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THE USE OF TIME STUDIES IN ROMANIAN FORESTRY: IMPORTANCE, ACHIEVEMENTS AND FUTURE

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Abstract: *Work measurement techniques, including time studies, are often used when assessing the efficiency of a given process, while other important applications such as energy balance assessment and Life Cycle Assessment (LCA) studies use data resulted from work measurement studies as well. Based on a bibliographic research which considered the studies carried out in Romania, this paper reviews the efforts made in Romanian forestry related to the use of time studies in efficiency assessment of different kind of equipments and develops a potential research roadmap related to the current international trends in such research by considering also the urgent needs of Romanian forest operations sector.*

Key words: *time studies, importance, achievements, research roadmap, Romanian forestry, forest operations.*

1. Introduction

The principia of work measurement, whose father is considered to be Taylor [1], have permanently evolved and improved being applied in many activity domains, especially when efficiency assessment is in question for different processes. Forest engineering is characterised by such processes, while timber harvesting operations, as part of the forest engineering, is developed in complex conditions [17]. In forest operations, work measurement is used in order to assess the efficiency of certain new (unstudied) forest equipments (processes) or in order to test already studied equipments (processes) in new conditions [22] by using some studies which yield, in general, empirical models. Depending on the extent of data used, the resulted models may be used as descriptors of a certain phenomena or they can be officially implemented [1], while the results of comparative studies may contribute to emphasizing the differences between the performance of two or more technological alternatives [1], providing this way the required support for decision making. While some studies included environmental indicators of different processes, these are still at the beginnings, although there are preoccupations concerning the use of scientific techniques such as Life Cycle Assessment (LCA) [16] or energetic efficiency [2], [18], [23] in certain forest operations. On the other hand, when dealing with applied research

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in forest operations, one key aspect refers to the possibility of using research results in practice, a fact that can be attained only by active collaboration with the related industries [10]. Also, harvesting operations are cost driven activities, while the cost of certain processes is considered to be one of the main indicators for evaluating efficiency related issues [13], [15], [17]. Given the fact that the costs are related to the equipments used in particular conditions, work measurement studies gain an increased importance in forest engineering since the costs involved in a process are closely related to its performance [17]. At the same time, in some cases, no viable strategies can be formulated in forest engineering without knowledge of the technical, economic and environmental issues involved in the applied processes in harvesting operations, a fact which led to the re-bordering of the analysed systems by transiting the scope of studies from the workplace level to a more integrative thinking [16]. While the technological progress improves substantially a given harvesting technology, it is expected that some (or all) of the downstream processes will be the subject to significant changes. A good example of this problem is the one related to the forest infrastructure development, where, the strategies for an optimal density should be unconditionally linked to the performance of upstream applied processes [15]. This becomes even more important as the modern forest equipments started to be included in the Romanian market [8-9], [21]. While it is commonly accepted that the extension of harvesting operations mechanization is a solution for efficiency increment [13], [17], a broader perspective like the one involving the use of a LCA technique [16] or an energetic balance analysis [18] may lead to different results or thinking. No matter the used approach, it is easy to forecast that work measurement will play a key role in future forest engineering. Given the importance of this discipline in the present context, this paper aims to perform a review on the time studies done until now in Romanian forest operations in order to emphasize the achievements and to develop research directions that may answer the practice needs in the future.

2. Material and Methods

In order to respond to the study's objectives, we performed several steps. First, we conducted a bibliographic research using all the available on-line databases, printed literature as well as the internet. Then, we constructed a database containing key issues for the identified studies and performed a critical analysis in order to identify the achievements and to develop a research roadmap dealing with time studies in Romania.

3. Results and Discussions

3.1. Number of sources and their accessibility

Following the bibliographic research we found out that only 10 references met the study criteria, dealing more or less with work measurement in forest operations. Also, while presenting some elements related to time studies, recent Romanian books do not actually report time studies results [13], [17]. We excluded from our study the available norms [24] since they refer to old concept machinery and harvesting methods. Most of the time studies were published in the last five years [3-6], [11-12], [14] while their major grouping in the last two years [3-6] emphasized the fact that this kind of research is still appreciated in Romania.

