Productivity analysis of current cable yarding operations in the French Alps

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In France, cable yarding with cable crane 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.

The first step consisted in comparing productivities and costs between the Swiss software Hepromo (costs calculation) and the field reality, in order to assess the feasibility to adapt this software to the French conditions or the need to build a new productivity model. Preliminary results indicate that this software can't be used in France, because of the irregular variations between the provisional cost of Hepromo and the calculated cost based on time studies. Moreover, the actual prices of logging operations (as a service) applied by companies are disconnected from the observed productivity.

The second step, focus of this presentation, is to analyze the productivity data for each phase (installation, production…) and identify the factors which can explain the difference of productivity for one or many companies. These factors could be different from one enterprise to the other, due to the different materials (2 or 3 winches, capacity of the carriage), practical organizations (2 or 3 operators for the line installation, whole tree or partial delimbing), or the field situations (length of the line, yield index[1], medium volume).

Expectations were that results would be helpful for the enterprises (cost determination, productivity gains), but also for forest manager who would gain information on how to adapt sylviculture schemes to the logging conditions to be more efficient.

Materials and methods

During one year, 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).

Four enterprises from French Alps did participate in the data collection. Different types of machines were involved but a cable crane on a trailer was always present and used on the logging site. Most equipment's have only 2 drums and use Woodliner for downhill hauling.

Data were analyzed with a statistical approach based on regression, variance analysis and multi variables analysis. The objective is to find the main parameters which impact productivity in different phases.

[1] Yield index : volume on the line / length of the line, unit: m^3/linear meter

Results on global productivity:

The average data of the lines are displayed in table 1.

Altitude	1200 m
Length of the line	414 m
Yield index	0.9 m^3/ml
Time for line installation	1,3 day (0 to 3 intermediate supports)
Time for line removal	0.6 day
Time for production	6.6 days/line, 60 m^3/day
Volume of the load	1,7 m3, 1,7 tons with branches (whole tree)
Speed of the loaded carriage	1.9 m/s
Speed of the empty carriage	3.5 m/s
Table1: average values for global productivity indicators.	

The main factors which explain the global productivity in cable yarding are the yield index, the length of the line, and the numbers of supports. As we can see on figure 2 and 3, the direction of haulage (uphill or downhill) has no real impact on productivity.

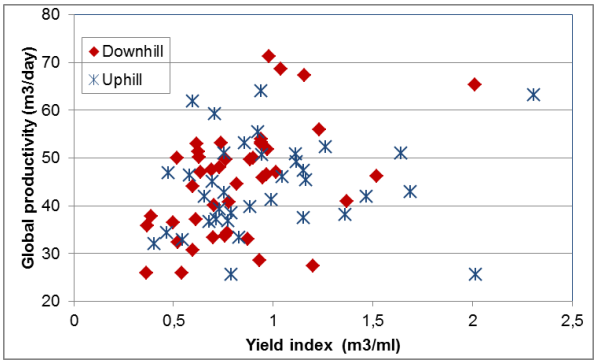

Figure 2: The global productivity (m^3/day) is increasing with the yield index (m^3/ml)

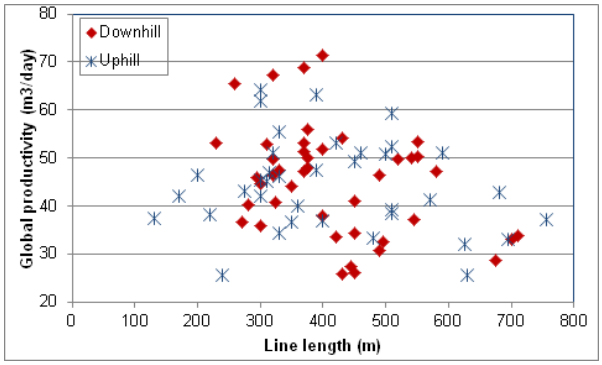

Figure 3: The global productivity (m^3/day) is decreasing with the length of the line (m)

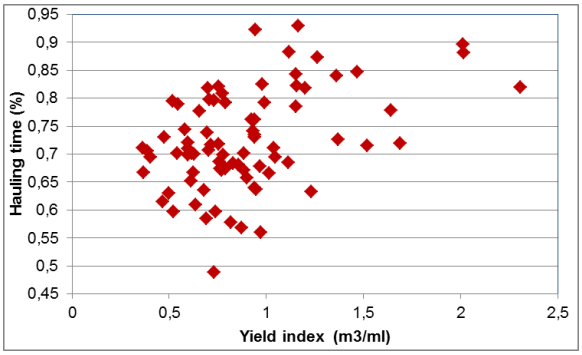

Figure 4: The rate of productivity time (%) increase with the yield index (m^3/ml)

In cable yarding, the installation and removal are non-productive time, and need to be the shortest. Productive time represent 75 % of total time. The productive rate increases with the yield index (figure 4). For an economic approach, this rate has to be the highest.

