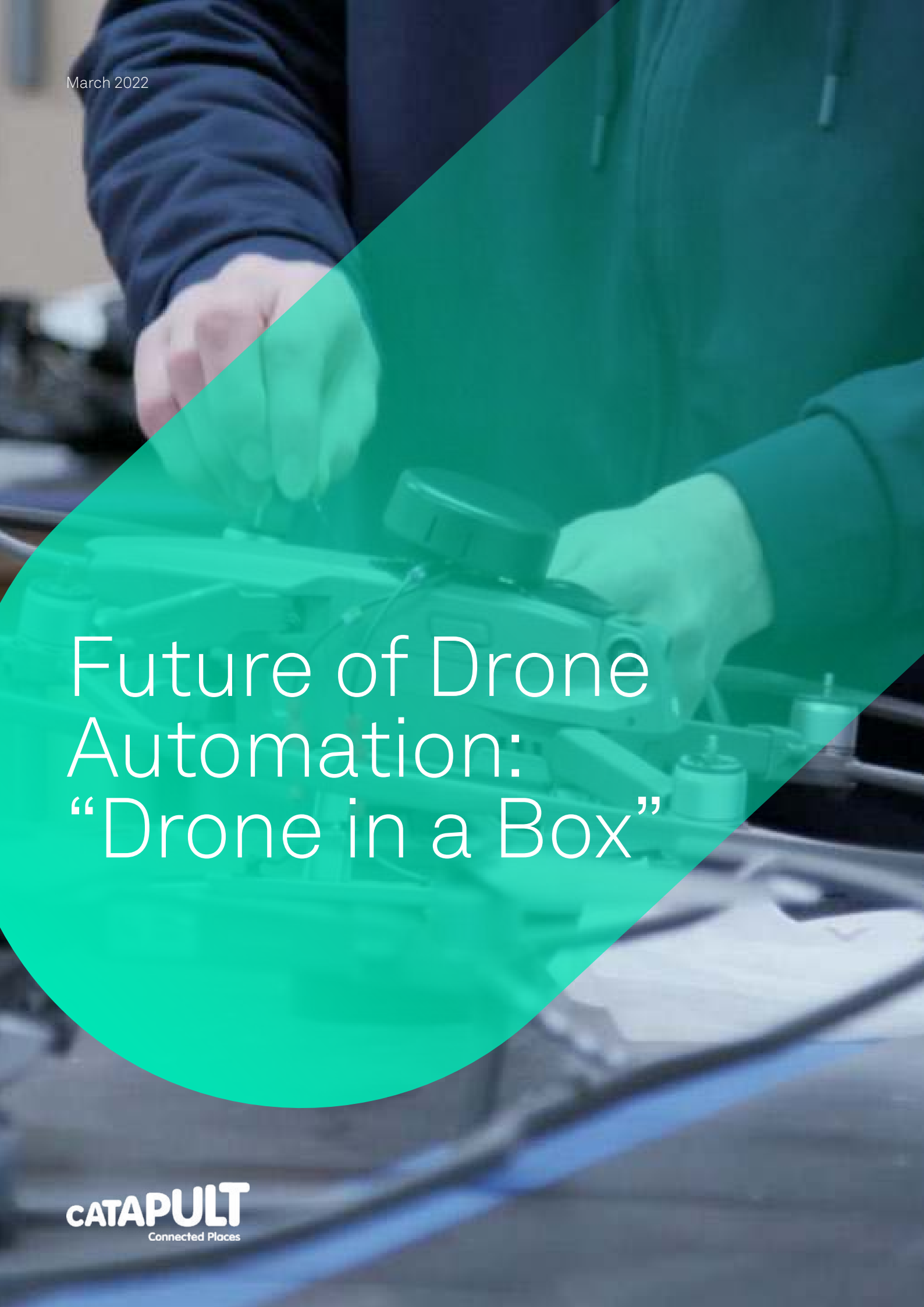


March 2022

Future of Drone Automation: “Drone in a Box”

CATAPULT
Connected Places

Automated drone solutions like drone in a box promise to provide safer, cheaper and more flexible operations, from infrastructure inspection to site security . They support a move towards ‘data on demand’, enabling decisions and operating models not previously viable.

