Ergonomics Codes of Practice: The Challenge of Implementation in Canadian Workplaces

Linda McLean and Jeremy Rickards
University of New Brunswick
Fredericton, Canada

ABSTRACT

Despite a reduction in the workplace injury rate for most industries in Canada, the number of compensation claims for the Canadian Forest Industry is not declining at a comparable rate. While mechanisation, particularly of tree harvesting operations, has improved injury rates in the last 5 to 7 years, the forest industry, along with similar labour-intensive industries such as mining, construction, and agriculture, continue to have unacceptable health and safety records.

This review of ergonomics codes of practice focuses on the issue of implementation, as perceived by the three major stakeholders, management, employees and their unions, and government. Barriers to implementation and successful programs are discussed, as is the use of Benefit/Cost analysis as one measure of success. Three examples of successful ergonomic interventions in Canadian forestry, manufacturing, and healthcare are detailed to illustrate the effective use of Benefit/Cost analysis as a measurement tool, and as the potential path to the implementation of universal codes of practice.

Keywords: *Ergonomics standards, benefit-cost analysis, ergonomics interventions.*

INTRODUCTION

The primary goal of ergonomic assessment and intervention is the protection of the worker. As with most occupational health and safety standards, ergonomics standards would seemingly benefit everyone in the workplace, from the forest worker who is at risk of injury that would prevent him or her from future work or activities outside of work, to union representatives, whose mandate is to protect union members from ill fate (physical, financial, or other), to management, whose concern is productivity, which inherently depends on the fitness of the employees to carry out their required tasks. Government too benefits by protection of its constituents from physical disability, which incurs costs in terms of pensions, medical treatment, and unemployment.

It would seem, therefore, that from an organizational approach, the implementation of an ergonomics code of practice would be a relatively simple task. Attempts at such a task, however, have proven difficult and often unsuccessful due to difficulties in creating standards that apply universally [4] and that are acceptable to both management and staff, and due to the ever changing economics of the work environment [31]. Potential reasons for the difficulty in implementation of an ergonomics code of practice stem from all levels affected by such a project, including government, management, union, and workers. This paper looks at the different viewpoints and concerns of these levels and reviews both successful and unsuccessful attempts at implementation of ergonomics standards to identify reasons for the failure to legislate ergonomics codes of practice in Canada.

Although injury statistics for the Canadian Forest Industry appear to cost only approximately $5 million per annum (which is one tenth the per-payroll dollar cost of other industries in Canada) [32], it is estimated that the true costs are much greater. The reason for this discrepancy is due to the nature of the forest industry itself. Many woodlots are small, private operations involving only one or two hired workers. Such small companies are not required to subscribe to the workplace compensation program, and thus the majority of injuries go unreported. The estimated injury rate within the forest industry is an order of magnitude higher than the present statistics suggest. The issue of workplace safety and ergonomics considerations is therefore of great importance within the Canadian Forest Industry.

POINTS OF VIEW TO CONSIDER

On the surface, it would appear that everyone involved in the implementation of an ergonomics code of practice stands to benefit from its success. Unfortunately those involved also see the potential drawbacks of such a system. The "costs" of implementation tend to occur primarily at the on-

The authors are, respectively, Doctoral candidate, Institute of Biomedical Engineering and Professor of Industrial Engineering, Forest Engineering Program.

set of the program, and thus little short-term benefit is seen by anyone. In tough economic times long-term benefits tend to be of less importance than the short-term financial costs. This feeling is reflected by workers at all levels within government and industry. In terms of benefit, little research literature is presently available that indicates measurable benefits of the implementation of ergonomics standards. Benefits are also inherently difficult to measure, and thus management is not easily convinced that ergonomic intervention is necessary. Most ergonomic interventions are aimed at the prevention of injury, and it is difficult to assess differences in the probability of a particular injury both before and after an intervention. Even if a decrease in the probability of injury were measurable, the fixed costs associated with this probability are largely unknown. The costs associated with an injured worker are often masked by budget structures. Some of these hidden costs include a decrease in productivity, hiring costs associated with replacement workers, and training costs associated with these new workers. Few employers are aware of these additional financial burdens associated with workplace injury, or even of the amount paid in compensation premiums.

