August 2021

The case for drone inspections in the UK

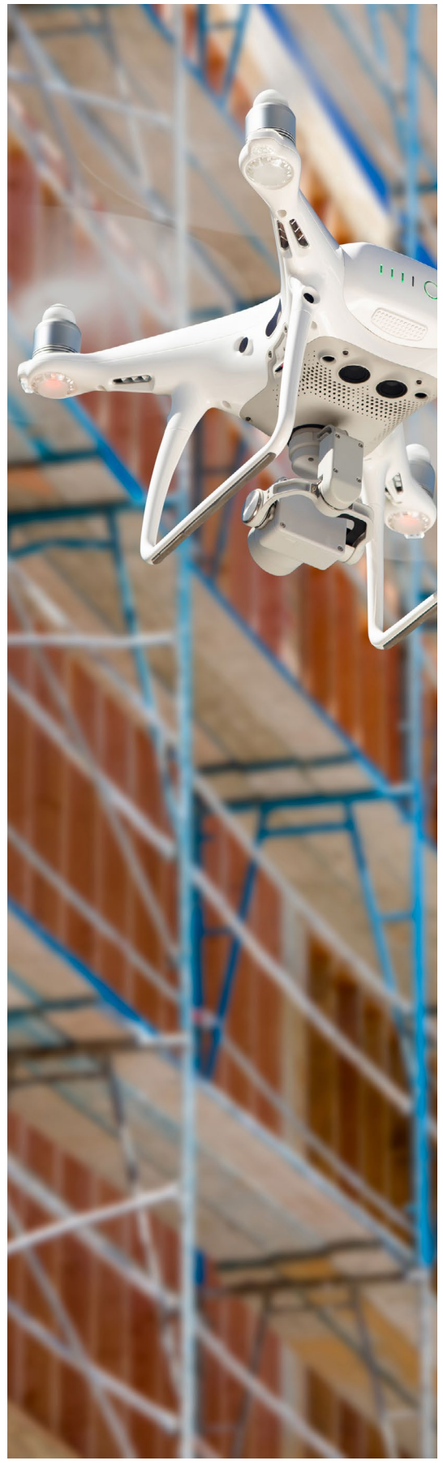
CATAPULT
Connected Places

Drones enable a step change in the way that buildings and assets are inspected. Owners of place and property portfolios can harness drone services to drive safety, productivity and efficiency whilst also improving resident and service user satisfaction.

This case study outlines the economic, social and environmental case for drone inspection compared to ‘business as usual’, and showcases how a housing association has adopted drones to reap immediate and long term benefits. Owners, managers, or maintainers of housing and other property portfolios will benefit from reading this document to understand the capabilities and potential opportunities for using drones in their organisations.

Key takeaways

- Connected Places Catapult organised housing inspections to showcase how Yorkshire Housing, a housing association with limited experience with drones, could easily benefit from them
- Yorkshire Housing have estimated that the inspections will provide more than 10x return on investment by enabling targeted maintenance in place of the extensive roof works which were previously planned
- Drones enable assets to be inspected quicker and cheaper enabling preventive maintenance regimes. Studies have found that preventive maintenance saves around 12-18% compared to reactive maintenance
- Other property portfolio owners like Renfrewshire Council have reported multi-million pound annual savings by reducing inspection costs and using drone-captured data to better understand asset life and reduce premature roof replacement
- Organisations responsible for a portfolio of assets in any sector could save time and money on inspections, make long-term savings through planned preventive maintenance (PPM), minimise working at height risks, and reduce disruption for residents and service users by using drones



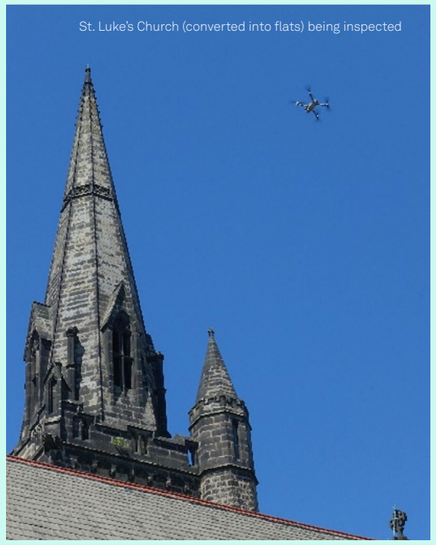
Why the housing sector will benefit from drones

