



# Perspectives on Material Handling Practice

Papers in the Perspectives series have appeared in conference proceedings of the Material Handling Institute between 1992 and the present. As such they provide a point of reference as to how the industry is changing as well as insight into accepted practice during this period. In many cases the authors credited have either changed jobs or are no longer in the industry. Some companies as well have been the subject of mergers or reorganization with a new corporate identity.

## ERGONOMICS AND MATERIAL HANDLING: A TASK ORIENTED ASSESSMENT OF NEEDS AND SOLUTIONS

### MATERIAL HANDLING APPLICATIONS USING THE LUMBAR MOTION MONITOR

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As a material handling professional, you are confronted with discovering, evaluating, and implementing improved material handling strategies. Here's a tool that can be used to evaluate the dynamic motion in a job and its resultant injury risk. This tool, The Lumbar Motion Monitor (LMM), allows you to more accurately predict the onset and severity of back injuries. The LMM can also assist in creating and documenting an improved risk reduction strategy.

#### What is the LMM?

The LMM is a worksite analysis tool that can more accurately measure and document job factors that may contribute to low back injury. The LMM was developed at Ohio State under the direction of Dr. Bill Marris, a leading ergonomic researcher in the study of low back injury. The LMM measures three dynamic job motions (forward bending, twisting velocity and side bending velocity), and combines them with information on reaching, lifting frequency and weight. These six risk factors are combined and compared with a computer database of 400 previously analyzed jobs to estimate the overall probability that a job may be high risk for back injury [1].

Twisting and bending have long been suggested to increase the risk of low back injury. The LMM allows us to accurately measure bending and twisting and use the information to determine



an enhanced job improvement strategy. This tool represents another approach in the assessment of low back injury risk, when compared to previous ergonomic low-back models.

*How does the LMM work? How is the LMM different from other task analysis tools?*

The LMM system is comprised of two parts, an external goniometer (hereafter called an exoskeleton), and a computer database. Information is collected about a particular job and compared against the database to determine the probability of low back disorder (LBD) risk.

The Ohio State research team first developed the exoskeleton, which is used to simulate the movement of the spine. The research team then collected back injury risk factor data on 400+ jobs. When collecting the data, the researchers obtained information on twisting, bending, reaching, weight and frequency. They also gathered incidence rate information on as many jobs as possible. The information gathered on all 400+ jobs was used to develop a comparison model, which is used to compare another job with the database. Some of the jobs in the original study had high incidences of LBD, while others did not. The information in the database allows the user to compare a job against the database information and determine the probability that our job is high risk for LBD.

In using the LMM, you are not comparing a job against some theoretical measurement criteria, but against a database of other actual jobs with known back-injury incidence rates. This represents a more realistic approach and a leap forward in worksite analysis technology. The LMM also measures the range of motion, speed, and acceleration of the motion. This increase in knowledge can enable improved decisions with respect to job improvement strategies.

*What will the LMM do for me?*

Often times, an experienced ergonomist, or other trained person can readily spot job task and their associated risk factors that may increase the risk of LBD. When observing the job, one might ask ‘Is this job really bad (high risk)?’, or ‘How bad is the job?’ If there’s no workers’ compensation losses, then we don’t really know. If we want to proactively promote ergonomics, then we want to remove those risk factors before an injury occurs. The LMM can help.

This technology has many possible uses. We can now measure the bending and twisting in a job, and combine that data with measurements of weight lifted, reaching and lift frequency. We can then:

- Simulate various solution strategies, to determine which will have the greatest LBD risk reduction.
- Measure the existing job duties, to determine their effect on LBD risk.
- Compare low cost vs. higher cost recommendations, to determine their effect on the risk of injury.
- Determine which job task has the highest contribution to LBD risk.
- Compare the methods of several employees to determine which has the lowest risk of LBD.
- Rank a listing of jobs for ergonomic analysis. A safety committee or ergonomic team could use this information when planning resource allocation.



Let's take this reasoning a step further. What if we could determine the existing low back risk factors and simulate a solution strategy all in the same day. We could then compare existing job conditions with proposed conditions. We would then have a before and after analysis that shows the percentage improvement in low back disorder.

