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A comparison of OWAS and REBA observational techniques for assessing postural loads in tree felling and processing

Nopparat Manavakun,
Department of Forest Engineering, Faculty of Forestry, Kasetsart University, Thailand
Contact: ffornrm@ku.ac.th

There are plenty of the observational techniques available for ergonomics study, very often they had been developed for different purposes and consequently applied under a variety of workplace conditions. This study aims to compare two observational techniques for assessing postural load, namely OWAS and REBA. The comparison was based on the evaluation results generated by the classification techniques using 248 working postures. The postures were sampled so that they covered varying work types from the tree felling and cross cutting by using chainsaws and brush saws in case of eucalyptus harvesting in Thailand. The selected postures were chosen based on 1) the most difficult postures, 2) the posture sustained for the longest period of time, and 3) the posture where the highest force loads occur. The test revealed that postural load by REBA was generally higher than by OWAS. Only about 22,6 % of 248 postures were classified at the action category 3 or 4 by OWAS, about 72,6 % of the postures were classified into action level 3 or 4 by REBA. It implied that OWAS underestimated posture-related risk compared to REBA. Furthermore, tree felling was more harmful in terms of musculoskeletal disorders than cross-cutting work phase. As well as, using chainsaws provided a greater harmful to postural load than brush saws especially in cross-cutting phase. Thus the application of brush saw for tree felling and processing may benefit to forest workers in terms of postural load improvement as far as trees are remain small size.

Keywords: Observational techniques, OWAS, REBA, tree felling, cross-cutting

Introduction

Work-related musculoskeletal disorders (WMSDs) constitute an important occupational problem, which increased costs of wage compensation, medical expenses, reduced productivity, and provided a lower well-being status (Kee and Karwowski 2007). In developing countries, physical labour still plays an importance role. Often job causes workers to exert forces in an uncomfortable or unhealthy body posture. Forest work is also considered as a physically demanding job, particularly labour intensive operations that mainly employs in Thailand. The research techniques for WMSDs can be divided into observational and instrument based techniques (Kee and Karwowski 2007). The observational methods are probably the most common approach to evaluate physical workload (Takala et al. 2010).There are plenty of observational techniques which have been introduced, for instance, RULA, REBA, LUBA, OCRA, OWAS, among others (David 2005, Takala et al. 2010).

Unfortunately, none of the methods are universally ideal for all purposes, due to the variety of user needs and the diversity of setting in working life. Besides validity issues, the user will have to consider the trade-off between accuracy, complexity, costs, and ease.of.use when identifying an appropriate method in a particular setting (Winkel and Mathiassen 1994). Sometimes rough and qualitative information may be sufficient, while in other situations detailed precise information is required as a sound basis for decision making. When selecting a method, users should first define their needs and constraints, after which our evaluation of, and further details in, the original reports may help them to select the optimal method to be used or modified for their specific purpose (Takala et al. 2010).

Each technique has its own posture classification scheme, which is different from other techniques this may result in assignment of different postural load scores for given posture, depending on upon particular technique used. OWAS application was studied in Thai timber harvesting by Manavakun (2013). However, OWAS has a wide range of use but results can be low in detail (Hignett 1994). Since a comparison of observational techniques with forest operations has not been performed yet in

Thailand, it is interesting to examine other observation techniques that may able to apply in forestry work and compare the results with OWAS method.

Objective of this study is to compare observational techniques, OWAS and REBA, in terms of distribution of postural loading scores, based on an analysis of 248 postures taken from tree felling and conversion processes.

OWAS

The Ovako Working Posture Analysing System (OWAS) was developed by a Finnish steel company. The OWAS method allows estimating the degree of static load of the workers at the workplace by analysing their posture, identifying four work postures for the back, three for the arms, seven for the legs, and three categories for the weight of load handled (Schilden 1989). Each of these factors has an attributed code value. The technique classifies combinations of these four categories by the degree of their impact on the musculoskeletal system for all posture combinations. According to the OWAS method, the degrees of the assessed harmfulness of these posture–load combinations are grouped into four action categories which indicate the urgency for workplace intervention (Mattila & Vilkki 2003; Kee & Karwowski 2007).

