The Impact Planning Cycle in detail

SR101

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Introduction

Smart low-cost air quality monitoring technologies hold great promise as tools that can improve our understanding of air quality at the local level and support a broad range of positive impacts. To realise these impacts, it is necessary to carefully plan for them from day one. Establishing a smart sensing device network demands a considerable investment of time and money.

Too often, we see technology deployed with the naïve assumption that throwing a few sensing devices up at random with little in the way of deeper planning will yield high quality usable data. The maxim that 'you get out what you put in' is critical here. There are many choices you can make when it comes to setting up a sensing device network. What do you need to measure? What sort of data quality do you need? What device functionalities and features do you need? How will you configure your devices? Where will you locate them? How much data analysis do you need? These questions barely scratch the surface of project planning, and all of them must be determined by the impact you wish to create.

Does your data need to stand up in court, or do you want to teach school children about climate change? Both these activities are important, but one requires very different approaches to the other. It is vital that you develop a strong vision of what you want to achieve and work out as clearly as possible how new data is going to help you to achieve it. From there, a whole impact planning process follows.

The OPENAIR Impact Planning Cycle is a tool that can help local governments to maximise the impact of a smart air quality monitoring project. It features six stages (**Identify**, **Develop**, **Implement and operate**, **Manage and analyse data**, **Act on evidence**, and **Evaluate**) each comprising several tasks.

> **WHAT IS IMPACT PLANNING?**
> Impact planning is a strategic approach to project development that connects planned activities with a specific problem, group of stakeholders, and a clearly defined set of outcomes and impacts. It helps to maximise your chances of creating measurable and meaningful impact that aligns with the needs of your community and your organisation.

Who is this resource for?

This resource is for use by local government staff tasked with leading the design and delivery of a smart air quality monitoring project. It is also relevant for any other staff working on a project to help familiarise them with the impact planning process at a high level (e.g. senior management, ICT professionals).

How to use this resource

This resource provides an extended guide to the OPENAIR Impact Planning Cycle, with detailed information relating to each of the six cycle stages. The information associated with each stage introduces you to the tasks, considerations and workflow associated with project delivery. Each of the tasks (from planning your device deployments to sharing data) has additional in-depth resources associated with it. Use this resource like a map or high-level orientation tool for planning the entirety of your project journey. Use the other in-depth resources to guide your through each task as you come to it.

An overview of the OPENAIR Impact Planning Cycle

The benefits of using the OPENAIR Impact Planning Cycle

The OPENAIR Impact Planning Cycle (Figure 1) is a tool, the use of which has the following benefits:

- It provides a step-by-step guide for developing and delivering an air quality monitoring project that will adequately address the needs of your organisation and your community and maximise your chance of creating positive impacts in your local area.

- It is a guide to the entirety of your project workflow, from identification of a problem and stakeholders to evaluation of the project and the impact created.

- The iterative and cyclical approach to project design reflects growing best practice for smart places projects. It can help you to explore the effectiveness of different strategies, designs and activities, maximise impact and return on investment, and support improved decision-making for future projects.

