SMART-Lift[SM]

The SMART-Lift[SM] is a PC-based software program that has been developed by Cytek, Inc., an affiliate of Continental Insurance. The purpose of the program is to calculate the NIOSH recommended weight limits for single- and multi-task manual materials handling jobs. SMART-Lift[SM] was designed for use by ergonomists, industrial hygienists and engineers, and rehabilitation professionals in performing NIOSH compliance analysis. This program incorporates the most recent (1991) NIOSH guidelines, equations, and data tables. The minimum system hardware requirements for running the program consist of an IBM or compatible computer with 405K RAM and a floppy disk drive. A math co-processor, an extended memory, and graphics enhancement are not needed to run the program. For this review, the program operated instantaneously on a notebook PC (486DX2) with a 66 MHz processor, 8 megabytes of RAM, and a 230-megabyte hard drive.

The user must enter the information required to compute the NIOSH equations into the program. These values are obtained by careful, direct observation or videotaping of the job in question. Distances and sizes of containers should be measured with a tape measure, materials weighed, angles of trunk rotation measured with a goniometer or protractor, and time/frequency measured with a stopwatch. The procedure manual provides a convenient data collection form for recording the necessary information. The following values must be entered into the program:

1. The horizontal distance of the load from the body at the origin and destination of the lift.
2. The vertical distance of the load from the floor at the origin and destination of the lift.
3. The angle of trunk rotation at the origin and destination.
4. Hand coupling (interface between object lifted and hands).
5. Frequency of the lift.
6. Weight
7. Duration of the task.
8. Whether or not the task requires the worker to control the weight at the end of the task.

The SMART-Lift[SM] program then calculates the recommended weight limit and the composite lifting index. The composite lifting index indicates whether the weight being handled during the tasks exceeds the NIOSH recommended weight limit.

The program also provides further analysis by indicating which of the factors (horizontal distance, vertical distance, weight, hand coupling, duration, or frequency), if changed, would most reduce the recommended weight limit. Another menu selection provides advice, albeit generic, on possible abatements that would decrease the physical stress placed on the worker, thus improving the composite lifting index. The user may also change the values entered for the distances, frequency, asymmetry, coupling, and duration values to determine how hypothetical abatements may change the stress involved in the task. The program allows the user to review the inputs and to save the task for future reference.

In the multi-task analysis, the program indicates a composite recommended weight limit and composite lifting index for the entire task. For each subtask, a frequency-independent recommended weight limit (FI-RWL, the weight limit for only one repetition of the subtask) and single-task weight limit (ST-RWL, the weight limit for the subtask if it is performed at the input fre-

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quency) are calculated. The program provides further analysis of the overall task by listing the subtasks in descending order of their frequency-independent lifting indices (FILI) and their single-task lifting indices (STLI). This listing helps the user identify which of the subtasks was the most stressful and, as such, most affected the weight limit. These calculations help the user to propose abatements for work station and task design that would minimize the risk of injury to the worker. All outputs are available in metric units, if the user prefers.

In general, the program is easy to use for an individual who has prior understanding and knowledge of job site analysis and the revised (1991) NIOSH lifting guide equation and data tables. This reviewer had prior knowledge of this content area and would suspect that the user who is unfamiliar with the NIOSH terminology would find the program initially difficult to use and understand. A tutorial included in the software package and further definitions and explanations in the procedure manual would greatly enhance the program's user-friendliness for the novice ergonomist.

In the single task analysis, the screens that prompt the user to give horizontal and vertical distances at the origin and destination of the lift are not labeled as to the variable that is being requested. Unless the user knows the available ranges for these values (which are listed on the screen) or the order in which the program requests the data, confusion might prevail. The procedure manual is fairly well written but again, could provide more definitions and information for the novice. This reviewer did not need any technical support to install or run the program. Therefore, no comment on the available technical support can be made.

In summary, the SMART-Lift^{SM} provides the ergonomist with a tool that can greatly reduce calculation time, especially for the multi-task job. The automation of these calculations then allows the professional to spend more time analyzing the results and devising abatements. More efficient analysis translates into improved profit for the ergonomist and time savings that can be passed on to the ergonomics consumer. At $395 (U.S.) plus sales tax for the software license fee, the program would seem to be a very cost-effective purchase for most ergonomists.

The only software program providing a similar type of analysis, to this reviewer's knowledge, is the University of Michigan's 2D Static Strength Prediction Program™ (Lechner, 1993). For the 2D program, the user must enter information regarding the magnitude of the weight, the direction of the force, the number of hands involved in the task, height and weight parameters of the individual performing the task, and limb segment angles. The computer then generates a stick figure that illustrates the task, calculates the horizontal and vertical distances, and provides data regarding the percent of workers capable of performing the task. The 2D program also provides information regarding the amount of disc compression at L5 and S1. Any loads that exceed the NIOSH strength or compression limits are noted.

Whereas both software programs are designed to provide a comparison of the task to NIOSH guidelines, they each provide that information in different forms and each has different advantages. The 2D Static Strength program focuses on the percent of individuals at risk for injury for a given task. The SMART-Lift^{SM} program focuses on the recommended weight limits and composite lifting index. The optimal program for analysis depends on the question being asked. The 2D Static Strength program has the advantage of providing a stick figure illustration for the task and calculating the horizontal and vertical distances. The latter feature may facilitate the use of the program when the only observation of the job task is by way of a videotape. The SMART-Lift^{SM} program has the advantage of being able to break down the task into its various factors. With the SMART-Lift^{SM} program the user can also determine which factors make the task hazardous. The SMART-Lift^{SM} program analyzes the entire task from origin to destination, whereas the 2D Static Strength Prediction Program™ only analyzes one point in the lift. Analysis of the entire task with the 2D program would require the user to repeat the static analysis at several points during the lift.

The 2D program, however, takes into account the individual's anthropometry, whereas the SMART-Lift[SM] does not. Having both programs would allow the ergonomist to provide analysis from two different perspectives. Information from one program should support and complement the other. If resources are limited and a choice between these two programs has to be made, consideration should be given to the type of questions the user most often encounters in the course of his or her work.

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REFERENCE

Lechner, L. (1993). The 2D static strength prediction program™. *Work, 3(2)*, 79–80.