Productivity analysis of current cable yarding operations in the French Alps

Paul MAGAUD, Alain BOUVET
(1) Institut technologique FCBA, Domaine universitaire, CS 90251, 38044 GRENOBLE, France, paul.magaud@fcba.fr
(2) Institut technologique FCBA, 10 rue de Saint Mandé, 75012 PARIS, France, alain.bouvet@fcba.fr

Context and objectives
In France, cable yarding is a quite new activity. Less than 20 companies work with such systems. In the French Alps, 50 000 m$^3$ are harvested annually, with different kind of machines and organizations, by five French companies and foreign teams who work there more occasionally.

In order to help enterprises and forest managers with their cost elaboration, the primary objective of the study was to identify the main parameters influencing the productivity of cable yarding operations.

During one year (2013), 80 cable lines on 34 logging sites were monitored in accordance with the European harmonized protocol AIR3-CT94-2097. The purpose was to collect data on forest stands and field conditions for each logging operations (time schedule, number of intermediate supports, time devoted to specific phases).

The purpose of this presentation is to analyze the productivity for each phase (installation, production,...) and identify the factors which can explain the difference of productivity. Data were analyzed with a statistical treatment based on regression, variance and multi-variables analysis.

**Global productivity**

The average data for the lines productivities are displayed in table 1.

| Altitude (m) | 1200 m |
| Length of the line (m) | 414 m |
| Yield index (m$^3$/linear meter) | 0.9 |
| Time for line installation (day to 3 intermediate supports) | 1.3 |
| Time for line removal (day) | 0.6 |
| Time for production (day) | 6.6 |
| Volume of the load (tons with branches) | 1.7 |
| Speed of the empty carriage (m/s) | 3.5 |
| Speed of the loaded carriage (m/s) | 1.9 |

Table 1: average values for global productivity indicators.

The main factors influencing global productivity in cable yarding are:
- **Yield index** (volume/length of the line, m$^3$/linear meter)
- **Length of the line**
- **Numbers of intermediate supports**

The hauling’s direction (uphill or downhill) has no real impact on productivity, compare to the length of the line (figure 2), or the yield index (figure 3).

**Line installation**

The line installation, as its removal, is a non productive time. Both represent 25 % of the global time, and the productive rate increases with the yield index (figure 4). The main factor for the line installation are the numbers of support, the hauling direction and the use of a tail line (fig 4).

**Productive time**

Three main factors can explain the hour productivity:
- **the length of the line**
- **the hauling direction (uphill or downhill)**
- **the difficulty of hooking**, which concern the presence of stone, branches, stumps, slope or snow.

The best productivity is downhill haulage with short distance (< 400 m) and easy hooking (figure 5).

**Conclusion and perspectives**

The length of the line, the numbers of intermediate supports and the difficulty for hooking are the most important parameters that can explain the various productivity observed in cable crane operations.

The next step will be the treatment of productivity and costs with a KNN analysis, which will also give logging companies and forest managers new and helpful tools to improve efficiency in cable crane logging operations.