The Forest Worker: Aspects of Selection and the Consequences of a Heavy Work Load

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Abstract
Job analyses of forest workers suggest that more attention should be paid to aptitude testing in the selection process. The paper discusses this point and outlines a range of related tests. The particularly high level of physical effort required in much forest work is also discussed as are the effects of vibrations and jolting on the operators of forest machinery. It is concluded that in the interest of safety and satisfaction much could be done in testing prospective forest workers and in incorporating greater ergonomic awareness into the design of forest machinery.

Introduction

THE proposed new Health and Safety at Work Order N.I. has already had the desirable effect of focusing attention increasingly on the human and subjective aspects of work. It is all too easy to carefully design a job from a mechanistic viewpoint and to ignore human aspects. Furthermore, it is possible, having recognised the significance of human aspects, to fail to consider the extent to which people vary as we slot them into the working situation. Hence if we are to be seen to improve the safety record among any work force we must design around human capacities and aptitudes and we must recognise that people vary widely in these aspects. People must be selected for certain jobs with care if we are to avoid designing working situations around the lowest common denominator of skill and capacity.

It needs to be stressed that care with selection is always in any worker's best interest. It means that people are directed to work which they can do well. Job satisfaction inevitably involves this prerequisite.

Clearly a proven record of ability in a skill which you wish to employ is excellent, but one is often dealing with potential trainees whose ability must somehow be assessed with respect to the proposed job. Analysis of the job is essential in order to establish a hierarchy of capabilities, aptitudes and attitudes commensurate with it.

The significance of such a hierarchy is simply that not all aptitudes have equal importance in selection. Take, for example, a hoist operator

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or someone operating forwarding machinery in a forest. It could be argued that such a person should possess:

(i) Good stereoscopic vision (depth perception)
(ii) Good eye-hand co-ordination
(iii) Good speed of reaction
(iv) Good distributed attention qualities
v) Good sense of balance.

The list may vary in detail but the idea of a hierarchy of aptitudes may be seen in the fact that if the potential employee has not got *good stereoscopic vision* it does not really matter what other qualities he has; he is unsuitable for this particular work. If one is selecting from a group then only those with acceptable scores at each test in the hierarchy would pass on to the text.

Several leading firms in the U.K. and in Europe test their whole work force over a range of aptitudes. Having related these aptitudes to specific jobs within the organisations, work force development and placement is greatly facilitated. A pilot study has been carried out in Northern Ireland to determine the correlation between the actual performance of some forest workers and their test scores. This has been partially successful and more work is planned.

Types of Test

In testing for skill potential there may be something to be said for simulating the job in mind by grouping the skills required into some specially designed test. Such simulation often incorporates confused learning criteria and may be unsatisfactory as an early predictor of training potential. It can be readily argued that simulation is more advantageous in the training function then in the selection function.

Several standard tests have been devised to measure the specific aptitudes into which the requirements of the majority of jobs can be divided. Some of the most widely applied tests are designed to measure the following:

1. Visual Performance — Standard tests have been developed to measure such aspects of vision as acuity, stereopsis, colour discrimination and phoria.
2. Eye-hand Co-ordination — A variety of simple tests have been devised which require the subject to keep an object on a moving route or target.
3. Speed of Reaction — This is normally related to the time interval required to cancel an audio or visual signal.
4. Distributed Attention — Such tests are an extension to testing speed of reaction. In this case the signals are varied in their location and nature.
5. Hand Steadiness — This is often indicated by one's ability to hold

a probe in a small ring or trace a very narrow path without making contact with the periphery.

6. Body Balance — Tests for body balance normally require the subject to stand on a small platform about 40 cm square. The platform is capable of tilting in any direction, within limits, and balance is related to the extent to which it can be maintained in the horizontal plane.
7. Manual Dexterity — The location of small dowels, bushes and washers on a simple pegboard can be used to give a measure of manual dexterity.
8. Hearing Sensitivity — Straightforward tests may be carried out under the correct conditions to measure a subject's threshold of hearing over the normal audio frequency range.
9. Physiological energy consumed can be measured using an "ergocycle" to gauge the mechanical work and a respirometer and oxygen analyser to determine the oxygen consumed. Other indicators of a subject's capacity for physical work are changes in heart rate, blood constituents and urine concentrations.

Of course while physical and physiological tests may indicate whether a person could do a particular job, such issues as willingness, motivation and vocational preference may also have to be considered. In these areas psychologists have developed several effective tests of the questionnaire type. Certainly information on attitudes and preferences is important in the selection of forest workers as with other workers.

The Forest Worker

The drop out figures among forest workers would suggest the need for a very serious look at selection. A recent bulletin (Scott and Cottell, 1977) of the Forest Engineering Research Institute of Canada (FERIC) indicated that only between 29% and 43% of those passing through training courses on logging in Canada were still on the job after one year. The same article suggested that in order to retain 3,300 loggers, 10,000 would have to be drawn into the basic training programme.