Owing to the size of the housing sector, a large amount of money is spent on repairs and maintenance. In social housing alone, more than £6.3bn annually is spent across the UK	English housing associations spent a combined £5.51bn on repairs and maintenance in FY 2019/20, which amounts to an average per home of £1,579[1]. Welsh housing associations spent approximately £274m[2], Scottish councils spent £396m[3] and the Northern Ireland Housing Executive spent £103.5m[4].
More effective inspection and a move towards preventive maintenance regimes will save money	Traditional methods of inspection like scaffolding and mobile elevated working platforms. These traditional inspection methods lend themselves to reactive rather than preventive maintenance. A move towards preventive maintenance can typically save between 12-18% over reactive maintenance[5, 6].
Drones improve the safety and productivity of inspections by:	• Improving safety by removing the need to inspect from height • Minimising the use of scaffolding and mobile elevating working platforms (MEWPs), saving money on inspection and reducing disruption for residents • Diagnosing problems more quickly and effectively by providing high resolution imaging and modelling, allowing off-site assessment and targeted maintenance • Ultimately facilitating a move towards preventive maintenance regimes, saving money in the longer term.
Residents will benefit from reduced disruption, quicker and cheaper repairs, and fewer faults	Drone inspections take as little as 30 minutes for a small single resident building, and up to a day or two for a very large block of flats. Targeted repairs and increased asset life are enabled by drone inspections, through a move to preventive maintenance. These benefits are passed down to residents and users of the property, who usually bear the brunt of disruption during inspection and repair.
The housing sector is not alone - any property portfolio owner can improve their services and save money	The benefits which drones bring to inspecting and diagnosing problems are transferable across sector and application.

Connected Places Catapult demonstrated how organisations can readily benefit from drone inspections

Organisations don't need in-house drone experience or capability to benefit

Connected Places Catapult, together with ARPAS and Disruptive Innovators Network partnered with Yorkshire Housing and a drone service provider, Vantage UAV, to showcase the benefits of drones for building inspection. Together, we demonstrated how an organisation with limited drone experience can leverage the expertise of the market to quickly carry out successful drone inspections. Vantage UAV carried out the planning, safety assessments and on-site work, requiring minimal input from Yorkshire Housing.



St. Luke's Church (converted into flats) being inspected

The inspections produced detailed, accessible outputs

Vantage UAV surveyed three different sites over 3.5 days and delivered outputs hosted in a browser based portal and on portable storage drives:

- Close up pictures of the entire buildings from all angles, with annotations of areas of interest or concern so that Yorkshire Housing could quickly identify where to focus attention during upcoming maintenance
- 4K footage of the building from all angles
- Orthomosaics and 3D models of each site, allowing an overall view of the buildings while allowing viewers to drill down to great detail
- A BIM (building information modelling) model

Yorkshire Housing chose to share the captured data with specific team members using built-in access controls on the portal. By giving access to surveyors and members of the maintenance teams, they were able to neatly use the outputs within their existing business processes, gaining benefits without requiring fundamental change.

Yorkshire Housing

VANTAGE UAV

The outputs gave Yorkshire Housing and their residents immediate benefits

Vantage UAV carried out inspections on three sites with known issues, where expensive repairs were already scheduled. Across three sites, under £10K was spent on drone inspections, and early assessment by Yorkshire Housing has predicted a greater than ten-fold return on investment by substituting extensive roof repairs and replacements with well-informed targeted maintenance.

This was achieved in around 3.5 days of on-site work, with minimal disruption to residents and no need for unsafe working at height. These targeted repairs will be far less intrusive for residents, and could save lease-holders a significant sum of money.

Andy Gamble, Executive Director Growth & Assets, Yorkshire Housing, said:

"It's really exciting to play a part in the national Drone Pathfinder Catalyst Programme. Yorkshire Housing look after some 18,000 properties across Yorkshire, so drones offer us a real opportunity.

Not only does it make real savings by reducing the need for scaffolding and using heavy machinery to carry out safety checks, it also means our customers can have problems at homes diagnosed and fixed far sooner."

The inspections will lead to long-term savings and service improvements

Yorkshire Housing now have an organised and easily interpretable data set to inform future maintenance decisions. They can use this to benchmark and compare against future inspections, forming part of their planned preventive maintenance (PPM) programme.

Both residents and Yorkshire Housing surveyors were impressed with the inspections

Yorkshire Housing gave residents one week's written notice before the inspections. On the ground, several residents engaged positively with the Vantage UAV team because they were interested in the works, but no concerns, even about privacy or noise, were raised either before, during or after the inspections.

