

USING AN UNMANNED AERIAL VEHICLE (UAS) TO PERFORM SAFETY AUDITS OF A FALLING OPERATION IN COASTAL BRITISH COLUMBIA

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Figure 1. Mid-coast harvesting operation*.

INTRODUCTION

In 2015, FPInnovations initiated a research program to explore potential uses of low-cost unmanned aerial system (UAS) or drone technology for the Canadian forest industry. To date, uses for the technology have been identified by forest industry stakeholders from simple mapping to visual reconnaissance of forestry activities in forest operations.

In October 2015, FPInnovations observed a UAS being used to supplement a safety auditing process. The safety audits took place at Lemare Lake Logging, a large stump-to-dump logging contractor currently operating on

the mid-coast of British Columbia (Figure 1). In the coastal forest industry, manual tree falling is the first step for old-growth tree removal on steep ground. To ensure that safe work practices are adhered to at all times during falling operations, WorkSafeBC regulations require that fallers be audited on a regular basis while they are working.

At this location, the contractor has been supplementing the conventional falling audit process with a UAS monitoring since the spring of 2015. The UAS is used for continuous safety checks and hazard identification throughout the operation, not just to monitor falling and stump quality.

*Photo credit: Lemare Lake Logging

EQUIPMENT

A DJI Inspire 1 UAS was selected by this contractor for its video quality, ease of operation, and non-obstructive view from the camera (Figure 2). It has a flight time of approximately 15 minutes per battery when used to a 30% remaining charge. The UAS can take 12-megapixel still photos and up to 4K ultra-high-definition (UHD) video.



Figure 2. DJI Inspire 1 UAS.

FALLING AUDITS

The contractor conducts a regulatory audit to satisfy WorkSafeBC requirements and a non-regulatory audit to ensure a continuous awareness about safety for the fallers and for other operational roles in the harvesting operation. A company culture around the safety of its employees is the driving force behind the extra audit this contractor has in place.

WorkSafeBC audit

Each faller in the crew must be audited, as mandated by WorkSafeBC. Once per week, fallers are audited for emergency response and preparedness, personal protective equipment (PPE), tools, workmanship, and falling

procedures. As part of the workmanship and falling procedures components of the audit, a live assessment is conducted while the faller is cutting and a total of 10 to 15 random stumps are evaluated per month. Evaluations include those for correct back-cut, anti-kickback step, holding wood, matching cuts and undercut dimensions (Figure 3). Georeferenced photos are taken of the evaluated stumps and associated data are entered into tablet computers. Scheduling records indicate where fallers were working at the time of the audit and the georeferenced photos are a record of where the stumps were located.



Figure 3. A photo of a correctly cut stump taken by the UAS from 1.5 metres away.*

UAS audit

Creating a safe work environment is the responsibility of the employer although Lemare continuously promotes employee responsibility around safety as well. With the assistance of affordable UAS technology, the contractor has been able to improve the safety monitoring process. In addition to the WorkSafeBC audit, the contractor voluntarily examines stumps on an ongoing basis using the UAS, thus exceeding the regulatory requirements.

*Photo credit: Lemare Lake Logging

Unacceptable stumps can be identified by an experienced supervisor either visually looking up the slope, or during a reconnaissance flight with the UAS after falling is completed. If unsatisfactory stumps are encountered, or hazards are identified, a corrective action can be communicated immediately with the faller.

Although the UAS was intended to assist the falling audit, there are other benefits:

- reduces time walking to the stump and eliminates the walking hazard in the felled and bucked stems on steep slopes
- increases the number of stumps that can be checked in the time available
- can check stumps in numerous fallers' quarters throughout the day
- can monitor daily falling progress for road right-of-way and within the cutblock
- hazard identification is more efficient when access to the immediate area is difficult or dangerous

Common hazards include the following:

- suspect snags, root wads, and hang-ups above and within the faller's quarter
- rock bluff conditions above work areas
- objects lodged in trees (Figure 4)
- old slide tracks above work areas
- newly identified slides (Figure 5).



Figure 4. Danger tree with a wedged-in shot rock*



Figure 5. A slide area identified above a work area*

OTHER UAV USES

The UAS at this operation was also used to perform safety checks during the yarding phase of the harvesting operation, monitor site conditions throughout the work area, and provide operational assistance.

Yarding phase assessment

During the yarding phase, the hook tender's movements can be monitored live with the UAS to ensure personnel are in the clear at all times when the lines are moving.

The site foreman can also assess whether haulback stumps have been tied back properly at the top of the setting. (Figure 6)



Figure 6. Haul back stumps that have been notched and tied*

The UAS can be used to check for proper notches in the haulback stump and whether the stumps are strung together appropriately (Figure 6). Although these checks were being done before, they can now be done more consistently and quickly with the UAS, without having to hike to the location and stop the yarding production.

Assessing site conditions

The UAS can be used for slide and slump investigation and reporting, and is an excellent tool for determining the severity of each. In the contractor's operating area, the ground is susceptible to slump activity due to a thin soil layer on top of smooth rock. Naturally occurring slumps can be hidden above a work area which can pose a risk to the operation. The danger

level can be determined by flying the UAS into the disturbed area to look for loose material, water back-up, and loose boulders that may pose a danger to people below.

If the land movement is identified as a slide, it must be documented and reported to the B.C. Ministry of Forests, Lands and Natural Resource Operations. Using the UAS to assess the area before falling and yarding can determine the slide hazard and the geo-referenced photos document and pinpoint the location for reporting.

Operational assistance

The UAS can transport items up the hill to assist with repairs to equipment, including nuts, bolts, light tools and supply. The UAS can also perform post-harvest inspections to find logs that may have been missed during yarding. This is especially useful if there is a hollow up-slope that cannot be seen by the yarding operator. Fibre utilization standards can also be assessed during yarding and can be addressed before the yarder is moved.

CONCLUSIONS

The use of unmanned aerial technology is becoming more widespread in the forest industry as the technology becomes more available, affordable, reliable and easy to deploy. The use of a UAS to supplement an existing falling audit safety program is unique and has opened up numerous other opportunities for process improvement within the contractor's operation.

The coastal logging environment is hazardous and the worksites are often steep with poor access. Incorporating the UAS into the day-to-day supervisory role of a foreman has created efficiencies on site that were not realized before. These efficiencies include:

*Photo credit: Lemare Lake Logging

- far less walking time up and down the slope to evaluate hazards, some of which may not need further action
- overhead geo-referenced photo record of slides for reporting
- safer monitoring of all industrial activities on the site from falling to yarding
- more frequent monitoring of activities for less cost
- monitoring activities without stopping production

Overall, since the UAS program has been introduced into the operation, compliance of safety procedures in all relevant areas has improved and fewer issues are being seen compared with before.

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