

SAFETY IN MECHANISED FOREST OPERATIONS: A TUSCAN PROJECT

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Keywords: biomass harvesting, high mechanisation level, safety, prevention.

Abstract: *In Italy, mechanisation is becoming more and more important and many loggers have mechanised their forest operations in order to increase productivity, decrease costs, and work more safely and comfortably. However, the new law on work safety issued in 2008 does not contain any specific provisions on mechanised operations. Tuscany is the Italian Region with one of the highest rates of mechanization in forestry, and regional officers are very concerned with preparing appropriate safety guidelines for mechanised operations. This is the goal of a new regional project launched in 2009 and focusing especially on cable yarders, harvesters, processors and chippers. The project is sponsored and promoted by the Regional Direction on Health and Safety Policies, and will produce a book of specific guidelines for increasing safety in mechanised forest operations.*

Project partners are: CNR Ivalsa, focusing on harvesters, processors and chippers; University of Florence (DEISTAF), for cable yarders; ISPESL for general machine safety criteria and conformity of machines to European directives; the four Health and safety Agencies of Tuscany for supervising the work and checking its applicability to Tuscan safety inspection programmes.

The guidelines produced from the project will need to offer reliable and sensible advice to mechanised forest operators. The document will be based on a thorough analysis of available bibliography and on a general survey of mechanised operators in Tuscany, for which a specific interview protocol has been designed. So far, 30 operators have been interviewed, collecting information on: accidents, near-misses, perceived hazards, best advice. Operators were also asked to rate their machines and their components in terms of safety. First results hint at a higher perceived safety for operators working from a cab, and a main concern for co-workers operating in the proximity of the machine – which have been often been indicated as the primary source of work hazard. Very few real accidents have been reported, while some near-misses were described and commented. These were most frequent when working with harvesters. Many operators also reported on the need for safe behaviour during machine maintenance. Some operations were also sampled for violations to safe behaviour, using a specific data-collection protocol.

1. Introduction

Many of the Italian forests are not utilized because of the poor quality, the difficult access and the general small size of the individual holdings. Against this background, the Italian foresters are trying to introduce mechanization and biomass harvesting, with the purpose of increasing the productivity of the few operators still willing to work in forestry, and of improving the value of the harvest. Modern mechanization is expanding rapidly, and many loggers have purchased state-of-the-art technology, hoping to achieve better productivity, reduce costs, and improve work safety and comfort. Such hopes are corroborated by current literature, which confirms a significant reduction of felling accidents after moving from motor-manual to mechanized felling (Bell, 2002).

However, the new Italian law on work safety issued in 2008 does not contain any specific provisions for mechanized operations. Tuscany is the Italian Region with one of the highest rates of mechanization in forestry, and regional officers are very concerned with preparing appropriate safety guidelines for mechanized operations. The use of new technologies entails new specific hazards, different from those typical of traditional operations, and as such yet unknown to local operators.

Producing such new guidelines is the goal of a new regional project launched in 2009, with a specific focus on cable yarders, harvesters, processors and chippers. The project is sponsored and coordinated by the Regional Direction on Health and Safety Policies, and will produce a book of specific guidelines for increasing safety in mechanized forest operations.

Project partners are: CNR Ivalsa (National Council for research – Tree and Timber Institute), focusing on harvesters, processors and chippers; the University of Florence (DEISTAF Agricultural and forestry Engineering Dept.), for cable yarders; ISPESL (National Labor Safety and Health Agency) for general machine safety criteria and conformity of machines to European directives; the four provincial Health and Safety Agencies of Tuscany, for supervising the work and checking its applicability to Tuscan safety inspection programs.

The guidelines produced by the project will need to offer reliable and sensible advice to mechanized forest operators.

2. Materials and methods

The project included four main steps: 1) an analysis of existing materials on safety in mechanized operations; 2) interviews with mechanized operators working in Tuscany, in order to draw from their specific experience and to gauge their awareness of specific risks; 3) direct observation of risk-taking behavior in selected mechanized operations; 4) drawing the guidelines and disseminating them.

The work started with a thorough and accurate analysis of existing publications on the subject, including manuals, guidelines, popular articles and scientific articles. Overall, about 70 titles were collected and studied.

Meetings were organized with all the partners in order to develop a most complete and comprehensive ergonomics and safety checklist, to be used for interviewing mechanized operators. Before starting with the interviews, a general test of the questionnaires was conducted by the complete study group in three plenary inspections of mechanized operations. All partners together were then able to check the effectiveness of the questionnaire, and to introduce appropriate improvements.

In the questionnaire were also considered:

- the logging company identification;
- the company structure;
- the types of machines used and their general analysis;
- the usual working process;
- the main tasks;
- the presence of the safety equipment on the yards;
- the operators experience;
- the operators risk perception;
- the operators rating;
- the risk analysis in the past and the near misses;
- our evaluation of the safety and wrong behaviors.

