Aerial imaging and data interpretation

Jamie Brookes, owner of LandScan UK, outlines the role 3D mapping with drone technology can play in the management of woodlands and what future potential may be unlocked by the forestry sector.

I started my career in the motorsport industry as an engineer, but I always felt a contradiction between my love for cutting-edge technology and my deep desire to see the natural world protected. After being exposed to forestry by a chance meeting 10 years ago, I found myself fascinated with the challenge of understanding complexity within a forest environment.

In pursuit of my interests, I founded LandScan, a UK company focused on developing digital approaches to problems such as measuring and counting in a forestry setting. We tend to use drones to do this, building accurate 3D digital representations from which we extract actionable information to help in forest management decisions.

This open letter to the sector aims to stimulate a debate as to how the industry can gain the highest value from this approach.

WHY DO WE USE THIS APPROACH?

We can do several things with drones that are hard to do from the ground. Firstly, the fact that our cameras fly above the canopy and are unobstructed by the myriad objects that clutter the forest floor means it's much easier to view the forest writ large.

Secondly, we capture and reconstruct a three-dimensional 'digital twin' of the whole forest at a moment in time. This data is then available forever, for any kind of computer analysis the industry invents. By using computers to measure and record many millions of data points, we can produce evidence-based information and ensure that any generated figures and statistics about a forest are trustworthy and repeatable.

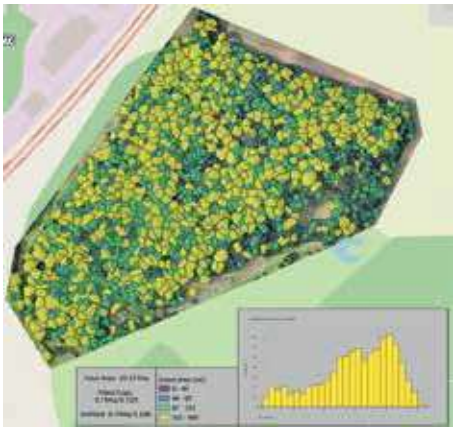
Thirdly, we can leverage technologies which expand the range of the human senses. We can use wavelengths of light outside normal human vision to infer differences in vegetative health, for example, before they become visible to our eyes. We can also shoot lasers through physical objects, allowing us to see through canopies and leaf cover!

These extensions to human senses allow for better monitoring of our forests. It's very important at this stage to note that (at least in the author's opinion) drone operators cannot – and should not - aim to replace all traditional and established forest management practices. People will always need to visit and assess the ecosystems in the intuitive way that only humans are capable of.

However, technology can add to our understanding by embracing the computational power of machines. The industry is already incorporating similar approaches but has not yet agreed on an aligned process and range of products.



Above: Comparison of computer-generated 3D model (upper half) compared with a photograph (lower half). This showcases the level of detail captured by the computer modelling.



Computer code can be used to predict crown boundaries and provide statistical information across the whole stand.

Many of the larger forest management companies, for example, have diversified into offering a level of drone services. Smaller practices are partnering with specialised providers to offer the services without the large investment in training and equipment required. It is now for forestry-focused drone providers and the community to come together to understand the improvements, needs and challenges that can be resolved.

SO WHAT DO WE NEED TO ASK?

It is generally seen as good practice to first identify the questions when searching for solutions. The following examples introduce several ideas intended to stimulate discussion about how best to seamlessly integrate this approach into existing practices.

Perhaps some shared guidelines would



3D Rendering of Small Leaved Lime Stand – This model features life size scale for accurate digital measurements.

be useful for individuals and companies to understand when – and when not – they might engage drone operations within their management and business plans.

- What data missing from on-ground monitoring could be analysed and exploited? For instance, could knowing the locations of trees showing signals of stress help when performing stand assessments?
- Could whole-forest distribution, density and height data (derived from aerial scanning) help to inform management decisions, for example in deciding when to thin?



3D computer model of an Irregular Silviculture site constructed from many combined photographs.

- How can the data be supplied in an easily accessible and standardised format?
- Which data derived from scanning could be useful to submit to a planting scheme, carbon credit applications and monitoring events, or natural capital assessments?
- How often should a site be scanned? There is of course a need to balance costs and benefits. A large commercial wind-stable and pest-free Sitka stand may not require intensive monitoring. A broadleaved forest undergoing transition to Irregular Silviculture standards may benefit from more frequent assessments.
- When considering whether to purchase a forest, is there a benefit to receiving or requesting a scan to reduce the risk of caveat emptor? Drone imagery is now becoming standard to showcase a site, but could this be added to by providing fully interactive 3D models, accessible from home?
- When engaging a new management company would there be a benefit in receiving an up-to-date forest scan as a standard part of the management plan creation?
- Could it be beneficial to encourage clients to submit their data to a national, open catalogue of forest models for research?



Evidencing areas of windblow can help with insurance claims and restocking planning.

- For those with CCF interests, is there value in a map predicting light penetration across the stand? What if we could produce a Marteloscope in, say, an hour, by performing a LiDAR survey and taking a vertical slice of the resulting data at breast height?

HOW CAN WE TAKE THIS FORWARD?

The above ideas may prove themselves to be only the hors d'oeuvres of what the technology can deliver. Some ideas will be transformative. Some ideas will not be feasible. Some management companies will exploit the new capabilities as early adopters, some may take a little more time.

I believe that most private and commercial clients will come to expect scans as standard – for a combination of data interests, assuring compliance or simply for the majestic beauty of viewing their forest in high-resolution, printed and mounted on the office wall.

To borrow terms from E.M. Roger's Diffusion of Innovation Theory, land and forest scanning is currently comfortably within the 'early adopter' stage and is starting to be picked up by the 'early majority'. A coordinated effort to standardise compliant approaches, service expectations and useful outputs will encourage understanding and familiarity for the end user. Drone scanning will have to demonstrate benefits which are clear, immediate, and fit within existing business practices.

In conclusion, digital mensuration techniques have the potential to add to the way we manage our forests. They can provide a cost-effective and efficient way to gather data and monitor the health of forest systems, allowing us to make better decisions about how to manage and conserve them. They can also provide valuable information to the forestry industry, helping to improve the yield and quality of timber, and increasing the sustainability of our operations.

However, the technology is still relatively new, and some people may be hesitant to adopt it. The key to realising the full potential of drones in forestry is to work together as a community, sharing knowledge and expertise.

With the right approach and careful implementation, we can all benefit from forest scanning. All that remains is to define the questions we want to ask.

If you wish to find out more or are interested in forming or contributing to a working group, please get in touch with Jamie at enquiries@landscan.co.uk.