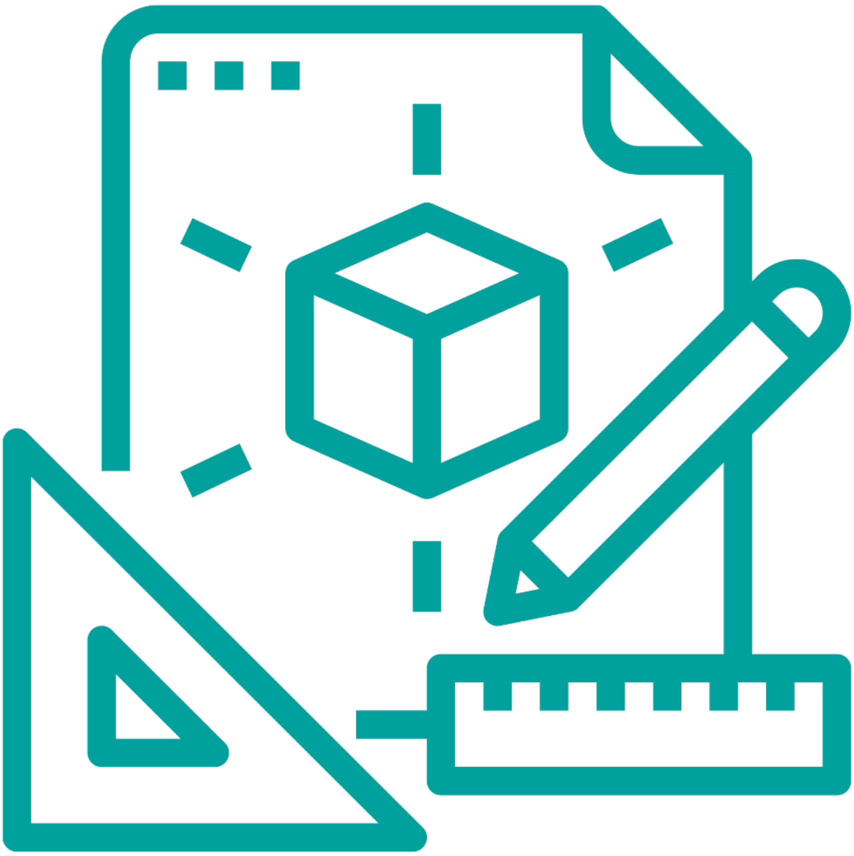
OPENAIR

Operational Network of Air quality Impact Resources

Best Practice Guide

BP206 | Develop

Platforms and digital services criteria



Introduction

This OPENAIR Best Practice Guide chapter discusses technology platforms used for air quality monitoring, and the criteria to consider when selecting platform solutions for your project. These selection guidelines are adapted from the Platform Selection Guidelines published by IoT Alliance Australia (IoT Alliance Australia, 2018).

There are two key topics covered in this chapter:

1. **Types of technology platforms**: IoT (Internet of Things)[1] platforms, data platforms, and analytics platforms
2. **Platform selection criteria**: business fit, quality, and technology fit.

WHAT IS A TECHNOLOGY PLATFORM?

A platform creates a technology environment (and associated services) to support functionality used by applications and other services. There are several types of platforms relevant to air quality monitoring, including IoT platforms, data platforms, and analytics platforms (see Figure 1).

IoT platforms manage IoT devices (including smart sensing devices), and capture the air quality data from those devices. Air quality data can then be stored in a *data platform*, which itself can be accessed by an *analytics platform* (for generating air quality data reports, dashboards, visualisations, and insights).

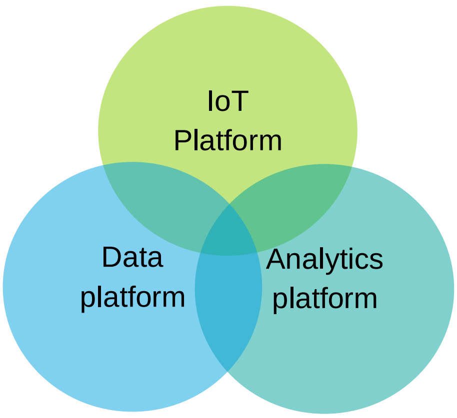


Figure 1. Air quality technology platforms

[1] IoT (or the Internet of Things) is the relatively recent connection of physical objects to the internet, in order to send information to (or from) those objects.

