flyinghigh

City drone strategy toolkit

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nesta

INDUSTRIAL STRATEGY | UK Research and Innovation

About this publication

This toolkit was developed and designed by the Good Problems team at Science Practice – a research and design consultancy that works with funders to help them identify and prioritise important problems and design effective innovation programmes.

www.science-practice.com/teams/good-problems

About Flying High

The Flying High Challenge is the first programme of its kind to convene city leaders, regulators, public services, and industry around the future of drones in UK cities.

www.flyinghighchallenge.org

About Nesta

Nesta is a global innovation foundation. We back new ideas to tackle the big challenges of our time.

We use our knowledge, networks, funding and skills – working in partnership with others, including governments, businesses and charities. We are a UK charity but work all over the world, supported by a financial endowment.

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Introduction

This pack is for cities interested in discovering how drone technology could be used to address local needs

This pack was originally developed to help cities selected to participate in Nesta's Flying High project. The methodology and activities were designed to help cities prioritise which drone use cases to explore further, potentially through proofs of concept, demonstrations, or even pilots. With this release, we've adapted it so that other cities interested in exploring urban drone use can benefit from it, too.

For the five cities participating in Flying High, this pack helped prioritise use cases so that one from each city could be selected for a more thorough technical and economic feasibility study. The results of this process are presented in the report Flying High: The future of drone technology in UK cities.

We think identifying opportunities and prioritising the most relevant and impactful ones is a helpful process for any city interested in integrating drone technology into the urban environment. Accordingly, the aim of this release of the prioritisation pack is to support individuals representing local governments and regional authorities in the process of prioritising suitable, impactful, and feasible drone use cases for their cities.

In this pack, we propose a four-part methodology with accompanying activities to help your city **explore** local priorities and drone applications, **define** use cases to create a longlist, **prioritise** these use cases by involving a local advisory committee to create a shortlist, and **investigate** select use cases to explore their potential **impact** and, for those that show potential for economic and social benefit, their **feasibility**. You can use this process to start shaping an ambitious drone vision for your city.

Outcomes of this process
Working through this pack will help you realise the following outcomes:

1. Understanding how drone use could benefit broader community priorities.
2. Clear descriptions of the possible drone use cases your city could pursue.
3. Prioritised selection of suitable, impactful, ambitious, yet feasible use cases for your city that consider community needs, opportunities, and social and economic objectives.
4. Reasonably comprehensive description of the potential impact and feasibility of your city's top priority use cases.

Before you begin

Background information to help you get the most out of this pack

Working iteratively

This guide proposes a method to explore, define, prioritise, and investigate how drones could operate in your city. We invite you to follow the exercises however it makes sense. You can turn suggested group work into an individual activity, ask for feedback in individual calls instead of committee meetings, and skip stages that you've found other ways to complete. Keep in mind that if you progress to one stage and find your current selection of use cases isn't working, or a use case needs to be modified in light of new information, you can always go back and re-run earlier stages to generate alternatives or surface new insights before carrying on. The Methodology (page 7) explains in more detail how working iteratively might change the way you use the stages and exercises in this guide.

City priorities

Having a clear idea of the current state of your city, and where it aspires to be in 5–20 years, positions you to assess how drones might be able to help. Before you begin to explore drone technology, we recommend collecting local goals and priorities related to transport, economic growth, and urban development. These could be taken from your local authority's strategic documents, or sourced through engagements with local stakeholder groups. With your city's priorities established, you'll be in a better position to identify use cases and assess these according to suitability, potential impact, and other criteria (page 6). See the Explore stage (page 8) for one way you can use priorities to help you identify use cases for your city.

Continues on next page...

What is a use case?

We think it's helpful to think of different ways drones could operate in urban environments in terms of use cases. A use case is a brief statement that captures the essential interaction between a drone and a city in a certain type of situation. When you start to **define** use cases (see Define on page 9), we recommend building use cases iteratively. Begin with general expressions of what a drone might do in an environment, e.g. "A–B delivery" (for more suggestions, see the Introductory pack). As you refine your focus, you can further specify these, e.g. "Medical delivery" (see the Use case pack). As you collect more research and feedback, you can detail your use case further, e.g. "Medical sample delivery between Hospital X and Lab Y".