3.2. Studied equipments

Most of the studies dealt with chainsaws [5], [11-12] and skidders [3-4], [6], [14] while only one addressed the use of animal logging [5] and another one cable yarding [9]. It should be mentioned that some of the studies had rather an elemental scope [3], [14] while other addressed groups of operations [4], [6], [11-12], [19] or entire systems [5], [7]. Unfortunately, no studies addressing new-entry equipments on the Romanian market [21] were found, while only one study addressed modern processor tower yarders and was limited in scope to basic figures about productivity and time consumption [9]. Given the fact that the most used forest equipments in Romania are the chainsaws, farm tractors and skidders [20], general focus on such forest equipments was not surprising.

3.3. Used methodologies and study design

While some of the studies lacked in what concerns a proper description of the experimental design, it seems that continuous timing method was widely accepted and used [3-6], [11-12], [14]. Also, some studies reported correlations between different inputs and process variables [11-12], while other were more focused in using advanced statistical techniques such as backward stepwise regression [3-6], [14], including techniques of choosing the best model [6]. However, linear models are the best solution for a practical use [1] and most of the studies used this approach [3-6], [14]. Given the fact that it is quite difficult to setup comparisons in forest operations for the studied equipments, it was not surprising to find that the majority of the Romanian time studies dealt with modelling.

3.4. Study conditions – process variables

When studying the chainsaw efficiency during processing operations, diameters at each crosscutting section were considered to be relevant process variables [11]. However, in tree-felling operations diameter at the breast height, stump diameter and tree volume were included in the study [5], [11-12], while only one study considered the distance travelled between trees to be felled [5]. In case of animal logging performed in thinning operations [5] several process variables were identified as being relevant for different work elements, while logging distance and number of logs within a load seemed to be the most relevant variables in explaining the time consumption for an entire work cycle [5]. Cable skidding operations considered the inclusion of various process variables such as winching distance [3-4], [6], [14] winching slope [14], log volume [4], number or logs within one load [6], and skidding distance [4], [6].

3.5. Analysed inputs/outputs

It seems that time consumption as input and productivity as output were the most used (studied) variables [3-6], [9], [11-12], [14], while only one study tried to explain the green house gases emission as a function of different process variables and equipment setups [7]. This fact leaves a lot of unstudied problems to be addressed in the future, including the use of LCA in forest operations given the fact that, while some equipments were studied internationally the Romanian ones are quite invisible.

3.6. Basic results and practical relevance

The reported results referred mostly to time consumption and productivity, which

were assumed as objectives for researching in the majority of studies. Given the fact that developing time consumption models and productivity estimates was a constant preoccupation, the obtained results may be useful in organizing and cost evaluation activities of harvesting operations, and they may have a broader use including extended studies such as LCAs However, on short term, a particular attention should be given to the extension of studies by including other process issues such as energy inputs and impact in order to gain a deeper insight into the efficiency of given equipments performing in certain conditions. Also, the use of long term collected data may provide increased accuracy of the developed models, therefore an increased level of confidence for practical use of models.

3.7. Research Roadmap – Potential Approaches

Following this study we found out that there is a direct correlation between the studied forest equipments and the state of art in using these equipments in Romania. For instance, we found that chainsaws, farm tractors and skidders along with animal traction are the most used equipments in forest operations in Romanian conditions [20]. However, while there are quite a lot of harvesters, chippers and forwarders in Romania, no Romanian studies addressed these equipments so far. This becomes even more important since a lot of attention is given lately to wood as an energy source, even in Romania. One example is the FOROPA project [25] which aims to promote and enhance the use of lignocellulosic biomass for energetic use, in the general context regarding the increment of renewable energy share in the final gross energy consumption. On the other hand, studies addressing harvesting operations in short rotation cultures (SRC) should be implemented since the preoccupations around this alternative biomass source have increased lately in Romania. Also, a greater importance should be given to cable yarders which currently are used on a small scale even if most of the Romanian forests are located in steep terrain and this forest equipment is recognized for its reduced environmental footprint [17]. There are a lot of conditions which are not covered by the Romanian and international time studies as it results from scientific literature. While group shelterwood systems are fairly covered by studies done in Romania, there is still a lack of knowledge about the performance of different equipments in thinning, clear cutting and other silvicultural interventions. Special attention should be given to the low intensity extractions like those performed in order to harvest timber affected by various calamities or pests, since this phenomena started to occur more and more frequently around the world. Given the fact that the performance of tree felling operations using chainsaws is affected to a great measure by the harvested species, time studies are required in order to cover some hardwood species (oaks) when using new chainsaws, aspects which were not studied until now even if oak species account for an important share in Romanian forests. Also, the transition between a centralized forestry to a private forest ownership led to a decreased interest in elaborating time consumption and productivity norms, while knowledge about equipments performance, including environmental footprint and energy flow are quite important in formulating strategies and policies [1]. This should be a sufficient reason for a funding effort in order to gain a deeper insight on the used equipment performances, especially since no studies addressed the energetic balance, LCA use in Romanian forestry or broader

