EMPLOYEE INTEGRATION AND AUTOMATION:
A STUDY AT CATERPILLAR TRACTOR COMPANY, PEORIA, ILLINOIS

ATIP PROJECT
MIT CENTER FOR POLICY ALTERNATIVES

by

Rebecca Marta Henderson

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
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May 8, 1981

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Submitted to the Department of Mechanical Engineering on May 8, 1981, in partial fulfillment of the requirements for the Degree of Bachelor of Science in Mechanical Engineering.

ABSTRACT

A study was carried out of the degree of integration of employees working with newly introduced automated equipment at a Caterpillar Tractor Company plant in East Peoria, Illinois. Two control groups of employees working with conventional production equipment were also studied.

It was found that the employees working with the automated equipment were significantly better integrated into the company than employees from the control groups of a similar age and educational background. The older, more senior employees working with the conventional machinery were found to be better integrated than either group.

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Title: Lecturer in Mechanical Engineering
Senior Research Associate, C.P.A.
Foreword

This study has been performed at the Center for Policy Alternatives of the Massachusetts Institute of Technology. It has been sponsored by the Caterpillar Tractor Company and is part of the Advanced Technology and Industrial Productivity (ATIP) Program.

The author acknowledges the help and cooperation generously provided by people from Caterpillar Tractor Company. Particular thanks are due to F. Allen Carpenter and W.B. Dronen.

I would also like to thank Clinton Stanovsky for his help in gathering information and Robert T. Lund for his comments and suggestions during the writing of this thesis. Special thanks are due to Judith Stein and Sheila Bowen who were responsible for the preparation and production of this thesis.

Rebecca Henderson
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INTRODUCTION

In January 1980, Caterpillar Tractor Company entered a joint study with the MIT Center for Policy Alternatives to examine the impact of an advanced technology on people, organizations and productivity.

This report is a part of that project. It seeks to investigate the degree of integration into the company of the employees working with the automated equipment, as compared to those employees operating the conventional equipment.

By "the degree of integration" of an employee is meant the extent to which the employee identifies with the company and its goals. An employee who is "more highly integrated" into the company will be rarely absent without cause, and will show a high degree of responsibility towards his work. He will generally be more receptive to change than an employee who is less well integrated into the firm.

Job "satisfaction" is the quantity more usually studied in the context. It is a nebulous, essentially subjective concept, loosely related to the degree of "happiness" of an employee. It is usually measured by asking an employee directly questions of the form "how satisfied with your work are you?". Although job satisfaction may be related to the degree of integration of an employee, it tends to be a
very subjectively defined quantity, and is one that is much more
difficult to measure.

Much of the data available enabled some measures of integration to be
obtained, while only vague indications of job satisfaction could be
measured without directly questioning the employees, and thereby
disturbing the situation under study. The degree of integration of the
employees was therefore taken as the object of the study.

Caterpillar has brought into production two new models of crawler-
type tractor: the D9L and the D10. Many of the main frame pieces
manufactured for the D9L are being machined on the newly introduced
automated equipment. This equipment is being introduced into building
LL, where machining for some of the smaller models of the line is also
performed. Installation of the machines was initiated in August 1981,
and is still progressing.

The automated equipment being introduced varies greatly in size and
complexity and is made by several different manufacturers. Both
numerically controlled equipment and some considerably more advanced
computer controlled automated equipment is being installed. For a full
description of the new technology, the reader is referred to the report
"Description of the Technology," by Clint Stanovsky.
Much work has been done on the degree to which the production process itself induces "alienation," or decreases integration into a company (see bibliography). Examination of the equipment being introduced in this light suggests that some of it is likely to be much more alienating than others, but since none of it is yet in full production, and no data has been taken in this field, such predictions can only be very general.

This study is concerned with the degree of integration of the employees before they started work on the automated equipment. If the plant were to be fully automated the size of the workforce would decrease dramatically. If the employees retained are those who are in general better integrated into the company, then even if the production process increases their general level of alienation, the resulting effect may be to increase the average level of integration in the plant.