Who is this resource for?

This chapter provides an introduction to the topic of technology platforms and digital services to local government staff engaged with the design and delivery of air quality monitoring projects, including:

- people leading quality monitoring projects
- smart city professionals
- planners
- environmental officers
- information, communication and technology professionals.

How to use this resource

There are a range of technology platforms available to local government for the provision of air quality monitoring solutions.

In choosing a platform, it is important for you to decide how a particular platform might fit with your organisation's capacity and technology environment, and how well it meets the needs of your air quality monitoring project.

The topics covered in this chapter will help you to:

- understand air quality platforms, and the services they provide
- develop air quality platforms and digital services selection criteria.

Platforms

This section introduces the concept of 'IoT reference architecture', and describes how different technology platforms relate to this architecture.

IoT reference architecture

In this context a *reference architecture* is a template that illustrates the various components of a technology solution and how they relate. It also includes standardised terminology for these components.

IoT Alliance Australia's [IoT Reference Framework] comprises a number of layers that describe different elements of any air quality monitoring solution. These are discussed in more detail in the OPENAIR Best Practice Guide chapter *IoT reference architecture for smart air quality monitoring*, and the OPENAIR supplementary resource *A reference architecture for smart air quality monitoring: detailed guide.*

Table 1 shows a simplified version of this architecture, focused on the layers most relevant to a local government air quality monitoring project. The three types of technology platforms that are the focus of this chapter (IoT platforms; data platforms; analytics platforms) have been categorised in Figure 2 as belonging to the 'intelligence enablement' and 'connection management' layers of the architecture.

Data users		
User interfaces (laptop, mobile, tablet, etc.)		
Application enablement	**Air quality data applications**	End user business and IoT applications: • data discovery and sharing (e.g. public dashboard; open data portal; custom API) • developer services.
Intelligence enablement	**Analytics and visualisation platform**	A user-facing dashboard that might incorporate maps, customisable graphs, and more advanced data analytics tools (e.g. GIS; digital twins; machine learning/AI).
	Data management and storage *[Data platform]*	Device telemetry (sensor readings) must be structured and stored in a way that is secure, searchable, and accessible. Storage options tend to be cloud-based third-party services (commonly Amazon or Microsoft) that are connected to data management systems, which structure data and manage user access.
Connection management	**Device hosting and management + basic data interpretation** *[IoT platform]*	You will need a contract with a service provider that hosts devices in a digital platform. Device management involves the onboarding and commissioning of new devices and their subsequent management, with alerts in place for failures and errors. Be aware of your basic data interpretation requirements (like humidity interference correction for particulate data, and calibration and drift correction for gas data), and communicate these before proceeding.
Connectivity + edge gateway	**Communications**	You will need a contract with a communications provider that supports the transmission of live data from devices to a central online management location. Your chosen communications solution might involve local government-owned infrastructure (gateways), or you might engage a telecommunications provider and make use of their existing infrastructure.
IoT end point	**Devices** (IoT end point)	Physical digital hardware that produces and transmits data.
The physical world		

Figure 2. Basic components of data architecture for a sensing network

IoT platforms

IoT platforms are used to manage the collection of data from IoT devices, including air quality sensing devices.

***Proprietary* IoT platforms** are specific to a particular brand of sensing device, and are included as part of a complete air quality monitoring solution (which includes the sensing devices, the IoT platform, basic data visualisation and analytics, and some support services). These platforms are easy to set up and use. However, they lack flexibility, and do not generally support other brands of IoT sensors. This can become a problem for organisations that want to avoid vendor lock-in, and be free to mix and match different types of IoT devices from multiple vendors over time.