perspectives including upstream and downstream processes. While carbon implications due to the use of forest equipment were addressed only by one Romanian study, a lot of effort should be done in order to deepen the knowledge about this issue.

Therefore, work measurement in the Romanian forest engineering should be focused on the following pending issues:

- Elaboration of time studies for those equipments used in certain conditions by extending the scope to new, broader conditions.
- Elaboration of time studies for equipments used and yet unstudied in Romanian conditions: harvesters, forwarders, forage harvesters, chippers, modern cable yarders, wood transportation means.
- Extending the scope of studies by including the energy flows or by using advanced LCA techniques.
- Elaboration of models for a broader application including decisional support for strategies and policy making, by using long term data or sufficiently large data pools.

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Futures studies, futures research or futurology is the systematic, interdisciplinary and holistic study of social and technological advancement, and other environmental trends, often for the purpose of exploring how people will live and work in the future. Predictive techniques, such as forecasting, can be applied, but contemporary futures studies scholars emphasize the importance of systematically exploring alternatives.[1][2][3] In general, it can be considered as a branch of the social sciences and parallel to the field of history. Futures studies (colloquially called "futures" by Forestry and Forest-Industry Sector Study in Romania. (A public sector TC operation) January 2011. Evaluation Department (EvD).Â Contract negotiations between the Client, the Romanian Ministry of Agriculture, Forestry and Rural Development (MAFRD) and the Consultant proved to be time consuming. The contract started in April 2007 and lasted initially for one year, but was later extended until September 2008. The Consultantâ€™s Final Report dates from August 2008. This is the main phase of the project, financed under commitment AUS1-2007-03-01, with a total commitment amount of â¬300,000. However, their importance is so high that once again at least briefly to remind you about them would be a crime. Remember their need for at least the next decade, while on the basis of these discoveries will not be made new, even more amazing scientific achievements. Reprogramming stem cells. Stem cells are amazing.Â It's very simple. Now imagine that the same robots, only thousands of times smaller, are introduced into your circulatory system and imple deployed to fight entrenched in your body of any serious disease. Larger robots also together, go on any search and rescue operation, and even larger â€“ are used for a fantastically rapid construction of new buildings.Â Gravitational waves are ripples of space and time, moving at the speed of light. The use of time studies in Romanian forestry: importance, achievements and future, Bulletin of the Transilvania University of BraÅŸov, 7(56): 1-6. 1/6. Habilitation thesis.Â â€“ relevance, benefits and threats, Proceedings of the Biennial International Symposium Forest and Sustainable Development, pp. 225-234. (BDI). Importance of Time Essay -Time is money. It is a Treasure and yet we waste it foolishly. We waste it thoughtlessly in meaningless activities. If we take care of time, other things we will take care of themselves automatically. We all grow in time, live in the time and die in time.Â But great men and women of the world make the use of time in their best possible way. They know how precious is time. Every minute is valuable for them and so they take good care of it and so leave their footprints on the Sands of Time. They know that â€œtime and tide wait for noneâ€ and that â€œtime once lost can never be recoveredâ€. It is really a delusion to think that we can waste time. On the contrary, time is wasting us.