Criteria for a good use case

To help you in the exploration and prioritisation of the use cases, this pack proposes a three-part framework and related criteria (see Framework and criteria on page 6). The framework asks you to consider impact, both social and economic, and feasibility in terms of technology, regulation, infrastructure, and implementation. It also suggests you consider suitability for your city. This relates to the city priorities you have identified, any unique geographic or climatic conditions, and the availability of or proximity to relevant expertise or industry. Of all the potential drone use cases, why does this one hold the most relevance and potential impact for your city?

Establishing an advisory committee

Building a network of key stakeholders and colleagues who can advise you either one-on-one or together as a committee can help ensure your work builds on multiple perspectives and draws on a diversity of expertise. We recommend connecting with representatives from civil society, local administration, the (drone) technology sector, local businesses, and emergency services. Whether you call on them separately or convene them at meetings and workshops, your advisory committee will help ensure the drone use cases you prioritise align with the local needs and goals, and take advantage of current and emerging technologies realistically and feasibly. In each of the stages described in this guide, there are suggestions for how you can involve members of your advisory committee.

Framework and criteria

To assess and prioritise identified use cases

To help you discover and prioritise use cases, this pack proposes a framework and set of criteria that you can use as a starting point to develop your own set of criteria for suitable use cases for your city.

SUITABILITY	**For your city** Does the use case solve a genuine problem in your city, is it in line with your policy objectives, and is your city best placed to implement this use case?
IMPACT	**Social** To what extent will this use case have a positive impact on your city and its constituents (e.g. in terms of quality of life and social outcomes such as health, housing, environment, safety)? **Economic** Is the use case economically viable and will it support economic improvements in your city (e.g. in terms of productivity growth, cost reductions, job opportunities, growth of new industry)?
FEASIBILITY *To research with technical experts during the stage* Investigate: feasibility *beginning on page 15.*	**Technology** What will drones be required to do to meet this use case and how far off are they now from achieving this? Can any technological innovations required be achieved in the next 2–3 or 5–10 years? **Regulation** What changes to existing regulation need to be in place to support the safe and secure implementation of this use case in your city? Can the relevant regulatory system be developed to support this use case? **Infrastructure** What additional infrastructure is needed to support the effective implementation of this use case and will your city be able to able to accommodate this? **Implementation** What kind of resources and partnerships are needed to implement the use case? Is your city able to provide these? Will the use case have sufficient legitimacy with the public and key stakeholders?

Methodology

To support the process of discovering and prioritising use cases

This pack proposes a four-stage iterative methodology. Use these stages and the activities they suggest to help guide your process.

We recommend starting with the **explore** stage, working to **define** a first shortlist of use cases, and then engaging key stakeholders in your community to **prioritise** these. Based on this process, you may find the selection of use cases you are considering changes quite dramatically. Stakeholders might suggest additional drone applications you hadn't previously included on your list, or you might redefine use cases based on new insights surfaced through research. It's also likely that when conducting an impact assessment to answer the questions in the **investigate** stages, you will realise that some drone applications lack a business case so there's no point in going further with gathering evidence as to their technical feasibility.

That's okay – you can always revisit earlier stages and pursue new iterations to refine your selection. While the process and steps presented in this pack suggest a linear process, in practice, you will most likely go back and forth between stages several times. We suggest using the presented activities and adapting them to your changing context to improve the selection, definition, and specification of the use cases your city is considering.

EXPLORE
Get started by identifying how drone technology could be applied in your city. Articulate local priorities, then connect these with potential applications based on perceived capabilities of drone technology.

DEFINE
Synthesise your insights from the explore stage to define use cases. Create succinct briefs for each use case. Use these briefs to create a longlist to share with key stakeholders in your community.

PRIORITISE
Engage with key stakeholders in your community to prioritise use cases and create a shortlist that you can then investigate in greater detail.

INVESTIGATE
Gather further evidence on the potential impact – including economic viability – and technical feasibility of implementing the shortlisted use cases in your city.

Explore

Do this to...
Articulate local priorities, then connect these with potential applications based on perceived capabilities of drone technology.

You'll end up with...
- A better idea of how drone technology might help realise your city's goals
- A longlist of drone applications which can be developed into use cases.

Time to complete:
10 minutes per goal

This exercise helps you get started by identifying how drone technology could be applied in your city.