- Action category 1: Normal and natural postures with no harmful effect on musculoskeletal system – No action required;
- Action category 2: Slightly harmful postures – Corrective action required in the near future;
- Action category 3: Distinctly harmful postures – Corrective action should be taken as soon as possible;
- Action category 4: Extremely harmful postures – Corrective action for improvement required immediately.

REBA

The Rapid Entire Body Assessment (REBA) is a postural analysis system sensitive to musculoskeletal risks in a variety of tasks, especially for assessment of working postures found in health care and other service industries (Hignett and McAtamney 2000). The basic idea of REBA is to assess positions of individual body segments are observed and postural scores increase when postures deviate from the neutral position. The posture classification system, which includes the upper arms, lower arms, wrist, trunk, neck, and legs, is based on body part diagrams. Group A includes trunk, neck, and legs, while group B includes upper and lower arms and wrists. These groups are combined into one of 144 possible posture combinations that are transformed to a general postural code (Takala et al. 2010). The method reflects the extent of external load/forces exerted, muscle activity caused by static, dynamic, rapid changing or unstable postures, and the coupling effect. These scores are summed up to give one score for each observation (Takala et al. 2010). This technique provides five action levels for evaluating the level of corrective actions:

- Action level 0: Corrective action including further assessment is not necessary;
- Action level 1: Corrective action including further assessment may be necessary;
- Action level 2: Corrective action including further assessment is necessary;
- Action level 3: Corrective action including further assessment is necessary soon;
- Action level 4: Corrective action including further assessment is necessary now.

Materials and methods

Task description

The field work was conducted in clear cutting of eucalyptus stands in Thailand. Basically, tree felling and conversion are based on motor manual technique. Cut to length is commonly applied, logs are cut into 2-3 m long. The most common tree felling tools are chainsaws and brush saws. Local forest operations, work processes are carried out work phase by work phase for entire or part of harvesting stand. Trees are first felled down, afterwards other processes would carry out step by step. The forest workers normally processed those felled trees based on the closest tree. For tree felling and cross

cutting, same tools are applied: chainsaws and brush saws. This study is only focus on tree felling and cross cutting operations.

Subject selection

A total of 248 working postures were sampled from motor-manual tree cutting including tree felling and cross cutting with two different tools: chainsaw and brush saw (Table 1). There are four workers are involved in this study, age varied between 28 to 42 years old. The field study details were recorded using a video camera. The postures were sampled based on 1) the most difficult postures, 2) the posture sustained for the longest period of time, and 3) the posture where the highest force loads occur. The selected postures were captured from the working images recorded with video camera.

Table 1. Distribution of sampled postures (n=248).

	Chainsaws (n)	Brush saws (n)
Felling	56	80
Cross-cutting	56	56

Data analysis

The video material was captured the static motion from a screen and manually analyzed. All sample postures were assessed by using two observation techniques: OWAS and REBA, which resulted in two postural load scores for each posture by each of the applied techniques. The analyzed postured were classified on the basis of work phase and cutting tool. According to work phase, the postures were divided into two phases: felling and cross cutting. And cutting tools are included brush saws and chainsaws.

OWAS classifies postural load for the urgency of corrective actions into four action categories. While REBA groups postural loads into five action levels, which have slightly different meaning from the action levels of OWAS. To enable a comparison of the REBA and OWAS, the risk levels of the REBA had to be reclassified into four levels with consideration of the meaning of action categories for both techniques (Kee and Karwowski 2007). The new four action levels of REBA were classified in Table 2.
The comparison of both techniques was conducted based on postural loads at each action category by work phase and cutting tools.

Table 2. The reclassified risk levels of REBA.

Regrouped action level	Originally action level	Meaning
1	0	Normal posture
2	1 and 2	Low risk posture
3	3	Medium risk posture
4	4	High risk posture

Results

Distribution of action category/level by the technique used and work phase is presented in Table 3. OWAS appears to slightly underestimate the risk levels associated with working postures compared to REBA in all cases. For example, the felling with brush saw, OWAS assessed about 78% of

postures with action category/level 1 or 2, while REBA evaluated about 76% of postures with action level 3 or 4. Many postures assessed with action level 3 by REBA were evaluated with action category 2 by OWAS, especially felling with brush saw and cross cutting with chainsaw work phases (Table 3). Postural loads by REBA were significantly higher than those by OWAS regardless of work phase and cutting tool.

