

## Track #1 - Published Abstract

Presented at the 41<sup>st</sup> Annual Council on Forest Engineering Meeting, Williamsburg, Virginia, July 15-18, 2018. *Revolutionary Traditions, Innovative Industries.*

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### How chipper type, age and annual use affect chipper maintenance cost

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Due to the development of a renewable energy market, many contractors have invested in chippers. Buying a chipper requires a significant capital investment and business profitability depends on a correct estimate of actual cost. Chippers represent a relatively new technology and have received less attention compared with other forest machinery. Chipping accounts for a large proportion of wood chip cost, and any errors in chipping costing will reflect on the reliability of production cost estimates.

Chippers are considered high-maintenance machines, and yet very little hard data is available about their maintenance cost. Maintenance cost is difficult to estimate because the severity and the frequency of failure can be variable and operators may record different cost figures for the same maintenance intervention.

Therefore, empirical data was gathered from 51 chippers in Italy, using a standardized data-collection questionnaire. Owners were asked to provide data about machine maintenance and repairs, separately for the main machine components (i.e. chipper, carrier and loader). Furthermore, owners provided data about machine age (years), initial and resale price, total use (hours and years), total production volume and fuel use.

The sample included a large variety of machines, from small chippers powered by tractors with 60 kW engines to large industrial machines with independent engines up to 400 kW. Twenty-one chippers were fitted with their own independent engine, whereas 30 were driven by the engine of their carrier, using a power-take off (PTO). The largest majority of the chippers in this study were drum types.

All figures were referred to the whole operation, inclusive of chipper, carrier and loader. Among them, the chipper represented the largest share, regardless of operation type.

Mean machine age was 7 years, with a maximum of 24 years.

Mean total use was 3500 h with a maximum of 19500 h. Mean production per year was 8544 t, ranging from 148 to 37467 t.

There were some differences between independent-engine and PTO-driven units. In general, PTO-driven units incurred half the annual and hourly maintenance cost of independent engine units, but they got a 50% higher maintenance cost per unit due to a lower productivity.

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Repair and maintenance cost ranged from 0.42 to 7.00 €/t with a mean value of 2.28 €/t. As an average, repair and maintenance accounted for 14% of total machine cost. Planned maintenance was higher than unplanned one. Preventive maintenance accounted for 74% of total maintenance cost, with differences between machine types and operation components. Concerning the chipper proper, 80% of the maintenance cost was related with knife management and included knife sharpening, knife and knife holder replacement, counter-knife replacement.

Despite its strong Italian bias, this study may represent other countries, since the Italian chipper fleet is international and local business models are similar to those found elsewhere in the world, all based on specialized contracting.

Keywords: Biomass, Energy, Economics, Costing, Contractors