- It enables you to clearly and transparently articulate and demonstrate the positive impacts of a project or activity. This can have several positive effects: it enables transparent reporting of impacts to the local community; it can encourage the team working on the project or activity by showing them how they contribute to positive impacts; and it can help attract further funding, new partners and collaboration.
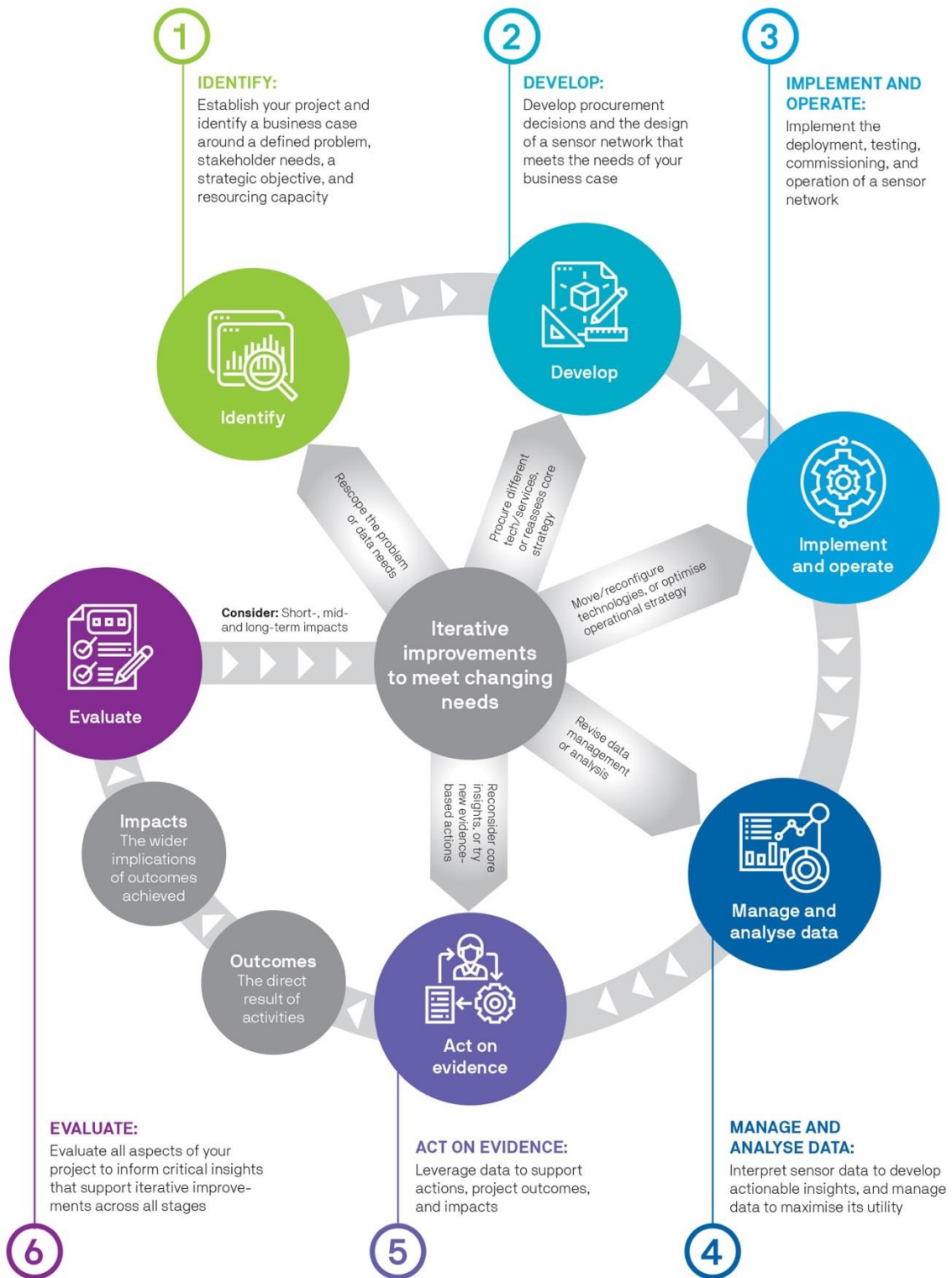
① IDENTIFY:
Establish your project and identify a business case around a defined problem, stakeholder needs, a strategic objective, and resourcing capacity

② DEVELOP:
Develop procurement decisions and the design of a sensor network that meets the needs of your business case

③ IMPLEMENT AND OPERATE:
Implement the deployment, testing, commissioning, and operation of a sensor network

Identify

Develop

Rescope the problem or data needs

Procure different tech/services, or reassess core strategy

Move/reconfigure technologies, or optimise operational strategy

Implement and operate

Consider: Short-, mid- and long-term impacts

Iterative improvements to meet changing needs

Evaluate

Revise data management or analysis

Impacts
The wider implications of outcomes achieved

Reconsider core insights, or try new evidence-based actions

Manage and analyse data

Outcomes
The direct result of activities

Act on evidence

⑥ EVALUATE:
Evaluate all aspects of your project to inform critical insights that support iterative improvements across all stages