***General purpose* IoT platforms** cater to a wider range of IoT devices. They may use open-source components and standard interfaces to accommodate the many types of sensors that are commercially available. They can also integrate with a range of data platforms, which may be important to organisations that have already invested in data platforms. These general purpose platforms provide flexibility to work with a range of different types of IoT sensors. However, they may require specialist skills (and additional resources) to make them fit for the purpose of air quality monitoring.

Data platforms

Data platforms support the ingestion, integration, storage, processing, and sharing of air quality data. Data is provided to the data platform by the IoT platform, and – in turn – makes data available to analytics platforms.

Data platforms can be operated in-house by organisations using their own IT systems. Alternatively, they may be operated as outsourced cloud services, often paid for through a subscription-plus-usage model.

Analytics platforms

Analytics platforms help users interpret air quality sensing data. They provide an integrated set of technology services for analysing air quality data, with a view to generating useful insights and conveying them in an engaging manner.

CATEGORIES OF ANALYSIS

Analysis is the act of extracting information from data. Several types of analysis can be applied to air quality data. The type of analysis you should use will depends on the objectives of your project. The broad categories are:

- **Descriptive** – what is the current or historical air quality?
- **Diagnostic** – what are the causes or reasons for that air quality?
- **Predictive** – what will the air quality be in the next hour, day, or week?
- **Prescriptive** – what interventions or policy options are available, and how can they be compared and contrasted?

As with IoT and data platforms, basic analytics platforms can be packaged by sensor manufacturers as part of an overall sensing solution. In effect, most sensor manufacturers or vendors can provide a single, proprietary platform that is an IoT platform, with elements of data management and analytics.

There are also separate analytics platforms that can be used to analyse a wider range of data (not just air quality data). Many organisations are already using these platforms in their enterprise IT systems.

Platforms selection criteria

This section will help local governments to select the right technology platforms for their air quality monitoring needs. The selection criteria are organised into three categories:

1. **Business fit**
2. **Quality**
3. **Technology fit**

You should consider which criteria are most relevant to your organisation's air quality sensing project, and determine appropriate weighting of each before using them as part of an official procurement process. You can also move criteria between categories, to suit your situation.

These criteria can be used (alongside the platform selection guidelines from IoT Alliance Australia) to guide your choices.

1. Business fit

Business fit criteria are about whether a solution will actually provide the air quality data required by your organisation and data use case. These criteria can help to determine whether a platform is 'fit-for-purpose' for your business needs (see Table 2).

Table 2. Business fit criteria

Criterion	Description
Features	How well does the platform support the planned air quality monitoring project, and the functional/technical requirements of the project?
Sensing devices	Does the IoT platform support the sensing devices and data communications infrastructure you are planning?
Data sharing	How well does the platform support your desired data sharing approach?
Analytics	How well does the platform support your air quality analytics needs?
Reporting	Does it provide reporting and visualisation capabilities? 'Reporting' refers to the ability of a platform to produce a report (or visualisation) based on a custom user query. More developed reporting capabilities might include a customisable metadata schema (the 'tags' that you search by); customisable search functionality (e.g. user-defined time periods, rather than presets); compound queries;

Criterion	Description
	and customisable visualisations. It also includes the ability to download search or visualisation outputs in a variety of formats.
Cost	How well does the platform meet the cost-effectiveness expectations from the organisation's perspective? Consider total cost of ownership over the life of the solution (e.g. initial set-up; upgrades; operations; and support over a number of years). Refer to cost-estimation calculators provided by external vendors for their services, and consult with your internal IT department to quantify costs.
Usability	Is it easy to use? 'Usability' refers to the user interface ('look and feel') and user experience of a platform service. A user-friendly (rather than complex) platform or service is more likely to be adopted by end users.

2. Quality

Quality attributes relate to how well a platform delivers the functionality required of it.

Quality often comes at a cost. Trade-offs may have to be made, and you will need to prioritise each quality attribute within the context of your own air quality monitoring project.

