



# Terrestrial Laser Scanning

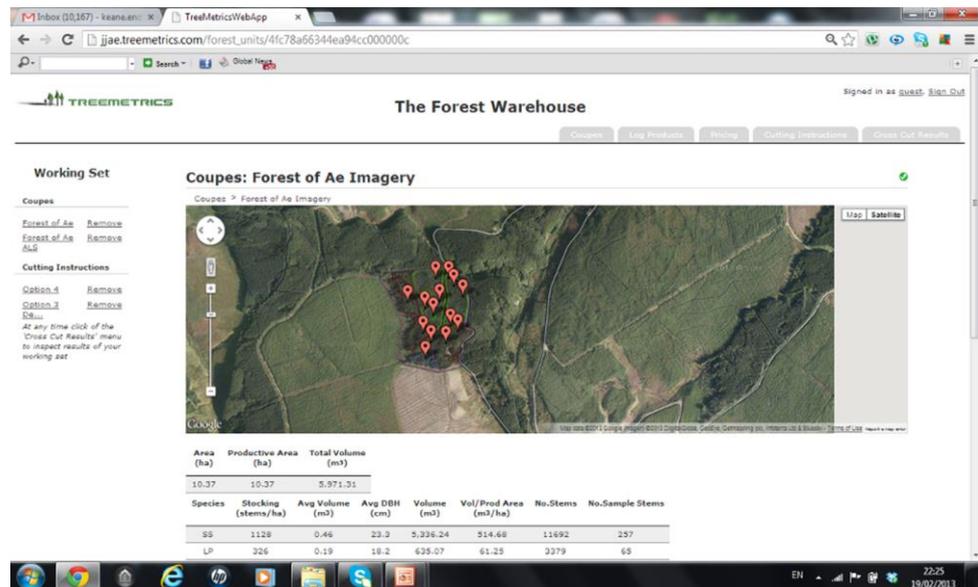
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## Understanding the Value Chain

TreeMetrics is an international leader in the area of forest measurement and yield optimisation. For the past six years TreeMetrics has pioneered and developed new technologies to replace the current 100 year old techniques for forest measurement. TreeMetrics focus is on the improvement of data collected in the forest but also more importantly the usability of this data to improve forest management and profitability to its customers and the forest industry.

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TreeMetrics is aware that at present most data on forests are sparse and inaccurate, compared with what technological advances can offer. This is due to several factors including outdated base modelling for tree measurements, inadequate sampling intensity and a lack of updated databases.



We have developed a new integrated system for forest management which has significantly improved both the quality and independence of the measurements, estimations of timber resources and the optimisation thereof and also implementing a data-mining process for all data available from different sources.

## LASER SCANNING

The primary capability of TLS is the generation of highly accurate, three-dimensional images. This imagery and 3D visualisation provides added confidence that mapped objects correspond to actual existing conditions. TLS increases the amount of data collected and reduces questionable data, provides oversampling to ensure accuracy and that all objects, structures and geometry are captured.

A 3D image from the laser is projected in one-colour, using the intensity values it is possible to obtain gray-scale image where the objects can be recognised (figure 2 Point cloud or TLS image). Additionally, the latest TLS devices have an integrated camera that allow it take pictures in multispectral bands (RGB) and afterwards colourise the point cloud data. This allows new analysis such as the potential for species recognition.



Figure 2: TLS image.

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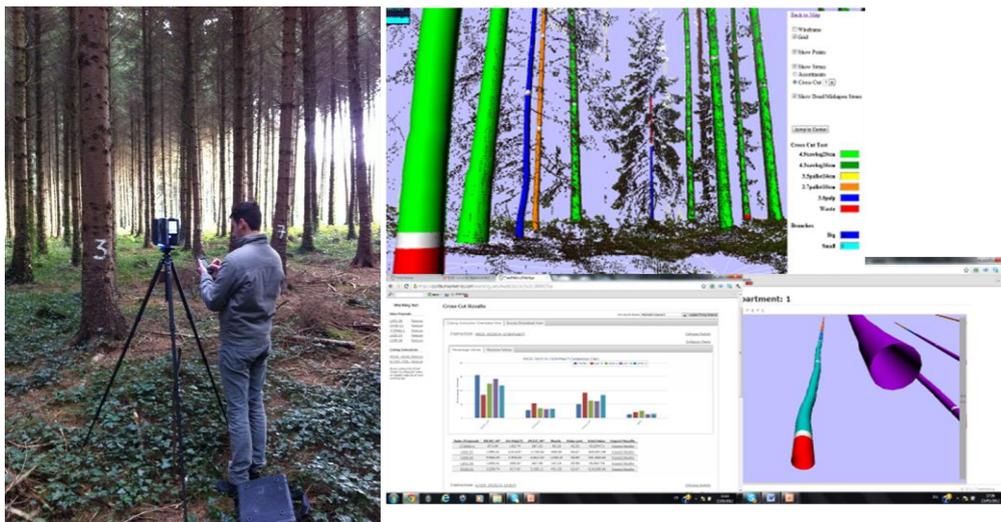
## OPTIMISATION SOLUTION