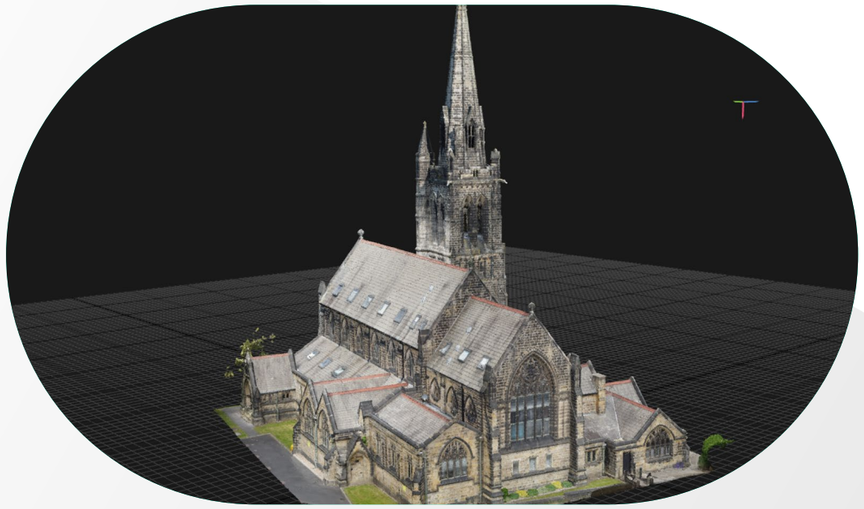
Yorkshire Housing surveyors were pleased with the quality and convenience of the inspections.

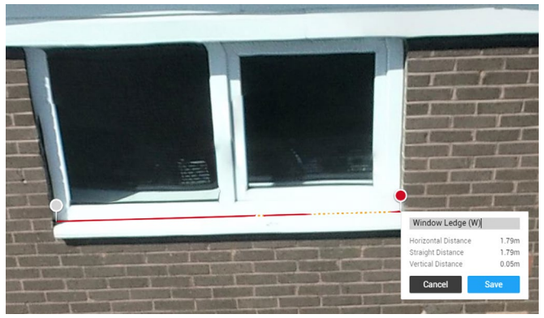
Stephen Deuchar, a Voids Surveyor at Yorkshire Housing said:

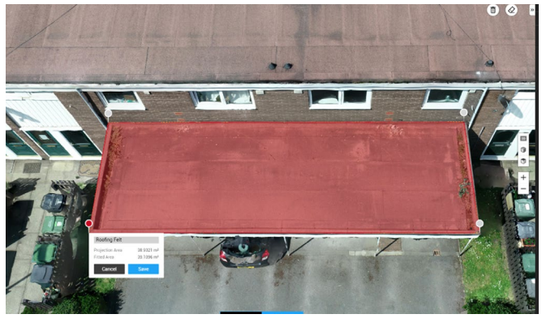
"I found the drone demonstration very helpful as I had a void (empty property) at Roundwood that had a leak coming through the kitchen. From the drone footage it showed that the roof felt was in good order and that it looked like the issues were from the internal guttering. A job was raised, and the contractor resolved the issue swiftly."

Inspection outputs

These 3D models allow Yorkshire Housing to view their asset in high-resolution and to-scale.







The 3D models are photographic in detail, allowing up close inspection. Geo-tagged data inputs and intelligent photogrammetry algorithms mean that the model is scaled accurately. Yorkshire Housing can take line, area or volume measurements at any point on the model with centimetre level precision.

A separate browser based portal called Scopito is used to store, organise and inspect the hundreds of detailed photographs taken by the drones. Annotations, severity, categories and locations of any defects or points of interest can be added and subsequently filtered and searched.

Based on the annotations, automated PDF reports can be generated for contractors or employees who need the information to hand.

A deeper dive: Drone inspection – the economic, social and environmental case

The use of drones allows for a safer, faster and cheaper building inspection which can deliver a range of benefits compared to the business as usual approach. This section outlines some of the key economic, social and environmental benefits arising from the use of drones for building inspections.

Business as usual

- Issue is reported, or planned inspection is due
- Inspection carried out either at ground level or at height via scaffolding, cherry picker or ladders
- Onsite diagnosis is reported back and remedial action taken

Drone inspection

- Issue is reported, or planned inspection is due
- Inspection carried out via drone
- Diagnosis carried out using live video streams or post-flight using an evidence portal
- Remedial action taken
- Subsequent drone inspections can validate repairs

Economic Case

Short-term time and cost savings on inspections

- The up-front cost of using drones to survey buildings varies based on the size and complexity of a building and the outputs desired
- Individual inspections on small buildings such as houses can cost as little as £200, and provide high quality pictures and videos to inform targeted maintenance
- A drone survey for a mid- or high-rise tower block may cost a few thousand pounds whereas fully scaffolding it could cost tens or hundreds of thousands[7]
- Costs scale very well if large buildings or multiple buildings on the same site are inspected
- Lead times for a drone inspection can be as little as one day with residents' prior permission