An essential (or non-negotiable) requirement can be considered a 'high' priority. A requirement can be prioritised as 'medium' if a workaround is possible. A nice-to-have (or optional) requirement can be classified as 'low' priority.

Table 3 outlines the quality attributes that can be used as a reference to define your organisation's own specific quality requirements for your sensing project.

Table 3. Quality attributes

Criterion	Description	Notes
Availability	Does it meet availability requirements (uptime and downtime)?	‘Availability’ refers to the amount of time that a platform or service is available to users, and able to perform its expected functions. It might be available at all times (near 100% or continuous availability), or much less. It can be specified as average availability levels, or ‘downtime per year’. Most air quality monitoring solutions used by local government will have lower availability requirements than customer-facing systems or enterprise business systems.
Reliability	Does it offer the capacity to meet required functional requirements under agreed conditions for a specific period? In the case of a period of downtime, how quickly will it be up and working again?	‘Reliability’ refers to the probability that the platform or service will do its job effectively, across a defined period of time. Put another way, reliability is a measure of the probability of system failure. It is often expressed as the ‘mean time between failures’. A system might be available while also running suboptimally, and thus unable to fulfil the functions expected of it.
Auditability	Does it maintain and provide full traceability of user access and transactions?	‘Auditability’ refers to the ability of a platform or service to provide and maintain full traceability of user access and transactions. Each time a user accesses a platform, it is possible to record *who* it was, *what* they did, and *when* they did it. This could be as simple as accessing data, or as intrusive as changing core settings or code (which should be possible by admin users only). Additional auditability functionality includes the capacity for generating custom reports, based upon such records. This can be vital to best practice security management, data management, and data sharing. It can also support rollback of system settings.
Documentation	Does it provide necessary documentation?	‘Documentation’ refers to platform design, configuration, deployment, and operation manuals. Documentation is necessary for understanding and using a platform.
Training	Does it offer user help and training?	‘Training’ refers to the level of user training support that accompanies a platform or service. This can include self-

Criterion	Description	Notes
		paced virtual and in-person training sessions; how-to guides; help and FAQ resources; user forums or knowledge exchanges; and AI-enabled virtual assistants. Training should be appropriate to different user roles - for example admin users, general end users and advances end users.
Performance	Does it support context-specific system performance needs?	'Performance' refers to the ability of a platform or service to support a series of context-specific needs. These include: - *response times*: application loading; browser refresh times - *processing times*: functions; calculations; imports; exports - *query and reporting times*: initial and subsequent loading times.
Portability	Does it support portability needs?	'Portability' refers to the ability to migrate data or applications between two platforms or cloud service providers. This is an important consideration, to avoid vendor-specific platform lock-in situations.
Security	Does it offer user access management and data encryption services?	'Security' refers to the ability of a system to detect and resist unwanted external interference (or data access) and applies at all levels of a technology stack. Notable areas of focus for platforms and services include: - *User identity and access management* – the ability of a platform or service to control who accesses a system, and to assign different permissions to different groups (custom access privileges). This can include access control functionality (e.g. password management; captcha; two-factor authentication). - *Data encryption* – the ability of a system to encrypt data where it is stored, or during transfer.
Supportability	Is it testable, adaptable, maintainable, compatible,	'Supportability' of a platform or service relates to how well it can be configured and adapted to fit within the broader

Criterion	Description	Notes
	and configurable to suit a specific context.	context of an organisation, and to be compatible with the specific context of a project or data use case.
Scalability	Does it offer the capacity to scale up and scale down, in order to meet contextual needs?	'Scalability' refers to the capacity of a platform or service to scale up or scale down to meet changing needs. Scaling can involve the addition of devices, or increasing network traffic, users, and data volume or velocity.

3. Technology fit

Technology fit refers to how well a platform will fit with your organisation's existing IT infrastructure and systems (see Table 4).