Government

Governments have a particular interest in the prevention of work-related injuries due to the resulting burden on the health care system. In recent years, increased public awareness of workplace health and safety issues has resulted in an increase in the number of reports of cumulative trauma disorders. This has resulted in public pressure on the government to implement prevention programs, and thus the cost to government has climbed [21]. For such a reason, many governments have begun looking into the implementation of ergonomics codes of practice, in order to reduce these costs. Problems arise, however, in terms of the global economic environment. Some governments simply cannot afford to hire the specialized manpower required to implement ergonomics codes. Others continue to have a lack of general awareness of occupational health and safety among workers [29], which results in less public pressure to implement ergonomics legislation.

In recent years, some inroads have been made in the area of ergonomics standards, generally under the realm of health and safety mandates. The Canadian Standards Association (CSA) has responded to some of the public pressure in its development of the CAN/CSA-Z412-M89 Standard on Office Ergonomics in 1989. This entirely voluntary standard deals primarily with the design of office furniture and equipment but says little about work practices. The International Organization for Standards (ISO), on the other hand, has solicited assistance from Canadian members and, in ISO 9241, has considered the factors affecting human performance instead of concentrating on the technical design of equipment [5]. Between 1975 and 1989, seven standards and fourteen draft standards of ergonomics were developed by ISO, which covered areas such as general ergonomics, thermal stress, auditory signals, and lighting [2]. By 1995, 18 standards were in existence and 31 more were in preparation. Concurrently, in 1987 the European standardization organization, Comité Européen de Normalisation (CEN) established a committee (TC122) in order to develop ergonomic standards. In contrast to ISO standards, CEN standards are mandatory, through legislation, within the European Union [2]. By 1995, 10 CEN standards covering the areas of general ergonomics, auditory signals, and visual display units were in place.

In many countries, such as Switzerland, France, and the United States, only those workers whose injuries and diseases meet certain requirements are eligible for compensation. The requirements usually insist that the particular disorder is present on a list of acceptable diagnoses, and that there is evidence that this disorder is a direct result of the working conditions of the client [22]. These stipulations do not account for a large proportion of injuries that are claimed by affected workers to be due to their work situation. Those inflicted with these disorders presently rely, where possible, on medical insurance for financial remuneration, and little is done in terms of prevention. Some jurisdictions have proved more successful than others in terms of the implementation of ergonomics standards (such as British Columbia, Canada, and California, USA) where public pressure has forced such action from government.

As the number of cumulative trauma disorders continues to rise, there is a strong likelihood that the insurance companies will begin to restrict payment on such claims, although this is not yet the case. At that time, the situation will then call for government interventions in the area of prevention and compensation for disorders related to workplace ergonomics. It is therefore in the best

interest of government, in terms of reducing health care costs, to begin the implementation of small aspects of the code in order to encourage the acceptance of such interventions, and then to slowly implement additional standards over a period of time. This strategy has been employed in Australia, where manual handling guidelines were implemented in 1990, and in the United States, where the meatpacking industry was targeted as one industry that required immediate ergonomics legislation for the prevention of back injuries [6] Implementing policy changes in specific areas where ergonomic intervention is unquestionably necessary is an obvious starting point. Government may then continue to target specific areas one at a time, and eventually all workplaces will be covered by ergonomics legislation. Such regulations have recently been initiated within the forest industry in Canada in terms of CSA 14000, which regulates logging operations.

The implementation of an ergonomics code of practice inevitably heightens the awareness of certain cumulative trauma disorders in the working population. This increased awareness brings about an increase in the number of compensation claims. Not only does this increase the cost of health care and insurance, but it may also require an increase in the staff required to process claims, and to assist with risk assessment, risk management, and risk control operations. In times of cutbacks and downsizing in the health care sector, an increased work demand will be difficult to justify.

