

VISUAL INSPECTION AT HEIGHT – EWP vs CAMERA DRONE

MMH have performed hundreds of visual inspections of mobile and fixed steel structures in mining and processing. Many of these inspections make use of an Elevated Work Platform (EWP) to access regions of structure which would normally be out of reach, and view, of the maintenance platforms. The desire to consider new, emerging or developing technology motivates us to consider the use of Camera Drones as an alternative or supplemental tool to perform such inspections.



This case study explores the pros and cons of using an EWP or a camera drone to conduct visual inspections of out of reach locations.

	Camera Drone	Elevated Work Platform
Safety and Training	Training Pilots of commercial drones complete an RPAS course and are registered with the Civil Aviation Safety Authority (CASA). Training takes approximately 5 days and is renewed every 3 years.	Operators require a licence to operate a boom-type EWP over 11m. Training takes approximately 2 days and is renewed every 5 years. EWP training is arguably more versatile. 
	Working at Heights Utilising camera drones eliminates the requirement for working at height and hence the associated risks. 	An EWP is a substitution control. While it may be safer than other options, the operator and inspector are still exposed to a fall risk.
	Dropped Objects Camera drones introduce dropped object risks (i.e. all or part of the drone) which can be mitigated by exclusion zones and spotters.	Work from an EWP introduces dropped object risks which can be mitigated by exclusion zones and spotters.
	Safety Around Others CASA regulations state that camera drones are not allowed to fly within 30m of, or directly over, any person not directly related to the inspection operation.	An EWP typically requires a barricaded region, or drop zone, to be set up below to alleviate risks of falling objects, but otherwise can be used in proximity to others. 
	Equipment Isolation Camera drones would be safe to use around most fixed and mobile plant, as well as in a reasonable proximity to certain operating plant, subject to a hazard assessment. 	An EWP would almost certainly be unsafe to use near mobile plant without an isolation. Some fixed plant could be inspected without isolation subject to a hazard assessment.

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	Camera Drone	Elevated Work Platform
Versatility and Usability	Reach Camera drones may be flown up to 120m. Limitations This would reach all regions of commercial fixed and mobile plant. 	While an EWP can reach heights of 55m they are typically found on work sites in the 25m to 36m range. Some regions of plant, i.e. the masts of mobile plant, may not be inspected with a 36m EWP.
	Proximity A drone pilot could safely position a drone within 5m of a critical location. This is sufficiently close to take a quality photo but surface dust cannot be removed.	Using an EWP an inspector can typically get within reach (1m) of most critical locations and can clean away any surface dust or light encrustation. 
	Access Photographs from a drone can be taken all around the structure including from above. 	Access in an EWP is from below or the sides.
	Terrain A drone can be utilised over all terrains including muddy/swampy ground and over water as well as over a sloped stockpile. 	An EWP requires solid, flat, and reasonably level ground to operate such as compacted dirt, gravel, asphalt, or concrete.
Effectiveness	Visual Acuity Top end drones typically have 4k video recording which is 8 megapixels and can simultaneously take still pictures at 12 megapixels.	The comparison of unmagnified eyesight to camera resolution is highly arguable. It is clear that healthy eyesight is significantly better at discerning fine detail. 
	Capture Resolution A professional grade camera drone would utilise 4K video at a resolution of 3840x2160 pixels, the equivalent of an 8MP camera, with photos taken at 12 to 16MP.	Varies, typically a 16MP camera with photo resolution of 5312x2988 pixels. 
	Capture Zoom Typically, 5 x optical, up to 30 x. Vibration and stability control are required to take highly zoomed pictures.	Typically, 12 x optical, up to 50 x. 
Cost	The cost of a camera drone is at least an order of magnitude less than an EWP. There are also significantly reduced ongoing maintenance and running costs. 	If we exclude the cost of an EWP, because typically one is readily available on site regardless, the cost per inspection is comparable.

Of the four categories assessed the Camera Drone is clearly preferable to the EWP in Safety, Versatility and Cost. There is a clear reduction in the effectiveness of the Camera Drone in visual acuity and photographic capture. The following page will discuss the impact this has on defect detection.

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DEFECT DETECTION

It is more likely that a small defect will be identified if the distance to the defect is reduced and/or optical zoom magnification is used. A defect is also more likely to be identified when viewed directly rather than via a screen, even when viewed as a live feed.

Photographs analogous to a Camera Drone

- An inspector could see that the fillet welds are complete and nuts/bolts are present.
- A defect which is well lit would likely be visible to the naked eye if the inspector knew it existed however it is unlikely to be identified unless the inspector is intentionally focused on this point.
- It is highly unlikely that a defect would be visible in shadow.
- A defect which is photographed, under zoom, would likely be visible however no defects are likely to be identified from a scene photo if viewed subsequent to the inspection.



Range 5m (analogous to 25m with x5 zoom)



Range 5m, Optical Zoom x 5

Photographs analogous to an EWP Inspection

- An inspector could see the quality of the fillet welds and bolts and can test the nuts by hand to determine if they are completely loose.
- A defect would almost certainly be visible to the naked eye and is likely to be identified as the inspector visually scans the connection.
- A defect in shadow is almost as easily viewed by the inspector as a well lit defect.
- A defect is likely to be identified from a photo however it is unlikely if the defect is very small or in shadows unless it was intentionally photographed under a zoom.



Range 1m



Range 1m, Optical Zoom x 5

All photos have been taken with a 16MP digital camera and have been digitally zoomed to size for comparison.

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CONCLUSION – HOW AND WHEN TO USE CAMERA DRONES

The summary points for using camera drones for visual inspection are;



Increased safety by removing the inspector from a position of working at heights.

Increased versatility;

- May be operated near or over operating equipment.
- May be operated over water and over live stockpiles.
- Can reach significantly higher than an EWP
- Can achieve views from above.

Reduced Upfront and maintenance cost



Cannot be used within 30m of another person.

Cannot physically interact;

- Moving obstructions, paint flake, dust, etc.
- Checking for loose items.
- Measuring (e.g. plate thickness)

Reduced effectiveness in defect detection.

- Reduction in defect detection in shadowed regions
- Reduction in small defect detection such as hairline weld cracking

MMH have reviewed the use of Drone Cameras in the context of conducting a visual inspection for risk management of production and handling plant predominantly steelwork. As a part of the review we utilised a quad rotor UAV, DJI Matrice 200, equipped with a DJI Zenmuse Z30 camera.

The desirable outcome of a risk management inspection is the early detection of defects before they escalate to result in significant damage or downtime. For some defects, such as loss of thickness or loose bolts, the inability of a camera drone to physically interact with the subject will hamper early detection. For other defects, such as fine weld cracking, the lack of visual acuity is detrimental. A camera drone is not ideal for defect detection.

Utilising a camera drone takes an inspector, and often a separate EWP operator, out of the line of fire and away from working at heights. This removes at least two significant risks to personnel injury. The value of this cannot be understated.

It would be possible to utilise a drone to inspect operating plant outside of the, normally hectic, shutdown schedule. With other workers not present on the plant, the operator could fly closer than 30m, to around 5m, increasing the likelihood to detect small defects. Camera Drones can also be used to identify medium to large defects and missing components, such as missing nuts or bolts.

MMH conclude that Camera Drones cannot replace the use of Elevated Work Platforms (EWP) for visual inspections aiming to detect defects.

In a well-considered inspection regime, where Camera Drones can be appropriately utilised, the frequency of EWP inspection may be reduced, harnessing the benefits of both systems and increasing safety without a significant reduction in effectiveness.

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