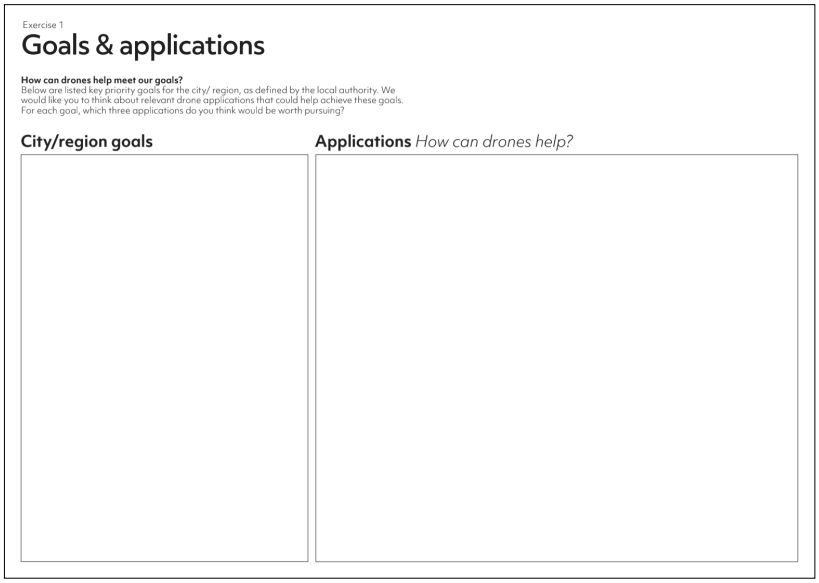
Before you start, compile a list of city goals or priorities related to transport, economic growth and urban development. These could be taken from strategic documents prepared by the local authority, or sourced through engagements with local stakeholder groups.

Using the Introductory pack and Use case pack, identify drone applications that might contribute toward the achievement of these goals. Going beyond these packs, propose additional drone applications that could support the goals.

This exercise could be done independently or as part of a meeting or workshop with key stakeholders or the public. To involve others in this process, you could:

- **Crowdsource drone applications**
  Involve the public and ask them to suggest applications that help meet your city's objectives.

- **Get expert advice**
  Set up an advisory committee for the project, and ask members to suggest applications in advance of a meeting.


Exercise 1

Goals & applications

How can drones help meet our goals?
Below are listed key priority goals for the city/ region, as defined by the local authority. We would like you to think about relevant drone applications that could help achieve these goals. For each goal, which three applications do you think would be worth pursuing?

City/region goals | **Applications** *How can drones help?*

- Brainstorm potential applications of drones and match these to the goals they could contribute toward addressing. You can download this worksheet and print on A2-sized paper to use in group settings.

Define

Do this to...
Capture ideas of drone use cases for your city, and share it with others who can help you decide which ones to prioritise.

You'll end up with...
- A set of briefs that describe key dimensions of drone use cases to consider
- A sense of the extent to which these use cases align with your suitability criteria
- A longlist of potential drone use cases for your city that you can share with decision-makers.

Time to complete:
10–25 minutes for each use case

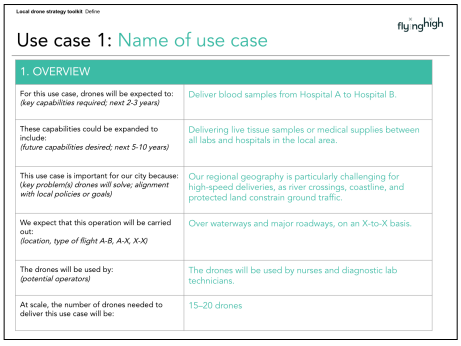
This exercise will help you synthesise your insights from the **explore** stage to specify use cases. Capture key characteristics of potential drone applications and define them in a series of use case briefs. Use these briefs to create a longlist to share with an advisory committee of key local decision-makers and drone experts in your city to inform them ahead of the **prioritise** stage.

Be sure to read What is a use case? (page 5) before you begin defining your first iteration of use cases.

Developing slide-based briefs

We've created a slide template you can use to bring key decision-makers and technical experts in your city up to speed on the drone use cases you are considering. For each use case, fill in the first slide called 'Overview'. This captures key features of your drone use case. You can also opt to fill in slides 2 through 4, which offer prompts to capture the suitability of your use case, social and economic impact, and feasibility. When meeting with decision-makers and drone experts, you can present each of the use cases by going through each of the completed 'Overview' slides, and use the additional slides as background to inform your presentation. These 'Overview' slides will also form the basis of conversations with your advisory committee to **prioritise** the use cases you've defined.