Many countries have made inroads, especially in the area of manual handling, due to the widespread knowledge that repetitive and heavy lifting cause back injury. The International Labour Organization (ILO) has supported the idea of international levels of occupational standards. A crude measure of acceptable weight limits for lifting tasks has been encouraged. Most developing countries tend to follow the American National Standards Institute (ANSI) recommended limit of 55 kg, although countries vary in their acceptable limits from 55 to 75 kg. Further, the ILO recommends separate standards for women and children, although these have not yet been reflected in the legislation of developing countries [29]. Unfortunately there is no simple calculation that accurately describes the maximal load one should lift. Many factors must be considered, such as the size of the load, the availability of handles, the displacement the load must undergo, and even the surface of the floor on which the handler stands. Regardless, at least there is a minimal awareness in the area of manual materials handling. In most countries, the prevention of most other work-related musculoskeletal injuries is not a high national priority. If a more detailed code costs government or industry too much to implement, then it will decrease the country's ability to remain competitive in international markets. In order to be successful, an ergonomics standard must keep implementation costs to a minimum, and must demonstrate a high potential for actually helping industry to save money either through decreased absenteeism or through increased productivity.

Management

The main concern of management in privatized industry is profit. This goal requires that the company be able to compete in national and international markets by keeping production costs as low as possible. Managers will only accept an ergonomics code if it stands to decrease production costs. In theory, ergonomics legislation should do just this. Compensation claims cost a company in many ways, including insurance premiums to the compensation program, loss of productivity, training of replacement employees, and overtime payments for those covering in areas where there are absences. In 1991, the ratio of direct to indirect costs for compensation in Australia was higher than 1:1.75 [18], meaning that for every dollar that the management was aware of paying to compensation premiums, there was an $1.75 paid out to cover expenses incurred by the company as a result of a workplace injury. It was found that many managers did not consider these "hidden costs" in their analysis of the financial considerations of workplace injuries. To many managers the cost of implementing an ergonomics program far outweighs the potential benefits. Benefit-cost analysis, as discussed later in this review, is an ideal way to convince management that there is an economic benefit to ergonomic intervention.

Management generally sees the implementation of ergonomics strategies as requiring expensive changes in tools, equipment, and physical layout. These types of changes are the easiest way to begin improvements, and the results are noticeable immediately [14]. Although such changes are often required, a government standard must be sensitive to the capital cost of such modifications. Often changes may be made inexpensively, or less expensive temporary solutions may satisfy the code requirements until sufficient funds are available to make major changes. In Australia, economic benefits often fol-

low health benefits in terms of occupational health and safety legislation, although this calculation is often made only after the introduction of a particular legislation [22]. This idea is thus not used in the "selling" of the impending legislation to management and employers and management need to be made aware of this fact. Cost-benefit analyses should be done prior to the implementation of an ergonomics standard.

Other management obstacles that block the implementation of an ergonomics standard include a lack of knowledge about ergonomics, lack of specific knowledge about the potential harm caused by certain work tasks, and poor interdepartmental communications. In many instances, the decision makers (management) are not located functionally or physically near the workers, and they do not see the health risk incurred by workers, based on their work tasks and the potential benefits, in terms of decreased compensation costs and absenteeism gained by the implementation of such a code [10].

Employers may also view the implementation of an ergonomics code as having a negative impact on productivity. In order to comply with such a code, some workers would be required to make time in their schedule for site inspections and modifications. While modifications are being made, there would also be a break in productivity as tasks are altered, and the employees learn the new task requirements. When first introduced, a code would likely make employees more aware of certain disorders. This would potentially cause an increase in absenteeism and compensation claims at the onset of the program, leading again to increased cost in the short term, although this cost would likely taper off within months.

Recent studies involving the implementation of a Manual Handling National Standard and Manual Handling National Code of Practice in Australia have shown that management may be convinced that a standard will provide long-term benefits to both administration and staff, although initial strong management support of such a program often wanes [3]. Improved success has been attained by including training sessions for managers and employees as part of the implementation process [1], although this may again be seen by some managers as an undesirable cost due to lost work time.

Employees

The workers are those who are most directly affected by the implementation of ergonomics standards. They are also those who are expected to put in the greatest amount of time in order to make the program successful. They must be involved in the identification of the tasks that pose substantial risk of injury, and they must also test the modifications.

In times of economic uncertainty (and thus budget constraints and layoffs), the workers tend to shift their focus from job satisfaction to simply holding on to their jobs. Employees will tend to take fewer sick days and to under-report occupational injury as they fear their job is at risk [31]. Introduction of ergonomics standards during times such as these make it difficult to gauge success. Workers will not complain to management for fear (either perceived or real) of jeopardizing their shift schedule or their job as a whole.