⑤ ACT ON EVIDENCE:
Leverage data to support actions, project outcomes, and impacts

④ MANAGE AND ANALYSE DATA:
Interpret sensor data to develop actionable insights, and manage data to maximise its utility

Figure 1. The OPENAIR Impact Planning Cycle

Impact pathways

The chances that data can support positive impact increase significantly if that data is collected, managed, interpreted and shared with impact in mind. Data-driven impact can be planned for through **data-activities-outcomes-impacts pathways** (defined in Table 1), which lie at the heart of the Impact Planning Cycle.

Table 1. Definitions of the data, activities, outcomes and impacts pathways.

Data	The collection and effective management and interpretation of new data should be done to support specific planned activities.
Activities	Activities are the things that you do in response to a defined problem. They lead to outcomes, which in turn lead to impacts. An activity is *enabled by* new data. Data collection, management, interpretation, and sharing is all designed to support specific defined activities.
Outcomes	Outcomes are the direct result of activities. They should be measurable. You should have a clear idea of the outcomes you want to achieve at the start of your project and plan activities that will help you to achieve them.
Impacts	Impacts are the wider implications of outcomes achieved. They should be measurable, though this can be difficult with some types of impact. The impact is the ultimate justification for acting in the first place and should guide all of your decisions.

Identify

This stage helps you to establish your project and identify a business case built around a clearly defined problem, stakeholder needs, a strategic objective, and your resourcing capacity.

Approve and setup your project	**Approve and setup your project internally** • Establish initial scope, vision and high-level budget and secure internal approval. • Establish reporting requirements.
Establish roles and governance	**Establish roles and governance** • Establish roles and a project team. • Formalise a governance structure and set recurring meetings.
Establish a timeframe	**Establish a timeframe** • Establish a project timeframe with a series of milestones.
Align with smart places best practice	**Align your project with smart places best practice** • Align your project design with smart places best practice. • Assess your organisation's progress on your smart places journey to help you to determine the type of air quality monitoring initiatives you are ready to undertake.
Identify and engage with stakeholders	**Identify and engage with internal and external stakeholders** • Identify community stakeholders and their air quality concerns. • Identify stakeholders within your organisation (e.g., prospective data users). • Build strategic partnerships with a broader community of practice.
Identify your strategic objective	**Identify your strategic objective** • Prioritise a specific air quality issue, identify activities for addressing that issue, and develop clear project aims defined by outcomes and impacts. • Define your air quality issue. What are the pollutants and the pollutant sources? Where and when is the issue occurring? Who is being affected? Who cares, and who benefits from any action taken? What are the risks of acting and not acting? • Review your organisation's policies/strategies (e.g., sustainability, planning, and data policies), and determine how they can support your project. • Prioritise issues based upon importance, urgency, and policy alignment.

	- Consider what activities you want to support with data. Activities might mitigate pollution, reduce people's exposure to pollution, or build capacity to engage with these issues. You will plan these activities in more detail later. - Think about the aims of your air quality monitoring project and define them in terms of planned outcomes and impacts.
Identify your data needs	**Identify what data is needed to support the aims of your project and consider how you will obtain it** - What data do you need to support the aims of your project? Think about: i) types of pollutants; ii) sources of pollution; iii) locations of pollution; iv) other types of data required for interpretation of your primary data set (e.g., meteorological). - Plan the collection of new data to support your project aims and planned activities, considering: i) where to collect it; ii) when and for how long it will need to be collected; iii) intended data users (internal/external). - Think about existing internal data resources, as well as accessible external data. Can existing data support your project aims? Do you even need to collect new data using sensing devices, or can you your aims with existing data?
Review your existing capacity	**Review your organisation's existing capacity to support your project** - Review your human resources. Who within or beyond your organisation can bring leadership skills, expertise, operational capacity and time to your project? Can you draw on expertise, knowledge or insights from similar past projects? - What existing technology, infrastructure and other assets does your organisation have that can directly support your project? - Are there services, programs or initiatives run by your organisation that align with your project aims and can help you to deliver your planned activities? - What internal and external financial resources are available? - Develop a detailed operational budget that incorporates these capacities.
Plan your evaluation strategy	**Plan a high-level evaluation strategy** - Plan how and when you will measure outcomes and impact. - What are your Key Performance Indicators (KPIs)?
Develop a Business Requirements Document and a Data Use Action Statement	**Formally capture your business case and data use case** - Create a Business Requirements Document (BRD) to capture a complete business case (see the OPENAIR *Identify Template* for detailed guidance). - Create a Data Use Action Statement (DUAS) that describes: the air quality issue; the stakeholders impacted by the issue, and why they care about it; the data you will collect to better understand the issue; the activities you will implement to address the issue; and the outcomes and impacts that you are aiming to achieve.