The union contract mandates that a promotion should be awarded to the most qualified employee who wants it. When several equally qualified employees want the position, the promotion should be awarded to the most senior of these employees. However, the high degree of responsibility demanded in the operations of the automated equipment suggests that it is in the company's interest to promote those employees who are best integrated into the firm, and hence by definition are the most responsible. This led me to formulate the hypothesis that those employees actually found operating the automated equipment would be those whose records suggest them to be the best integrated employees.
CHOICE OF EMPLOYEE GROUP FOR STUDY

The focus of this study is the degree of integration of those employees who are now working with the automated production equipment. Control groups of other employees were chosen, so that these workers could be compared to others working in the same plant, the collection of manufacturing facilities at East Peoria, under similar conditions.

Those employees now working with the automated production equipment are the "automated equipment operators" in building LL. This group comprises 28 people, who are all grouped by Caterpillar into the same general job classification, having the "7M" prefix before their job number. While there are differences within this group in skill and pay levels, corresponding to differences in the level of skill required to operate the automated equipment, in this study this group is treated as a single unit.

The automated machine operators are a part of a section, the "automated equipment section" (department 163). The other employees in this section act as support personnel for the automated equipment operators and can be divided into two groups. The first is a group of ten "skilled machinists." These employees operate conventional machine tools requiring a high degree of skill in their use, performing rework and preparatory machining on pieces that are to be, or have already been,
machined on the automated equipment. The second is a group of 11 "entry-level" employees who perform the simpler conventional machining jobs and operations like sweeping, chipwheeling and deburring.

The "automated equipment section" was compared to two other sections, one within the same building--building LL--and the other in another building within the same plant, building X. The employees of all three sections are members of the same union local, and hence are employed under the same contract. They are all employed in the same location and are drawn from the same community. The two control sections are employed in producing a very similar product to that produced by the automated equipment section. Their conventional machine tools, therefore, perform almost identical machining operations to those performed by the newly introduced automated equipment. They can, therefore, act as controls for the presence of automation alone, as distinct from any other complicating factors. One control section was located in a different building, so that the effect of the building "ambience" itself--its management style and general ambience--could be controlled for.

Both of the control sections comprise three groups of employees. One group, the "skilled machinists," has very similar skill and pay rating within the company to the automated machine operators, and to the skilled machinists of the automated section. They have, in Caterpillar's terms, the general classification "2M," and perform skilled work to high
tolerances on conventional machine tools. In "conventional section LL," the control section in building LL (section 8310), there are 8 skilled machinists. In "conventional section X," the control section in building X (sections 1103 and 1124), there are 14 skilled machinists.

In addition to these groups of skilled machinists, conventional section LL contains a group of 14 semi-skilled machinists and 10 entry-level employees. Conventional section X contains a group of 23 semi-skilled machinists and 17 entry-level employees.

The semi-skilled machinists have, in Caterpillar's terms, the general classification "1M." They have lower classifications and pay rates than the skilled machinists and perform less demanding work on conventional machine tools.

The entry-level employees perform the same operations of sweeping, chipwheeling and deburring that are performed by the employees of the entry-level group in the automated machinery section.

A summary of the employees chosen for study is given in table 1.

All three sections also contain a number of employees who act as welders. These people were not studied because the difference in their work content between the automated equipment section and the control sections is only slight.
Table 1: Number of Employees Studied Within Each Group

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Equipment Operators</td>
<td>28</td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td></td>
<td>14</td>
<td>23</td>
<td>37</td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>10</td>
<td>8</td>
<td>14</td>
<td>32</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>11</td>
<td>10</td>
<td>17</td>
<td>38</td>
</tr>
<tr>
<td>TOTAL</td>
<td>49</td>
<td>32</td>
<td>54</td>
<td>135</td>
</tr>
</tbody>
</table>
JOB HISTORY AND PATTERNS OF PROMOTION

The job history of each employee is recorded by the company in his or her personnel file and upon the "EPIC" data base. This data base contains a profile of every employee. Together with the name, age and sex of the employee, it records his date of hire, seniority date, and his job history at the company since 1976. A general pattern of promotion and mobility can be observed that was significantly changed upon the introduction of the automated equipment.