Further, workers tend to resist change [18], especially when it is accompanied by further monitoring of their work activities. However, workers consistently agree that ergonomic design will significantly improve the work environment, enabling safer and more productive work [9]. Resistance to change may be overcome by involving workers directly affected by changes in the decision making process. Perhaps the involvement of worker's unions in the implementation of ergonomics codes of practice would serve to convince workers that these codes are for their benefit and protection.

Problems arise when the workers are asked to participate in such a program. Even with management support, worker participation becomes difficult when there are scheduling limitations. While a worker is performing duties related to applying the ergonomics standard, someone must cover their usual duties. Even if someone can be available to do so, problems due to scheduling often hinder success [26].

PROBLEMS WITH THE IMPLEMENTATION OF ERGONOMICS STANDARDS

Manual handling guidelines have been developed in the US (NIOSH lifting guidelines) [8], Europe and the United Kingdom (ECSC Force Limits) [8, 4], and Australia (Manual Handling National Standard) [19]. The major problem incurred in the

development of such guidelines is the diversity between anthropometrics, strength, and mobility between individuals, and the diversity of work tasks. The NIOSH guidelines, for example, are appropriate only for a lift that is smooth, two-handed, and symmetric in the sagittal plane with a moderate width of load (less than 75 cm), good couplings (handles, shoes, and floor), and a good ambient environment. The ECSC force limits go somewhat further in identifying tasks that generally impose abdominal pressures greater than 100 mm Hg, which has been deemed the maximum permissible pressure generated that does not pose significant risk of back injury. As developed, both guidelines should produce the limits at or near the same range of loads, although this is not the case. The nonlinear relationship between these load limits demonstrates the difficulties that arise when attempts are made to standardize tasks for a diverse population. A better approach may be to identify risk tasks for a given worker, and individualize standards based on the strengths of that particular worker. This would require increased involvement on the part of management and workers, and a participatory approach to problem solving.

The State of California, USA, has since 1973 required physicians to report all incidents of repetitive strain injuries caused by occupational tasks [17]. Between 1989 and 1991 potential epidemic clusters of carpal tunnel syndrome were identified by an annual period prevalence of five percent or greater, or a doubled annual incidence of surgical and/or worker's compensation cases (i.e., double the baseline rate of 1 case per 1000 person-years). Where the incidence of carpal tunnel syndrome was high for a particular workplace, the employer was encouraged to seek assistance from ergonomics professionals. If assistance was not sought, then legislation was passed in order to enforce ergonomics intervention in the area. This type of strategy was found to fail due to both employer and worker attitudes. Workers were discouraged to report incidents of repetitive strain injury by their employers in order to avoid enforcement by the state labour department. As the employees feared losing their jobs or being transferred to lower paying jobs, they tended to abide by the wishes of the organization, despite encouragement by government to report such cases. The employers feared enforcement due to the cost associated with changing workstations.

Although the concept of identifying potential epidemic clusters by physician reporting is good in principle, the use of this information without the active participation of both management and the workers tends to promote negative attitudes toward the enforcement of standards. Within the forest industry, there is a large non-uniformity in the reporting of accident statistics [16]. In order for sound ergonomic solutions to be implemented, accurate monitoring of these statistics is essential. If statistical measures differ greatly, then epidemiological comparison studies are valueless.

An attempt was made to implement an ergonomics program in which the workers were trained in ergonomics assessment and intervention at a unionized plant in the US. The program was based on a participatory learning approach. One study found that there were no significant differences in training outcomes (on measures of trainee satisfaction, ergonomic knowledge, or performance in job surveillance skills) between workers trained by ergonomics specialists or by their peers (who were trained by these specialists and who then trained the workers) [27]. Problems arose in the implementation of such a program, however, due to the participants in the program not being provided the work time and scheduling flexibility to perform ergonomics assessments and interventions. The interventions made were successful in terms of reducing the risk of musculoskeletal injury, although the researchers lost 50% of their ergonomics-trained workers from the study. These workers stated that they received little management support, and thus ran into scheduling difficulties when performing the tasks assigned to them under their roles as ergonomic trainers. Suggestions made following completion of the study included the adoption of a longer time frame to complete the introduction of the program (five years was suggested), the development of organizational structure and support arrangements prior to the implementation of ergonomic change activities (i.e., to provide adequate scheduled time for the peer ergonomics-trained workers to perform interventions), the simultaneous integration of training and interventions (in order to promote improved understanding of how to perform an intervention), and the provision of a wide range and scope of shop-floor intervention activities. Again the bottom line seems to be that such an ergonomic intervention program must be profit driven in order to acquire and maintain management support, and that without this management support the program will not

succeed.