We have designed a system to integrate accrued data from different sources for a data mining analysis. The Forest Warehouse™ platform (Figure 4) allows the user to quickly analyse all available data in the database for any custom enquiries through a plot viewer. This powerful platform is very flexible and dynamic; it allows the analysis of different log-harvest scenarios introducing custom log descriptions and market conditions.



- Efficient and Easy to Use (3.5 min per scan and 5kg weight).
- Collects a Colour image.
- GPS Location of Scan matches the Scan to the Forest
- Scans are stored on a SD card for easy transfer.
- Provides accurate Tree Profile Information (stem taper and straightness)

Figure 3: Faro Focus scanner.

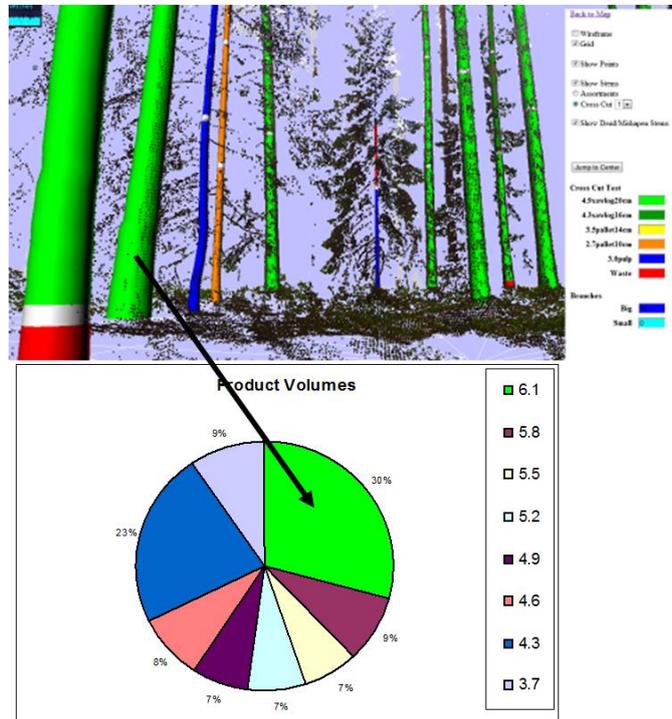


This 3D analysis provides added confidence that mapped objects correspond to actual existing conditions. TLS increases the amount of data collected and reduces questionable data, provides oversampling to ensure accuracy and that all objects,

structures and geometry are captured. AutoStem Forest™ is the software developed and used by TreeMetrics to find and create a 3D model for each tree.

AutoStem Forest™, developed by TreeMetrics, provides accurate stem information for hundreds of stems in a forest stand that can be used to estimate the actual status of the stand, but also is very interesting for forecast and growth models.

The system allows the user to evaluate available forests in relation to log outturn, against timber market demands and provides decision support for timber yield optimisation. This in effect allows the user to create numerous virtual harvest scenarios or cutting instructions simulating the operation of a harvesting machine in each forest.



The Forest Warehouse™ is at the core of the wood supply chain and good warehouse management plays an essential role in ensuring the speed and accuracy of inventory movements. These technologies enable better decision making, to realise the maximum economic value of forest estates.

Due to time and cost, Terrestrial laser scanning (TLS) is a sampling method utilising plot or transect samples, particularly in vast forest areas. In order to provide the minimum stand volume error the TreeMetrics inventory system also allows for improved sampling representativeness (secondary stratification). It is also possible to employ inference techniques from the output data to product map the forest i.e. identify where high percentages of saw log and pulp are in each forest.

By using remote sensing methods it is possible to realise extensive analysis in the forest stands. It provides information from the terrain survey on forest stratification to improve the sampling system and the inference process.