Before the introduction of the automated equipment, promotion among those employees of substantially equal capabilities was strictly upon the basis of seniority. A job opening would be canvassed among qualified employees by the foreman, and the most senior of the qualified employees applying for it would be awarded the position. Because the conventional technology was well established, routes of progression had become established, and seniority had become the criterion for promotion. The general paths of promotion were as shown in Figure 1.

This system of promotion means that the skilled machinists are generally older and of greater seniority than the semi-skilled machinists. The entry-level employees, from whom the higher classifications are drawn, are a mixed group, however, because it contains both those employees who have just joined the firm, and also
those employees who either did not wish to be, or who lacked the competence to be, promoted.

Promotion into the automated machine operator's jobs has not been strictly on the basis of seniority. The personal records of those employees in these positions show clearly that they were more often promoted on the basis of having "greater qualifications" than on the basis of seniority. The supervisor in charge of choosing people for the positions has described himself as seeking employees with a "basic mechanical aptitude and with a high degree of responsibility."
Thus, the automated machine operators are not uniformly older or more senior than the semi-skilled operators who are below them on the promotional path, and many are younger and less senior than the skilled machinists who have equal skill and pay ratings.
LITERATURE REVIEW: CHOICE OF VARIABLES

1. Introduction

Most of the literature now available concentrates upon the issue of job satisfaction rather than of job integration. However, it does provide some information as to which variables may be critical in determining the degree of integration of the employee into the company, and which variables are useful indicators of this degree of integration.

2. Age and Seniority

Several previous studies, \(^{13,16}\) have suggested that there is a strong correlation between the age and seniority of an employee and his integration into the company. The older, more senior employee is more likely to have developed a commitment to his work than a younger or more inexperienced man, and is likely to be an employee who is better integrated into his company and work.

The same studies also suggest that an older employee, with less formal education, may be less receptive to technical change since he is in general unfamiliar with its basic nature, and is less willing to learn the new skills required to work with it.
3. **Mobility and Marital Status**

Work done in this field,\textsuperscript{13,15} suggests that those employees who are less mobile and have large numbers of dependents are likely to be more integrated into their companies than those employees who are single and have been changing their location frequently.

4. **Sex and Race**

The work of Blauner\textsuperscript{1} suggests that female employees are likely both to hold the less skilled jobs within a workplace, and to be less committed to those jobs. This is the result of work holding a less central position in their lives than it does in the lives of their male colleagues. Since the date of this study, some writers\textsuperscript{13} have suggested that this may be changing as the position of women in society in general changes.

It has been frequently found\textsuperscript{9,13,14} that black employees are likely to be an anomalous group. Because of their "generally alienated condition" from a dominant white culture, they appear to be unusually less well integrated into a given workplace, generally having unusually high rates of absence, and more severe disciplinary problems.
5. **Education**

There is some evidence in the literature\(^5\) that a greater level of formal education among employees will increase both their independence and ambition and their expectations of their job. Such employees are more likely to be less well integrated, and to be absent from their work or to have disciplinary problems than those employees of a similar age and background who have less formal education.

6. **Disciplinary and Absence Records**

Studies of the disciplinary records of individual employees\(^{15,16}\) suggest that, in general, the more heavily disciplined employee is one who is less likely to be well integrated into the company and to be less "satisfied" with his work.

However, similar studies\(^{13}\) of the absence records of employees suggest that the degree to which an employee is absent from his work correlated more closely with his position in his life cycle than with his expressed attitude to his job. In general, older and more senior employees are much less likely to be absent from their work. Among employees of a similar age and having similar educational background, however, absence is a useful indicator of the degree of an employee's integration into the company.
7. **Grievance Activity**

Those writers\(^{15,16}\) who have studied grievance activity within a plant found it to correlate more closely with the norms of a particular group and the attitude of the union than with the attitudes of a particular employee, although a single employee who is a constant source of grievances is likely to be less well integrated into the company than other employees who do not use this form of action.
SOURCES OF DATA

1. Age and Seniority

The company maintains a data base, the "EPIC" system, which records the birth date and seniority date of each employee. The date of last hire, which is also recorded, is sometimes not the same as the seniority date, but in such cases the seniority date is a more accurate indication of the amount of time that the employee has worked for the company.