This case study outlines the benefits of automated drone solutions, particularly ‘drone in a box’ systems, that enable automated flight management, data management and system maintenance. We’ll take a look at their journey to maturity, and see how organisations are already using them to drive productivity and safety. Whether or not you already use drones, assets and infrastructure managers in the UK will benefit from reading about why and how drone automation can improve existing operations.

Key takeaways

- Connected Places Catapult partnered with Herotech8 and IDIPLOYER to explore and showcase drone in a box technologies
- Drone in a box systems take-off and land, charge, and manage captured data automatically. They enable remote, automated and scalable operations
- These solutions can be used for security, site management and asset inspection across many sectors: from construction, to transport infrastructure, to power infrastructure, to prisons.
- They drive benefits primarily by enabling efficient off-site oversight for drone operations. This reduces operating costs, increases staff safety and alleviates excess travel.
- Drone automation technologies are yet to be fully exploited, but organisations such as EDF, MSD, UK prison operators and solar farm operators are trialling and scaling these solutions across the UK and Europe.
- In future, automation will enable more service- and output-centric drone operation paradigms such as “drones as a service” and “data as a service”.
- Organisations who explore this technology now stand to gain the quickest from it. Get in touch with Connected Places Catapult, Herotech8 or IDIPLOYER to find out more.

The case for drone in a box systems

The UK is sprawling with infrastructure and assets that need inspecting, maintaining and securing.	Including: • 2,300 miles of motorway[1] • 20,000 miles of Network Rail managed track, 30,000 bridges, tunnels and viaducts, and thousands of signals[2] • Over 90,000 pylons, 4,300 miles of high voltage overhead lines[3] • 120 commercial ports[4] • Hundreds of airports and airfields • 100Bn of ‘new work’ construction outputs across GB in 2020[5]
Drones are being adopted across UK sectors to improve the ways assets are managed	While each application varies, they are generally used to do things safer, faster, more cost effectively, and ultimately provide better data outputs to support decision making.
Manual drone operation is ‘good enough’, but automation enables scale.	Automation unlocks scale and economic viability. It is improving the business case for applications where drone use is already compelling, and it’s enabling new applications that were not possible before.
In future, more use cases will be viable due to drone automation.	From automated security, to regular inspection, to ‘drones as a service’; drone automation, as part of UK-wide digital transformation, will transform some applications and improve many others.
Drone in a box systems are one tool which takes us closer to automation	Drone in a box systems allow automated flight management, data management and system maintenance. They can enable entire remote operations and 1-to-many control of drones, allowing operating efficiency not possible with manual operations.
Connected Places Catapult partnered with UK Drone in a Box suppliers to demonstrate their capabilities	Herotech8 and IDIPLOYER are both UK based manufacturers of drone in a box systems. CPC partnered with them to understand how their clients are using them and to what benefit.

Introduction to drone in a box

What are drone in a box systems?

At its core, a ‘Drone in a Box’ is an integrated system of:

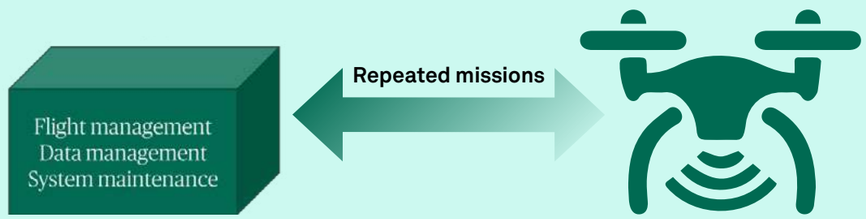
1. a drone, commercially available or bespoke
2. a “box” docking and charging station
3. IT, including control and communication systems

The combination of these sub-systems and others creates an adaptable tool to enable automated drone operations. The capabilities of a drone in a box include:

Flight management
- Automated take-off and landing
- Automated flight management
- Off-site remote control

Data management
- Real-time remote data feed
- Automated data upload and storage
- Integration into existing IT systems

System maintenance
- Charging between flights
- Automated pre-flight checks and system monitoring
- Security and weather-proofing



What do they enable?

