Controlling the costs of work related illness in forestry. – What can the contractor do?

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Abstract. Mechanised forest work has long suffered from occupational health problems. As yet there is no way of assessing the costs caused by these problems or the benefits achievable through addressing them. The aim of this paper is to present and reflect upon a contractor costing methodology recently developed within an EU project, Ergowood. The project carried out a research effort combining literature surveys, a questionnaire study (n=359) and an interview study (n=118) among forest machine operators and contractors. A handbook was developed focusing on work environment management, tools included costing of illness and preventive measures for forestry small and medium sized enterprises (SME). Conservative estimates indicate that the work related illness may cost forestry contractors from 1000 € for an operator who is ill at work for two weeks to 50 000 € to replace an operator who has become too ill to work. In a new three year EU project, Comfor, we are focusing on developing methods which will encourage SME forestry contractors to adopt ergonomically sound working practices. Through action research together with ten European forestry contractors we will explore the impact of ergonomic considerations on business performance, and describe economic and management factors supporting or preventing work environment improvement. We will refine and evaluate current methodology for cost estimation of illness and counter measures as well as refine and evaluate key indicators on health monitoring. Given the general insistence on the need to cut costs in forestry, controlling the costs of illness must be a priority.

Key words: work organisation, ergonomics, cost-benefit, action research, health and safety

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Introduction

In many countries forestry is going from motor manual to mechanised operations, frequently from larger companies to smaller contractors. Mechanisation has led to both positive and adverse effects for the work environment (Axelsson, 1998). Smaller businesses often have less formalised structures which may act faster but which may not have the same access to competence and documentation capacity as may exist in larger businesses (Axelsson, 2002). The development of work related illness is a slow and frequently very obscure process. The physical causes for work related illness may be diffuse, its influence on performance difficult to observe (Johansson et al., 2003). Given these facts, estimating the costs of illness is very difficult. Investments needed to address the problems underlying deteriorating health may also be difficult to make due to missing information and budgeting formats.
The general need to cut costs in forest harvesting implies that curbing the costs of illness should have a high priority. In order to have control of costs in the area of work related illness and work environment management, a contractor would at minimum need a costing frame work to keep track of costs. He also needs detailed knowledge on the state of health of himself and his operators and a precise estimation of how the health status affects performance in order to make the right management decisions. Lastly, he needs to have a close knowledge of developments in the work environment – particularly of adverse effects in the form of causes for work related illness and how it affects operator performance.

The action needed to address problems leading to work related illness is many times referred to as pertaining to “ergonomics”. At the same time the term ergonomics has a tradition tied to mechanisation, and it is sometimes interpreted quite narrowly, implying a “technical fix” to a technical problem. In mechanised forestry the action called for may frequently be of an organisational character. For our purposes we want to broaden the issue and call it “management of the work environment” rather than “ergonomics” to indicate that a number of measures may be taken of both a technical and an organisational orientation to remedy a number of problems conducive to work related illness.

At present there does not seem to exist any detailed knowledge of operator health and performance in forestry harvesting teams and contractor businesses. The relationship between health and performance is difficult to establish since there are few or no objective measuring methods which could be relied upon. Standard procedure for estimating performance in forest harvesting is usually determined by some selected technical parameters, the extent of which may vary according to country, company, and harvesting form. A minimum requirement involves knowledge of machine performance, mean stem diameter, and transporting distance. In the actual forest operations the just mentioned parameters are, of course, merely indicative, it is the operator competence and state of health and mind which decide the actual performance. A very competent operator may produce above estimations, an inexperienced operator, or an operator who feels unwell will perform less than estimated. Needless to say, in the extreme case, if the operator is ill at home and there is no replacement, all of the technical parameters are rendered useless, performance is set to zero. But there is no objective mechanised way of measuring operator well being, the most important factor influencing performance of forest operations. We believe that estimating health and its influence on performance can be learnt to a greater extent than they are known today, but not through external measuring. What is suggested in this paper is a process of observation, discussion and attempted remedying, achieved by the contractor and his staff in an on-going problem solving process. Focusing on costs is a means to raise the awareness and priority of management of the work environment.

