The impact of absenteeism on the quality of assembly line production.

Ricardo Mateo
School of Economics and Business Administration,
University of Navarra

I. Introduction

In mechanised systems, such as assembly lines, the company defines the system of production in accordance with the scientific theory of work. This system clearly defines the mechanical work to be carried out by the operator. The concept of the company's mechanised production, introduced by Frederick Taylor in his work on the scientific management of work (Taylor, 1911), and further developed by Henry Fayol (Fayol, 1984), rests on the assumption that work specialisation and division of labour are the keys to productivity and quality standards on assembly lines. Thus, absenteeism poses a threat to assembly line production because it requires an immediate replacement of the worker. This replacement reduces the level of specialisation in direct manual labour on the assembly line and threatens the quality of products made during the process. Companies that use mechanised forms of production can respond to this reality by introducing a higher degree of technological sophistication and reducing the importance of specialisation in manual work. The use of strong technological processes has reduced the need of specialised workers in the plants. In this article we test the validity of this hypothesis by observing the effects of a rise in the absenteeism level on the product quality. Many researchers consider that absenteeism is an important problem for employers (Inman, Jordan, Blumenfeld, 2004; Pinker, Shumsky, Wein, 1995; Hackett, 1989; Hackett & Guion, 1985; Allen, 1983; Muchinsky, 1977; Lyons, 1972). The impact of absenteeism in quality of products, employee turnover and performance of workers, justify this importance. Because of that, absenteeism has been widely studied.

When a worker with specialised training is replaced by a non-expert worker, the probability that defects in the product will occur increases and the likelihood that such defects will be detected decreases. This description of the assembly line production process prompts the conclusion that absenteeism in the line will cause more defects in the process itself and in the end products. The decrease in specialisation caused by absenteeism must be compensated with the strength of the production process itself.

Figure 1: The problem of absenteeism

Absenteeism ⇒ Less qualified persons within the chain
(Absenteeism means that there are less qualified people in the chain because the experience and the specialisation of the workers in each place cannot be replaced immediately)
↓
The process require specialised workers The process don’t require specialised workers
(Specialised workers mean that they must have knowledge and specific abilities to make the work well)
↓
Greater probability of generating defects Equal probability of generating defects
Lower probability of avoiding them Equal probability of avoiding them.
↓
Multiplied by thousands of products Multiplied by thousands of products
↓
More real defects Equal real defects Greater internal reworking Equal internal reworking

This article studies the impact of absenteeism on product quality. Our focus is on the problem caused by absenteeism, rather than on the causes of absenteeism. The empirical evidence presented in this study, which was obtained from an analysis of several assembly line production processes, is intended to validate the model of production that the article proposes.

The central question addressed by this article is the following: is product quality adversely affected by worker absenteeism?

It is possible that this question may be answered in affirmative. In cases of absenteeism, given that the work group on the assembly line as a whole is less qualified, since not all the workers in the group have received the specific training deemed necessary for the performance of their task, product quality may be lower.
H0: The replacement of expert workers with less expert workers leads to an increase in the number of defects in products.

At the same time, however, it is possible that the specialised training of the absent worker might be compensated with a strong and sophisticated production process.

H1: The replacement of expert workers with less expert workers does not lead to an increase in the number of defects in products.

The methodology of research for this article is described in the following section.

II. Method
Participants
The participants in this study were four assembly lines that comprise a total of 4000 workers. All assembly lines work in the automobile industry with the latest technology.

The participants are employees of a multinational company. The organisation system is just in time apply international norms of quality to products, to the process and to the system of management. During the period of research, workers work in the same post on the assembly line, without rotation. There is a quality control of 100% of products at the end of the process. Any product that did not fulfil the requirements is retired. This assembly line is totally automatic. The workers only have to control that everything is working well. The level of specialisation is low and the workers have experience in their posts. The level of production is constant.

The study consisted in an analysis of working days on the four assembly lines during 2003. The variables used in this study are the following:
Q'ij (Quality ij): The number of defects reported on day i on assembly line j which cannot be immediately rectified.
A'ij (Level of absenteeism ij): This variable is defined as the percentage of workers who are absent from their posts on assembly line j on day i, in order to carry out their tasks on the assembly line.

Data Analysis
The data included in this study was collected through 200 working days in 2003.