### **Application Sample.**

Company C is a small widget packaging company. Widgets are graded according to size and diverted to several conveyors for packaging. Corrugated boxes are automatically filled and taped. An employee lifts each box and moves it to a pallet. The employee lifts each box, carries it to the pallet, and lowers it to the pallet. A filled box weighs approximately 35 pounds. The packing employee stacks the boxes five layers high, with nine boxes per layer or 45 boxes per pallet. An average of 198 cases is moved each hour on each line. The employee then manually stretch wraps each pallet. A forklift picks up the pallet and delivers it to the shipping dock or a storage area.

Business Challenges:           How much LBD risk is in this job?  
  How could the job be improved?  
  How do we know that the job is improved?

STEP 1. Examine loss data and OSHA-200 log. If the incidence rate (IR) and severity rate (SR) for this job is very high, or we have high losses, then the LMM may not be necessary as a documentation or selling tool for an ergonomic improvement. However, we have used the LMM to sell management on ergonomic proposals, even though there was a high incidence rate for LBD.

### STEP 2. Collect initial data.

- What's the weight lifted? 35 pounds/box
- What's the lifting frequency? 198 boxes/hour/line
- How much reaching is involved? Reaching is measured during the actual study.
- How much bending/twisting/side bending is involved? These dynamic variables are measured by the LMM.



The conveyor layout and pallet positions are as follows:

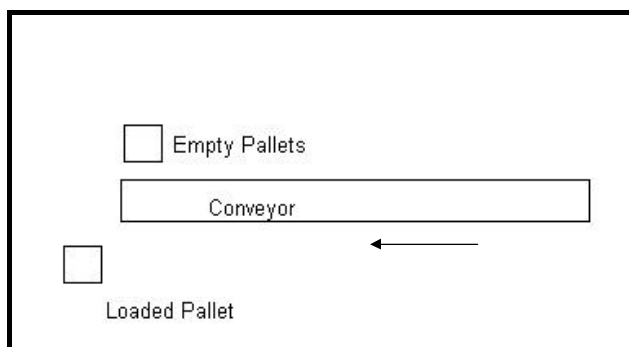


Figure One: Example Layout for Line One

### STEP 3: Collect LMM data

The LMM exoskeleton is strapped to the line one loading employee. The person proceeds to perform their job using the existing method, layout, and equipment. The LMM collects data concerning the existing job conditions and stores it in the computer. After completion of >10 repetitions, we have the confidence necessary to define the low back risk. The computer will compile our data, compare our job conditions to the database, and give us an estimate of the job's overall probability of low back injury risk. The probability score is called a "benchmark".

Let's assume that our existing widget-packing job has a benchmark score of 80%. What does this mean? An 80% score means that there is an 80% probability that the widget-packing job is high risk, based on the database of previously studied jobs. In other words, a lower benchmark means that there is less chance that the job is high risk for back injury. Our goal is to propose a job improvement strategy that will lower the 80% score as low as possible. The nice thing about the LMM is that we can do several "what if" type analyses and determine a cost and benefit for each one.

### Solution Strategy

Let's assume we want to propose a job improvement solution consisting of a scissors lift and the exact same layout as shown in figure one. We can now simulate that scenario and determine if the low back injury risk decreases and by how much.

Now, what if we propose a scissors lift and change the layout. Does this solution further improve the job? We can find out by simulating that change.

We could also determine the differences in risk between line one, line two, etc., or employee one, employee two, etc. Which operator has the best technique that might be filmed and used in a training program? Which line has the most risk?



For this widget-processing example, we would most likely propose adding a scissors lift with a turntable, and relocating it at the end of the conveyor so the boxes can be slid to the pallet. This type of solution would lower the risk to <50%. Ask yourself this question, is it worth \$2-3 thousand dollars to implement this solution and cut the risk of back injury in half? This type of information is very valuable in determining where resources should be spent.

The LMM can be used for many different types of analyses. What if you are working with an ergonomics team, have ten recognized ergonomic projects, and want to rank them according to risk. The LMM can be used for that purpose.

One word of caution is suggested. The LMM is not the cure all to end all. *The LMM is best used for repetitive lifting situations with some degree of dynamic motion.* If a material-handling job has a very low lifting frequency (lift once or twice per shift), the LMM may not be the best analysis technique.

### **Bibliography**

[1] Marras, William S., Lavender, Steven, A., Leurgans, Sue, E., Rajulu, Sudhaker, L., Allread, W., Gary, Fathallah, Fadi, A., and Ferguson, Sue, A., The Role of Dynamic Three-Dimensional Trunk Motion in Occupational-Related Low Back Disorders, *Spine*, Volume 18, Number 5, pp. 617-628, 1993.