Drone in a box systems enable operations to be carried out remotely, automatically and at scale.

Remotely

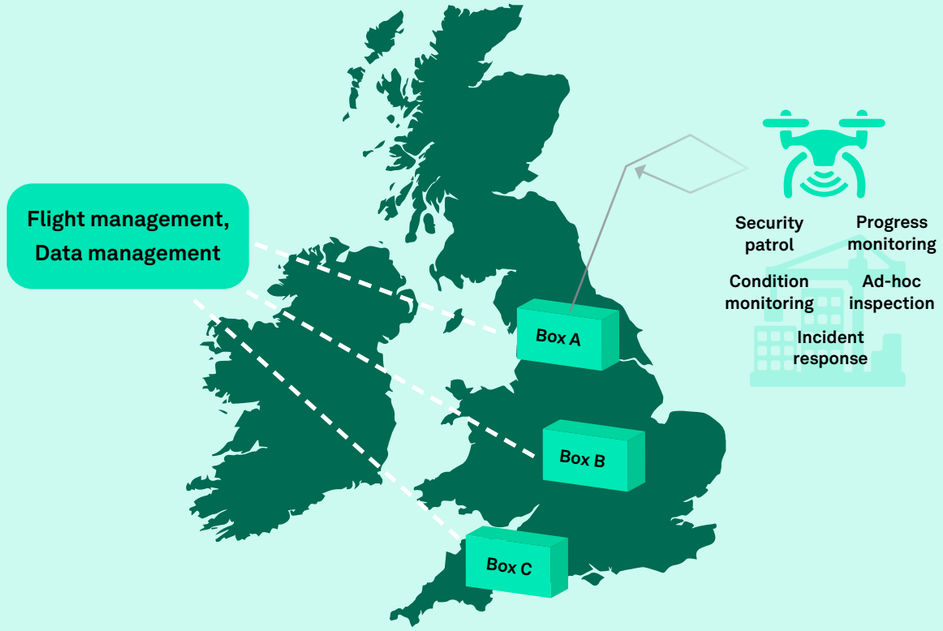
- Operators can be situated anywhere with a data connection. Once deployed, the systems are designed to function with limited on-site human interaction.

Automatically

- Via their own flight management systems or integration with other systems, they can react to requests or alerts, automatically capture and upload data, and carry out other responsive or pre-planned operations automatically.

At scale

- Data and flight management can be aggregated so that many systems, distributed across sites, can be overseen by one operator.



What can they be used for?

Drone in a box solutions should be considered wherever drones would be beneficial, but the remoteness, frequency, responsiveness or scale of the required operations would be challenging using on-site piloted flight.

Use cases include security, site management, and asset inspection, across sectors like agriculture, power generation and transmission, emergency services, utilities, sensitive site, construction, transport infrastructure

Response to perimeter security alerts

Regular security patrol and deterrent

Routine asset inspection and surveying

Responsive inspections of faults

First response and incident call-out

Construction site progress monitoring

Pre-flight runway checks

Volumetric resource monitoring

Several real-world examples from Herotech8 and IDIPLOYER are provided lower down in this document.

What are the benefits?

Drone in a box systems can unlock economic, social and environmental benefits across the UK.

Economic Case

- Reduced expenditure on travel and on-site drone operation
- More frequent data capture, enabling preventative and targeted asset management decisions
- One-to-many drone oversight and control, streamlining operations

Social Case

- Remote operation, reducing access required to unsafe working areas like rail tracks, roofs or pylons
- Providing an additional layer of safety and support between security staff and potentially dangerous incidents
- Remote operation, alleviating lone working at isolated sites