Two tests were carried out to establish the validity of the null hypothesis:

1. An analysis of cases grouped together according to the absenteeism variable: the second form of analysis carried out involved the division of the observations of each workshop/assembly line into two samples. The first sample-group comprised the observations in which the level of absenteeism was higher than or equal to the average level of absenteeism in the original sample. The second sample-group comprised the cases in which the level of absenteeism was below average. This analytic approach was intended to establish if the level of quality in both sample-groups belonged to the same population of samples, or if they constituted two distinct populations of samples with different average levels and different variations. (Independent samples T test)

2. We undertook an analysis of the correlation between absenteeism and quality to see if a linear relationship exists between them.

Model
Independent variable
Qij: Product quality on day i in workshop j.

Dependent variables
Aij: Worker absenteeism on day i in workshop j.

Qij = Q'ij/Constant (*)
Aij = A'ij/Constant (*)
Qij = f (Aij )+ e
Conclusion
The replacement of expert workers with less expert workers does not lead to an increase in the number of defects in products.
See tables 1,2,3,4,5

No relationship between absenteeism and quality can be established even at high levels of absenteeism, up to and including 10% of the workforce. This conclusion is partial and must be checked with future research in assembly lines. In particular, is convenient to check the significance of variables like specialisation, experience, technology of assembly line and collaboration of workers in a group.

REFERENCES

Table 1: Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Stan.Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUALY_1</td>
<td>200</td>
<td>1.00</td>
<td>2.44</td>
<td>1.5049</td>
<td>.24068</td>
</tr>
<tr>
<td>ABSE_1</td>
<td>200</td>
<td>1.00</td>
<td>3.88</td>
<td>1.9318</td>
<td>.78894</td>
</tr>
<tr>
<td>QUALY_2</td>
<td>157</td>
<td>1.00</td>
<td>3.92</td>
<td>2.0678</td>
<td>.42977</td>
</tr>
<tr>
<td>ABSE_2</td>
<td>157</td>
<td>1.00</td>
<td>2.43</td>
<td>1.5000</td>
<td>.30898</td>
</tr>
<tr>
<td>QUALY_3</td>
<td>105</td>
<td>1.09</td>
<td>3.27</td>
<td>1.8220</td>
<td>.34554</td>
</tr>
<tr>
<td>ABSE_3</td>
<td>105</td>
<td>1.00</td>
<td>4.16</td>
<td>2.6791</td>
<td>.85034</td>
</tr>
<tr>
<td>QUALY_4</td>
<td>165</td>
<td>1.00</td>
<td>2.58</td>
<td>1.6087</td>
<td>.30081</td>
</tr>
<tr>
<td>ABSE_4</td>
<td>165</td>
<td>1.01</td>
<td>9.04</td>
<td>2.9221</td>
<td>2.39194</td>
</tr>
</tbody>
</table>
Table 2: Two independent samples. Test of Assembly Line 1.

<table>
<thead>
<tr>
<th>Group Statistics</th>
<th>N</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Stand.Error of the Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSE_1</td>
<td>&gt;= 1.93</td>
<td>61</td>
<td>1.4721</td>
<td>.23997</td>
</tr>
<tr>
<td></td>
<td>&lt; 1.93</td>
<td>139</td>
<td>1.5193</td>
<td>.24044</td>
</tr>
</tbody>
</table>

Table 3: Two independent samples. Test of Assembly Line 2.

<table>
<thead>
<tr>
<th>Group Statistics</th>
<th>N</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Stand.Error of the Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSE_2</td>
<td>&gt;= 1.50</td>
<td>74</td>
<td>2.1117</td>
<td>.36364</td>
</tr>
<tr>
<td></td>
<td>&lt; 1.50</td>
<td>83</td>
<td>2.0286</td>
<td>.47997</td>
</tr>
</tbody>
</table>

Table 4: Two independent samples. Test of Assembly Line 3.

<table>
<thead>
<tr>
<th>Group Statistics</th>
<th>N</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Stand.Error of the Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSE_3</td>
<td>&gt;= 2.68</td>
<td>56</td>
<td>1.7885</td>
<td>.36242</td>
</tr>
<tr>
<td></td>
<td>&lt; 2.68</td>
<td>49</td>
<td>1.8602</td>
<td>.32465</td>
</tr>
</tbody>
</table>

Table 5: Two independent samples. Test of Assembly Line 4.

<table>
<thead>
<tr>
<th>Group Statistics</th>
<th>N</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Stand.Error of the Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSE_4</td>
<td>&gt;= 2.92</td>
<td>31</td>
<td>1.5427</td>
<td>.24886</td>
</tr>
<tr>
<td></td>
<td>&lt; 2.92</td>
<td>134</td>
<td>1.6240</td>
<td>.31041</td>
</tr>
</tbody>
</table>