



Universitatea *Transilvania* din Braşov

**HABILITATION THESIS
SUMMARY**

**ASSESSING THE PERFORMANCE OF SOME TIMBER
HARVESTING, TRANSPORTATION AND SAWING
EQUIPMENT AND SYSTEMS**

Domain: FOREST SCIENCES

Author: Assoc.Prof.Dr.Eng. Stelian Alexandru BORZ
Transilvania University of Braşov

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SUMMARY

This Habilitation Thesis presents the results of research that has been carried out after the public defense of my PhD thesis entitled *Research Regarding the Timber Harvesting in the Forest Conditions of the Râul Negru Upper Basin, Covasna County*, in 2009 at Transilvania University of Braşov, and it is structured in the following sections: an abstract, the scientific and professional achievements, the career development plan and a list of references.

Nowadays, there is a number of timber harvesting equipment and systems that are employed to extract and bring the wood into economy, and their performance is subjected by the operational environment in which they are used. For instance, the Romanian forest operations rely on the use of motor-manual tree felling and processing and timber extraction using skidders, with only some minor exceptions when the cable yarding and animal traction is actually used. Therefore the motor-manual tree felling and processing, followed by skidding is extensively used in the mountainous and hilly forested areas of Romania. On the other hand, the state-of-art harvesting equipment started to be introduced also in the Romanian forest operations, and there is an increased need to evaluate the performance of such equipment, including the traditional one because the results may help in understanding the harvesting systems behavior and develop the adequate measures and strategies in this particular research field.

This Habilitation Thesis explores the performance in terms of time consumption and productivity of forest equipment, based on the implementation of work measurement specific studies, develops empirical models for such purposes and includes some comparisons between specific technological alternatives. It also focuses on issues like the way in which the technical prescriptions are actually used in motor-manual tree felling in the context of an increased rate of occupational accidents in forest related activities.

In the case of motor-manual tree felling and processing, the results indicate rather small productivities and an increased time consumption for a particular case study that was developed in the conditions of harvesting broadleaved trees resulting from thinning operations. Furthermore, in the conditions of a very dense forest stand, it is likely to be needed additional time to solve some problems related to tree leaning following the motor-manual felling. The procedural prescriptions in motor-manual tree felling are not properly used in practice as demonstrated by a number of three case studies carried out in mountainous and hilly conditions, where the chainsaw operators took increased risks when performing tree felling operations. This should trigger additional studies in order to observe if this behavior is rather generalized.

Horse traction performance was studied in thinning conditions developed in broadleaved forest stands. Along with the empirical models, the productivity estimates indicate rather low performances which were related to the increased extraction distances and the number of logs within a load. In this respect, this kind of equipment would be more appropriate for timber extraction for short distances, or, other alternatives should be identified for similar operational environments.

Detailed studies were conducted in order to identify the significant factors affecting the timber winching performance that was assessed in terms of time consumption for several experimental treatments. It seems that the winching distance, slope on the winching direction, winching direction itself, log volume and the operational behaviour of the operators affect the performance in such operations. Given the highly variable potential conditions of the operational environment as well as the resource intensive activities in data collection, it is concluded that some automatic procedures would be required in order to further collect such data and also to explore the physiological strain in cable winching operations.

The performance of skidding operations is affected by many factors as being specific to operational environment and the used practices. Empirical models aiming to assess the performance, built by using population level data are required in order to understand the

equipment behavior, plan and organize the production as well as to design and analyze downstream processes or systems. A population level study was conducted in order to develop time consumption and productivity models for reduced accessibility conditions as being specific in the Romanian skidding operations. The results indicate that in such conditions the productivity is rather low, and it is also affected by an important portion of time lost as delays. Practices such as increasing the load per turn are used to balance the skidding productivity. It is also concluded that further studies should be conducted in order to get more reliable models and to integrate the technological progress.

Processor tower yarders represent the state of art in yarding technology, being characterized by several extraction-processing capabilities. However, little information is available in what regards their performance in landing processing operations, and a study was designed to model the time consumption and productivity of such equipment when processing coniferous trees resulted from thinning. The results indicate that such equipment may replace the traditionally used one, under the pending diligence of developing the road transportation infrastructure. Compared with a traditional system, the productivity was several times greater.

The performance of wood transportation systems plays a key role in enabling a steady flow within the wood procurement supply chains. In Romania, there are some cases in which intermediary storage facilities are used to concentrate the wood prior to its shipping to industrial processors. A study was conducted in order to differentiate the performance of wood loading equipment operating in a storage facility that emphasized the effect of assortments length and the transportation mean over the loading performance. Therefore, loading productivity was greater when loading railway wagons and 4 meter in length wood assortments. However, experimental studies should be further conducted in order to gain more reliable knowledge.

About 7000 small wood processing facilities existed in Romania in 2007, and there exists some knowledge about their capacities and production, but, similar to other regions, little is known about the factors that are influencing the performance in such operations as well as their magnitude. Since most of the wood processing facilities were rather small, an experimental study has been employed to assess the performance in terms of feeding speed, recovery rate and time consumption of a small Romanian made bandsaw. Along with the empirical models that were developed in order to assess the aforementioned indicators, estimates were produced for the same indicators in case of five wood essences. The study concludes that further research is required in order to evaluate the performance as a function of other parameters including the used technology.

Based on the research results included but not limited to those presented herein, the research tematics and directions are presented along with a plan for academic career development in the second section of this Habilitation Thesis.