A large part of our material stems from an earlier EU project, Ergowood. In order to provide the reader with a more general description of how and why data has been collected and how costing may fit into a larger perspective of work environment management a first section of the paper is dedicated to this project.

Modern mechanised forestry work demands highly qualified operators (Gellerstedt, 2002). The degree of complexity varies, with harvesting in thinnings being perhaps the most demanding task. The operators need great skills and knowledge and the ability to take many decisions within a very short period of time. For an operator to perform at his best he needs to be focused and in good health. Small deviations from perfect conditions may yield substantial effects on performance and the economic result. The tasks involved in forest harvesting and the competence and performance
requirements are addressed in a second part of the paper.

Accidents influence performance immediately and obviously. Work related illness on the other hand develops gradually over time, symptoms are many times diffuse and effects on performance are difficult to observe in early stages. Both accidents and illness may be accounted for but the detection of work related illness is more difficult. The remedies which can be put forward to counteract poor health and illness development are complex, there are few “technical fixes”. One notable exception is improved maintenance and repair which could bring down accidents – for instance to immediately repair grips, steps, ladders and other equipment which would help against common accident causes such as slipping and falling due to climbing on wheels and other unforeseen work procedures. To provide the reader with a partial understanding of the problems a forestry contractor may be confronted with regarding accidents and work related illness, some findings on the subject are presented in the third part of the paper.

The main focus of this paper is to present and reflect upon a costing methodology for work related illness and management of work environment in forestry which could be used at contractor level. Linking illness to company costs is difficult; many costs are hidden, or difficult to estimate and account for. We therefore proceed to find out what knowledge exists today on the costs illness give rise to, and whether there are any models which allow for budgeting for preventive measures in the fourth section.

A simplified methodology for costing of illness and work environment management in forestry is presented in the fifth section. It is based on what we know about illness occurring in forestry and how it may influence performance. The methodology is primarily based on four illness scenarios. The model will be further refined according to contractor knowledge and preferences in a new project, Comfor. A brief discussion of the plans for this work concludes the paper.

**Material from Ergowood**

Ergowood was carried out between 2002 and 2005 with participation from Sweden, Norway, Germany, France, the U.K. and Poland. The project comprised a fact finding phase made up of literature reviews, respondent surveys and seminars. The literature surveys concerned the social conditions, safety and health of forest machine operators, machine technical ergonomics, work organisation, costs and benefits of a better work environment and controlling and monitoring systems (Lewark, 2005). Group discussions were conducted, collecting contractors, machine operators, forest managers and supervisors to discuss different prioritised areas. Next a questionnaire study (n=359) and an interview study (n=118) were carried out among contractors and forest machine operators concerning the working conditions in forestry in the six countries (Vik, 2005). Lastly tools and guidelines to support the propagation of a sound work environment were developed, including the handbook Health and Performance in Mechanised Forestry Operations (Gellerstedt et al., 2005).

The handbook starts with a five step inventory and action process aimed at improving the forestry work environment. There are tools to support individual stages of this process including a minimum set of key health indicators which should be discussed and added upon in the team at regular intervals to find out what the development trend for their health and the work environment is. The economic appraisal tool presented in this paper is another important tool of the handbook. This kind of handbooks and tools is not altogether new, but the emphasis here, both on the forestry work environment with all its particulars, and the insistence that it is the contractor and
the team itself who have the knowledge and can provide the proper planning and action is something of a novelty. At the same time this autonomy may be the largest difficulty, because there has to be a reliance on estimations and soft data which the contractor and the team themselves produce and there can – as yet – be very limited control against objective measurements or data.