Develop

This stage guides your through procurement decisions and the design of a sensing device network that meets the needs of your business case.

Plan participatory approaches	**If you plan to include citizens in the design of your project and the collection of data, develop a strategy and methodology for delivering this** • Plan who you will engage and how, where and when you will engage them. Participatory approaches need to be baked into a project from early on and should inform all of the other design decisions that you make (technology procurement choices, data sharing, deployment planning, etc.)
Develop technical requirements	**Develop a list of technical requirements for devices, platforms and** services **and platforms,** based on **the requirements of your business case and data** use case • Identify smart air quality sensing devices and supporting data services and platforms that can meet the needs of your project and organisation. • Establish a data architecture that defines the integration of sensing devices, data communications, platforms and services.
Develop a high-level approach to data management and sharing	**Develop a high-level approach to data sharing that can guide the design of your project from an early stage** • Who do you plan to share data with? (Internally/with partners/with public?) • What data do you plan to share? (All or some? Abstracted summaries only?) • Develop a clear justification for your data sharing plan, including how you intend for recipients to make use of the data. • Establish a data management and sharing plan for your project, including: data administration roles; ethical considerations/risks relating to the collection, management and sharing of project data; data access privileges.
Develop a high-level design plan for deploying sensing devices	**Plan the design of your air quality monitoring network, balancing the needs of your data use case against practical and operational constraints** • Develop a high-level design plan for deploying a sensing device network: general locations to deploy devices; what to mount them on; how to mount them; and how to support their operation (communications, power, etc.).
Plan and procure data communications	**Develop a detailed plan for sensing device data communications** • If you chose devices with data communications that require private gateways (e.g., Wi-Fi, LoRaWAN), determine how many and where to deploy them. Create detailed deployment plans and secure approvals.

	• If you chose devices with data communications that make use of existing communications infrastructure and services (e.g., 3G/4G/NBIoT), make a plan to establish services that meet the needs of your project. • Select and procure data communications hardware and/or services, as well as additional mounting equipment if required (e.g., masts, power supply).
Deploy and test communications infrastructure	**Deploy and test private communications infrastructure (if required)** • Ensure that gateways function reliably and that undeployed test devices are connecting and sending data through them. • Conduct on-the-ground surveys to check the viability of signal coverage in all of the general locations where you plan to deploy devices. This provides more detailed empirical understanding than you can gain from RF mapping.
Plan and approve details of all sensing device deployments	**Develop detailed documentation for each specific device deployment** • Develop and approve detailed deployment documentation for each sensing device in your network, specifying exact mounting, power supply, and communications solutions, as well as micro-siting details (e.g., height above ground, orientation). • This level of detail is contingent upon having active communications in place, allowing you to confirm viable connectivity.
Procure devices, platforms and services	**Procure technologies to support your project, informed by initial technical requirements and additional needs/constraints of your deployment plan** • Select and procure exact numbers, models and configurations of sensing devices, power supply solutions and mounting equipment. • Select and procure platforms and services to host and manage devices, store and manage data, and analyse and utilise data.
Develop a data schema	**Develop a data schema for your project** • Establish a project data schema document that lists and characterises all of telemetry and metadata fields you will capture. • Establish a master document to store metadata, and a process for collecting and managing it. *Note: A data schema is the blueprint for managing your project data. This task is part of stage 4 (Manage and analyse data), however it is necessary to develop the schema earlier in the project.*
Plan for evaluation	**Plan for evaluation** • Identify the key performance indicators (KPIs) that will enable you to evaluate: the collection and management of data; the quality and usability data; the success and sustainability of data-driven activities.