2. Mobility and Marital Status

The company maintains no records of the change of address of an employee. One of the computer based data systems, the "EMR" system, does maintain records of the marital status of each employee and of the number of his or her dependents, but these records are maintained for tax purposes because a person may choose to declare fewer or more dependents to alter tax withholdings. This information was therefore not used because the data may not be accurate, and no attempt was made to obtain it.

3. Sex and Race

The "EPIC" system records the sex and race of each employee.
4. **Education**

Formal education received before an employee joined Caterpillar is recorded on the employee's application form. Training received subsequently at Caterpillar is recorded in his personnel file. Formal education obtained at evening classes during the time the employee is working for Caterpillar is entered into the employee's file only at the deliberate request of the employee.

5. **Disciplinary and Absence Records**

Records of disciplinary action taken against an employee before 1976 were placed directly into his or her personnel file. After the institution of the "EPIC" system in 1976, an employee's disciplinary record was recorded directly into the EPIC system itself.

Since 1976, the company has maintained a data base, the "FRACS" data system, that records the number of hours missed per day for each employee, together with a code indicating the reason for the absence. It has thus been possible to calculate the average number of hours missed per year by each employee for a given reason.
6. **Grievance Activity**

The records of grievances entered against Caterpillar are stored in chronological order in four different locations, depending upon the stage at which they were settled. It was found impractical to process this information to obtain individual rates of grievances.

7. **Voluntary Contributions**

One of the data files maintained by Caterpillar, the "EMR," records the deductions from each employee's payroll toward the United Way, and toward the purchase of U.S. Savings Bonds. While such contributions are a good indication of an employee's degree of integration, some difficulty was experienced in gaining this data, and it was not used in this study.
RESULTS

1. Age and Seniority

The average age and seniority for the various groups studied is given in tables 2 and 3. The patterns of promotion within the plant had suggested that the skilled machinists would be older and more senior than the semi-skilled, and this was observed in conventional sections LL and X, where the average age of a skilled machinist is 52 and 46 respectively, with an average of 24 and 22 years seniority. The semi-skilled machinists have average ages of 32 and 29 and seniorities of 8 and 6 years. The automated equipment operators of the automated equipment section are slightly older and slightly more senior than the semi-skilled machinists of the two control sections, having an average age of 33 and an average seniority of 10 years. This supports the observation that they have been largely promoted from among the semi-skilled machinists, rather than from among the more senior skilled machinists. The skilled machinists of the automated equipment section seem to be an anomalous group, having an average age of 30 and an average seniority of 6 years, suggesting that they are considerably younger than the skilled machinists of the control sections.

Although the entry-level group is described as "entry-level," and includes those jobs into which employees are placed immediately on entering the plant, the average age and seniority of these groups is
### TABLE 2: Average Age of Employees Within Each Group

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Equipment Operators</td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td>32</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>30</td>
<td>52</td>
<td>46</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>43</td>
<td>46</td>
<td>37</td>
</tr>
</tbody>
</table>

### TABLE 3: Average Seniority of Employees Within Each Group

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Equipment Operators</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td>8</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>6</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>13</td>
<td>18</td>
<td>12</td>
</tr>
</tbody>
</table>
greater than those of the semi-skilled machinists. This is because these groups also contain those employees who chose to refuse the opportunity to be or who were unqualified to be promoted, and may have been with the company for several years. For example, the average seniority of the entry-level employees of conventional section X is 12 years, as compared to 6 years for the semi-skilled machinists of the same section.