Health and performance in forestry

The tasks of machine operation

Performance is a function of how competent the individual operator is and how difficult the tasks are. The more difficult the tasks are, the more varied will the performance be according to individual operator characteristics such as training and general well being. Gellerstedt (2002) reports a study on the operation of a one-grip harvester. The tasks of machine operation are varied and complex, especially for operating a harvester in thinnings. It was estimated that an operator may make 4000 control inputs per hour. Main tasks in thinning concern planning for and driving the machine, positioning the machine, tree selection, steering out the boom, positioning the harvester head and gripping the stem, felling the tree, pulling and delimbing, cross-cutting, and finally placing the logs, limbs and the top.

The different tasks involve different skills which may be more or less difficult to learn. Learning to steer the machine may take a month, reaching full capacity may take two years. Positioning the machine for optimal performance in the thinning operations and tree selection requires experience of different kinds of stands, thinning principles, seasons and weather conditions, and knowledge of silviculture. On average, it takes five years to reach full capacity in thinning. To acquire an acceptable capacity in making logs the operator needs theoretical knowledge about log grades, the final use of wood, and learning the skill of assessment, this learning takes several years. Summarising these findings we may say that the recruitment of a new operator fresh out of training means at least a partial company loss of performance during many months, perhaps years. Gellerstedt (2002) also reports that differences between individual operators’ productivity may vary ±20%.

Health and safety in a longer term perspective

Vik and Veiersted (2005) make a literature survey on social conditions in mechanised forest harvesting. They recognise that forest operations are increasingly becoming mechanised. Regarding health and accidents they state that the prevalence of accidents decrease with the rate of mechanisation. Accidents in mechanised forestry are now on par with other industry. More accidents occur during harvesting than in forwarding, especially during maintenance and alighting. Most common health complaints in mechanised forestry are musculo-skeletal disorders, psychosomatic complaints and hearing loss. There is a tendency of decreased low back pain and increased neck and upper extremity disorders. It is difficult to ascertain the severity of illnesses. However, there have been indications that poor health makes operators leave their occupation. In a Swedish study of machine operators leaving the business between 1986 and 1990 it was found that 50% had done so for health reasons (Lidén, 1995).

Health and safety conditions of today

In Ergowood several survey questions were put to the contractors and operators on the subject of their health (Vik, 2005). Diagnosing the severity of illness is very difficult. There may be many instances of feeling ill, feeling pain, stiffness, physical discomfort
or psychosomatic disturbances like head aches or tiredness which manifest themselves without any further diagnosis or record keeping. Yet, one definite demarcating line is whether an operator is too ill to go to work.

When the operators and contractors were asked about whether they had stayed home due to accidents having occurred during the last 12 months, 8.6% reported that they had stayed home for one day or more. Another 9.7% had been home from work due to illness which they considered caused by work, out of this population more than half the respondents had been home for 5 days or more. Another 27.7% had been off work due to illness not considered to be related to work. Operators were more often ill than contractors, but once ill the contractors were on sick leave for longer periods of time. Forwarder operators were least affected by work related illness (5.8%), work related illness among operators of harvesters was 10.1% and among skidder operators 21.1% (Vik, 2005).

There is also an “illness at work”. Asked whether at times they went to work even though they felt so ill that they should have stayed at home, 45% of the respondents answered affirmatively. Out of this total some 30% indicated that this condition had prevailed for 1–4 days, another roughly 30% indicating 5–9 days, and another 30% indicating 10–19 days, the remaining 10% had gone to work even though feeling too ill for more than 20 days. When asked about special symptoms of illness, 37.3% reported that they suffered from headaches, of which 65.3% was considered to be work related. Sleeplessness was reported as a problem by 14.8%, 62.3% considering it to be work related. Respondents could also indicate problems relating to the musculo-skeletal system on a five degree scale, the two most pronounced indications being “often” and “very often”. Counting the respondents indicating “often” and “very often”, between 11.2% and 16.2% had frequent problems in the neck, shoulder and upper back, another 26.2% had frequent problems in the lower back (Vik, 2005).