Table 3. Distribution of action category/level for 248 postures by methods and task phase (%)

Task phase	Method	Action category/level			
		1	2	3	4
Felling with brush saw	OWAS	26,25	51,25	10,00	12,50
	REBA	–	23,75	63,75	12,50
Felling with chainsaw	OWAS	37,50	14,29	8,93	39,29
	REBA	–	14,29	33,93	51,79
Cross-cutting with brush saw	OWAS	55,36	42,86	–	1,79
	REBA	–	67,86	30,36	1,79
Cross-cutting with chainsaw	OWAS	3,57	78,57	14,29	3,57
	REBA	–	5,36	64,29	30,36

Another comparison was made with respect to leg postural balance. The “balance” posture was defined as the posture where the body weight was evenly distributed on two legs and feet. If legs and feet were not in an evenly balanced posture, the posture was classified as “unbalances”. The 248 postures were composed of 77 balanced and 171 unbalanced postures.

The results showed OWAS underestimated posture-related stress compared to REBA. OWAS rated about 71% of balanced postures with action category 1 or 2, while REBA did about 66% of the postures with action level of 3 or 4 (Table 4). OWAS assessed about 20% of unbalanced postures with action category 3 or 4, whereas REBA did about 75% of the postures with the same level.

Table 4. Distribution of action category/level for 248 postures by methods and body balance (legs) (%)

Body balance (legs)	Method	Action category/level (%)			
		1	2	3	4
Balanced	OWAS	32,47	38,96	10,39	18,18
	REBA	–	33,77	40,26	25,97
Unbalanced	OWAS	29,24	50,88	7,60	12,28
	REBA	–	24,56	53,80	21,64

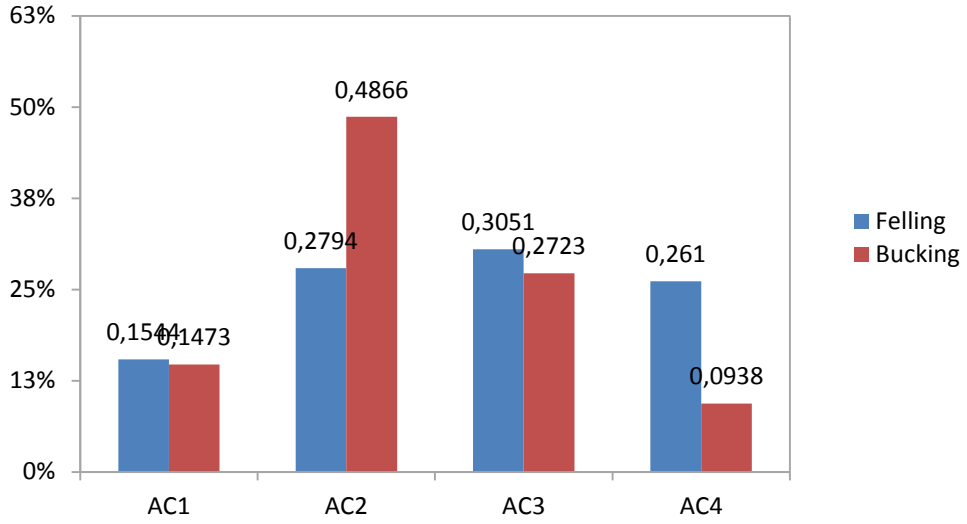

Figure 1. Distribution of action category/level for 248 postures by work phases (%)

Without considering cutting tool and observational technique, the proportion of action category/level by work phase applied was calculated in order to compare and estimate the risk level associated with work phases (Figure 1). The proportion cross cutting of action category 3 or 4 accounted for about 37%, whereas felling did about 57% of the postures with the same level. This illustrates tree felling is more harmful in terms of musculoskeletal disorders than cross-cutting work phase.