2. Sex and Race

The only women around the employees studied are the three women employed as entry-level employees in conventional section X. Employees may choose to refuse promotion because they are unwilling to work under the pressure of production job, or are afraid of failure in a more demanding job. Overall, 4% of the employees studied are black. 4% of the automated equipment operators, 7% of the skilled machinists, and 18% of the entry-level employees of conventional section X are black. All the other groups of employees are wholly white. These results are displayed in tables 4 and 5.

3. Education

Education was divided into two types: that received before the employee joined the firm and training obtained subsequently. An
TABLE 4: Number of Black Employees Within Each Group
(% of black employees in the group is given in parentheses)

<table>
<thead>
<tr>
<th>SECTION</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automated Equipment Operators</td>
<td>1 (4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td>1 (7%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>0</td>
<td>0</td>
<td>1 (7%)</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>0</td>
<td>0</td>
<td>3 (18%)</td>
</tr>
</tbody>
</table>

TABLE 5: Number of Female Employees Within Each Group
(% of black employees in the group is given in parentheses)

<table>
<thead>
<tr>
<th>SECTION</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automated Equipment Operators</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>0</td>
<td>0</td>
<td>3 (18%)</td>
</tr>
</tbody>
</table>
educational "index," weighted towards educational opportunities requiring a higher degree of ability and initiative on the part of the employee, was constructed and calculated for each group within each section.

a. Pre-Employment Education

None of the employees studied had graduated from college. However, many had taken college courses. The scale chosen assigned a value of 0 to those employees who had not graduated from high school, a value of 1 to those who had obtained a high school diploma or its equivalent but had not gone to college, and a value of 2 to those who had taken at least one college course. For each group, the number assigned to each person was totaled, and the sum divided by the number of people to give a final result for the group.

The results are shown tabulated in table 6. It can be seen that the men of the automated equipment section had in general more formal education before they joined the firm than the other employees.

b. Training Received at Caterpillar

Caterpillar offers two forms of further training to its hourly employees on a regular basis; "on shift" and "off shift" courses. A variety of full time programs are also offered. "On shift" courses are taken during regular working hours at the request of the employee's
TABLE 6: Pre-Employment Index for Each Group

<table>
<thead>
<tr>
<th>SECTION</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automated</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Skilled</td>
<td>.6</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Machinists</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilled</td>
<td>1.7</td>
<td>.6</td>
<td>.8</td>
</tr>
<tr>
<td>Machinists</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entry-Level</td>
<td>.8</td>
<td>.5</td>
<td>.7</td>
</tr>
<tr>
<td>Employees</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

foreman. An employee is assigned to a course as it becomes necessary for him or her to use the skills on his or her job. The "on shift" courses are in subjects like "blueprint reading" and "fundamentals of welding."

The company does offer an on shift course in numerically controlled machining, but this course is not directly linked to the operation of the specific machines in this study. Those employees who have taken this course, however, can be described as "better qualified" to become automated operators than those with more seniority who have not. In some cases, the foreman will ask a man or woman who he wishes to promote to take the course so that he or she can be more easily promoted. It
was observed that 14% of the automated equipment operators had taken this course, but that none of the other employees studied had done so.

The company also offers "off shift" courses to those employees who wish to take them. These courses are voluntarily undertaken by the employee, and must be taken on unpaid time.

A training scale was constructed by assigning 0 to those employees who had taken no courses at all, 1 to those employees who had taken on shift courses only, and 2 to those employees for whom there was a record of their having taken off shift courses. This weighting was used because it shows: (1) evidence of ability because a person was recommended for one or more on shift courses; and (2) of both initiative and ability in taking off shift courses. The results obtained are shown in table 7.

