ABSTRACT
There are a plethora of evaluation tools commonly used to evaluate jobs to insure that they meet accepted ergonomics and safety criteria. Each of these tools has been validated for use in specific environmental circumstances for different manufacturing systems. However, practicing ergonomists must select among a wide range of these tools without the necessary domain specific knowledge to make the most appropriate choice considering accuracy, ease of use, and expense. Support of these practicing ergonomists would increase their effectiveness and decrease the costs of compliance with ergonomic regulations and standards. This paper presents an innovative method which can be used to provide the necessary information directly to the workplace. This approach is the use of a computer-based knowledge system. This system would assist the ergonomist in selecting among the evaluation tools by providing detailed information about the tool's applicability to a particular manufacturing system. The Level5 Object for Microsoft Windows has been used as the development tool for this innovative approach. This developed program will have several important characteristics, including a user-friendly interface, a comprehensive database of ergonomic evaluation tools, and a robust design for tool selection.

INTRODUCTION
The selection process used by most practitioners to select an evaluation methodology for their ergonomic analyses is guided by some non-optimal factors. Familiarity is probably the most common. Practitioners learn a few select analysis tools in their college training or in an ergonomic short course and then use these tools to evaluate the jobs they encounter. This method has a few significant flaws which can jeopardize the results of the analysis. Most ergonomic tools have assumptions which can not be violated if the method is to provide reliable conclusions about a job. For example, the NIOSH lifting guide has several assumptions. Materials handling activities other than lifting, such as holding, carrying, pushing, and walking are assumed to be minimal. Unexpected movements such as slips and falls or unexpected exertions are ignored. All lifts must be two-handed, with no sitting, kneeling or constrained work space. If these assumptions are violated, the Lifting Index will not be an accurate reflection of the stress associated with the job. Using the Lifting Index as a guideline for how much weight can be lifted may put workers at risk if the lifting task has high accelerations.

A limitation of the Liberty Mutual Psychophysical Tables is that psychophysical limits may not be sensitive to the back pain that results from twisting or bending motions. However, it is easy to evaluate manual materials handling jobs without regard to this limitation, especially since this information is not prominently displayed within the tables. It is included in all publications, but many practitioners may not read these papers comprehensively.

THE APPROACH
A technique which assists practitioners in the selection of evaluation methods which are appropriate for the task at hand would reduce the likelihood of unintentionally placing workers at undue risk. This technique should consider the assumptions and limitations of each method and guide practitioners in the selection process. Based upon the complexity of the tool selection process, the application of a computer-based expert system to this problem domain would go a long way towards satisfying this need.

A computer-based expert system is an intelligent computer program that uses knowledge and
inference procedures to emulate the decision making process of a human expert in a specific knowledge domain. Fundamentals of expert systems can be found in several publications 3, 4, 5, 6. A typical expert system consists of an inference engine and a knowledge base. The inference engine is the general solving mechanism. The knowledge base contains both declarative knowledge and procedural knowledge for solving specific problems. This Artificial Intelligence (AI) approach can efficiently solve most difficult problems since this technology works especially well with the applications that deal with ambiguous, uncertain, and/or complex subjects that conventional programming techniques can not address.

The innovative approach for this particular problem domain is being developed. The Level5 Object for Microsoft Windows7 has been used as the development tool. Level5 Object is an integrated software tool which combines client/server technology, object-oriented programming, graphical user interfaces as well as knowledge-based systems. It will be used to elicit domain knowledge from ergonomic experts. This expert system will have about 20 classes. Several classes will have multiple instances of objects, which include data and methods for ergonomic regulations and standards investigation. About 15 demons and 120 methods drive the program based upon available data and user input. Since this system is expected to be used by users with different knowledge backgrounds, about 50% of the objects, demons and methods will be designed to provide a pleasant and efficient user interface. The interface includes color, pictures, animation, and audio files to introduce critical concepts and to make execution enjoyable. Several useful help screens will also be included. The other half of the objects, demons and methods will execute logic for comprehensive search of ergonomic regulations and standards as well as the most appropriate tool to be selected. To provide the idea of how this expert system can guide an ergonomist in the selection of a methodology for job evaluation, Figure 1 presents a simplified logical network of the system. The actual logical network will be much more complicated and may not be able to present in any graphical form.

The complexity of the problem domain for the tool selection process can certainly be simplified by the use of Artificial Intelligence. The ergonomic tool selection system being developed has been presented here. The sources of the knowledge base are from the collection of several related ergonomic publications, several ergonomic experts and the current documented information in this area. This computer-based knowledge system will run on regular Microsoft Windows, Windows ’95 and Windows NT. Also, it is possible that the outcome of the system can be presented in several other foreign languages such as Spanish, Japanese and Thai. The system is certainly expected to make the most appropriate choice for the ergonomic tool to be used in manufacturing process with high accuracy, ease of use, safety and least cost.

REFERENCES


CONCLUSION

The conventional approach for the tool selection process is generally inaccurate due to the nature of the tools’ complexity, comprehension of the practitioners themselves and ergonomic regulations and standards. As a result, it may become costly for the manufacturing process and unintentionally place workers at high risk.