Results on line installation

On the studied lines, average time for installation is 2.5 hours/ 100 meters. The total time of line installation increases with the length of the line, and the figure 5 shows that the line installation is a bit more efficient with uphill hauling. The height of the intermediate support has no impact on installation time, and the average time for a support installation is 107 min (1.8 h). The main factors are the numbers of drums (presence of tail line), the number of supports and the hauling direction (figure 6).

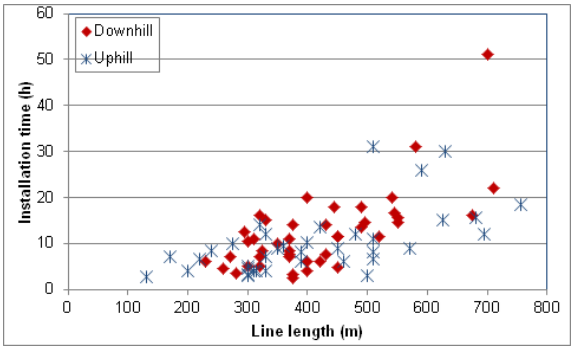

Figure 5: Installation time (H) and length of the line (m)

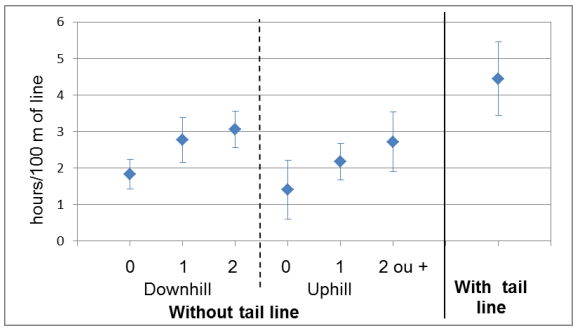

Figure 6: Average installation time and 95%confidence interval (H/100m line) as a function of the number of supports, the hauling direction and the presence of a tail line

Results on line removal

As for the installation, removal time depends of the length of the line, the numbers of intermediate supports (61 min or 1h for each removed support), and the presence of a tail line (figure 7).

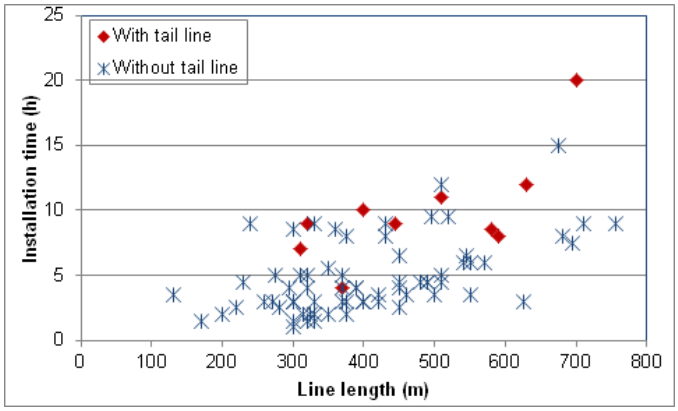

Figure 7: Average removing time and 95% confidence interval (H) as a function of the length of the line and the hauling direction

Results on productive time

The productive time is based on the hourly productivity and it doesn't include installation and removal. It is determined by the same upper-mentioned factors: length of the line and direction of hauling. But a new parameter appears: the difficulty of hooking. This parameter concerns the presence of stones, branches, stumps, slope and snow which influence the hooker's movements within the stand and the working site.

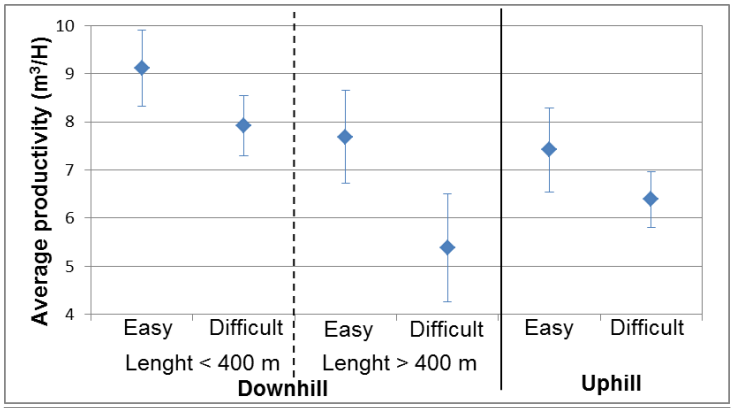

Figure 8: Average productivity (m3/H presence) as a function of various parameters

The best productivity has been monitored with downhill haulage on short distance (< 400 m) and easy hooking (figure 8).

Conclusions and perspectives

Most of theses analyses confirm what professional operators feel with experience. Some factors can explain various productivities in specific activities such as installation or production. But the global productivity is more complicated to analyze, and the variability of the field parameters is so important that the impact of each factor can't be clearly assessed with models. A productive time study analysis will be a good complement, in order to identify more precise parameters for the production time (speed of the carriage, volume of the load, hauling distance for hooking …).

However, 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 these result will be used for cable crane logging programming, in order to determine the preferential logging sites (length of the line, profile of the line, stand condition's…).

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.

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