Environmental Case

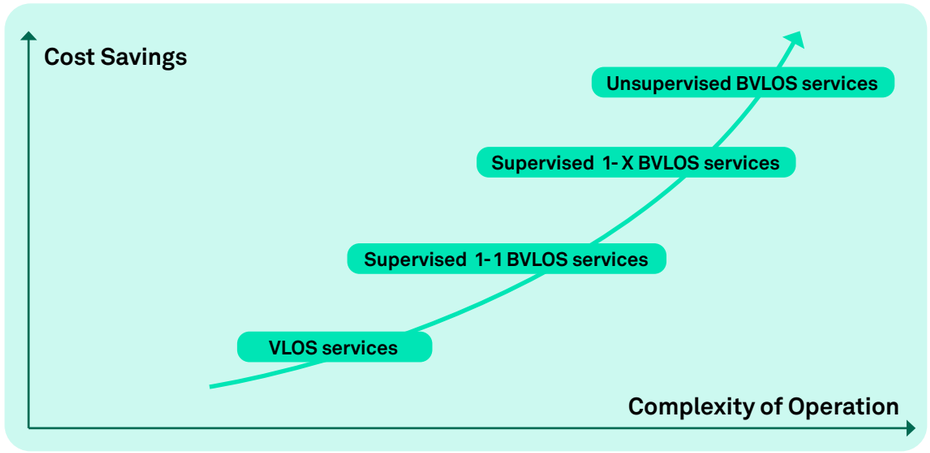
- Reduced routine travel to-and-from remote inspection sites
- Preventative and targeted asset management reducing maintenance works overall and therefore the use of heavy plant equipment and materials

How mature are they?

Drone in a box technologies have been commercially developing over the last c. 5 years, steered by advancing technologies and regulatory frameworks. Both operational use cases and trials for new applications are picking up momentum. Industries that are exploring and investing in these technologies now are already realising benefits, and many are looking to scale up.

Today’s applications are not the full picture, however. Current deployments of a drone in a box systems in UK uncontrolled airspace require at least a spotter on-site, providing “extended” visual line of sight of the drone so that information can be relayed to the remote pilot in case of an emergency.

Once routine beyond visual line of sight flight is possible in the UK, many more drone in a box applications will become commercially viable. Herotech8 use the following figure to explain this trajectory towards increased cost savings and operational complexity as the technology and regulations enable different types of operation.

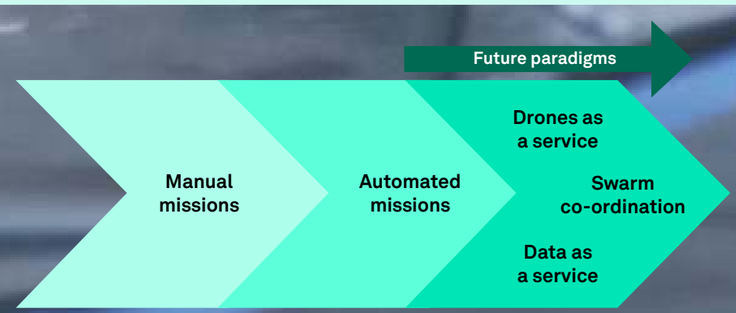


Graph showing how new types of operations enable cost savings and more complex operations. Credit to Herotech8 .

Term	Meaning
VLOS	Visual Line of sight
BVLOS	Beyond visual line of sight
1-1	One pilot to one drone/system
1-x	One pilot to many drones/systems
Supervised/unsupervised	Whether or not a ‘spotter’ is required on site

What is the future?

Drone operations will become increasingly automated, driven by demand for cheaper and more convenient solutions. Drones are ultimately a means to an end; a tool. Automation will enable more focus on the outputs and services that drones provide for end-users, and less attention will be paid to the drone technology. Services like Herotech8’s Open Air will enable new service paradigms:



Real world examples

Power infrastructure security & monitoring - Herotech8 with EDF

EDF are a global power and energy supplier and are the largest provider in France. The facilities and networks that EDF manage are critical to maintaining the continued supply of power to its customers, with each site being highly complex and closely managed.