As you're filling these out, you might find that some use cases no longer seem suitable. It's still worth capturing these use cases and sharing them with decision-makers as examples of use cases that do not align with your criteria.


Local drone strategy toolkit Define

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Use case 1: Name of use case

1. OVERVIEW	
For this use case, drones will be expected to: *(key capabilities required; next 2-3 years)*	Deliver blood samples from Hospital A to Hospital B.
These capabilities could be expanded to include: *(future capabilities desired; next 5-10 years)*	Delivering live tissue samples or medical supplies between all labs and hospitals in the local area.
This use case is important for our city because: *(key problem(s) drones will solve; alignment with local policies or goals)*	Our regional geography is particularly challenging for high-speed deliveries, as river crossings, coastline, and protected land constrain ground traffic.
We expect that this operation will be carried out: *(location, type of flight A-B, A-X, X-X)*	Over waterways and major roadways, on an X-to-X basis.
The drones will be used by: *(potential operators)*	The drones will be used by nurses and diagnostic lab technicians.
At scale, the number of drones needed to deliver this use case will be:	15–20 drones

Create your use case longlist by filling out an 'Overview' slide for each of the potential applications identified in the exploration stage and share it with an advisory committee of local decision-makers and drone experts.

Prioritise

Do this to...
Get input to help you prioritise which use cases you should continue to explore in more depth.

You'll end up with...
- A shortlist of three to five drone use cases to prioritise for further investigation
- A better idea of what opportunities decision-makers see in drone technology, and why.

Time to complete:
2 hours

Once you've shared your use case longlist with your advisory committee members, involve them in prioritising a shortlist of use cases. You can use this shortlist to decide which use cases to beign with when conducting more detailed research during the **investigate** stages.

It's up to you to decide how to involve your advisory committee members, whether individually or as a group. Here, we suggest a structure for a workshop-style committee meeting where you present the overview slides developed in the **define** stage and then ask members to prioritise them through consensus.

MEETING PREPARATION

You will need:
- One print of each of the first 'Overview' slide representing the use cases you have longlisted.
- Access to a set of criteria (see criteria framework on page 6 for a starting point) specific to your city.
- Enough coloured dot stickers for each committee member to have three red, three yellow, and three green stickers.
- Flipchart paper.

CRITERIA FOR A GOOD MIX OF USE CASES

In addition to suitability and social and economic impact, you may wish to consider the following when selecting your top three to five use cases:

Mix of ambitiousness Your top three preferences should include a mix of use cases that are relatively easy to implement in the near future (2–3 years), but also more ambitious cases that would call for further drone innovations (5–10 years).

Commercial potential All top use cases should be reasonably expected to hold some long-term commercial viability. This could either be covered by the use case per se or the use case could support the development of a technical, regulatory and infrastructure system that would enable future commercial applications.

Cumulative impact As part of your prioritisation consider use cases that can have a positive impact on different communities or groups.

Coherent vision Consider the extent to which your top use cases help you build a coherent vision for drone use in your city/region. What role are you envisioning drones playing in your city/region and how well is this captured buy your top three selection?

Using the framework and criteria to prioritise through consensus

You can follow this structure when convening your advisory committee to prioritise your use cases into a shortlist.

1. Familiarise all advisory committee members with your chosen use cases by going through the 'Overview' slide for each use case.

2. Have a discussion about the criteria framework (page 6). What are the criteria that need to be fulfilled by the shortlisted use cases?

3. In groups of four to five, discuss which of the use cases best meets each one of the selection criteria (i.e. which is most suitable, which promises highest social impact etc.).

4. Within each group, decide on the top three to five use cases that best match each criterion (use coloured stickers provided).

5. Identify the use cases with most dots/votes in each group. Have groups collectively decide on their top three use cases.