WHAT WORKS IN TERMS OF ERGONOMIC INTERVENTION

Programs That Already Exist

In general, it has been found that a participatory approach between management and employees works best in the implementation of ergonomics programs [13, 28]. This form of approach is good for two reasons. Firstly, it heightens interest in and awareness of ergonomic interventions, and secondly, it contributes to the sustainability of the program after the health-and-safety ergonomist has departed. Ideally, a successful implementation ends with a self-perpetuating ergonomics program, with the support and participation of both management and staff. If there is a change in management, there must be evidence of ongoing commitment to the program or it runs the risk of deterioration. In Sweden, as an alternative to legislation, the forest industry agreed to limit continuous machine operation to four hours in order to reduce injury. With this managerial implementation of occupational health controls, it was found that other positive effects were observed in their workers, such as an increase in work motivation and a willingness of the workers to broaden their competence in other areas within the forest industry [15].

On the implementation of the Victoria Manual Handling Regulations in Australia, one study suggested that expert consultants are not required in order to abide by the regulations, but that more objective, reliable, and repeatable assessment methods are required [30]. This feeling is reflected by many involved in the implementation of manual handling standards in Australia. Others found the same rules applied to workers in the US [25]. They felt that education of workers was important, but that instead of teaching the workers "how to lift", they should be taught "how to identify risks". The most important risk factors were identified as: repetition, awkward postures, the requirement of excessive or prolonged forces, pressure, and environmental factors such as extreme heat or cold. They also felt that in order for implementation of ergonomics standards to be successful, legislation was necessary.

The Australian State Regulations and Code of Practice: Manual Handling was first introduced in 1986, and its implementation is ongoing. Literature regarding successful implementation of the strategy again indicates a need for cooperative decision-making between management and staff. In 1994, one study described a protocol that implemented the code of practice in the quarrying industry [1]. The first stage involved a site visit, which consisted of an analysis of accident records, observation of the workplace, and video-taping of a specific manual-handling task to be used as a case study. Two three-hour training sessions followed, with the goal of training managers and employees in the process of hazard identification, risk assessment and risk control, and to address the identified task as a teaching tool for the development of solutions to reduce the risk associated with manual handling. Those involved in the training sessions would ultimately design a training package including guidelines, case studies, and checklists that could be readily used by quarry managers and workers to address manual handling problems. Results regarding the success of this implementation remain unavailable.

An implementation protocol for the Australian State Regulations and Code of Practice: Manual Handling was also devised [17]. The study felt it was important to involve employee consultation through all stages of risk identification, risk assessment, and risk control. The study provided a risk assessment for manual handling that included a process of quickly identifying problems and problem tasks, a method of risk assessment that was self-contained (and which included a method of rating risk, documentation that would serve as an assessment tool, and a legal record), an educational approach where the tools used acted also to educate users, realistic performance criteria, and a comprehensive consultative approach. This program was implemented at a large chemical processing company. Supervisors and managers were given two days of training, and employees were given one day. The staff was divided into working groups. Each group identified ten problem tasks within the workplace, two of which were given as priorities. After the initial training session, priority problems were to be solved by each group before the second training session. The program concluded with formalization of policies and procedures for the particular workplace in terms of manual-handling assessment and intervention. Each working group had identified ten problem tasks by the end of the training session, and each identified task was scheduled to undergo a full assessment, with implementation of the required modifications to follow.

Following from the chemical plant program, four

separate qualitative assessment checklists were designed: lifting/carrying/holding, pushing/pulling, seated workstations and vehicles, and standing work. This separation into specific task assessment was aimed at streamlining assessments and thus reducing the time required to perform inspections of work tasks. A letter-grading system was chosen, as it provided less opportunity for misuse of the assessment results in terms of attributing clinical meaning to the scores. In this case, the ergonomists were able to create a self-sustaining program at the plant, and the implementation was deemed a success.