With the extensive list of activities and services that are happening at any one time on a power facility, site security and asset inspection are critical parts of day-to-day operations. Traditional perimeter inspections on such large sites are incredibly resource and time intensive, needing individuals to manually walk the sites multiple times per day. Facilities and rooftop inspections are equally time consuming, and inevitably lead to safety risks due to working from height.

Drone in a box use case
In collaboration with HEROTECH8, EDF explored the potential of improving efficiency on a particular site in Brennilis, a repurposed nuclear site now producing power through alternative sources. The complexity and sheer size of the facility means that regular inspection and maintenance is challenging. In this instance, the primary focus for EDF was to explore how site and perimeter security could be made more efficient.

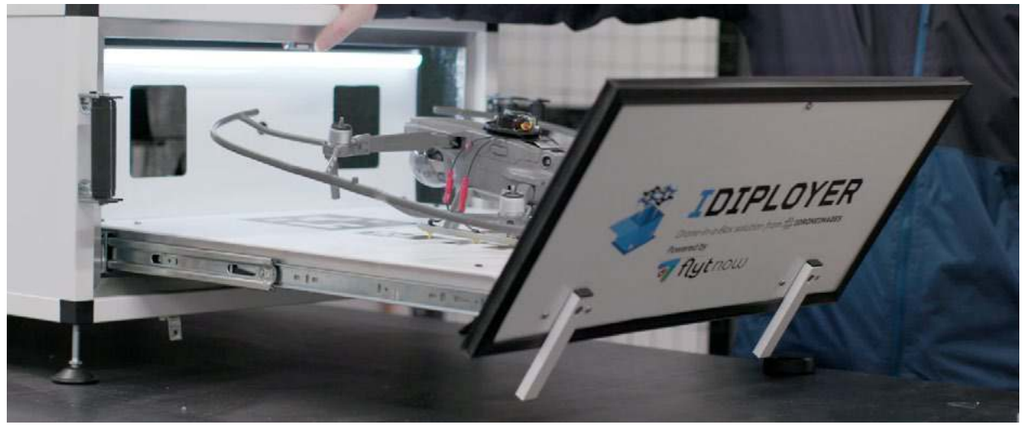
Following a full review of the facility, it was deemed that two drone in a box systems would be capable of providing round the clock capability security and perimeter surveillance, as well as some additional services once the system was fully operational.

As part of the development work for the implementation, one of the world’s most advance Operation Safety Cases was developed. The systems are flown multiple times a day, at the touch of a button, overseen and monitored by the security team on site. There are no drone pilots required and the system works fully autonomously, all day every day. As a result security patrol teams can refocus on other areas of the site that require their attention, knowing that the perimeter is under control, in the hands of the automated drone systems.

Data output from the drones is downloaded to the cloud following each flight and available to review remotely by any team that requires it, all completely remotely.

Wider application
Following the successful implementation for security purposes, EDF are also now using the systems to conduct rooftop inspections, using both the 4K and thermal image capture capabilities. The feedback is highly positive, suggesting that several potential defects have already been identified. This will allow targeted pre-emptive maintenance, saving money compared to a reactive approach.

The benefits to the business are easy to see, with reductions in cost, time, resource and risk all making significant improvements to the site operations.



UK prison security - IDIPLOYER with Drone Defence

Prisons in the UK face perimeter security concerns and illegal contraband deliveries, both from people and from drones themselves. IDIPLOYER partnered with Drone Defence, who specialise in counter-drone technologies, to see how drone-detecting radars combined with drone in a box technologies could be used to enhance prison perimeter security, providing more coverage and a greater deterrent.

Drone in a box use case
Stationed within prison perimeter, the drone in a box system supplements existing CCTV. Perimeter alerts can automatically trigger a drone flight to the alerted area via the box’s control system APIs, providing video feeds to capture evidence and provide support to ground teams. Crucially, in combination with Drone Defence’s radar system, security drones can also find and follow adversary drones to deter contraband drops.

If the site requires redundancy and true 24hr operation, then multiple systems can work together, charging and patrolling on a rotation to ensure coverage. IDIPLOYER’ box system is vertically stackable, allowing multiple box systems to be deployed within the same physical footprint as a single box.