6. Have each group share their top use cases with the rest of the advisory committee.

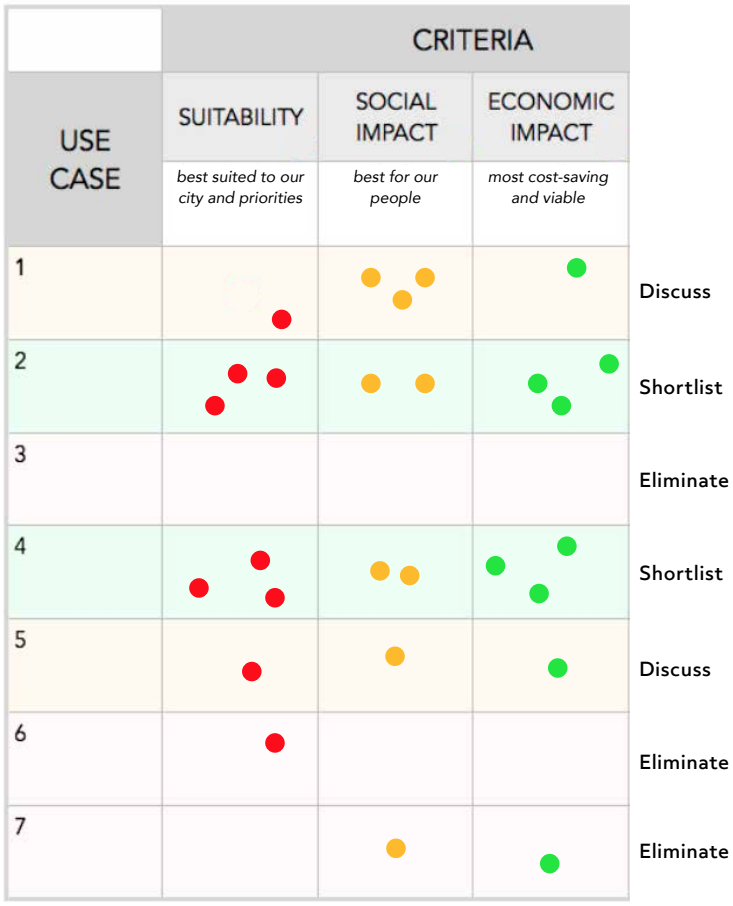
Sample group discussion and voting sheet. You can create a similar sheet for each discussion group on flipchart paper. Note that the technical feasibility criterion has been excluded to reserve detailed technical discussions for the Investigate: feasibility stage (page 15).

7. As each group shares their top use cases per criterion and overall, tally up votes by combining them on one sheet.

8. The use cases with no/few votes are eliminated.

9. Discuss the top overall use cases and make a collective decision about which use cases to shortlist.

You will further assess the potential impact – including economic viability – and feasibility of the resulting shortlisted use cases in the **investigate** stages.



Sample all-group combined votes showing use cases to shortlist, discuss, and eliminate.

Investigate: impact

Do this to...
Gather evidence on the potential impact of implementing shortlisted use cases in your city.

You'll end up with...
- Evidence that helps you assess whether or not your shortlisted use cases are viable, and decide if you should pursue them further.

Time to complete:
1 hour per use case; longer if you pursue additional impact assessment research.

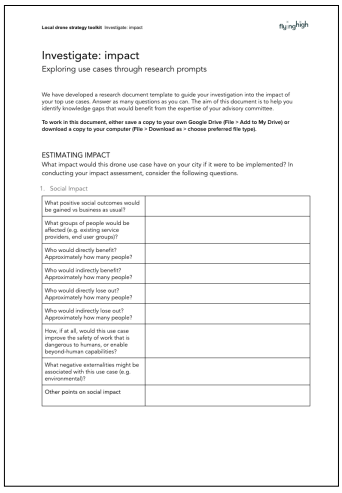
This exercise is to help you to start exploring the impact of implementing shortlisted use cases in your city. To support this process, we have included a list of questions to act as research prompts. The questions are included here, but you can also work from the downloadable template.

We recommend structuring your research process according to the following principles:

- **Use gaps to guide conversations with experts**
  Using the questions to guide your research, investigate each of the shortlisted use cases. Fill in all the answers you can, and identify knowledge gaps that would benefit from input from advisory committee members. Use these gaps to create a discussion guide for conducting meetings and interviews with relevant advisory committee members.

- **Work iteratively**
  As you draw on the expertise and perspectives of the task force members, update the research document for each of the shortlisted use cases so it reflects your current understanding.

If evidence suggests that there is a business case to be made for pursuing a given use case, then proceed to **investigate: feasibility**. If it suggests that there is *not* a business case, then return to your shortlist or to the original longlist and investigate the impacts of other prioritised use cases.



Local drone strategy toolkit: Investigate: impact

Investigate: impact

Exploring use cases through research prompts

We have developed a research document template to guide your investigation into the impact of your top use cases. Answer as many questions as you can. The aim of this document is to help you identify knowledge gaps that would benefit from the expertise of your advisory committee.

To work in this document, either save a copy to your own Google Drive (File > Add to My Drive) or download a copy to your computer (File > Download as > choose preferred file type).