Employees within the automated equipment section have slightly higher in-house training indices than those within the conventional sections.

c. Advanced Training

The company also offers several courses designed to lead to promotion out of the general pool of operators into supervisory positions. A two year mechanical apprenticeship program is offered, whereby students of the program are exposed to a number of the manufacturing processes,
TABLE 7: Training Index for Each Group

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Equipment Operators</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td>.5</td>
<td>.8</td>
<td></td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>.8</td>
<td>.5</td>
<td>.8</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>1.1</td>
<td>.5</td>
<td>.7</td>
</tr>
</tbody>
</table>

and given courses in science, engineering and mathematics. Admission to the program is competitive, and awarded upon the basis of merit. Employees that show supervisory potential may nominate themselves or may be recommended by their foreman for a foreman training program, the 'new supervisor selection and training program' (NSST). This program lasts for six months and is designed to train men and women to lead small sections. Promotion may then follow to the position of foreman. Graduate of the apprentice program who wish to become foreman must go through the NSST.
Two of the automated equipment operators had completed the two year apprenticeship program, and one had been a foreman and had subsequently been demoted. None of the other employees studied had entered any of the advanced training programs.

4. Discipline

Disciplinary action may be taken against an employee in three ways, short of discharge from the company. The employee may be "cautioned." His or her supervisory will orally warn him or her that a given action, if continued, will result in further disciplinary action. A record of this caution is entered into the employee's file. A supervisor may enter it under the headings of "caution" or "matter of record." "Matter of record" is a general class, which includes any item about an employee that a supervisor thinks should be in an employee's file. When the data were scanned for this study, care was taken to ensure that those "disciplinary matters of record" did refer to disciplinary warnings.

An employee may be given a formal "written warning." This is considered to be more serious than the oral caution. The written warning states that a given action, if continued, will result in suspension or discharge. The most serious form of disciplinary action short of discharging the employee is suspension for some days without pay.
A "disciplinary index" was constructed by assigning each form of disciplinary action a value in order of increasing gravity. Disciplinary matters of record and cautions were assigned a value of 1, written warnings a value of 2, and suspension a value of 3. Employees having no record of disciplinary action were assigned a 0. The total obtained for each employee was then divided by the number of years that he had worked for Caterpillar. The average value of these individual annual averages was then found for each group of employees. The data are shown in tables 8 and 9.

The average disciplinary index for conventional section X is considerably higher than that for the other two sections, if the skilled machinists of the automated equipment section are not included in the comparison. This may reflect differing standards of discipline in the two buildings, rather than a lower degree of integration of those employees working in building X.

This implies that the high index of the semi-skilled machinists of conventional section X may be the result of this difference in standard. The skilled machinists of the automated equipment section seem to be a group that has an anomalously high index. One possible explanation for this could be that they are not well integrated into the company.
The average index for the automated equipment operators and the semi-skilled machinists is much higher than that of the entry-level employees and the skilled machinists, suggesting that they are less well integrated into the company.

TABLE 8: Disciplinary Index for Each Group

<table>
<thead>
<tr>
<th>SECTION</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automated Equipment</td>
<td>.33</td>
<td>.30</td>
<td>.72</td>
</tr>
<tr>
<td>Operators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td>.30</td>
<td>0</td>
<td>.11</td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>.87</td>
<td>0</td>
<td>.11</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>.08</td>
<td>.02</td>
<td>.13</td>
</tr>
</tbody>
</table>

The average incidence of suspension per year of employment within the company was calculated for each group. The skilled machinists of the automated equipment section have an average incidence of .12, more than double that of the closest figure: that of .05 for the semi-skilled machinists of the control groups. The skilled machinists of the control groups have a zero incidence of suspension, while that of the automated equipment operators is .02, suggesting that both groups are highly integrated.
TABLE 9: Average Number of Suspensions per Person per Year for Each Group

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Equipment Operators</td>
<td>.02</td>
<td>.05</td>
<td>.05</td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td>.05</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>.12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>.02</td>
<td>0</td>
<td>.03</td>
</tr>
</tbody>
</table>

5. Absence

Four types of absence were recorded for each employee: unpaid absence, late arrival, leaving early and disciplinary action. Each employee is allowed fifty hours of 'personal time'. He may be absent for up to fifty hours 'provided he gives his supervisor prior warning. Beyond this time, or if he is absent without warning, the hours are recorded as 'unpaid absence'. Late arrival and leaving early are those hours missed through those actions. "Disciplinary action" are those hours missed because the employee had a disciplinary suspension.