Automated systems like these could improve the security of prisons while relieving stretched prison staff and reducing their exposure to potentially unsafe perimeter breach incidents. The overall benefits to security and contraband reduction in prisons could contribute to savings for the prison system which far exceed the modest cost of setting up the systems on site.

Wider application
The systems are also used for regular building inspections and site maintenance tasks, and can provide aerial vantage points to support ground-based security during incidents.

IDIPLOYER and Drone Defence are exploring how these systems could be rolled out UK wide. Security use cases are ideal for drone in a box systems, so other sensitive or high-value sites could learn and benefit from these deployments. IDIPLOYER is also working with Thames Valley and Hampshire Police to investigate how their systems can support first response to public incidents.

Rail infrastructure inspection - Herotech8 with Network Rail, DroneCloud and Future Aerial Innovations

Network Rail Limited is the owner and infrastructure manager of most of the railway network in Great Britain. The UK rail network consists of 20,000 miles of tracks and some 30,000 bridges, tunnels and viaducts. Network Rail is an “arm’s length” public body of the Department for Transport. The sheer size and scale of the infrastructure that Network Rail is responsible for means inspection and monitoring tasks are some of the most involved and labour intensive of any industry.

Drone in a Box Use Case

Working in collaboration with Network Rail and DroneCloud (Network Rail’s flight management partners), a trial to explore the efficacy of Herotech8’s drone in a box system was devised.

Aim: Explore the feasibility of drone in a box deployment at Network Rail yards to carry out remote inspections, enhancing safety by removing people from hazardous environments.

Objectives:

1. Undertake site feasibility assessment at Bescot depot
2. Network Rail staff to conduct review of data collection
3. Conduct supervised automated flights using drone in a box for routine inspection within visual line of sight
4. Examine whether data shows automated process enhances the current manual process
5. Conduct a full Proof-of-Concept review to prove operational viability

Network Rail continues to conduct proof of concept flights to determine how drones in general can act as an additional tool for its workforce, removing people from hazardous environments.

Wider Application

Drone in a box systems have the potential, alongside other technologies, to make dramatic impacts on resource, risk and time as part of infrastructure asset managers’ overall toolsets.

Remote solar farm monitoring - IDIPLOYER with Drone Process

Solar farming is a rapidly growing energy production method across the UK and the world. Large arrays of solar panels are set up in often-remote locations and operators monitor asset condition by sending staff to site to carry out labour intensive walked inspections.

During the COVID lockdown, some of these sites began facing staff shortages which prompted investigation into how automation could improve operational efficiency and mitigate these shortages. IDIPLOYER partnered with local drone solution providers to deploy their drone in a box solutions to sites in France and Italy, enabling them to mitigate short-term resource issues and realise the broader long-term benefits that these systems provide. These partners have now begun to roll out IDIPLOYER drone in a box systems across their portfolio.

Drone in a box use case

Solar farm operator use the drone in a box technologies to inspect their farms from height, using thermal imaging to identify panel faults, assessing vegetation overgrowth and checking for dirt build-up. The drone in a box system can be programmed to cycle through surveying segments of the farm, pausing to charge and upload captured data to an AWS cloud for analysing or pushing into the client’s own asset management systems. This means that refreshed data is available for review or automated analysis every few days or weeks, depending on the farm’s size and the client’s needs.

The benefits of this are multiple. The quality, consistency and frequency of the captured data is greater than that of manual inspections, and the end-to-end workflow is more streamlined. This enables more effective predictive maintenance and targeted repair works, saving money. Staff travel costs to site can be minimised, and lone-working inspections can be avoided in lieu of automated surveys. All of this could contribute to more effectively run, sustainable solar sites, for the benefit of farm operators and ultimately the wider public who are increasingly aware of their energy’s origins.

Wider application

The operational concepts proven on these solar farms are transferable to other remote infrastructure sites that require periodic inspection - railway assets, power lines, distribution sites and more.