How to Measure Success

Effects of ergonomic action can be measured by the incidence of illness absenteeism and occupational injury reports [12]. When a program is implemented that targets a particular disorder, there tends to be an increase in reports of this disorder due to an increased awareness of potential injury by the workers [21]. This phenomenon must be taken into consideration when reports of injury are used for measuring the success of an ergonomics intervention. Repetitive strain injuries also tend to be under-reported [19] and thus significant uncertainty in the validity of injury reports exists both prior to and after the implementation of an ergonomics intervention. Other measurement strategies such as productivity, job satisfaction, and symptom surveys must therefore be investigated.

A logical way to measure success following ergonomic intervention is benefit-cost analysis. This strategy will undoubtedly become an essential means of promoting and evaluating ergonomic interventions in the workplace. Three recent examples of benefit-cost analysis are discussed below, and provide evidence regarding the value of such follow-up information.

Benefit-Cost Ratio Analysis : Examples of Successful Ergonomics Intervention

In 1985, an ergonomic intervention program was implemented in maintenance shops for forestry equipment and vehicles in Canada [24]. The mechanics had complained of sore back and legs during and after work, and many multiple injuries in the workplace were attributed to worker fatigue. These shops recorded above-normal absenteeism and low productivity prior to intervention. Simple changes in the workplace were made, such as floor space redesign to minimize nonproductive walking, the addition of step-stools and anti-fatigue mats at each workstation, and the introduction of powered hoists and wheeled trolleys. In addition, partially impaired persons were hired as assistants.

These simple interventions resulted in an average increase in productivity of 12%, a reduction of minor injuries by 63%, an elimination of complaints of back and leg soreness and no reporting of back injuries after one year. The benefit-cost ratio, averaged over three years of implementation, was 1.75, and was increasing each year following initiation of the program.

In 1995, a major hospital in British Columbia, Canada, undertook an ergonomics intervention program [20]. The hospital was incurring large costs due to worker injuries, particularly due to lifting and transferring patients. A total of 5,800 work days were being lost annually at a direct cost of CAN$950 000, with estimated concurrent indirect costs reaching CAN$4 million. Musculoskeletal injuries accounted for 63% of these lost-time injuries. Through the introduction of risk hazard assessments by in-house physiotherapy staff, the development of new transfer and lift procedures, nurse training in such procedures, the purchase of inexpensive transfer boards and belts, and the implementation of a no-manual-lift policy and the introduction of donated electric lifting and transfer equipment, direct claim costs were reduced by 95% during a six-month study period. The benefit-cost ratio in this instance was calculated to be 1.72, with additional savings in Workers' Compensation Board premiums reaching CAN$219 000 in year four, and CAN$102 000 in year five.

A final example is derived from a study of a worksite that performed copier machine sub-assemblies [7]. In 1995, through workstation redesign, the purchase of pneumatic nut runners and screwdrivers, improvements to workplace lighting, the introduction of sit/stand chairs, and the installation of anti-fatigue floor matting, a benefit-cost ratio of 5.20 was obtained. This result was obtained by a decrease in production time for each assembly by 23%, a reduction of assembly errors by 11%, a reduction in the number of persons required to maintain the production schedule (a 29% reduction in labour costs), and improved quality levels resulting in reduced inspection time.

CONCLUSION: HOW DO WE CHANGE ATTITUDES?

From the above review, it is evident that some work must be done prior to the implementation of ergonomics standards. Because of the general lack of knowledge regarding the benefits of ergonomic intervention, certain efforts must be made even prior to ergonomics legislation being passed. The public must be aware of ergonomic principles, and following these principles must become everyday activities both at work and at home. Health care professionals need to make patients aware of how ergonomics affects quality of life. Work-related cumulative-trauma disorders must be identified and reported to the Occupational Health and Safety Commission (OHSC). Appropriate epidemiological monitoring should be performed, and the public should be kept aware of the magnitude of the problem.

Existing standards are another area that needs improvement. Definitive research that indicates the success of particular interventions is scarce. Interventions must be investigated scientifically by the ergonomics community in order to validate the associated health benefits. Areas that already provide ergonomics services should encourage the recording of statistics such as symptoms surveys and absenteeism in order to validate their work. At present, few follow-up studies exist, which leads to difficulties in the evaluation of interventions.