ESTIMATING IMPACT

What impact would this drone use case have on your city if it were to be implemented? In conducting your impact assessment, consider the following questions.

1. Social impact

What positive social outcomes would be gained vs business as usual?	
What groups of people would be affected (e.g. existing service providers, end user groups)?	
Who would directly benefit? Approximately how many people?	
Who would indirectly benefit? Approximately how many people?	
Who would directly lose out? Approximately how many people?	
Who would indirectly lose out? Approximately how many people?	
How, if at all, would this use case improve the safety of work that is dangerous to humans, or enable beyond-human capabilities?	
What negative externalities might be associated with this use case (e.g. environmental)?	
Other points on social impact	

The research document template can be downloaded or saved to Google Drive.

Impact assessment research prompts

ESTIMATING IMPACT
What impact would this drone use case have on your city if it were to be implemented? In conducting your impact assessment, consider the following questions.

1. **Social impact**

   What positive social outcomes would be gained vs business as usual?

   What groups of people would be affected (e.g. existing service providers, end user groups)?

   Who would directly benefit?

   Who would indirectly benefit?

   Who would directly lose out?

   Who would indirectly lose out?

   How, if at all, would this use case improve the safety of work that is dangerous to humans, or enable beyond-human capabilities?

   What negative externalities might be associated with this use case (e.g. environmental)?

2. **Economic impact**

   What is the potential scale of this solution at local and national level and what would be the implications of operating at scale?

   Is this use case likely to lead to significant local productivity gains?

   What type of cost savings would be associated with this use case and for whom?

   What kind of added costs would be associated with this use case and for whom?

   What would be the impact on the local/ regional workforce?

   Would this use case create new local business opportunities?

   What type of negative externalities could be associated and what would be the level of mitigation costs?

Investigate: feasibility

Do this to...
Gather further evidence on the technical feasibility of implementing the most promising use cases in your city.

You'll end up with...

- Evidence that helps you assess whether or not your shortlisted use cases are technically feasibile, and whether they make sense to potentially test and pilot in your city.

Time to complete:
1 hour per use case; longer if you pursue additional technical feasibility research.

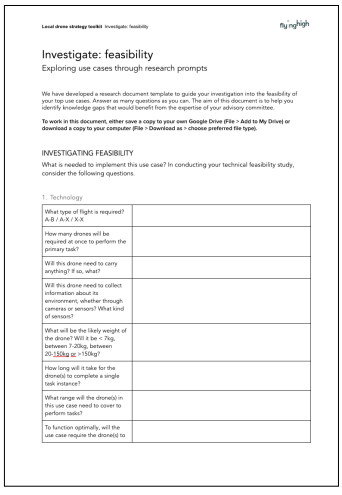
Only proceed to investigating feasibility for use cases that demonstrate a business case and good potential for positive social and economic impact as a result of the your investigation into impact.

This exercise is to help you to start exploring the technical feasibility of implementing shortlisted use cases in your city. To support this process, we have included a list of questions to act as research prompts. The questions are included here, but you can also work from the downloadable template.

We recommend structuring your research process according to the following principles:

- **Use gaps to guide conversations with experts**
  Using the questions to guide your research, investigate each of the shortlisted use cases. Fill in all the answers you can, and identify knowledge gaps that would benefit from input from advisory committee members. Use these gaps to create a discussion guide for conducting meetings and interviews with relevant advisory committee members who have the technical expertise needed to inform your research.

- **Work iteratively**
  As you draw on the expertise and perspectives of the task force members, update the research document for each of the shortlisted use cases so it reflects your current understanding.



Local drone strategy toolkit Investigate: feasibility

Investigate: feasibility

Exploring use cases through research prompts

We have developed a research document template to guide your investigation into the feasibility of your top use cases. Answer as many questions as you can. The aim of this document is to help you identify knowledge gaps that would benefit from the expertise of your advisory committee.

To work in this document, either save a copy to your own Google Drive (File > Add to My Drive) or download a copy to your computer (File > Download as > choose preferred file type).

INVESTIGATING FEASIBILITY

What is needed to implement this use case? In conducting your technical feasibility study, consider the following questions.