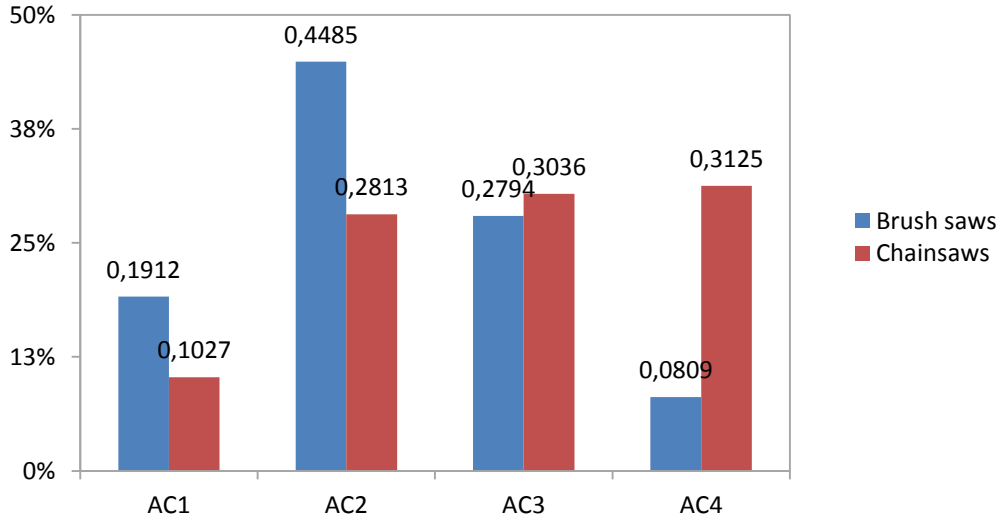

Figure 2. Distribution of action category/level for 248 postures by cutting tools (%)

Without considering work phase and observational technique, the proportion of action category/level by cutting tool applied was calculated in order to examine at the effect of cutting tool on workers (Figure 2). The proportion of action category 1 or 2 accounted for about 64% in brush saws, but the proportion was no more than 38% in chainsaw, which was nearly half of that of brush saws. This implies using brush saws for tree cutting and cross cutting is safer than using chainsaws.

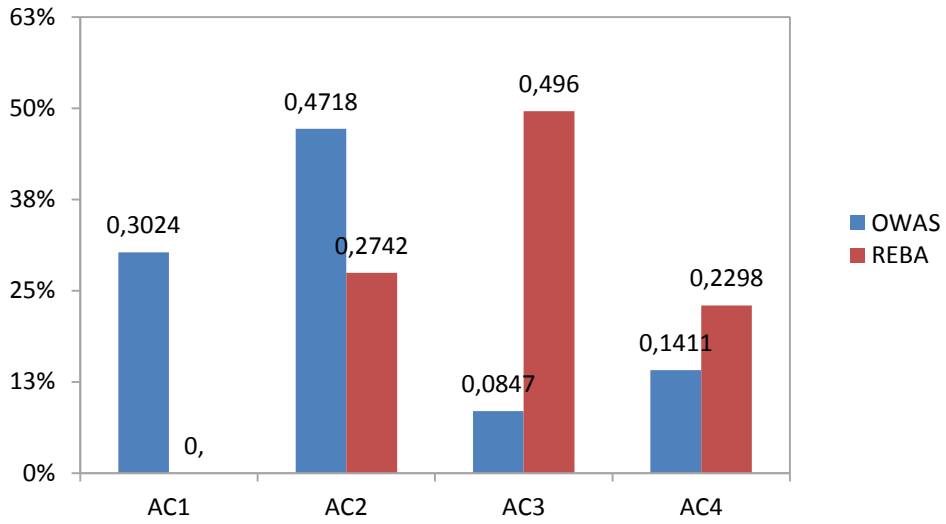

Figure 3. Distribution of action category/level for 248 postures by observation technique (%)

Without considering work phase and cutting tool, the proportion of action category/level by techniques applied was calculated in order to look at the overall tendency of assessment (Figure 3). The proportion of action category 1 or 2 accounted for about 77% in OWAS, but the proportion was no more than 28% in REBA. On the other hand REBA evaluated about 73% with action level 3 or 4. OWAS shows the relative underestimation tendency compared to REBA.