**Economics of illness and work environment management**

Benefit-cost analysis is a generally applied tool for investment decisions, but for the investment in occupational health and safety measures it is not so well documented a field, particularly at business level (Oxenburgh, 2004). Case studies of illness costs and the costs of ergonomic interventions have been identified pertaining mostly to the mechanisation of manual tasks within large industries. Main benefits of ergonomic investments on company level include evaded illness costs and improved productivity. Historically, pay-back times for ergonomic investments range between four months and two years, largely due to productivity gains (Oxenburgh, 1997).

Whereas the methodology of cost/benefit estimation is well established, its application to ergonomics in small-scale enterprises is very difficult for three main reasons. The incidence of illness and accidents may be uncertain within a small business, the exact impact of illness on productive performance may be uncertain, and the effectiveness of measures to counteract illness is frequently difficult to estimate (Bohlin, 2005). National standards also vary substantially regarding the classification of illness, e.g. whether a medical certificate is needed, the extent of cost coverage for illness, and what costs are allocated to the individual, the business and the state levels (Grundemann & Vuuren, 1997). There have been no published cases of benefit-cost analysis of forest related companies. Case studies primarily come from large industries and concern the mechanisation of different manual tasks (Bohlin, 2005).

A general methodology for benefit-cost analysis of ergonomic measures is presented by Oxenburgh (1991). The costs that illness give rise to are derived from
the true productive hours worked, the true salary cost (including nominal salary, obligatory charges and administration), and the employee turn over costs (for recruitment, temporary personnel and training and productivity and quality losses due to illness, including overtime, over employment and substitution costs). Next we need to account for the estimated health and safety benefits to be had from the ergonomic intervention, primarily reduced absence and improved productivity. The cost for the improvement is then divided by the benefits resulting from it and a pay back time for the investment derived. For larger investments Oxenburgh (1991) recommends using the net present value.

Three models for the accounting of costs and benefits of ergonomic interventions on company level have been identified. The Productivity Model (Oxenburgh, 1991, 2004) serves primarily to analyse single ergonomic investments. The model stresses the important influence of illness not only as a source of increased personnel costs but also reducing productivity. The model has been used to evaluate many cases with positive results. Harms – Ringdahl (1990) describes a model developed for forest industry. The model takes it departure point in large-scale investments. The cost of keeping up a system to monitor health and safety is also included in the model. Costs are monitored and accounted for by following the cycle of (old) system investigation, system improvement and (new) system operation. Costs occur primarily during the first two phases, benefits largely during the third phase. A third Swedish model has been developed for forestry applications. It takes its departure point in estimating the costs of work related illness in forest machine operations based primarily on costs for lost production and increased salary costs. Case experience and scenario costs are then compounded to illustrate an available room for ergonomic investments. The methodology relies on a consultant showing how to use the model (Arbetarskyddsämnden).

Designing a tool for contractor costing of illness and work environment investment.

A tool based on case experience was developed to cost illness and preventive measures (Gellerstedt et al., 2005). The intended users of the tool are contractors and harvesting teams in mechanised forest harvesting. In order to be easy to use the methodology needs to be as close to the situation facing a contractor as possible. The method also needs to address the fact that contractor firms are frequently small with very limited resources for business administration. A great effort was made to simplify the cases and the terminology used, the logic being that the simpler it was, the more likely it would be that the tool would be used. Continued revisions also meant continued simplifications.

In the introduction to the methodology it is indicated that the economic impact of investments in a good work environment go beyond what may be accounted for in direct cost-benefit terms. Positive effects which are not entered into the calculus may concern improved operator motivation, having an attractive work place and ease of recruitment as well as keeping good operators. The investment may therefore prove more valuable to the contractor than what can be shown in a calculus.

Economic effects are then shown in stylized examples. The positive effects on performance which may result from an improved work environment are shown in three examples. How illness may generate costs is illustrated in four examples. The illness cases are based primarily on how Ergowood respondents described their illnesses, notably the “ill at work” case. The performance changes are very conservative.
estimates based on the literature already quoted on training times to reach optimal performance and performance variation between individual operators. The reliability of the performance change due to illness used in the examples has also been verified in forestry reference groups. The methodology for accounting for total personnel costs is described. Since there is such a large national variation in the extent of cost coverage for illness, and what costs are allocated to the individual, the company and the state, these costs are not part of the cases. In this sense the company costs are underestimated. The terminology used in the method is described in Figure 1.

