Modelling traceability in the wood supply chain – does it pay?

[1] B. Talbot, [2] N. Søvde, [2] H. Fridén & [3] L. Wilhelmsson

[1] The Norwegian Forest & Landscape Institute bta@skogoglandskap.no
[2] IVL, Swedish Environmental Research Institute
[3] The Forest Research Institute of Sweden
Corresponding author: Bruce.Talbot@skogoglandskap.no

This paper builds on findings from the recently finalised work package 3.9 of the EU Indisputable Key project. Three institutes cooperated in developing intricate models spanning from the standing tree to the dispatch yard of a Swedish window manufacturer. Numerous timber properties were assigned to RFID tags, applied to the log at felling by a specially adapted harvester head. Logs were allocated to each of seven sawmills according to their timber properties using an LP based optimisation procedure. Simulation was then used to compare the fate of traced timber throughout the production lines of one of the sawmills and its downstream manufacturers.
Some of the parameters that can be estimated at varying degrees of accuracy during a pre-harvest inventory include:

- Theoretical assortment yield to log classes and dimensions
- Internode length (distance between branch whorls)
- Log cracking potential
- Log twisting potential (spirality)

During the actual felling and processing of the tree (i.e. felling, delimbing and bucking) it is further possible to provide information on:

- The top diameter of the log (automatically captured from harvester head)
- The length of the log (automatically captured from harvester head)
- Species – usually spruce vs. pine
- The heartwood content of the log (visually estimated by the operator)
- Allocation to general quality categories (on the basis of rot or discolouration, excessive taper, sweep or knottiness, physical damage).

The costs of gathering information, marking the logs and monitoring or utilising the data were assessed against the benefit of accruing the information at each stage of the chain. Through a number of repetitions, the principal elements contributing to value added were identified for individual segments and for the overall chain. Separating the allocation problem from the process model (simulation) provided an opportunity to analyse the effect of sub-optimal roundwood deliveries on downstream processing, the level of value-adding, and the potential to pass gains upstream to the harvesting entrepreneur or forest owner.

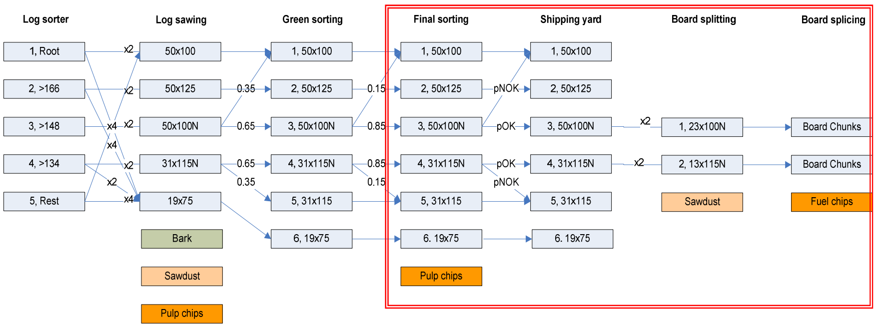

Figure 1: An overview of the simulated product flow from the log yard to board splicing at the secondary manufacturer. The red rectangle indicates the most crucial processes in 'tailor-made' supply

In the simulation, the sawmill stipulates that only a limited range of log diameter classes should be marked for this customer. This is due to the fact that the customer requires only 50x100 mm and 31x115 mm boards, an order which can be most advantageously met through the sawing patterns predetermined for log diameter classes 134-148 mm and 149-166 mm. Using the product flow indicated in Figure 1, the output from green sorting and final sorting was as given in Fig. 2.

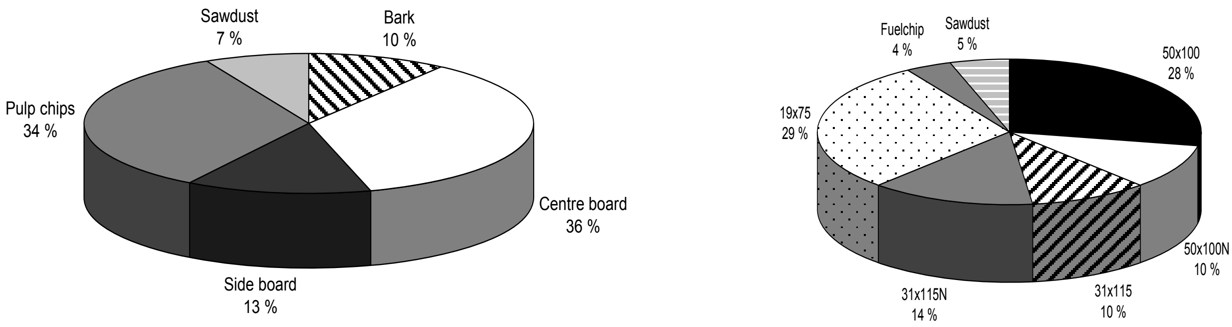

Figure 2: Product flow output after green sorting (left) and final sorting, after drying, on the right. Apart from fuel chips and sawdust, the final sorting only yields boards of varying dimension.

Green sorting was done on the basis of meeting some minimum criteria on wood density, heartwood fraction, and a stochastic downgrading probability, to cover a range of generic parameters that weren't made explicit in the model. The importance of possible green sorting on the basis of these parameters comes from the fact that they can be used in optimising the drying process. Knowledge of the density, heartwood content, and the position in the log (and tree) the board comes from (twist potential) can be used in manipulating temperatures and drying times in achieving a better product. The concept of deriving and using a 'value added' sorting function, offers players a tool for price negotiation, but also for optimising product flow to areas that ensure the highest returns generated on a supply-chain wide scale.

The simulation model developed is able to report on a number of Key Performance Indicators, which cover product distributions, economic yield and environmental impacts. A web version of the simulation is publicly available on the internet