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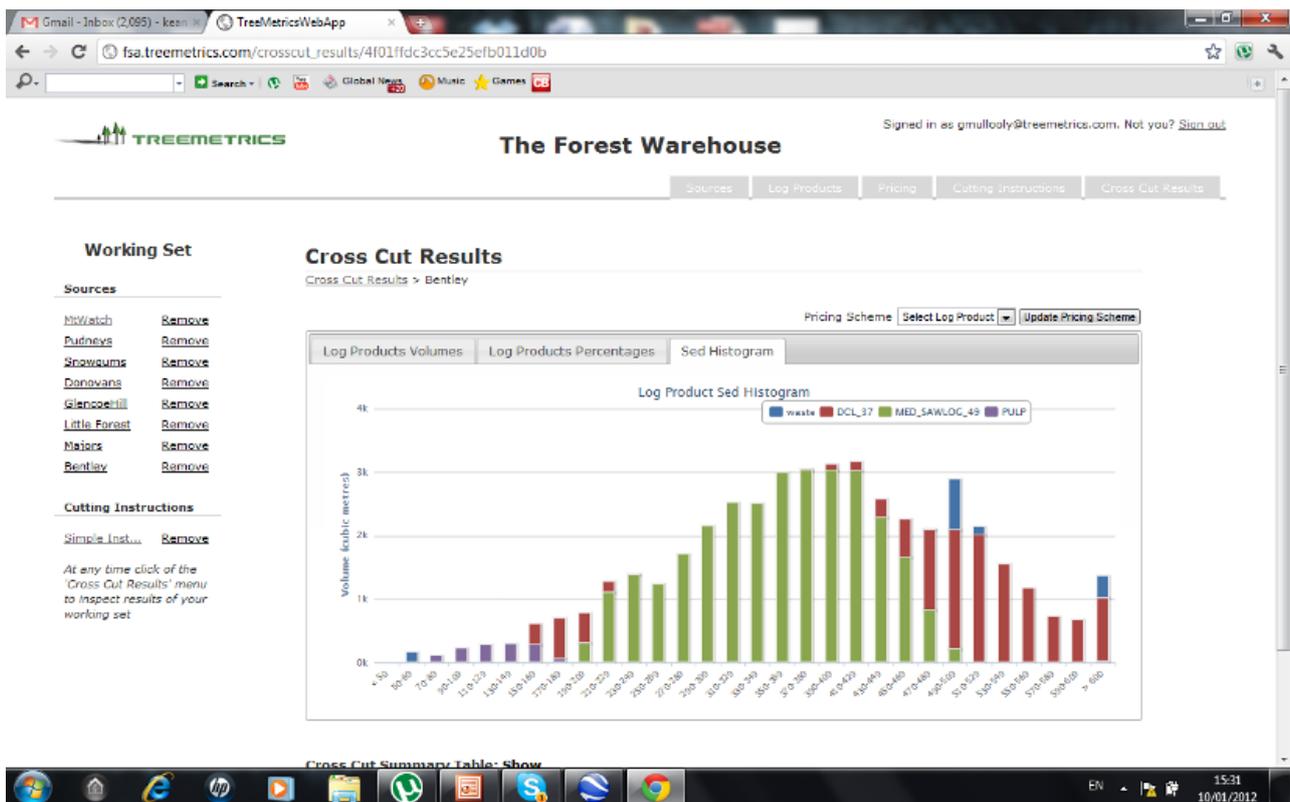
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## THE MEASUREMENT SOLUTION

Timber inventories are the main tool used to determine the volume and value of standing trees on a forested tract. While timber inventories have traditionally been performed to place a value on a stand before sale, they are also useful for providing information for the development of management strategies, estate planning and valuation.

Forest inventories are based on well elaborated standards, but usually carried out in a very traditional way. Some of these standards are hard to develop accurately in practice, due to the rudimentary tools used. Most basic parameters such as diameter at breast height (DBH) or total tree height (h) often include an error depending on the operator. Although calliper and hypsometers have



a precision of millimetres, they are very sensitive to small changes, the operator position from the tree or the incorrect use of these tools increases the measurement error significantly. Aligned to this, is the fact that the manual data is entered into generalised models to determine forest volume, but are generally poor at determining product breakout.

We have also developed new tools that will allow the integration of wood quality parameters such as branch size and branch frequency. We are also developing automated tree species recognition. This could be very useful to the industry to help determine the quantity of woody biomass. Future research for automatic measurement of crown size, leaf index, CO<sup>2</sup> verification and validation with other parameters is also being carried out.