The production value is equivalent to the price paid for the harvesting service. Despite simplification there could still be difficulties in determining the profit contribution for the contractor if e.g., the harvesting service is paid for by m$^3$ instead of by the hour. There could also be more services than the harvesting included in the price, like demarcation and inventory after the thinning. An example showing how to calculate the profit contribution is therefore also supplied in the handbook.

The pedagogic approach involves giving a method and cost estimates for four different illness scenarios. Users are then invited to use the method to make their own calculus for each case based on their own conditions and experience. The last calculus is made to sum up relevant illness case costs for the individual contractor business. This sum may then be used to identify an investment room for improving the work environment.

**Effects of good health and work organization on performance**

Improved performance due to good health may increase gross machine availability, net machine availability and/or hourly productive performance. Generally speaking we may well have effects in all three areas. Gross machine availability is the calculated yearly utilization rate of the machine after deductions for holidays, training, calculated illness. If we can be certain of reducing illness yearly utilization rates improve. Net machine availability refers to the machine in daily operation, stressful situations or reduced mobility of the operator may lead to increased production stops, i.e. reduced availability. Reduced mobility due to pain or stiffness or stressful conditions may also reduce operator performance in the stand, both productivity and the quality of cross cutting. The profit contribution used is 70 €/hour.

Gross machine availability. Every gain of a day not lost by sickness renders an additional 7.5 productive hours per year. Economic benefit: 525 €/year

Net machine utilization. 5% increased net availability render an additional 100 productive hours per year based on an initial 2000 hours/ year. Economic benefit: 7000 €/year

Operator performance. Operator performance is the key to high productivity. A good productivity in a clear cut might be 20 m$^3$ per hour. We consider a harvesting system set up for a yearly two shift production of 15 hours per day and 215 production days to the year. With good work organization and proper ergonomics 5% improved performance translates to a production increase of 15 m$^3$ per day (15 hours*0.05*20 m$^3$) or 0.75 hours production time per day. With 215 production days
this corresponds to a yearly production gain of more than 160 hours. Economic benefit: 11 200 €/year. If instead we consider a one shift harvesting system the gain would be 5600 €/year. Other parameters may also be changed to fit the situation of the individual contractor.

**Illness cost scenarios**

Four different illness cost scenarios have been developed. In the first scenario the operator continues working while ill, increased costs only apply to loss of performance. In the next case the operator is ill and absent from work but there is a replacement available, in which case there will be increased salary costs and perhaps reduced production. In the third case the operator is absent and there is no replacement available. In this case the loss will be equivalent to the profit contribution multiplied by the time applicable. The fourth case involves a long-lasting illness and the company needs to recruit a new operator which will entail both recruitment costs and training costs. The examples use a profit contribution of 70 €/h and 37.5 hours machine time per week for each operator.

Example 1. The operator continues working whilst ill. The operator experiences substantial pain in his neck for two weeks but continues working while ill. The pain leads to reduced mobility and perception and a need to take more breaks. In this case the cost will be confined to the individual’s deteriorating health and reduced performance, estimated to 20%. The estimated cost is 1050 €.

For your calculus, enter the number of days and productive hours and the percentage reduced performance you think will apply, and then use the value for profit contribution which you have calculated (Table 1).

<table>
<thead>
<tr>
<th>Description/formula</th>
<th>Estimation</th>
<th>Your calculus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit contribution/h</td>
<td>Production value - variable costs</td>
<td>70 €</td>
</tr>
<tr>
<td>Production loss/h</td>
<td>20% reduced performance</td>
<td>14 €</td>
</tr>
<tr>
<td>Total cost for reduced production</td>
<td>$75 \text{h} \times 14 €$</td>
<td>1050 €</td>
</tr>
</tbody>
</table>

Example 2. The operator is ill and absent for two weeks, there is a replacement. The operator is replaced with an in-company operator. The additional salary costs are 20% (6 €/hour). The performance of the substitute operator is 10% less than the ill operator’s performance. The estimated cost is 975 €.

