null
or some combination of the two sources of data. The sampling methods will be adjusted based upon the amount of variability observed in the task characteristics, such as the weight of load lifted, horizontal distance, asymmetry, etc. The greater the variability between lifts, the greater will be the requirement for data sampling.

The concept for the method is similar to the CLI method for multi-task jobs. The difference is that rather than using individual task elements, all of the lifts will be distributed into a fixed number of FILI categories (one to nine categories), each with a variable frequency. These six FILI categories will then be weighted using the CLI equation. The frequency multiplier for each category is based on the average overall frequency for the six individual LI categories. The VLI should provide a reasonable estimate of the physical demand of the job that can be used to determine if the task is acceptable or not and how changes in the mix of tasks might affect the overall physical demand of the job. The steps are as follows:

1. Determine the range of FILI values for all of the sampled lifts.
2. Divide the range of FILI values into six categories, taking into account the variability of obtained results.
3. Determine the frequency of lifts in each of the six categories.
4. Apply the VLI using the CLI equation, but use the frequency data for each LI category to calculate the appropriate FM values for the calculation.

The VLI is computed as follows:

1. The task categories are renumbered in order of decreasing physical stress, beginning with the task category with the greatest single task lifting index (STLI) down to the task category with the smallest STLI. The STLI is the defined as the LI value for each task, independent of the other tasks. The task categories are renumbered in this way so that the more difficult task categories are considered first.

2. The VLI for the job is then computed according to the following formula:

\[ VLI = STLI_1 + \sum \Delta LI \]

Where:

\[ \sum \Delta LI = ( FILI_2 X \left( \frac{I}{FM_{1,2}} - \frac{I}{FM_1} \right)) \]

\[ + ( FILI_3 X \left( \frac{I}{FM_{1,2,3}} - \frac{I}{FM_{1,2}} \right)) \]

\[ + ( FILI_4 X \left( \frac{I}{FM_{1,2,3,4}} - \frac{I}{FM_{1,2,3}} \right)) \]

Note, that (1) the numbers in the subscripts refer to the new task category numbers; and, (2) the FM values are determined from the frequency table published in the Applications Manual (Waters et al., 1994). The appropriate FM values are based on the sum of the frequencies for the task categories listed in the subscripts.

**EXAMPLE**

A hypothetical example will demonstrate how the VLI equation might be applied. Assume that job sampling at a manufacturing plant revealed that the largest FILI sampled for any individual lift was 2.8. According to the VLI procedure, the range of FILI categories should be evaluated and a set of FILI categories should be chosen. For this example, six FILI categories were chosen and were defined as: 0-.45, .46-.61, .62-.99, 1.0-1.51, 1.52-2.02, and 2.03-2.8. The choice of FILI categories is somewhat arbitrary, but we suggest choosing six categories. Also, assume that analysis of the sampled data revealed that the average FILI for individual lifts in each of these six categories and the percentage of tasks falling into the six cells are as shown in Table 1. As with the SLI approach, the VLI approach works best if the job is performed for a full eight hour shift (Waters et al. 2007). If the overall frequency of lifting across an eight-hour shift is 4/min, then the frequency of lifts for each category can be calculated (see Table 1).

<table>
<thead>
<tr>
<th>LI Categories</th>
<th>0- .45</th>
<th>.46- .61</th>
<th>.62- .99</th>
<th>1.0- 1.51</th>
<th>1.52- 2.02</th>
<th>2.03- 2.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representative FILI within category</td>
<td>0.33</td>
<td>0.53</td>
<td>0.79</td>
<td>1.20</td>
<td>1.66</td>
<td>2.8</td>
</tr>
<tr>
<td>Renumbered</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Percentage of Tasks</td>
<td>10%</td>
<td>15%</td>
<td>25%</td>
<td>25%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Frequency (lifts/min)</td>
<td>0.5</td>
<td>0.9</td>
<td>1.1</td>
<td>0.9</td>
<td>0.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>
Based on the hypothetical data presented, the VLI for this job can be calculated, as follows:

\[
VLI = STLI_1 + \sum \Delta LI
\]

\[
STLI_1 = 3.32
\]

\[
\Delta FILI_2 = 1.66 ((1/.80) - (1/.85)) = .116
\]

\[
\Delta FILI_3 = 1.2 ((1/.70) - (1/.80)) = .204
\]

\[
\Delta FILI_4 = .79 ((1/.60) - (1/.70)) = .205
\]

\[
\Delta FILI_5 = .53 ((1/.50) - (1/.60)) = .159
\]

\[
\Delta FILI_6 = .33 ((1/.46) - (1/.50)) = .069
\]

\[
VLI = STLI_1 + \Delta FILI_2 + \Delta FILI_3 + \Delta FILI_4 + \Delta FILI_5 + \Delta FILI_6
\]

\[
= 3.32 + .116 + .204 + .205 + .159 + .069 = 4.07
\]

**SUMMARY**

The VLI method should provide a useful method for assessing lifting tasks with highly variable task characteristics. The method remains to be validated.

**REFERENCES**


