degree (minimum) from an HEC-Recognized university in Data Science, Computer Science, Statistics, Mathematics, Artificial Intelligence, Information Systems, Engineering, Economics, or a related discipline.

4.2 Experience

- Minimum 5–10 years of relevant professional experience.
- Demonstrated experience in large-scale data-analytics and machine-learning projects.
- Experience working with utilities, public-sector organizations, infrastructure agencies or development institutions will be preferred.
- Experience in projects funded by International Financing Institutions or donors (preferably the World Bank) will be an added advantage.

4.3 Technical Competencies

The candidate should demonstrate proficiency across the following domains:

Domain	Required Proficiency
Programming Languages	Python, R, SQL; Java and Scala desirable.
Data Science Tools	Pandas, NumPy, Scikit-Learn, TensorFlow, PyTorch, Apache Spark.
Visualization Tools	Power BI, Tableau, Looker Studio, GIS dashboards.
Database Technologies	PostgreSQL, MySQL, SQL Server, Oracle, and Big Data platforms.
GIS & Spatial Analytics	ArcGIS, QGIS, spatial statistics.
Cloud & Data Platforms	Microsoft Azure, AWS, Google Cloud Platform.

4.4 Other Skills

- Strong analytical, problem-solving and communication skills, with the ability to translate complex analytics into clear guidance for senior management.
- Proficiency in English; working knowledge of Urdu is an advantage.
- Knowledge or experience of working in Pakistan, South Asia or similar environments is an added advantage.

5. Reporting Line

The specialist will be recruited and contractually managed by the Project Director (PD). For administrative purposes, including contract management, performance evaluation, leave approval, and other personnel matters, the incumbent shall report to the PD.

For day-to-day operational, technical, and functional matters, the incumbent shall work under the direction of and report to the Chief Executive Officer (CEO). The CEO shall provide work priorities, technical guidance, and oversight of assigned responsibilities. The PD and CEO shall coordinate as necessary regarding performance and work planning. The Specialist will be required to submit monthly activity/progress reports, highlighting key tasks undertaken.

6. Contract Duration

The Data Scientist / Senior Data Analytics Specialist is initially required to work for a period of one year, with an annual review of performance forming the basis of renewal and any extension. The probation period will be three months, during or up to which the contract may be terminated owing to unsatisfactory performance. The contract may be terminated with one month's notice by either party. The Specialist will be based at KW&SC Head Office, Karachi (with field travel as required).

7. Salary, Benefits and Conditions of Service

A market-competitive salary based on qualification and experience will be offered. The salary and benefits will be discussed and agreed with the successful candidate. The contract and conditions of service follow the general conditions of service stipulated in the Project Operations Manual (POM) and will be discussed and agreed with the successful candidate.

8. Selection Process

An individual will be selected in accordance with the process stipulated in Section VII, "Approved Selection Methods: Consulting Services", Clause 7.34 (Approved Selection Methods for Individual Consultants), of The World Bank Procurement Regulations for IPF Borrowers (Fifth Edition, September 2023), available at: World Bank Procurement Regulations (September 2023).