FERIC refers to some recent Canadian research on performance variations among logging machine operators which categorically concludes that it is possible to measure factors which influence such variations. The particular attributes singled out for attention are visual depth perception (i.e. good stereoscopic vision), manual dexterity, motivation and length of experience. It is suggested that the greatest motivation for increased productivity, from the operator's point of view, is an awareness and a recognition that he is capable of doing the job; surely an observation which underlines the importance of careful selection.

Among the suggestions for eliminating the unsuitable applicant in the Canadian context was to charge a fee for training — hardly an acceptable idea here. It is also suggested that a thorough exposure of prospective candidates to forest operations in action in poor weather might drive off the lazy and fainthearted.

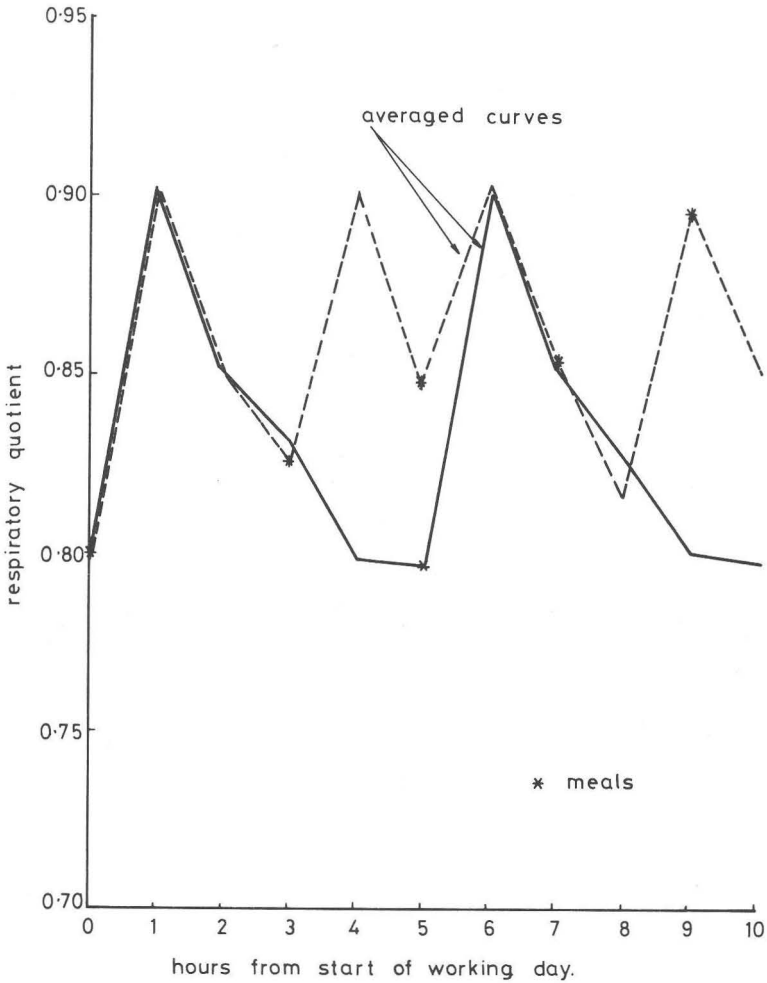
Early classical investigations in Sweden and Norway have shown that in traditional forest work the daily energy production of the forest worker was 6,000-7,000 k cal per day. Of course, with improved conditions and increased mechanisation, study within the last decade has shown that the energy production of manual forest workers was within the spectrum 2500/5000 k cal per day. Since work-scientists are generally agreed that the maximum energy expenditure recommended in industry for an 8 hour day should not exceed 5 k cal/min or 2400 k cal per day, one can see that forest work is rightly regarded as very heavy work. Of course, the concept of yearly averaging must be applied to forest work as with farming where extremely heavy work loads are experienced during harvesting. Also a correction must be made to the recommended norms for the age of the worker. It is also worthy of consideration here that man's capacity to convert the energy consumed into mechanical work may vary from around 5% to 30%. There can be little doubt that fatigue in forest work is a most significant factor in the context of safety criteria. Vigilance and speed of reaction data can demonstrate some of the hazardous affects of fatigue.

Clearly, in any attempt to combat fatigue, a worker's diet and the frequency of food intake is significant. Respiratory quotient (i.e. the ratio of CO^2 produced to O^2 consumed) has been found to relate to muscular efficiency and fatigue (Figure 1). This indicates the advantages of spreading the intake of food more evenly over the working day. Respiratory quotient is thus kept from falling too low.

Vibrations and Jolts

Together with the fatiguing affects of a high energy expenditure, forest machine operators are subjected to low frequency vibrations of considerable magnitude. This may have superimposed upon it substantial and not infrequent jolting. These aspects were the subjects of papers delivered at the World Congress of the International Union of Forest Research Organisations in Norway, 1976 (Hansson, 1976); Woulijoki, 1976).