Given the crucial role of forests in currently intensively debated issues such as climate change and biosecurity conservation, the forest inventories increasingly need to give answers to more complex and intensive forest information, demanded from many parties. TreeMetrics believe TLS will be an essential tool to answer these requirements.

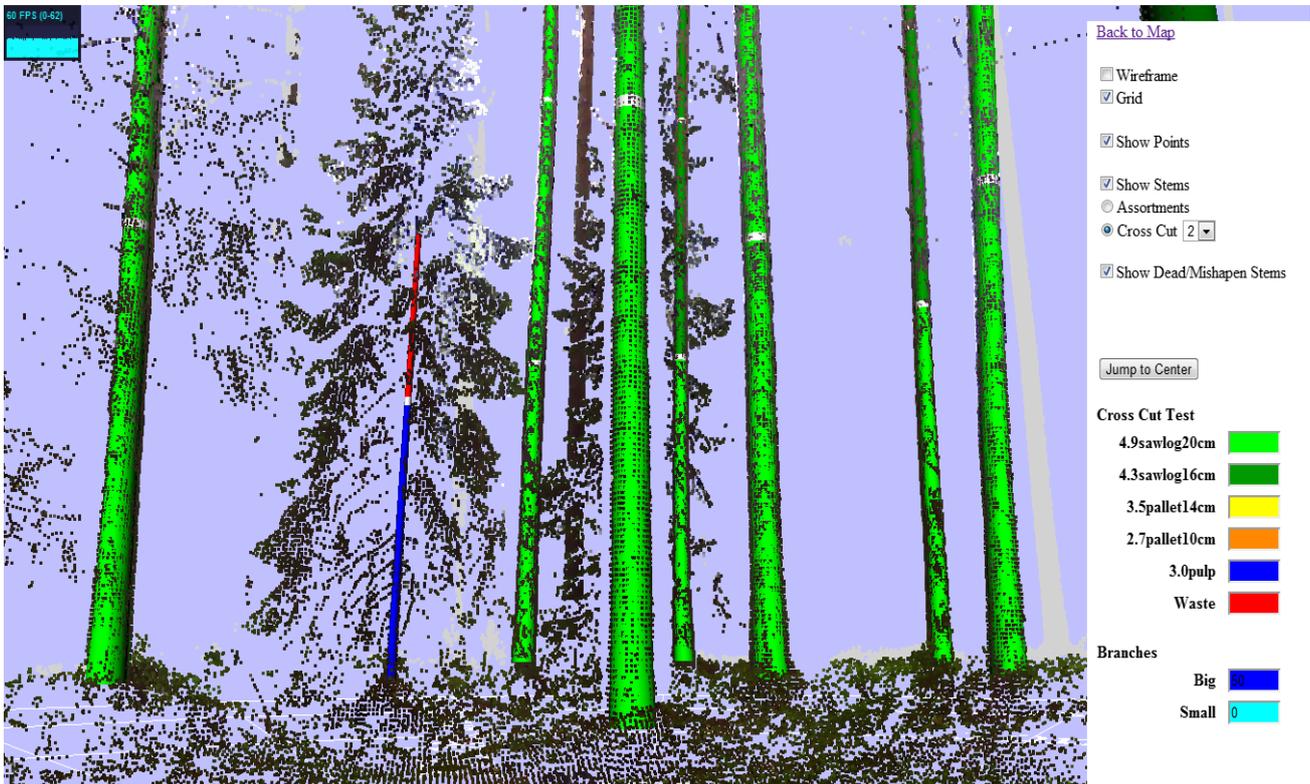


Figure 4 Sample plot viewer of stems and log positions taken from the scanner

The company has developed a system that provides forest industry organisations with greater forest product knowledge and transfers that knowledge across functional groups and by doing so it can help create an aligned and integrated environment. This ultimately will enable forest organisations to utilise their forest resource in a more timely and efficient manner.

Mr David Leslie, General Manager from James Jones and Sons has stated *“very impressed with the state of the system providing a proven and accurate way of measuring timber”*

TreeMetrics is working in conjunction with Woodilee Consultancy Ltd, based in the UK, who represents our business interests.



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We also offer other services including our new development called Real Time Forest Intelligence (RTFI) which is an integrated satellite communication system linked to our forest warehouse and AutoStem™ system.