So far, 30 operators have been interviewed, collecting information on: accidents, near-misses, perceived hazards, best advice. Operators were also asked to rate their machines and machine components in terms of safety and comfort, using Likert scores.

Upon arrival to the worksites, operators were informed about the project and its goals, and were asked if they could devote some time to an interview, possibly during the lunch break or any other pause in the work cycle. Participation was voluntary and no compensations were provided. The operations were also observed during regular work, and five were specifically sampled for risk-taking behavior, using a dedicated data-collection form.



Figure 1-2. Mobile tower yarder and chipper - processing and loading at the landing

3. Results

During the interviews, we obtained data about 1) machine compliance to safety and ergonomics rules; 2) perceived hazards; 3) past accidents and near misses; 4) risk-taking behaviour during work.

3.1 Evaluation of the machines

3.2 Cable yarder

The changing conditions of forest management put an even greater emphasis on environmentally sound logging technologies, and there is no doubt that cableway timber skidding is one of the best methods from an environmental point of view. Wood harvesting also, in mountain areas is often particularly difficult, due to terrain morphology. Cableways are in these circumstances the best choice, and the couple cableway plus processor is becoming more and more frequent in Italian forests (Hippoliti et al., 2000). At the moment few people have a direct experience of operating with cableways and the needs of training courses are still high.



Figure 3. Mobile tower yarder mounted on truck

The main problem concerning safety in cable yarder extraction operation is due to the several factors and components that are involved in the whole production chain (Kanzian et al., 2003). Indeed independently of the types of machine used the components assembly of the cable yarder is one of the most crucial steps of the process and wrong mounted cable yarder systems often occur in our forest (Marchi 1997). The coupling of the several elements should be provided by the manufacturer's handbook.



Figure 4. Mobile tower yarder, mounted on tractor

Also for cableways the checked machines complied with the main specifications for safety and were CE labelled. As to machine self-evaluation, all the operators were satisfied with the safety and comfort provided by their cable system.

3.3 Harvesters and processors

All checked machines complied with the main specifications for safety and were CE labeled, except for a very old chipper.

A main problem for excavator-base harvesters and processors was the coupling of head and carrier. In many cases, the manufacturer's handbook for the carrier did not specify the head types and models which could be fitted on the machine, which is a binding requirement of European safety law. Lacking such indications, owners should get their complete machine inspected and approved by ISPESL officials, which few had done.

Furthermore, windows on the excavators occasionally lacked suitable OPS. Where present, some of the OPS grates were too thick and impaired visibility.

As to machine self-evaluation, most operators were satisfied with the safety and comfort provided by their units. Negative appreciation only concerned the lighting and climatisation of excavator-base units. Old excavators often lack a functional air conditioning unit, and are only comfortable in winter time. A number of studies have documented productivity reduction in loggers exposed to the heat in warm climates (Smith et al., 1985, Hansson, 1968). Some operators reported that during the hottest summer days, the temperature inside the cabin can be so high that they cannot work without keeping the doors fully opened and taking frequent rest breaks. On the contrary, just one of the operators using dedicated harvesters complained about the inefficiency of the a/c system.



Figure 5. Dedicated harvester



Figure 6. Excavator-base harvester

3.4 Chipper

All checked machines complied with the main specifications for safety (CE label), except for a very old chipper.

Chipper operators occasionally complained about poor lighting. Lowest scores were attributed to dust and noise, mostly for chippers without an enclosed cab.

4. Perceived hazards

4.1 Cable yarder

In cableway extraction, the operators must identify:

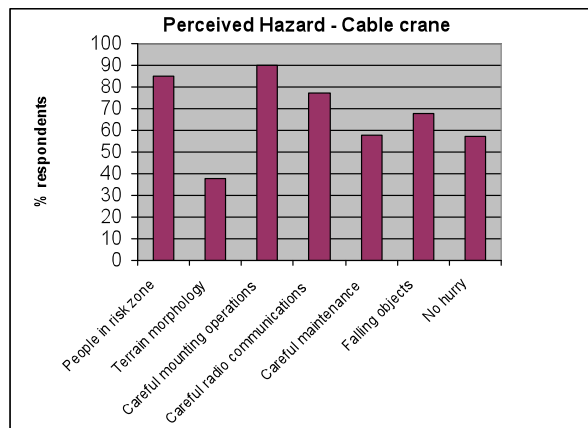
- suitable stacking points;
- rack layout in relation to landform;
- the availability of spar and support trees especially in thinning operations.

A high hazard perception for the workers often occurs during loading and unloading operations under the line. Unloading is considered as the primary source of work hazard, but also maintenance and wire rope handling are often dangerous operation.