Because the number of hours missed due to the first three types of absence is determined by the employee, while hours missed through disciplinary suspension are imposed by the employer, the first three types of absence were combined and labeled as "voluntary absence."
The average hours absent from work per person per year for each group were calculated cumulatively for the "voluntary" types of absence, and for disciplinary absence. The results are shown in tables 10 and 11.

The skilled machinists of the control sections show the lowest number of hours missed per year. Those of conventional section LL had an average of 2.3 "voluntary" hours missed per person per year, with no hours missed through disciplinary action, while those of conventional section X have an average of 8.7 "voluntary" hours missed per person per year, again with no hours missed through disciplinary action.

The automated equipment operators have a "voluntary" figure of 13.7, while the semi-skilled operators have figures of 16.6 and 19.4 hours missed per person per year for sections LL and X respectively. The number of hours missed through disciplinary action is much higher among the semi-skilled machinists, being 6.0 and 4.7 hours missed per person per year for sections LL and X respectively, while among the automated equipment operators it is 0.6 hours missed per person per year.

The entry-level employees seem to lie between the semi-skilled and skilled machinists, as might be expected from their mixed composition. In the automated equipment section, there are 10.7 voluntary hours missed per person per year, and 0.6 disciplinary hours. In conventional section LL, these figures are 6.1 and 0.1 respectively and in conventional section X 15.8 and 1.9.
**TABLE 10: "Voluntary" Absence: Average Hours Missed Per Person Per Year**

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Equipment Operators</td>
<td>13.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td>16.6</td>
<td>19.4</td>
<td></td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>11.6</td>
<td>2.3</td>
<td>8.7</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>10.7</td>
<td>6.1</td>
<td>15.8</td>
</tr>
</tbody>
</table>

**TABLE 11: "Disciplinary" Absence: Average Hours Missed Per Person Per Year**

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Automated Equipment</th>
<th>Conventional LL</th>
<th>Conventional X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Equipment Operators</td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Skilled Machinists</td>
<td>6.0</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>Skilled Machinists</td>
<td>2.4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Entry-Level Employees</td>
<td>0.6</td>
<td>0.1</td>
<td>1.9</td>
</tr>
</tbody>
</table>
The skilled machinists of the automated equipment section again seem to be anomalous. They have an average of 11.6 hours per person per year missed voluntarily, and of 2.4 due to disciplinary action. These are much higher figures than those of the skilled machinists of the control sections.

It is notable that the absence figures for conventional section X are overall rather greater than those for conventional section LL. This may mean that the employees of building X are less well integrated into the company than those of building LL. An alternative explanation might be that there is a difference in management styles between the two buildings, and this produces different behavior in the employees of the two buildings.

The absence data were analyzed by age group and educational history as well as by job classification. The results obtained are shown in table 12. They show a clear correlation between age and absence, as was expected, with hours missed due to voluntary absence and to suspension decreasing with increasing age. The results also suggest an increase in hours missed in both classes with increasing education, although this is not so clear.

The results for black employees alone were studied, and are shown in table 13. While the aggregate figures obtained were higher than those for white employees, they are not abnormally above those for some of the other breakdowns—for example, those employees below forty.
TABLE 12: Absence: Corrected for Age and Education
(Figures given are average hours missed per year per employee)

<table>
<thead>
<tr>
<th>Age</th>
<th>Voluntary</th>
<th>Disciplinary</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>19.1</td>
<td>3.9</td>
</tr>
<tr>
<td>30-39</td>
<td>17.6</td>
<td>1.5</td>
</tr>
<tr>
<td>40-49</td>
<td>8.4</td>
<td>0</td>
</tr>
<tr>
<td>50+</td>
<td>7.6</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Education

| No High School Diploma | 14.2 | 0.9 |
| High School Diploma   | 12.3 | 2.3 |
| College Courses       | 17.9 | 1.4 |

