Technical Report No: 62-1-2000

Ergonomics Evaluation of Scan Index Operators

Stephen Bao
Peregrin Spielholz
Barbara Silverstein

SHARP Program
Department of Labor and Industries
PO Box 44330
Olympia, WA 98504

Sarah Martin

Internal Safety and Health Program
Department of Labor and Industries
Olympia, WA 98504

January 2000

Summary

Musculoskeletal complaints have been a major occupational health and safety concern in the Scan Index unit, in spite of the continuous effort toward ergonomic improvement. At the request of the supervisors of the Scan Index unit, SHARP conducted an extensive ergonomics evaluation to identify risk factors possibly causing injuries and investigate changes in workstation design or work practices which may reduce the risk factors. L&I's Internal Health and Safety staff also participated with SHARP in this evaluation.

Operators of the Scan Index teams A, B and C were selected for this evaluation. Reported injury statistics between 1997 and 1999 were obtained from the Unit to identify the most frequently injured body parts. A psychosocial questionnaire survey was conducted to compare the psychosocial conditions of the operators with the results found in a 1997 survey. Activity logs for the individual operators of a week from September 1999 were obtained and compiled to compute the task distributions in terms of number of hours and percent of time spent on the different task activities. Productivity statistics were also obtained from the teams in order to determine the production variations in different weeks and days.

The actual evaluation was conducted by measuring the task exposure of three selected operators (one from each team). A job exposure was then estimated based on the task exposures. Task exposure is the physical load (e.g. muscle load, and wrist postures) when the operator was performing a specific task. A job exposure is the accumulation of the different task exposure applied on the operator in a workday. After consulting supervisors and conducting on-site visits, the following tasks were selected for evaluation: (1) desktop scanning, (2) high speed scanning, (3) indexing, (4) pre-scanning, and (5) tattoo checking. As most reported injuries happened on the shoulder/neck and hand regions, it was decided to measure the muscle load of the upper trapezius, forearm flexor and extensor muscles, and wrist/forearm postures and movements. The muscle load was measured by the surface electromyography (EMG) technique. This technique used adhesive surface electrodes, which were attached to skin over muscles of interest, to measure muscle electrical activities. The higher the electrical signal, the higher the muscle load. This electrical signal was picked up by electrodes and transmitted telemetrically through a signal transmitter to a receiver. The muscle activity was normalized and expressed in terms of the maximal capacity of the specific muscles (%MVC). Wrist and forearm postures and movements were measured for wrist flexion and extension, wrist ulnar and radial deviation, and forearm pronation and supination. An electrogoniometer and an electrotorsiometer were attached to the hand and forearm of the operators. They continuously measured the hand and wrist postures during work. The measured signal was also telemetrically transmitted to the receiver. Thus the measurement had minimal influence on the task performance of the operators. After a calibration procedure, work postures of the wrist and forearm could be obtained in degrees. A further calculation gave results of the hand and

forearm movement velocity (in degrees/sec).

Task exposure measurement was also conducted for alternative workstation settings for each task. This provided us the opportunity to test whether simple workstation adjustments could reduce the task exposure.

Results showed that the psychosocial work conditions of the Scan Index operators have improved compared to the results from the 1997 survey. Operators in the Scan Index unit consider themselves to have a high clarity role at the job with infrequent conflicting demands and more often they considered themselves as having some influence over their jobs. However, the operators still often considered their work pace too fast and experienced high levels of mental stress.

Indexing and pre-scanning were the major tasks in the Scan Index operators' job and comprised over 70% of their work hours. So the job exposure was mainly determined by the task exposures of the indexing and pre-scanning tasks. Therefore, ergonomic intervention efforts will be effective when attention of effort is concentrated on these tasks.

The results showed that the trapezius static and median load levels were generally high during most of the tasks, and particularly during indexing and pre-scanning. The left trapezius static load could be up to 10.3%MVC and the median load up to 20.6%MVC, while the right trapezius static load could be up to 13.3%MVC and median load up to 21.1%MVC. These load levels were considered too high according to available ergonomic recommendations (Jonsson 1982). The static trapezius load level should not exceed 2%MVC and must not exceed 5%MVC, while the median trapezius load level should not exceed 10%MVC and must not exceed 14%MVC. Static load refers to when the muscles are continually contracted. High static loads reduce blood flow to the muscles and result in fatigue, discomfort and probably injury.

The median forearm movement velocity could be considered too fast for some individual operators (e.g. up to 111 degrees/sec of pronation-supination movements of the operator from Team A) and at certain tasks (e.g. 158 degrees/sec of pronation-supination movements when performing the tattoo checking task). These values exceed those described in a high risk group by Marras and Schoenmarklin (1993), who indicate that the high risk group has a mean pronation and supination velocity of 91.3 degrees/sec, while the low risk group has a mean pronation and supination velocity of 67.7 degrees/sec.

Although the static and median trapezius load was generally high when performing most of the scan index tasks, the load was reasonably low for some individual operators (e.g. the operator from Team C compared to the one from Team B). The fast hand and wrist movements were seen among some operators (e.g. the operator from Team A), but not among others (e.g. the operator from Team C). These differences might be due to the individual work techniques, individual workstation adjustments, and job contents. If this assumption is true, we may be able to develop training material to promote ergonomically correct work techniques and ergonomic guidelines for

adjusting workstations, and improve job procedures to reduce or eliminate some of the identified risk factors. Ergonomic awareness training may also help to reduce the exposure to individual operators.

There is still room to reduce the exposure through workstation adjustments. For example: working in a standing position, providing adjustable arm rests to seated operators, raising seat heights for operators who might sit too low, and placing computer keyboards on keyboard trays could all reduce the upper trapezius load. Frequent brief stretching exercises is recommended to the operators. Use of biofeedback techniques is suggested to by used by the operators to assist the improvement of working postures through proper adjustment of workstations.

The results were presented to the individual Scan Index groups and discussions were made around issues of the identified risk factors and possible solutions. Training materials will be developed with the cooperation of the Scan Index unit, Internal Safety and Health program and SHARP.