The vibrations have to be damped in the body by absorption of the kinetic energy by the skeleton, joints, ligaments and muscles. The muscles play a vital role. This increased muscular activity is tiring although largely involuntary. The reaction to a jolt or vibration is to stiffen the body and the stiffer body is less able to effectively absorb



EFFECT ON RESPIRATORY QUOTIENT OF EATING TWICE PER WORKING DAY COMPARED WITH EATING FIVE TIMES. (AFTER HAGGARD AND GREENBERG (2))

Fig. 1

energy. One may perhaps draw the analogy with the rigid novice and the relaxed, experienced horse rider.

Horizontal vibrations were found, in the Norwegian work (Hansson, 1976), to be critical and yet there is a tendency to devise seats from the point of view of damping vertical vibrations. Seats tend to have the sides and backs with cushions into which the driver sinks, all of which effectively convey the effect of any horizontal vibrations present. High amplitude, low frequency vibrations are not healthy at the best of times but when the body is also twisted as shown in figure 2 the affect must be aggravated.

Finnish researchers (Woulijoki, 1976) have been looking with others at the effects of vibrations upon visual acuity and have discovered that between 3 and 5 Hz vertically and 23 and 34 Hz horizontally there is substantial loss of focusing ability. These frequencies were found in forest machine operations. Since the natural frequency of the eyes is said to be abovce 60 Hz it is suggested that this loss in focusing results from other tissues and organs in the head resonating.

Psychological Aspects

Much of the above has been about fatigue because fatigue in its turn can be a significant contributor to the causes of accidents.

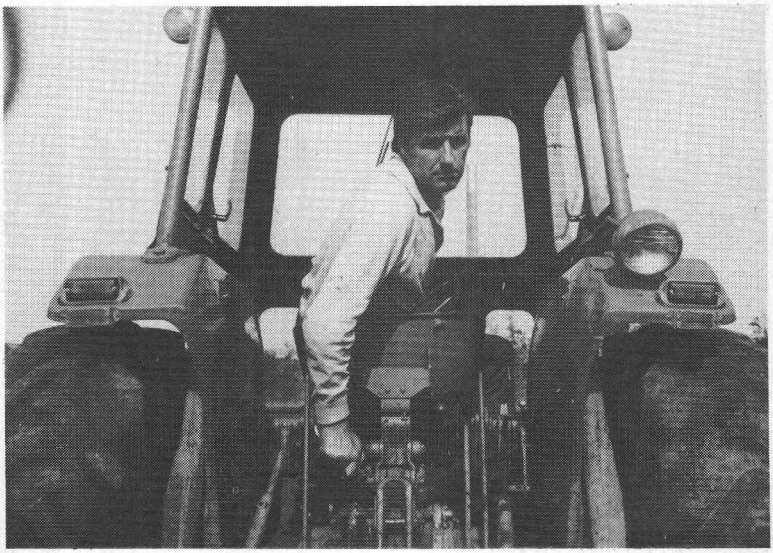


Fig. 2. Common tractor working position

However, it would be wrong to conclude that fatigue arises exclusively from environmental or physiological sources. Professor Grandjean (1969) summarises the various sources of fatigue as:
(a) Monotony
(b) Intensity and duration of physical and mental work
(c) Environment (climate, light and noise)
(d) Responsibilities, worries, conflicts
(e) Illness, pain, nutritional state.

Stress leads to fatigue in humans as well as in metals and important qualities which influence stress in most people are:
(i) Level of stimulation
(ii) Degree of control over working situation.

Aronsson (1976) studied two groups of sawmill workers, some sawyers and some maintenance workers. The sawyers worked on jobs with short repetitive cycles; there was rigid control over methods and too much noise to chat. The maintenance men had long non-cyclic work, personal control over methods and the opportunity for conversation. Of the sawyers, 74% complained of boredom, where only 8% of the maintenance men did so. None of the latter group complained of tiredness before work or nervousness afterwards, whereas almost half of the sawyers complained of both. It is often unwise to generalise, but much evidence suggests that there is a need to leave a degree of control as to how a person works in his or her own hands. Too often, allegedly improved production techniques result in repetitive, machine paced working with severe mental and physical restraints. This in turn induces stress, contributing to fatigue and accident proneness.

Conclusion

A paper such as this may reasonably be criticised for a lack of specific concrete proposals. However, it would be sheer arrogance for the writer who is not expert in forest matters to pontificate in that context.

It is clear that more could be done to facilitate good selection by introducing some related aptitude testing. Breaks and eating habits of our forest operatives could be looked at closely. The anthropometry and general ergonomics of harvesting machinery could be improved.

The forests have a good safety record but it is interesting to note that nearly all the forest workers one speaks to have had minor accidents and near misses. These are serious accidents in embryo. Let us not become fanatics, i.e. those who, it has been said, redouble their efforts after they have forgotten their aims. People in forest work are

in business to grow trees and to provide timber and amenities but how much better if those employed to do so do it as safely as possible.

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