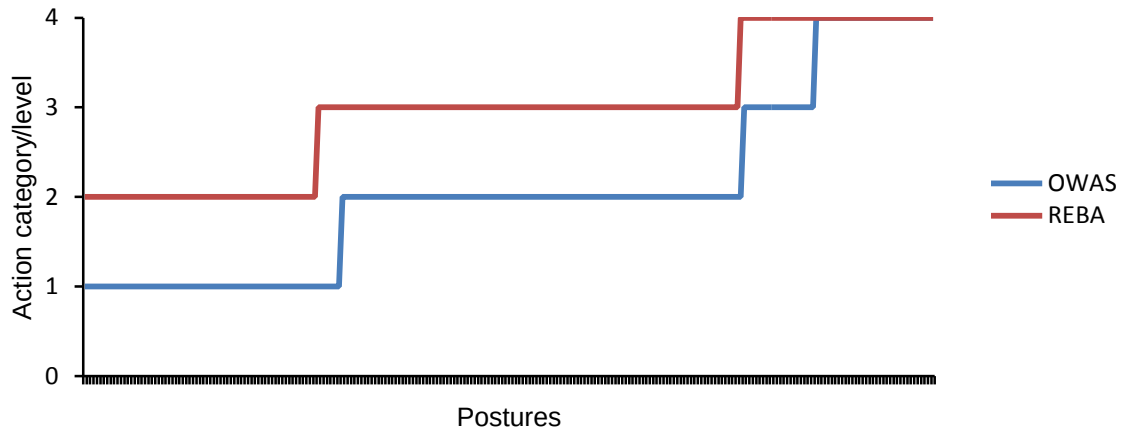

Figure 4. Comparison of postures analysis results.

Average score of REBA is 8,79 which is high risk equivalent to action category 3 of OWAS. The average OWAS action category is 2,06 ~ in overall is equivalent to action category 2. The REBA method has presented a better sensibility to detect fast and urgent action levels. The REBA has detected a bigger proportion of postures in these categories than the proportion detected by the OWAS method (Figure 4).

Discussion and conclusion

The observational techniques of OWAS and REBA were compared based on the results for 248 postures. The results showed that regardless of work phase and cutting tool, OWAS underestimated posture-related risk compared to REBA. Overall, OWAS assessed most of the postures with low postural loads of action category 1 or 2, with 77%, while REBA assigned more than half of the posture (73%) with high loads of action level 3 or 4. The REBA method has presented a better sensibility to detect faster than OWAS, probably due to higher degree of details assessment. This may caused by the REBA method reflects the extent of external forces exerted, dynamic, rapid changing or unstable

postures, and the coupling effect. Furthermore, REBA also has more sensitivity and body part detail to be assessed than OWAS. Whereas OWAS is rather simple evaluation method, no extension assessments included in analysis i.e. activity, dynamic, coupling.

The results pinpointed that forest operation with chainsaw is more harmful than applying brush saws, corresponding to Manavakun (2013). The reasons may be due to workers having to carry the heavy load of the chainsaw and the back being bent during felling. Thus the application of brush saw for tree felling and processing may benefit to forest workers in terms of postural load improvement as far as trees are remain small size.

Regarding the work phase, felling is more harmful than cross cutting. It was noticeably during data analysis that when the workers were felling tree, their trunks were most of the time bent and twisted, as well as legs were in unstable position i.e. weight is on one leg or bent knee. This may influence the higher risk level of felling phase compared to cross cutting.

In summary, each technique has its own strengths and weakness depending upon the assumptions made. Such as, OWAS does not separate right and left upper extremities. Assessments of neck and elbow/wrists are missing. In addition, it does not consider repetition or duration of the sequential postures (Takala et al. 2010). Where REBA, right and left hand have to be assessed separately and there is no method to combine this data: the user has to decide what to observe (Takala et al. 2010). Also the duration and frequency of items not included. A high proportion of jobs with high postural load are not an indication that a method is superior to others (Kee and Karwowski 2007). No single tool appears to have a clearer advantage over any other. Both observational techniques were developed for different purposes, and were meant to capture different type of risks. When trying to select the most appropriate method in a specific setting, users should define their needs and how the information will affect decision making (Takala et al. 2010). In addition to choosing an appropriate method, the sampling strategy is essential if the results are to be generalized beyond the observed sample.

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