Long term savings via preventive maintenance

- Planned preventive maintenance (PPM) regimes have been found to save money and improve outcomes cross-sector - from the energy sector[8], to manufacturing, and of course in the building sector[9 10]
- Across sectors, the principles are largely the same. While reactive maintenance waits for a problem to take action, preventive maintenance uses a schedule to proactively inspect and fix potential problems before they get worse
- Studies have found that preventive maintenance saves around 12-18% compared to reactive maintenance[11]
- By allowing buildings to be inspected more quickly, cheaply and therefore more often, drones support preventive maintenance regimes
- This leads to longer lifespan of property assets, fewer unplanned repair works, increased safety management and a better-quality maintenance outcome

Savings on lost-time accidents

- The total cost of workplace injury in the construction sector (which includes housing[12]) in 2018/19 was estimated at £1.2 billion, including around 500,000 lost working days annually[12]
- In the sector 47% of the 40 fatalities were caused by a fall from height in 2019/20[12]
- Falls from height also accounted for 19% of the 46,000 reported injuries (estimated annual average 2017/18-2019/20) in the construction sector and 8% across all sectors, highlighting the increased risk of sectors involved in building construction and maintenance[12]
- Using drones to carry out inspections completely eliminates the risk of working from height accidents during inspection. Through better diagnosis of problems and targeted maintenance, they also reduce the exposure to at-height working, post-inspection

Savings via validation of undergone repairs

- Owing to their low cost, repeatability, and the timestamped evidence they collect, drones can be used to validate repair work and track progress or change over time
- Repeatably collecting the equivalent data via traditional methods is harder to justify if scaffolding or machinery is required each time
- The evidence they collect can be used to effectively engage with residents about repair works or hold contractors to account

Social Case

Avoiding deaths and injuries from working at height

- The social cost of injury and loss of life are significant, having lasting lifestyle and livelihood impacts on the victims and their friends and families
- 59% of the costs of fatalities and injuries are borne by individuals, not employers or the governments[13]. This means victims are often saddled with heavy financial burdens as well as coping with the physical effects
- Drones reduce or eliminate the need to work at height both during and after inspections

Reduced disruption to residents

- A drone inspection can be carried out in as little as 30 minutes for a simple building. A multi building site, or a large high rise building may take a day or two to inspect
- With a polite advanced notice, residents are typically very amenable to drone inspections instead of lengthy scaffolding installations

Reduced disruption to public

- The use of unsightly scaffolding or noisy heavy machinery to carry out inspections or unplanned maintenance can disrupt public space, pavements, roads and building facades. It may also require local licencing
- Scaffolding creates safety and security risks for the public, both while in use and between active use. Drone inspections on the other hand, leave no trace and pose no risk between active inspections

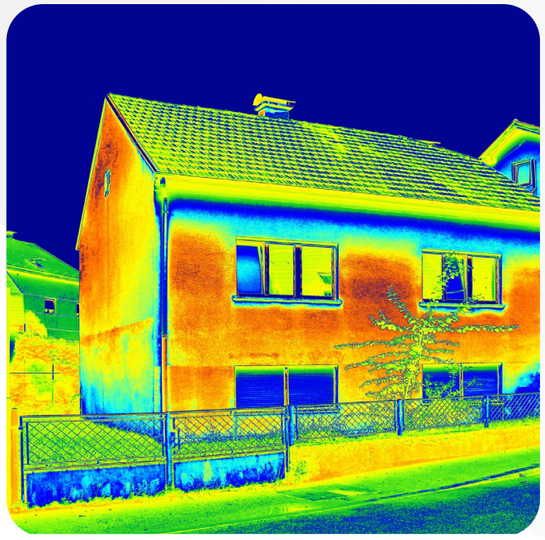
Improving accessibility and empowering employees

- By providing another option for data capture, drones can enable more accessibility for otherwise manual inspection tasks. Those who are unable to work at height can interrogate captured data from any computer
- The Royal Institute of Chartered Surveyors (RICS) are developing training programs and guidance specifically designed to allow surveyors to make the most of drone capabilities[14]

Environmental Case

Thermal inspection to help meet insulation targets

- Specialist drones with thermal cameras provide accurate data about heat loss from buildings
- From their aerial vantage point, drones can capture a more comprehensive and precise dataset than is usually possible from the ground
- Thermal data can be used to justify interventions, reducing energy wastage through roofs, external walls, windows, and defective installations