Benefit-cost analyses must be provided each time an ergonomic intervention is made, and must indicate the net saving to both government and employers if such a program is to be successful. Work in this area has been initiated [23] as described above, and is desperately needed. Government should fund ergonomics consultants to assist employers with annual evaluations, risk identification, and risk control procedures in order to monitor compliance with the program. This will help to decrease the new administrative and financial burden to employers incurred as a result of the implementation of the ergonomics program.

Once these areas have been addressed, it will be much easier to pass legislation pertaining to an ergonomics code of practice. An implementation strategy must then follow what has been shown to work. Specifically, the implementation must encourage open communication between employees and management, where areas of high risk are identified by employees and dealt with by management. Employees must be provided with sufficient education to identify risks. They must not be told how to perform a certain task, as different task techniques may be equally efficient, but rather they should simply be able to identify those tasks that have significant associated risk. Employees must be involved in all phases of program implementation and evaluation. The employees involved must be provided adequate time to perform these tasks.

As discussed above, ergonomics standards are more easily applied incrementally, beginning with areas such as forest and agriculture where the need to reduce workplace injuries is most evident. By implementing codes in these areas, and by then showing promising benefit-cost analyses, ergonomics standards will gain local acceptance. Slowly expanding these standards to more widespread applications, using positive benefit-cost examples from prior interventions, appears to be the most feasible way of acquiring widespread support of management, unions, government, and individual workers. Only then will government legislation of ergonomics codes of practice be embraced universally.

REFERENCES

[1] Barnett, C. and F. Callaghan. 1994. Smart moves in manual handling in the quarrying industry. In: Ergonomics: The fundamental design science. Proceedings of the 30th Annual Conference of the Ergonomics Society of Australia, Sydney, Australia, Dec. 4–7, 1994. Pp. 95–99.

[2] Dul, J., P.M. deVlaming, and M.J. Munnik. 1996. A review of ISO and CEN standards on ergonomics. International Journal of Industrial Ergonomics 17:291–297.

[3] Fairfax, R. 1994. Manual handling strategies, in ergonomics. In: The fundamental design science. Proceedings of the 30th Annual Conference of the Ergonomics Society of Australia, Sydney, Australia, Dec. 4–7, 1994, pp. 187-193.

[4] Freivalds, A. 1987. Comparison of United States (NIOSH) lifting guidelines and European (ECSC Force Limits) recommendations for manual work limits. American Industrial Hygiene Association Journal 48:698–702.

[5] Goumain, P. 1996. The Canadian contribution to international standards in ergonomics. HFAC Communique 26(5):5–7.

[6] Haag, B. and B.A. Cohn. 1992. Ergonomics standards, guidelines, and strategies for prevention of back injury. Occupational Medicine: State of the Art Reviews 7(1):155–165.

[7] Helander, M.G. and G.J. Burri. 1995. Cost effectiveness of ergonomics and quality improvements in electronic manufacturing – a case study. International Journal of Industrial Ergonomics 15:137–151.

[8] Hidalgo, J., A. Genaidy, W. Karwowski, D. Christensen, R. Huston, and J. Stambough. 1995. A cross-validation of the NIOSH limits for manual lifting. Ergonomics 38(12):2455–2464.

[9] James, D., S. Grennan, and G. Mulhern. 1994. Ergonomics in Northern Ireland: A survey of knowledge, attitudes, and implementation in industry and the public services. Ergonomics 37(5):953–963.

[10] Joseph, B.S. and D.A. Seiloff. 1994. Ergonomics training – A joint labor-management approach. Occupational Medicine 9(2):159–169.

[11] Kastenholz, E. 1996. Report on the Joint FAO/ECE/ILO Committee on Forest Technology, Management, and Training. Seminar on "safety and health in forestry are feasible". Oct. 7–11,1996. Emmental, Switzerland.

[12] Knave, H., *et al.* 1991. Incidence of work-related disorders and absenteeism as tools in the implementation of work environment improvements: the Sweden Post strategy. Ergonomics 34(6):841–848.