The main problems reported are related to the mounting and dismounting process of the cable yarder, to climbing operations needed to prepare intermediate supports and to the risk of slipping on the forest ground during loading (Fabiano et al., 2001). Also bad postures were noticed during loading operations.

Moreover operators are particularly concerned with people entering the risk zone, and especially under the line during extraction and at the landing for unloading.

They usually use at least some of the prescribed Personal Protection Equipment (PPE), such as gloves and safety boots but the periodical use of the helmets in the risk area was noticed.



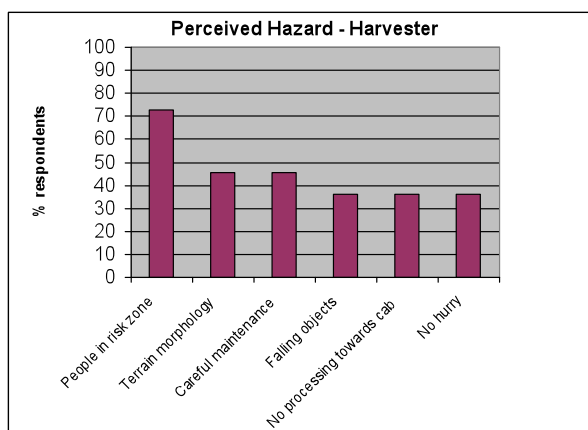
Graph 1. Perceived hazards – Cable yarder

4.2 Harvesters and processors

First results hint at a higher perceived safety for operators working from a cab. For most, the main concern is represented by co-workers operating in the proximity of the machine – which have been often indicated as the primary source of work hazard. Many operators also reported on the need for safe behaviour during machine maintenance.

Maintenance and repair work is generally performed by the operator in the forest, outside the cab, often in difficult terrain and/or in adverse weather conditions. The main problems reported for maintenance are related to: bad working postures; the need of great strength in handling heavy machine parts; the risk of slipping and falling associated with climbing up to and working on machines. Studies report that the

accident rate for maintenance work is higher than that for machine operation, and nearly as high as in manual logging work (Vayrynen, 1984).



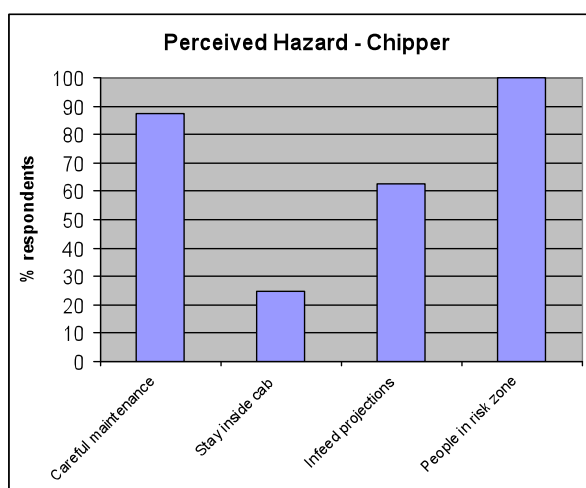
Graph 2. Perceived hazards - Harvester

4.3 Chippers

Chipper operators using industrial machines generally work inside an enclosed cab, giving some protection against noise, dust and adverse weather conditions. Operators using small manually-fed chippers enjoy much less comfort and declare that they need to be very careful during feeding, because logs can “lash back” when they are engaged by the feed rollers. They usually wear tight clothes and use at least some of the prescribed Personal Protection Equipment (PPE), such as hearing protectors, gloves, goggles, and safety boots.

Chipper operators are particularly concerned with people entering the risk zone, and especially the loader swing area, the infeed area, the chip discharge area and the truck manoeuvring area. Many are also concerned with projection hazards, as the chipper can throw large wood chunks and occasionally metal parts, especially in case of mechanical failures. Preventive maintenance is carried out whenever the machines are stopped for knife changing.

Both harvester and chipper operators perform all maintenance work with the engine is off, unless this must be kept running for locating a failure.



Graph 3. Perceived hazards - Chipper

5. Direct observation of risk-taking behaviour

Very few real accidents have been reported, while some near-misses were described and commented.