1. Technology

What type of flight is required? A-B / A-X / X-X	
How many drones will be required at once to perform the primary task?	
Will this drone need to carry anything? If so, what?	
Will this drone need to collect information about its environment, whether through cameras or sensors? What kind of sensors?	
What will be the likely weight of the drone? Will it be < 7kg, between 7-20kg, between 20-150kg or >150kg?	
How long will it take for the drone(s) to complete a single task instance?	
What range will the drone(s) in this use case need to cover to perform tasks?	
To function optimally, will the use case require the drone(s) to	

The research document template can be downloaded or saved to Google Drive.

Technical feasibility study research prompts

INVESTIGATING FEASIBILITY

What is needed to implement this use case? In conducting your technical feasibility study, consider the following questions.

1. **Technology**

   What type of flight is required?

   A-B / A-X / X-X

   How many drones will be required at once to perform the primary task?

   Will this drone need to carry anything? If so, what?

   Will this drone need to collect information about its environment, whether through cameras or sensors? What kind of sensors?

   What will be the likely weight of the drone? Will it be < 7kg, between 7-20kg, between 20-150kg or >150kg?

   How long will it take for the drone(s) to complete a single task instance?

   What range will the drone(s) in this use case need to cover to perform tasks?

   To function optimally, will the use case require the drone(s) to operate within visual line of sight (VLOS), within an extended visual line of sight (EVLOS), or beyond visual line of sight (BVLOS)?

   What level of control, in terms of communication and autonomy, will be required of the drone?

   Will this use case impose any noise constraints on the operation of the drone?

   Are you aware of any existing implementation of this use case & lessons learnt?

   Are there any additional technical requirements that drones will need to carry out this use case?

2. **Infrastructure**

   What are the envisaged flight corridors/ flight paths for this drone use case?

   What is the structure of the built environment where drones will operate (e.g. density & height of buildings)?

   Will the drone(s) require any take-off/ landing pads? If so, where would these be located?

   Will the drone(s) require any refuel/charging points? If so, where would these be located?

   Are there any airports in the proximity of your city/region? If so, how will these affect envisioned flight paths & the operation of the drones?

   What kind of telecommunications infrastructure is required to support the safe operation of the drone(s) at scale?

   What is the existing telecommunication infrastructure in your city? Are there any future development plans (e.g. 5G networks)?

   What is the estimated level of infrastructure investment to scale the use case?

   Are there additional infrastructure requirements that drones will need to carry out this use case?

Continues on next page...

3. Regulation

Will the drones be collecting any public/ private data? How will data privacy, use and storage be managed?

What kind, if any, additional safety regulations are required for this use case to operate?

Will any noise regulations apply to this use case?

Will the envisioned flight paths for this use case have implications on properties below?

What regulation is needed to support the successful operation of the drone(s) – VLOS/ EVLOS/ BVLOS?

Are there any additional regulatory requirements that drones will need to carry out this use case?

4. Implementation

What partners & support networks do you have/would you need to support the implementation of this use case?

How do you envision the service delivery model operating for this use case?

What kind of resources are needed to support the implementation of this use case?

Is your city/region able to meet these resource requirements?

What facilities are needed to support the testing and development of this use case?

What are local/regional/national public attitudes likely to be towards drones in the context of this use case?

What is the level of support from local authorities & regulatory bodies with regards to drone use in your city/region and specifically this use case?

Are there any additional implementation requirements that drones will need to carry out this use case?

What's next?

Public engagement

You may have already involved the public in the **explore** and **prioritise** stages of the iterative process suggested in this guide. If you haven't, you should consider doing so before moving forward with building your case for testing and piloting the most promising use cases. Drones operating in urban environments will be flying near people's houses, workplaces, schools, and transport corridors, so with your help they must determine how to work toward a future in which urban drone use is acceptable and beneficial.

System and service design

The future of drones in urban environments will not be constrained to a single use case. In developing your use case(s) further, it will be important to demonstrate that you have considered interactions with other drones carrying out other applications within the same air-space. What is needed to protect public safety? Who will be allowed to operate drones? What infrastructure will be needed to support communication and network connectivity? How will drone ownership and missions be confirmed by airspace controllers and people on the ground? In addition to the technical, infrastructural, and regulatory provisions needed to realise a use case, you will also need to consider each one in terms of the service it is delivering. Who are the organisa-tions and actors that will be participating in this system, and what will their roles be? How will the system be governed? How will the service ensure that it provides for and is accountable to the needs of users?

Building a test case

Building on your investigation and identification of promissing drone use cases for your city, the next step will be to advance conversations towards practical implementations. How to test and pilot drone use cases in your city?

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