For your calculus, enter the length of the illness, the increased salary cost and whether you consider that there will be a reduction in performance (Table 2).

<table>
<thead>
<tr>
<th>Description/formula</th>
<th>Estimation</th>
<th>Your calculus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased salary costs</td>
<td>$75 \text{h} \times 6 €$</td>
<td>450 €</td>
</tr>
<tr>
<td>Production loss</td>
<td>-10% performance $\left(0.1 \times 70€ \times 75h\right)$</td>
<td>525 €</td>
</tr>
<tr>
<td>Sick pay + other replacement costs</td>
<td>Difficult to generalise</td>
<td>-</td>
</tr>
<tr>
<td>Total cost for reduced production</td>
<td>$450 + 525$</td>
<td>975 €</td>
</tr>
</tbody>
</table>
Example 3. The operator is ill but there is no replacement available. In this case the machine will stand still during the episode (Table 3).

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimation</th>
<th>Your calculus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production loss/hour</td>
<td>Production value – variable costs</td>
<td>100–30=70 €</td>
</tr>
<tr>
<td>Sick pay + other replacement costs</td>
<td>Difficult to generalise</td>
<td>-</td>
</tr>
<tr>
<td>Daily cost for failed production</td>
<td>7.5 * 70</td>
<td>525 €</td>
</tr>
<tr>
<td>Total cost for 1 week’s failed</td>
<td>5 * 525</td>
<td>2 625 €</td>
</tr>
</tbody>
</table>

Example 4. Long-term illness and need for recruitment. If an operator develops a long-term illness there will probably be a number of illness episodes and costs similar to the ones quoted above for a long time, perhaps for years. The costs will add up, and the operator might become so ill, that he cannot continue working. There will be a need to recruit a new operator.

If we consider that recruitment, interviewing and selection takes two weeks and the training time involves 4 months or 90 days of lost production from the harvester, this translates to a total cost of 49 650 € (Table 4).

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimation</th>
<th>Your calculus</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 weeks’ recruitment costs</td>
<td>10 days * 240 €/day</td>
<td>2 400 €</td>
</tr>
<tr>
<td>90 days’ lost production</td>
<td>90 * 7.5 hours * 70 €/h</td>
<td>47 250 €</td>
</tr>
<tr>
<td>Severance pay, other replacement costs</td>
<td>Difficult to generalise</td>
<td>-</td>
</tr>
<tr>
<td>Total cost</td>
<td></td>
<td>49 650 €</td>
</tr>
</tbody>
</table>

**How much to invest and why**
You invest to improve working conditions, to evade some of the costs listed above. The outcome of the investment is frequently uncertain, it may fall short of or surpass expectations. An exact calculus is therefore not possible. What is suggested here is that you agree upon an investment, then use the costs and benefits that you have calculated before to get a rough idea of how well the investment is funded. This also gives you a way to follow up on the investment at a later stage, by checking if the benefits you have listed actually occur (Table 5).

<table>
<thead>
<tr>
<th>The investment is to be funded by the following benefits:</th>
<th>Total investment cost, €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit</td>
<td>No.</td>
</tr>
<tr>
<td>Increased productive hours</td>
<td>at a value of</td>
</tr>
<tr>
<td>Evaded ill-at-work episodes</td>
<td>at a value of</td>
</tr>
<tr>
<td>Evaded sick days</td>
<td>at a value of</td>
</tr>
<tr>
<td>Evaded hours of production stops</td>
<td>at a value of</td>
</tr>
<tr>
<td>Other benefits</td>
<td>at a value of</td>
</tr>
<tr>
<td>Total benefits</td>
<td></td>
</tr>
</tbody>
</table>
As an example we may say that we know that two operators have neck and shoulder problems, one operator has been ill at home for a week for this ailment during the last year. We want to invest in a medical check up and a physiotherapist designing appropriate training programmes for the whole team consisting of five persons including the contractor, total cost 1500 €. We count the evaded illness costs and think they will add up to one evaded ill-at-work episode at work costing the company 1050 € and one sick with replacement episode at 975 €. It would seem that investing in the medical check up and the physiotherapist are worth while but the investment needs to be followed up.