Implement and operate

This stage guides you through the deployment, testing, commissioning and operation of a sensing device network.

Calibrate sensing devices	**Ensure that devices are calibrated to meet the needs of your data use case** • Calibration may require your own co-location process, either for all devices that you are deploying, or for a representative sample of devices. Refer to OPENAIR Best Practice Guide chapter *Sensing device calibration* for further guidance. • Calibrate individual devices as required, and develop data correction factors formulated for your context and a data use case.
Procure device deployment services	**Select and procure services for the deployment of all sensing devices** • Referring to your detailed device deployment documentation, develop a detailed step-by-step deployment methodology to support device deployment activities by a third party. This should include instructions relating to: assembly of components and mounting equipment, device activation, device micro-siting guidelines, installation method for all types of mounting infrastructure, verification and quality control procedures, deployment metadata capture and record keeping, workplace health and safety. • Arrange in-person briefings with prospective installers to introduce example equipment and supporting documentation, enabling them to accurately quote. • Procure services according to standard organisational procedure. • It is recommended that you oversee and approve a demonstration installation prior to commencing main deployment activities.
Develop operational procedures procure operational services	**Develop operational procedures and procure operational services** • Establish operational procedures and a routine audit/maintenance schedule. • Establish contracts/services for: device management and field maintenance, managed communications, platform, and data management and storage. • Clearly appoint operational roles and responsibilities, internally and amongst contractors. • Configure automated device/network management alerts (if supported by your IoT platform) to support standard operations.
Integrate systems	**Integrate all the technology components of your smart sensing system** • Integrate your chosen data communications solution with your IoT platform.

	• Establish data storage and management that is aligned with your data schema and integrate this with your IoT platform. • Onboard devices into your communications server and IoT platform. This means that devices are registered and recognised throughout the system and that pathways for data flow from devices through to a database are established.
Conduct test device deployments	**Conduct test device deployments to verify deployment methodology and end-to-end data flow** • Deploy two or three test devices in a controlled location with strong communications coverage. • End-to-end data flow means that data is flowing from devices, through all layers of the IoT architecture, to be stored in the database.
Install and commission the full device network	**Install the full network of sensing devices** • Acceptance test all devices (confirm activation prior to deployment). • Assemble devices with mounting solutions and supporting equipment. • Deploy devices and capture deployment metadata. • Verify reliable data flow from devices to data storage for a planned test period. • Verify device deployment metadata and initial data quality. • Commission devices and begin the main period of data collection for your project.
Undertake troubleshooting	**Troubleshooting of issues arising** • A period following deployment of a network where various issues with devices and the collection of reliable, trusted, and useable data are diagnosed and addressed. Troubleshooting tends to have a strong initial focus before transitioning into a less demanding open-ended operational activity.
Engage with cybersecurity	**Ensure that appropriate cybersecurity measures are in place** • Speak with your IoT service providers about cybersecurity risk and mitigation. • Aim to implement best practice identity and access management (IAM). • Implement IoT system security to ensure that data is protected, both in transit and at rest, and that appropriate authentication is applied to any system providing data collection or device control.

Note: At this stage your systems should be correctly collecting and storing data.

Manage and analyse data

This stage explores how to interpret, verify and analyse sensing device data to develop actionable insights, and how to manage data to maximise its utility.