Table 1. Violations data protocol

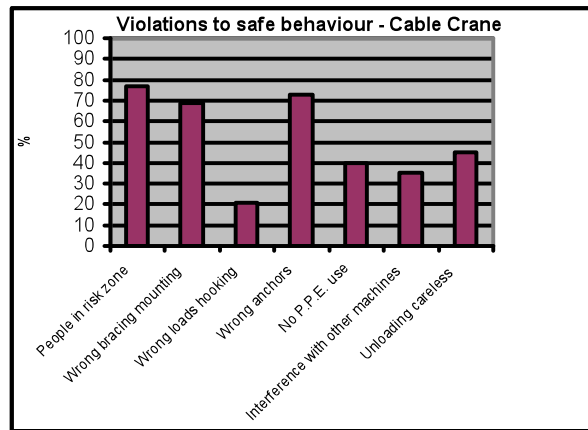
<i>Cable yarder data collection protocol</i>		
<i>Violations to safe behaviour</i>		Code
	People in risk area	1
	Interference with other machines	2
	Wrong line mounting	3
	Wrong bracing mounting	4
	Wrong loads hooking	5
	Wrong radio communications	6
	People under the line	7
During work	Unloading problems	8
	Command site disersion	9
	Operating without communications	10
	Overloaded	11
	Safety devices removal	12
	No P.P.E. use	13
During maintenance	Maintenance with engine on	14
	Refueling with engine on	15
	Operating without gloves	16
	Components release with engine on	17

So far, different operators were observed several hours each for risk-taking behaviour. Violations to safe working practice were characterized and annotated, obtaining a frequency distribution of different risk-taking behaviours, which can be related to time, number of events and output.

5.1 Cable yarder

As regard cable yarder systems the setting up and safe operation require a well trained working crew that is capable of recognising conditions that could potentially lead to failure, such as weak stump anchors, unusual line stresses etc. Technical guidance to avoid cable system failures is often available in the form of operating manuals. However, their application often depends on the knowledge and the skill of each individual crew. Using a specific data collection protocol the violations to safe behaviour were investigated.

In cableways extraction operations, the most frequent observed violations to safe working practice consisted of wrong cableways and bracing mounting and wrong loads hooking. Some operators often work without Personal Protection Equipment especially at the landing and they usually don't pay a careful attention to the wire rope maintenance.



Graph 4. Violations to safe behaviour – cable yarder

5.2 Harvesters and processors

With harvesters, the most frequent observed violation to safe working practice consisted of working with open doors, always pertaining to excavator-base machines and generally depending on the absence of an efficient a/c system. Some operators also stated that they preferred to work with open doors in order to obtain better visibility. All knew this is unsafe practice, but they deemed heat stroke and poor visibility to be higher risks. Many operators also did not use seat belts, although all machines were equipped with them. Finally, some operators mounted and dismounted by jumping, even if all machines were provided with suitable steps.



Figure 7. Bad behavior: working with open door.

5.3 Chippers

Observation of chipping operations yielded similar results to those listed above, with the most common violations pertaining to open doors and lack in the use of seat belts. In one case, we also observed maintenance being conducted without gloves, which entails the risk of wounding and/or contamination with potentially hazardous fluids and chemicals.

6. Discussion and conclusions

Nowadays, with the new regulation in terms of prevention and worker safety (D.lgs 81/2008 e s.m.i.), all workers are required to attend specific training courses managed and defined by their companies.

Training is essential to allow crews to efficiently operate cable systems. Focused training such as crew productivity training for entire crews, with emphasis on how the actions of individual crew-members may influence the productivity of the entire team.

Even experienced operators benefit from refresher training. It is important that the machine and system are equipped with ropes and components in a serviceable condition, that meet the manufacturer's recommended specification. The weight of the load must not exceed the manufacturer's recommended safe working load, which must be clearly stated on the machine.

None of harvester, chipper and cable yarder operators have attended a formal training program, but just few days in coincidence with the delivery of the machine, by the manufactures. Most relied heavily on a combination of "on the job training" and experience gained in the logging or other similar previous works. This lack of training appears to be primarily due to the high daily production demands necessary to keep the operation profitable. Therefore, nobody is willing to leave his/her workplace for more than a week, because the missed income would be too significant.

Attention to work safety is motivated by a number of different considerations, deriving from ethics, self-preservation and legal obligations. However, it also has a further dimension in economics, because less accidents mean less lost workdays, and therefore less revenues for both the employer and the employee.

Safety and ergonomics are closely related, because an uncomfortable operator can get too tired and lose concentration, which makes he/she more prone to engage in risk taking behaviour. At the same time, productivity also declines, with the increased risk of machine and product damage.

Most of the loggers interviewed during the study have a very clear perception of the risk inherent to their work, yet they may occasionally engage in risk-taking behaviour, as we observed during our study. Once asked about the specific events observed, most answered that they knew they were violating safety prescriptions, but they were confident in their own experience, and in their capacity to control the work process.

Safety training administered through specific courses could have an important role not just in the prevention of accidents, but also in building a new class of mechanized professionals able to get the most from their sophisticated machines, in terms of increased productivity, better process control, reduced machine maintenance and limited impact on the forest environment.

Acknowledgements

Special thanks are due to ASL 9 – Grosseto, and to the Regional Direction for Health and Safety Policies for project support and funding.

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