6 Design and Operation of Work Systems

6.1 Work Systems

A work system can be considered to be the interaction between the worker when performing a given task, and his workplace. The correct design of work systems minimises operation time, reduces fatigue and the possibility of operator error; it involves the application of ergonomic principles and work study techniques. Since most tasks must be performed by a number of different operators work systems should be designed around the average dimensions and level of ability of operators. Both man–machine systems and man–assembly systems are considered in this chapter, together with the working environment and fatigue. The second half of the chapter considers the application of method study and work measurement.

Figure 6.1 Representation of a man–machine system

J. D. Radford et al., The Management of Manufacturing Systems © J. D. Radford and D. B. Richardson 1977
Man – Machine Systems

In general machines are used in factories to supplement human effort; they rarely have adaptive ability and are capable only of performing prescribed functions. Where discretion or variability is required human beings are usually superior to machines.

When a man is operating or closely supervising a machine the relationship is referred to as a man – machine system (figure 6.1). It will be seen that a man’s performance is affected by his physical and mental ability, as well as by the psychological and physical environment, whereas the performance of the machine depends on its design and its physical environment. Physical environment will be dealt with in section 6.2; the psychological environment was discussed in chapter 5.

A man operates a machine through its controls, and in some instances the operation follows a predetermined sequence, as with a capstan lathe, or in other instances the control movements could be the result of visual displays from the machine.

Design of Displays

Displays should convey information unambiguously and in such a way that they can rapidly be converted into decisions. The misreading of instrument dials or graduated scales can result in spoilt work, damaged equipment or accidents.

The application of visual displays falls into three main categories

1. quantitative – a numerical measurement
2. checking – a broad indication of the state, for example, coolant pump on
3. setting – adjusting to a predetermined position, for example, setting a machine slide to a given position.

<table>
<thead>
<tr>
<th>Type</th>
<th>Use</th>
<th>Warning light</th>
<th>Switch</th>
<th>Counter</th>
<th>Dial (pointer moves)</th>
<th>Dial (scale moves)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative</td>
<td>Good</td>
<td>—</td>
<td>Good</td>
<td>Good</td>
<td>Fair</td>
<td>Fair</td>
</tr>
<tr>
<td>Checking</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Setting</td>
<td>—</td>
<td>—</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Fair</td>
</tr>
</tbody>
</table>

*Figure 6.2 Types of indicator*

The four main types of indicator are shown in figure 6.2, together with their relative advantages for various applications. It will be seen from figure 6.2 that indicators frequently incorporate dials; the following points are relevant to dial design and selection.

1. Scales should be numbered in a simple numerical progression, for example, increasing in steps of 10.