Sensitive manufacturing security - Herotech8 with MSD

MSD is a pharmaceutical manufacturer, particularly notable for the creation and distribution of COVID-19 vaccinations. MSD’s innovation centre is located in Milton Keynes and covers a site area of nearly 5,000 square metres. Management and security of the facility is paramount to the successful and continued operation of the business.

Drone in a box use case
MSD approached Herotech8 to understand how a drone in a box solution could support and improve the management of their Milton Keynes facility, particularly focusing on site security and building maintenance.

The security team were able to dramatically reduce the time taken and increase the frequency of full site surveillance using drones instead of on foot patrols. As such visibility of all areas of the site are now far easier to maintain and manage going forward, keeping individuals and assets more secure.

In addition to the security needs, the facility management team are using the drone in a box system to regularly conduct inspections on building conditions, inspect the rooftop integrity, and assess pipelines. One particular benefit identified by MSD is the quality of the assessment performed by the drone in a box solution of their pipelines on site. In the past this was an incredibly labour and time intensive process, but by utilising the drone’s inbuilt thermal imaging camera they have been able to easily detect defects and weaknesses in the pipelines via thermal leakage creating significant opportunities for operational efficiencies and related cost savings .

By removing the need for manual inspections, the overall business risks have been massively reduced. The ability to conduct these inspections far more quickly and regularly also means that potential issues can be addressed sooner, or even prevented altogether, saving MSD costs on building management.

Wider Application
MSD have demonstrated dramatic cost savings across their site operations and as such are looking at the potential to roll out autonomous drone stations across more of their sites.

They are also keen to explore further applications on the sites, such as stock and inventory management inside the warehouse facility. This would involve using the drones to inspect stock being held, which would ultimately save time and improve accuracy.

MSD HEROTECH8 OPEN AIR

Doing it yourself: common questions

If your organisation has limited experience with drones, you may have questions about where to start. The table below may help you.

What if our organisation hasn't used drones before?	Drone solution providers are prepared to work with organisations who have no experience with drones. They can offer an end-to-end service and take individual organisations' needs into account.
How does the weather affect drone inspections?	Just like traditional works, wind or rain can delay drone operations and flights are generally carried out in daylight. In changeable weather you may have to rearrange inspections at short notice. Drone solutions providers usually work flexibly to account for this.
Do we have to consider airspace restrictions or permissions?	The drone solution provider will check for airspace restrictions during flight planning. If there are restrictions, they will advise on the implications of these.
Should we buy a drone ourselves?	While many organisations successfully use drones in-house, we'd recommend working with an experienced drone solution provider first if you've not used drones before. This can help you collect evidence and experience to build a business case for whichever longer-term operational model works in your organisation.
How do I find a drone solution provider?	Ask your industry body for advice, use ARPAS's member finder function, contact memberships@arpas.uk, or get in touch with a solution provider through a web search. An experienced provider will be able to prove their competence by sharing: • Their operator ID and flyer ID, • Appropriate qualifications such as a valid PfCO or Operational Authorisation, A2 Certificate of Competency (CofC) or a General Visual Line of Sig… Certificate (GVC), • Examples of previous work. • EC 785/2004 compliant insurance • Landowner's permission to take off and land the drone. • Risk assessments for each flight that Is planned, Make sure that the works and deliverables are documented in a formal contract.

Future of Drone Automation: “Drone in a Box”

References

1. https://www.gov.uk/government/statistics/road-lengths-in-great-britain-2020/road-lengths-in-great-britain-2020
2. https://www.networkrail.co.uk/who-we-are/about-us/
3. https://www.nationalgrid.com/stories/energy-explained/everything-you-ever-wanted-know-about-electricity-pylons
4. https://www.maritimeuk.org/about/our-sector/ports/#:~:text=There%20are%20about%20120%20commercial,such%20as%20coal%20or%20oil.
5. https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/articles/constructionstatistics/2020#construction-output

Get in touch with us for more information, or visit the Connected Places Catapult website.

Follow us on Twitter
@CPCatapult

Follow us on LinkedIn
Connected Places Catapult

Email us
drones@cp.catapult.org.uk

CATAPULT
Connected Places