Improved process efficiency and asset life

- Drone inspections do not rely on heavy plant inspection vehicles like cherry pickers, or trucks to transport scaffolding. Substituting these traditional methods removes large fossil fuel vehicles from the road, along with the local pollution they produce
- By enabling PPM regimes, more specific and targeted repairs can be carried out. Again, this reduces the need for heavy plant
- One of PPM's benefits is extending assets' useful life. Doing so reduces the resources and energy expenditure needed to replace broken assets ahead of their expected lifetime

Protecting building condition and character by reducing contact

- On large or complex roofs, and particularly sloping ones, scaffolding and edge protection is required to prevent falls during a traditional inspection[15]. This can potentially damage the façade, guttering and roof itself
- No-contact drone inspections in the first instance ensure that these higher-risk physical interactions are only carried out when justified, and can be targeted to reduce damage

There are many use-cases where drones drive significant benefits

This case study has focussed on building inspection, but drones can provide a wealth of benefits in other scenarios relevant to housing providers and asset managers.

High rise maintenance and cladding inspection

In place of extensive and prolonged scaffolding use, drones can be used to survey high-rise buildings for a fraction of the cost. Southampton City Council used drones and abseilers to inspect a block of flats that they predicted could cost £300,000 to scaffold otherwise[16].

Development land inspections

Drones can be used to inspect land earmarked for development and provide accurate survey data for architects, planners and developers.

New or void property marketing using 3D modelling and video

Aerial pictures, videos or even 3D visualisations of properties can showcase properties and their surroundings when embedded in websites for prospective tenants to view.

Solar-panel inspection

In properties with solar panel installations, drones can be used to identify manufacturing defects, cracks, faulty inter-connectors, and the build-up of dirt which all result in a reduction in operating efficiency if left untreated.

Estate management and tenancy issues

Used in the right way, drones can be a valuable tool for teams addressing issues with fly tipping, untidy gardens, graffiti, abandoned vehicles, dirty communal areas, anti-social behaviour and parking.

And many more use cases

- Vegetation Management
- Parking Planning
- Environmental monitoring/control
- Utility Mapping
- Geographic Mapping
- Insurance Inspection and Validation
- Planning Applications
- Construction Monitoring

Renfrewshire Council, Scotland – a multi-million pound success story

The UK Drone Trade Association ARPAS interviewed Renfrewshire Council in Scotland and found out about the £4m+ annual saving they've made by using drones.

Renfrewshire Council owns roughly 12,000 properties in their social housing portfolio, consisting of 2-5 story low rise accommodations and 14 high rise towers. Until 2016, they had been using mobile elevated working platforms and scaffolding to carry out façade and roof inspections, but now they regularly use drones when possible.

Under their previous inspection regime, roof tiles with a 30 year life-span were replaced after their advertised life-span. Since using drones to inspect their properties, the council has been able to assess the health of roof structures more effectively and decide whether to maintain them for an additional 2, 5 or 10 years. Using traditional methods, the data gathering process would have been too slow for this approach to be viable.

Last year alone, this methodology saved the council £4m+ and allowed an entire program of inspections to be carried out in under 2 months (as opposed to multiple years for a similar scope using traditional methods).

Getting involved with Connected Places Catapult

Connected Places Catapult has partnered with *Disruptive Innovators Network* to continue driving drone adoption in the social housing sector. If you are a social housing provider interested in using drones, or provide drone inspections, keep an eye out for the brochure and attend our Connected Places DINLab Briefing event on Monday 20th September 2021. To book your space at this free event, *follow this link.*

Missed the Connected Places DINLab, or want to get involved in a different way? Get in touch with *drones@cp.catapult.org.uk* for more information, or if you're a drone service provider visit the *Connected Places Catapult Opportunities* page.

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 inspections at height, wind or rain can delay inspections and they are generally caried 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.
How do we inform our residents or users?	You can use your standard communication channels to inform residents or users in advance of inspections. Yorkshire Housing posted letters to residents one weeks in advance, and received no adverse feedback from residents before, during or after inspections.
Do we have to consider airspace restrictions or permissions?	The drone solution provider will check for airspace restrictions during flight planning. 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?	You can attend our Connected Places DINLab to 'try before you buy', 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 Sight Certificate (GVC), and examples of previous work. It is also important that they have EC 785/2004 compliant insurance and landowner's permission to take off and land the drone. You should ask to see risk assessments for each flight that Is planned, and make sure the works are documented in a formal contract.

This demonstration was carried out in partnership with:

ARPAS-UK Association of Remotely Piloted Aircraft Systems · Disruptive Innovators Network · PIN Proptech Innovation Network · VANTAGE UAV · Yorkshire Housing

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