Complete a Master Metadata Record	**Complete a Master Metadata Record** • Capture all the metadata field entries for the project in a Master Metadata Record. These might relate to: devices, administration, deployments, telemetry, data harmonisation, data users/owners, data sharing. • Make sure that the Record is available to everyone who requires access. • Formalise a process for updating the record and tracking those updates.
Identify and integrate complementary data *(if required)*	**Identify and integrate complementary data** • Complementary data is third-party data that supports the use or analysis of your own 'primary' sensing device data. It might include other types of environmental data (e.g., meteorological or regulatory air quality data), or non-environmental data that relates to your focus issues (e.g. traffic/pedestrian counts). • Complementary data streams should be integrated into your data store or analytics platform.
Correct and harmonise data	**Correct and harmonise all incoming data prior to storage** • Apply correction factors to incoming telemetry, for calibration and environmental interference. • Harmonise all incoming data with your project data schema.
Apply data quality control	**Apply data quality control to static data sets, or as an automated platform function** • Key actions include: data cleaning (detecting and either removing or fixing data anomalies and outliers), abnormal trend detection, data completeness check. • Configure data quality control functions in cases where they can be automated into an IoT platform to process live data streams. • Undertake operational data verification to improve the trust in and usability of your data: verify environmental data against external references, and/or cross-verify data from multiple devices in your own network.

Analyse data	**Apply data analysis to meet the needs of your data use case** • Data analysis includes a range of approaches, of varying complexity. It is always necessary to some degree, however the specifics of your data use case will dictate your requirements and the associated effort. Common analytics approaches include: statistical analysis; temporal interpolation; spatial aggregation and interpolation; complex geospatial system modelling; and AI and Machine learning applications. • Data analysis can be applied manually (to exported static data sets), or it can be built into the functionality of an IoT or data platform with varying degrees of sophistication.
Manage and share data	**Manage and share data in line with the aims of your business case** • Assess your data to determine what you will share and how you will share it. • Create a data management and sharing plan to support accountable, safe and responsible sharing of data. • Assign roles and responsibilities for the management of data and data sharing within your organisation; Establish data sharing infrastructure and management systems. • Share data internally, externally with select partners, and/or openly with the public. Ensure access to data and/or data insights by stakeholders engaged in your chosen activities (colleagues, partner organisations, community members, etc.).

Act on evidence

This stage explores how to leverage data-based insights to support actions. The direct result of actions are your project outcomes. The wider implications of these outcomes are your impacts.

Develop insights and build an evidence base	**Interpret the results of data analysis to resolve actionable insights** • Build insights based upon data analysis to create a foundation for action on your chosen air quality issue. • If required, adapt your data collection and analysis to support the insights that you need.
Plan and implement activities for impact	**Plan and implement activities for impact** • Work with stakeholders to plan and implement data-driven activities that result in planned outcomes and impacts. • Activities can include those that are justified by data-derived evidence and insights, or those that are more directly responsive to live data streams. • Communication about your project may start much earlier in the process, however the main effort is likely to occur now, when you have clear insights and activities that you can talk about. Communication may include production of official outward facing reports, articles for publication, and presentations about your project at events and conferences.
Build institutional capacity for impact creation	**Engage people from within your organisation with your project and support impact creation at an institutional scale** • Build awareness and understanding of your project within your organisation, including: the issue you are addressing; your data collection activities and the data that you are producing; the data-driven insights that are emerging; and the data-driven activities you are undertaking to address your chosen issue. • Connect data resources with potential data users. Ensure that people are supported to confidently and effectively access and utilise data and insights. • Develop institutional procedures and practices to support optimal ongoing utilisation of project data within your organisation.

Engage your community with data	**Actively engage specific sections of your community with data and insights, to deliver social impact** • Identify specific priority stakeholder groups in your community and conduct activities to help you to understand their concerns, behaviours and motivations relating to air quality. • If you identify disadvantaged or marginalised groups with a stake in your project, reach out to colleagues who have expertise in working with those groups and seek their advice, then base your engagement strategy around that advice. • Develop active programs and initiatives to engage priority stakeholder groups, supporting participation, education, empowerment, capacity building and impact creation.
Support data discovery and visualisation	**Design and implement user interfaces for data discovery and visualisation** • Design and implement tools and strategies that can be used to communicate air quality data to stakeholders and collaborators in meaningful and useful ways. • Consider integration of your data with existing interfaces and platforms that already have established user bases, allowing you to reach a large existing audience. Examples might include integration with: internal systems within your organisation that are widely used by many departments and staff (e.g. a city-wide digital twin); website widgets that display live data updates; automated social media alerts linked to live data; open data portals.
Build communities of practice and share knowledge	**Build and engage with communities of practice and share knowledge and insights from your project** • Actively build and engage with communities of practice for smart air quality monitoring. By connecting with others, knowledge and insights can be shared, collaborations can be created, new funding can be accessed, and increased value and impact for communities can be leveraged. • Report on key aspects of your project (e.g., project design and governance, methodologies, network and system design, data use cases, data insights). Engage in critical reflection and capture deep methodological and process learnings and insights that can help others doing similar work. Publish and actively share these reports with your community of practice.