[13] Kogi, K. 1995. Participatory ergonomics that builds on local solutions. Proceedings of the fourth SEAES Conference "Ergonomics for Productivity and Safe Work", Bangkok, Thailand, Nov. 21–23, 1994. Journal of Human Ergonomics 24(1):37–45.

[14] Kumashiro, M. 1995. How to benefit from ergonomic interventions through participation by workers, managers and the company: An example of a small- to medium-sized factory with no ergonomic knowledge. Journal of Human Ergonomics 24(1):123–29.

[15] Liden, E. 1996. Report on the Joint FAO/ECE/ILO Committee on Forest Technology, Management, and Training. Seminar on "safety and health in forestry are feasible", Oct. 7–11, 1996. Emmental, Switzerland.

[16] Maizlish, N., L. Rudolph, K. Dervin, and M. Sankaranarayan. 1995. Surveillance and prevention of work-related carpal tunnel syndrome: An application of the Sentinel Events Notification System for Occupational Risks. American Journal of Industrial Medicine 27:715-729.

[17] O'Sullivan, J.J. and K.R. Horrigan. 1993. Manual handling risk assessment for employers, ergonomics in a changing world. Proceedings of the 29th Annual Conference of the Ergonomics Society of Australia, Perth, Australia, Dec.1–3, 1993. Ergonomics of Australia. Pp. 70–76.

[18] Oxenburgh, M.S. and H.H. Guildberg. 1993. The economic and health effects on introducing a safe manual handling code of practice. International Journal of Industrial Ergonomics 12:241–253.

[19] Pemberton, I. 1992. New legislation and auditing for ergonomics. Occupational Health. Pp. 266-269, Sept. 1992.

[20] Perrault, M., Investing in ergonomics. Occupational Health and Safety Canada, Sept/Oct. 1995. Pp. 39–45.

[21] Rauska, A. Director, Prevention Services, Workplace Health, Safety, and Compensation Committee of New Brunswick, personal communication, Oct. 1995.

[22] Rey, P. and A. Bousquet. 1995. Compensation for occupational injuries and diseases: Its effect upon prevention at the workplace. Ergonomics 38(3):475-486.

[23] Rickards, J. Professor of Forestry and Environmental Management, University of New Brunswick, and Ergonomics Consultant at the Workplace Health, Safety and Compensation Commission of New Brunswick, Canada, personal communication, Oct. 15, 1996.

[24] Rickards, J. and W. Williams. 1985. The productivity of maintenance mechanics in woodlands garages of the Canadian Forest Industry. Proceedings–CPPA Annual Conference, Montreal, Quebec. Pp. 19-28.

[25] Schneider, S., L. Punnett, and T.M. Cook. 1995. Ergonomics: Applying what we know. Occupational Medicine: State of the Art Reviews 10(2):385-394.

[26] Schurman, S.J. and B.A. Silverstein. 1994. Designing a curriculum for healthier work. Occupational Medicine 9(2):283-304.

[27] Schurman, S.J., B.A. Silverstein, and S.E. Richards. Designing a curriculum for healthy work. Occupational Medicine: State of the Art Reviews 9(2):283-304.

[28] Tandhanskui, N., *et al.* 1995. Experiences of successful action programmes for occupational health, safety, and ergonomics promotion in small scale enterprises in Thailand. Journal of Human Ergonomics 24(1):105-115.

[29] Veturi, S.M., B.K. Lakshmi, A.K. Ganguli, and A.K. Chakrabarti. 1987. The impact and feasibility of international/national standards in the prevention of musculoskeletal injuries in developing countries. Ergonomics 30(2):405-410.

[30] Waniganayake, A. 1989. Risk assessment: Application of the Victorian Manual Handling Regulations. In: Ergonomics, Technology and Productivity. Proceedings of the 25th Annual Conference of the Ergonomics Society of Australia, 26-29 Nov. 1989, Ergonomics Society of Australia, Fortitude Valley, Queensland. Pp. 199–207.

[31] Westlander, G., E. Viitasara, A. Johansson, and H. Shahnavaz. 1995. Evaluation of an ergonomics intervention programme in VDT workplaces. Applied Ergonomics 26(2):83–92.

[32] Workplace Health, Safety and Compensation Commission of New Brunswick, Annual payroll, claims, and lost-time statistics, 1987–1997.