Table 4. Technology fit criteria

Criterion	Description
Standards	How well does the platform align to your organisation's supported standards and platforms? Consider the following factors: • conformance to enterprise architecture standards • conformance to technical design standards • conformance to coding standards.
Platform management	Does the platform include the tools needed by your IT staff to manage sensing devices, data, reporting, or access permissions?
Documentation	Is there sufficient technical support documentation available about the platform?
Support	To what degree is the platform supported by your IT team (e.g. are there sufficient or insufficient technical skills and resources to easily manage and support the platform)? What support services are available from the platform vendor or reseller?
Integration	Does it allow for integration with existing systems?

	'Integration' refers to the ability of a platform or service to integrate with other relevant platforms or services, in order to form a large, complete, functional system that meets your project's needs.
Interoperability	Does it support data sharing and interoperability needs? 'Interoperability' refers to the ability of a platform or service to exchange data (and integrate functionality) via common shared language and protocols. It is closely related to integration (see above), but is more sophisticated, as it tends to be standards-based, and can therefore be assessed in terms of compliance. Interoperable platforms should integrate with each other without the need for costly customisation.

References

IoT Alliance Australia. (2018). *Internet of Things Platform Selection Guideline*. https://www.iot.org.au/wp/wp-content/uploads/2016/12/WS7-Platform-Selection-Guidelines-V1.0.pdf

Additional resources

IoT Alliance Australia (IoTAA)* | *Internet of Things Platform Selection Guideline

This document provides concise and relevant guidance to private and government organisations to assist in the adoption of IoT technologies. It is intended to help organisations understand the factors to consider when comparing platforms.

IoT Alliance Australia* | *IoT reference framework

The reference architecture is a generic framework that identifies the various components and data flows that make up a complete technical solution for IoT solutions (air quality monitoring is one example).

IoT Alliance Australia* | *IoT reference framework application guide

This document provides an overview of the IoT Reference Framework and provides examples of how it can be used for a different applications of IoT solution.

Associated OPENAIR resources

Best Practice Guide chapters

IoT reference architecture for smart air quality monitoring

This Best Practice Guide chapter introduces the OPENAIR reference architecture for smart air quality monitoring. The reference architecture is a framework that identifies the various components and data flows that make up a complete technical solution for smart air quality monitoring. It is a generic reference that can help local governments to design and implement their own technical solutions.

Sensing device procurement

This Best Practice Guide chapter provides guidance on the selection and procurement of smart low-cost air quality sensing devices. It explores critical considerations relating to the design and functionality of devices and the quality of the data that they produce, supporting procurement choices that are appropriate to the needs of a project and organisation.

User interfaces and data stories

This Best Practice Guide chapter introduces some of the key tools and strategies that can be used to communicate air quality data to stakeholders and collaborators in meaningful and useful ways. The chapter focuses on the design and functionality of user interfaces, including dashboards, data portals, and a variety of live data integrations. It also explores communication strategies, and the use of 'data stories' for effective engagement.

Data communications procurement

This Best Practice Guide chapter explores the various communications technologies that can support smart low-cost air quality sensing, and provides advice on selecting technologies that are appropriate to a project and organisation.

Supplementary resources

Technical requirements template

This template is an extended, step-by-step tool that supports the development of technical requirements for a smart air quality monitoring project. These requirements define the details of technologies (sensing devices, platforms, and services) that can meet the specific needs of a project, and are intended to support procurement decision-making.

A guide to developing technical requirements

This resource is a companion guide to the technical requirements template.

A reference architecture for smart air quality monitoring: detailed guide

This resource is an extended, stand-alone guide to the OPENAIR reference architecture for smart air quality monitoring. The reference architecture is a framework that identifies the various technical components of a complete air quality sensing network, and shows how devices, communications, platforms, databases, and user interfaces integrate and support the flow and management of data. It is a generic reference that can help local governments to design and implement their own technical solutions.

Further information

For more information about this project, please contact:

Peter Runcie

Project Lead, NSW Smart Sensing Network (NSSN)
Email: peter@natirar.com.au

This Best Practice Guide chapter is part of a suite of resources designed to support local government action on air quality through the use of smart low-cost sensing technologies. It is the first Australian project of its kind. Visit www.openair.org.au for more information.

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