Discussion

Ascertaining the occurrence of work related illness at company level is frequently difficult. Medical problems are frequently perceived only in the “back mirror” when an operator is already on sick leave. Once symptoms have developed to full scale illness, rehabilitation is more difficult and costly. Different work environment assessment methods already exist to identify health and safety problems in the work place, but they frequently become a formality, going through a routine, ticking off boxes in a form. Should problems be identified there is a need to know what costs may be involved and what budget room this may provide for preventive countermeasures.

Regarding the model presented, some input data like personnel costs and the profit contribution of operations should be more easily acquired; others are very difficult to estimate. E.g., regarding the illness it may be close to impossible to judge how far an aching back has developed to becoming an acute illness, when not feeling rested turns into a psychosomatic illness, or when a stomach ache develops into an ulcer. At the other end it is very difficult to estimate to what extent this illness affects performance. Productivity is measured as volume wood handled by the machine. This productivity is initially estimated as a function of a certain mean stem diameter and, sometimes, mean transporting distance, standing volume, terrain factors. It would need a very close knowledge of the individual to be able to discern how operator performance varies according to health and other “non-forest” factors. Quite possibly it would be an estimate needing input also from the operator who can himself explain if he thinks his performance has been impaired. Attempting to cost illness therefore also becomes an important reason to acquire information on the operator health status in the first place.

Primary difficulties indicated so far is that it is held that the competence and the economic information are not available on the level which the tool is aimed at. Further testing will elucidate this point. There have also been calls for more measuring points. This goes against the expressed need for simplicity. It may also be a sign of too high expectations. The primary aim with the tool is not to provide exact answers; neither research nor common knowledge is ready for this as yet. This is only a first step up from the situation of today where ergonomic measures frequently only take the form of rehabilitation after the fact of incurred illness. The tool could be a beginning for planning and budgeting for health issues and ergonomics. We believe that the kind of knowledge needed to make more exact cost estimates may be developed over time, during continued discussions within the team. During continued meetings, the contractor and individual team members may try to describe their state of health, how it is influenced by the work environment, whether it has improved, remains the same or has deteriorated.

As yet the economic appraisal tool is based on theoretical and empirical findings.
from discussions with researchers, contractors and operators. It will be put to the test and further customized in a long-term evaluation among ten contractors in a new EU project, COMFOR, along with other work science approaches aimed at improving occupational health and safety problems. Action research will involve presenting and discussing the tool, taking in-depth notes of the discussions, of the problems encountered and the solutions proposed. It may also involve making suggestions for e.g., specific investments to improve the work environment.

Action research is a collective term used for research where the researcher is actively trying to influence a development. Holme & Solvang (1991) state that action research involves the researcher combining his research with giving a contribution to the other parties involved. Greenwood (2002) emphasises how action research opens up for a dialogue between theory and practice. It is important for the different parties involved in action research to be on equal terms. Reciprocity, participation and active contribution are essential components (Gustavsson et al., 2001). Action research may be seen as a continued development of what Bryman (2001) has called participant observation.

Time is extremely short and limited in today’s forest operations. The most important action to undertake to address problems in the work environment is for the contractor to allocate time to meet and discuss work procedures and health status, take time to inventory problems and discussing remedies. The active interest and support of the contractor is in itself a first important step to work environment improvement (Clarke & Cooper, 2004). Many contractors have monthly “production meetings” when the productivity of existing operations, new areas to be harvested, machines, maintenance and other matters of importance to company production are discussed. It will be suggested that these production meetings are also used to discuss the work environment and the health of the staff according to the tool presented in this paper. Addressing the costs of illness and work environment management may prove an important factor to both short term and long term business profitability.

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