Integrated Programme for Better Air Quality in Asia

Integrated Programme for Better Air Quality (IBAQ Programme)

CITY SOLUTIONS TOOLKIT:

OPERATION AND MAINTENANCE OF AIR QUALITY MONITORING STATIONS

BACKGROUND

Air quality management (AQM) relies on sound data that accurately describes the quality of air in a locality. One must understand the extent of a problem to be able to address or manage it, hence, air quality monitoring systems are an indispensable component of AQM. It must always be ensured that air quality monitoring equipment are in the best possible condition and produces the most accurate air pollution data.

There are numerous air quality monitoring systems established globally, and concerns surrounding these systems are common among cities. For air quality managers, it is a usual challenge to ensure that air quality instruments are working in top condition. Extensive technical capacity and substantial budget requirements, among others, are needed to guarantee reliability of data and the sustainability of the system.

In this module, common challenges and general considerations involved in the operation and maintenance of air monitoring stations will be discussed to help air quality managers better plan and implement the AQ monitoring system for their city.

CONTEXT

There are a few rules of thumb in the operation and maintenance of air quality monitoring stations, regardless of the specific technology employed per instrument. Various technologies are available, and these rapidly change and improve through time. There are general considerations that must be taken into account to better help air quality managers in allocating the right amount of time, manpower, and budget in operating and maintaining stations.

As emphasized in the module Guide to Designing Ambient Air Quality Monitoring Systems: Siting and Number of Monitors, the monitoring objectives should be clear and this will guide what kind of monitoring equipment is needed. Once the monitoring system and instruments have been identified, its capabilities and limitations should be clearly understood by the air quality managers and instrument operators to plan for and execute the appropriate operation and maintenance scheme.

In some cases, air quality monitoring is seen as a simple activity that mainly involves the procurement of pollution measurement instruments. This underestimates the amount of time required to effectively operate and maintain the air monitoring system, as well as the realistic amount of manpower and financial resources needed. Before finalizing the air quality monitoring plan, this module would be useful in identifying all factors that must be considered to save time, money and effort, while ensuring the accuracy of data from the instruments.

RESOURCE REQUIREMENTS AND STAKEHOLDER ENGAGEMENT

The operation and maintenance of air quality monitoring instruments is dependent on the instrument type and the required monitoring period. For example, filter-based samplers may require filter change (can be automatic, but usually manual) every 24, 12 or 8 hours. On the other hand, real-time online measurements are operating 24/7. Ideally, some instruments are calibrated every month or every quarter, depending on the need and instrument type and sensitivity. In most cases, the instrument suppliers are the ones to explain, facilitate, or conduct the actual maintenance.

What is most crucial is the planning process that air quality managers must undertake with an air quality monitoring working group in order to streamline the steps after the set-up of the air quality monitoring system. It is important to map existing resources and infrastructures, as well as tools and current technical capacity. This can help in identifying needs and external assistance that can be outsourced or allocated budget and time for.

Timeframes are indicated per concern/action on monitoring stations. As for resources, the limitations on the capacity of a city or community to develop and maintain a monitoring system would be the best indicator on how much resources, technologies, and manpower should be appropriately used on the project. Therefore, an integral step which is common for most of these toolkits is that a proper plan must be established.

The monitoring working group would have to be aware of the air quality monitoring responsibilities planned/decided for each group or individual. The equipment supplier can be commissioned to handle and maintain the instrument depending on the specific instrument type and technology. Local government personnel and/or individuals from academic and research institutions may also be involved, especially if the monitors are placed within their premises and are tasked with its maintenance and security.

KEY CONSIDERATIONS

Below are the main considerations in the operation and maintenance of air quality monitoring stations.

1. **Air intake and position**

All samplers must be able to gather sufficient amount of air sample to test. Regardless of the specific measurement technology, this feature is common for most monitoring systems and is called the air intake. The air intake goes through an 'inlet' and its position in monitoring stations should be unobstructed for uncompromised data collection. As such, it is necessary to consider a monitoring station's immediate surroundings and ensure that constraints to the ambient airflow should be avoided (Schwela, 2011) as a free airflow around the sampling inlet is necessary to ensure representative sampling.

Periodic checking of the monitor's air intake is a requirement. This can be accomplished on a weekly schedule to observe if any dust or debris has accumulated or the position of the monitor has changed. Through time, some long-term monitoring stations are also affected by changes in the surrounding environment (e.g. construction activities, tree canopy covering inlet, etc.) and must thus be regularly checked.

2. Power supply and internet connection

Although power supply seems to be the easiest to secure among the requirements of air monitoring instruments, power outages and fluctuations can damage the system. For small sensors and instruments this is rarely an issue, but for larger instruments, frequent disruption of the power supply not only disrupts operations and results in intermittent data, but also can damage the equipment.

For real-time monitoring equipment, internet access is also important to transmit the data from the instrument to a cloud or virtual storage. Intermittent connection or the lack of stable internet can lead to gaps in data or lags in the time stamp and the measured levels of pollution. Some instruments have an automatic backup and data transmission once internet connection is stable. For most instruments, data can also be manually obtained through an SD card or USB port.

3. Details of operation

Each instrument has a specific operation mechanism that must be understood by the air quality managers and the air quality monitoring team. To avoid mishandling of the equipment, these details must be thoroughly understood. Instrument suppliers usually do trainings on the operation of the instrument. In case of already existing instruments, new personnel must be trained thoroughly on its proper use.

4. Calibration and maintenance

The equipment must have its regular cleaning and calibration. The goal is to ensure that equipment is operating accurately within pre-determined control limits and that problems are identified in a timely manner. This is achieved through periodic calibrations, zero/span checks, use of field and trip blanks, laboratory standards, controls conducted within each analytical run, and other similar procedures.

The table below lists some other actions that can be done for operations and maintenance of the monitoring system. This provides an overview of the Quality Control and Quality Assessment schemes in place to achieve the larger objective of having the most reliable and valid information air quality managers and technical officers can get out of the monitoring systems.

Quality Assurance (QA)	Quality Control (QC)
• System audit - ensures that procedures are observed and followed or modified to reflect current practice • Performance audit - evaluates outputs for external standards • Inter-laboratory comparisons and co-located sampling • Interference evaluation with reference materials	• Standard Operating Procedures (SOPs) - as a guide and reference in the conduct of QC processes; revised periodically • Periodic instrument calibrations through comparison with a standard instrument of higher accuracy • Periodic adjustments to zero and setting the desired span (difference between the lowest and highest value of the calibration range) • Replicate analyses • Cross-instrument comparisons • Internal consistency tests

CONCERN 4: Data storage

The storage of data from the monitoring system is also an important consideration. The local data storage time is from several days to months. Make sure there is enough storage for the expected volume of data collected and that scheduled retrieval of data is executed. The timing of data retrieval will depend on the type of data stored and how much can the station hold. It could be as frequent as an everyday retrieval schedule.

Calibration values should always follow the data collection units for transmission into the database. This will then enable the necessary data quality controls and calibrations to be taken into account before data are approved. This manual collection of data should follow the instrument calibration routines. As suggested, the monitoring stations are visited every week for checks and calibrations. The same frequency should be applied for collecting data.

The AQ monitoring system is only at its best and bringing in reliable information if the monitoring stations are well maintained. More research can be done to see what other technologies are effective for the planned monitoring system, which matches the set objectives of the AQ management approach.

REFERENCE:

Clean Air Asia (2019). Guidance Framework for Better Air Quality in Asian Cities: Guidance Area 1 - Ambient Air Quality Standards and Monitoring. Unpublished