Evaluate

This stage guides you through all aspects of project evaluation. Evaluation delivers critical insight into all aspects of the project, supporting iterative improvements across all stages.

Evaluate all aspects of your project *(Business case and data use action statement; data collection and data efficacy; data insights; data sharing; data-driven activities for impact)*	**Evaluate your business case and Data Use Action Statement (DUAS)** • Evaluate your business case against the actual experience of delivering your project. Are the planned outcomes that were used to justify the business case being realised? Are you delivering on your aims? Do you now need to adapt/update your business case in light of your experience? • Does the data that you are collecting align with your original Data Use Action Statement? Are the expected stakeholders making use of data in the ways that you anticipated? If different types of data are emerging, or if data us being used in ways that were not anticipated, by people that you did not consider, how would you adapt/update your DUAS now?
	Evaluate data collection and data efficacy • Evaluate your technology choices, your sensing methodology, and the design of your monitoring network. • Evaluate the practicality and ongoing sustainability of operating the sensing device network in its current form. Consider resourcing capacity, risk and alignment with your business case. • Evaluate the quality and usefulness of the data collected and consider changes to your data collection methodology, data management and data analysis approaches that might improve data efficacy.
	Evaluate data insights • Test your assumptions and verify the thinking behind any emerging insights to ensure that you have arrived at robust conclusions. This may lead to a need for additional data collection and further targeted analysis.
	Evaluate data sharing • Evaluate the perceived risk of data sharing against actually occurring harm. • Consider whether data might need to be modified or abstracted to desensitise it in future data releases. • Evaluate the reach and impact of data sharing (e.g., number of data users, number of downloads, most used interface, etc.).

	• Evaluate your organisation's capacity to sustain data sharing activities over the short, medium and long term and make a plan for continuing, expanding, or wrapping up.
	Evaluate your data-driven activities for impact • Evaluate your data-driven activities for impact. Are they supporting the outcomes and impacts that you planned for, and can you measure them? Can you improve the design and delivery of your activities? Can you sustain existing activities and are there practical constraints or challenges that might require a change of approach? • This includes evaluating activities that: engage within your organisation and build institutional capacity; engage your local community and build grassroots capacity; communicate and promote the work of your project to a wider audience; directly mitigate air pollution or urban heat; support reduced exposure or people to air pollution and urban heat.
Report on evaluation outcomes	**Report on and publish the results of the evaluation process**

Associated OPENAIR resources

Factsheet

The Impact Planning Cycle at a glance

This factsheet presents the OPENAIR Impact Planning Cycle, a simple practical framework designed to assist local governments with impact planning for a smart air quality monitoring project.

Best Practice Guide

The Impact Planning Cycle overview

This Best Practice Guide chapter introduces the OPENAIR Impact Planning Cycle, a simple practical framework designed to assist local governments with impact planning for a smart air quality monitoring project. The Impact Planning Cycle is a planning tool that can help to maximise the impact of a project and address the needs of an organisation and community.

Sensing device calibration

This Best Practice Guide chapter provides guidance on the calibration of smart low-cost air quality sensing devices. It discusses calibration, co-location, decision-making, and developing and following a plan.

Supplementary resource

Identify template

This template supports creation of a business plan and 'data use action statement' as strategic foundations for a smart low-cost sensing project.

Further information

For more information about this project, please contact:

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This supplementary resource 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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