TABLE 13: Absence Corrected for Race
(Figures given are average hours missed per year per employee)

<table>
<thead>
<tr>
<th>Race</th>
<th>Voluntary</th>
<th>Disciplinary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>16.5</td>
<td>2.2</td>
</tr>
<tr>
<td>White</td>
<td>10.5</td>
<td>1.8</td>
</tr>
</tbody>
</table>

The hours missed from work for the automated group since August 1980, when the automated machinery was first used extensively, were also examined. The results are shown in table 14. They suggest that hours missed from all causes have decreased from their customary level, but this may be because the sample time is too short to give accurate results.

TABLE 14: Absence of Automated Equipment Operators
Since August 1980

<table>
<thead>
<tr>
<th>Voluntary</th>
<th>Disciplinary</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6</td>
<td>0</td>
</tr>
</tbody>
</table>
CONCLUSIONS

If integration into the company is measured in terms of disciplinary action and numbers of hours absent, it would seem that the skilled operators of the conventional machinery are those best integrated into the company. However, these employees are in general older and more senior and these results are explicable more by their position in the life cycle than by the content of their work.

If the automated equipment operators are compared to the semi-skilled conventional operators who have similar ages, seniority and educational background, then they would seem to be better integrated, having lower "voluntary" absence and far fewer hours lost to disciplinary action. Although their disciplinary indices are similar to those of the semi-skilled machinists, their incidence of suspension is lower. The "training index" of the automated equipment operators is higher than that of the semi-skilled machinists of the control groups, suggesting further that they are more highly integrated into the company.

Given the selection criteria used in choosing the group, however, this is not surprising. In compliance with the union contract, the most qualified employees were chosen for promotion. Informal conversation with supervisory personnel suggested, however, that the qualifications used as a basis for selection were in some cases somewhat intangible,
consisting of things like 'a high degree of aptitude and responsibility'. The supervisors indicated that it was important for them to explain this to the more senior employees with very similar former qualifications. Most of the senior skilled machinists have been offered positions working with the automated equipment, but have refused them. One possible explanation for this is that they are given less encouragement to accept such positions than the younger employees. The original hypothesis advanced is confirmed since those employees chosen to operate the new equipment have tended to be those who are more fully integrated into the company.

The majority of the data gathered are from the period before the introduction of the automated machinery, and thus it is hard to judge the results of its introduction. Absence data gathered for the automated equipment operators suggests that the average number of hours absent for the group decreased, but even if this is a significant result, it may be a result of the "excitement" attending the introduction of the new machinery. The period over which the operator learns about the equipment and adjusts to his new level of responsibility is likely to be an unrepresentative one.

The skilled machinists working with the automated equipment section are an anomalous group. They are considerably younger and less senior than the skilled machinists of the control groups, and have similar
pre-employment education and training indices similar to those of the semi-skilled machinists and automated equipment operators. They seem to be less well integrated into the company, however, than either of the groups, despite having high skill and pay levels. Their disciplinary index is very high, as is their average number of suspensions per year of employment, and their average hours missed through disciplinary action.

One possible explanation for this is that the younger skilled machinists are transferred to the automated equipment section, and then the most well integrated among them are promoted to be automated equipment operators. This leaves behind a group of exceptionally less well integrated employees.

It was found, as was expected from a study of the literature, that those who have a greater degree of formal education have a high degree of voluntary absence, but not a correspondingly high disciplinary rate. Older employees are found to be absent less and to have a low level of disciplinary action. It should be noted, however, that these tendencies tend to reinforce each other, since the older employees are generally those with less formal education.
RECOMMENDATIONS

Further work on changes in the degree of integration into the company of these employees must take into account the difference in orientation of the different groups. The employees working with the automated equipment are a young, motivated, educated group who have historically been highly integrated, and they must be studied from that perspective. Because they are more highly integrated into the company to start with, it will be of interest to study changes in this initial degree of integration over time, to measure the long term impacts of automation on this group.
BIBLIOGRAPHY


