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Experiment in worker productivity

Clifford George Egner

The University of Montana

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AN EXPERIMENT IN WORKER PRODUCTIVITY

By
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B.A., Northwestern University, 1967

Presented in partial fulfillment of the requirements for the degree of
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Chairman, Board of Examiners
Dean, Graduate School
Date
# TABLE OF CONTENTS

LIST OF TABLES ........................................ iii
LIST OF ILLUSTRATIONS ............................... iv

Chapter

I. PROBLEMS OF WORKER PRODUCTIVITY .............. 1
   Measuring Worker Productivity
   Increasing Worker Productivity
   Studying the Company Alpha Problem
   Previous Research
   Objectives of This Study

II. METHODOLOGY ...................................... 11
   Definitions
   General Format
   Physical Description

III. RESULTS ........................................... 17
   Output Analysis
   Questionnaire Analysis
   Observations

IV. CONCLUSIONS, WEAKNESSES, SUGGESTIONS
    FOR FURTHER RESEARCH ......................... 25
   Conclusions
   Weaknesses of the Study
   Suggestions for Further Research
   Summary

APPENDIX .............................................. 32

BIBLIOGRAPHY ......................................... 37
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Units of Completed Output</td>
<td>17</td>
</tr>
<tr>
<td>2. Summary Table and F Value Calculation</td>
<td>18</td>
</tr>
<tr>
<td>3. Analysis of Question One</td>
<td>20</td>
</tr>
</tbody>
</table>
LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Output</td>
<td>15</td>
</tr>
<tr>
<td>2. Questionnaire</td>
<td>19</td>
</tr>
</tbody>
</table>
CHAPTER I

PROBLEMS OF WORKER PRODUCTIVITY

Worker productivity is currently a much discussed topic in business and many business articles have been written about various aspects of this subject. Most of these articles address themselves to one of two basic problems: (1) how to measure worker productivity, and (2) how to increase worker productivity.

Measuring Worker Productivity

Example

In some cases, the measurement of worker productivity is very difficult. For instance, consider the following situation which occurred at a large parts warehouse of an agricultural implement firm (Company Alpha). Company Alpha received its parts in wooden pallets. Computer cards accompanied the parts and were compared against the parts actually received. If accepted, the pallets were unloaded by hand, parts were placed in carts, and workers wheeled the carts to appropriate bins and placed the parts in the bins. The computer cards were supposed to serve as proof that workers actually placed the parts in the bins. The system, however, could not guarantee that parts were binned properly since
workers could easily collect the computer cards and leave the parts in convenient but wrong places.

Computer cards were also the basis for picking parts for shipment. Each worker had a schedule and he was expected to pick eight packs of sixty cards each during an eight hour shift. After completing the schedule, any time left belonged to the worker to do with as he pleased. The picked parts were packed by packers, sent to a loading dock and were shipped to buyers.

Attempts at measuring worker productivity (output/time period) were nearly futile. The use of receiving computer cards was a weak output measurement device; even if the workers honestly binned the parts, the cards did not reflect the different effort required for different tasks. For example, binning a sack of washers received the same output credit as binning a cart of bearings even if the time and effort involved in each job were different. A related problem was that the workers seldom turned in all of the cards that they collected during a shift. Instead they saved the extras for days that they were ill or unwilling to work at a minimal capacity. In the shipping area, measurement was just as futile since no minimum requirement accompanied the picking schedule. Thus, the workers seldom picked the expected number of decks.
Benefits

Why should a company want to measure worker productivity? There are basically two reasons. The first is to attain a better estimate of labor costs and, thus, to trim excess labor. At the parts warehouse, management had a general idea of how many workers were required to maintain a certain volume of order-filling capacity. They had, however, no specific idea of how many workers were needed for a given capacity. The second reason is that worker productivity must be known if it is to be increased. If a company knew the productivity of its individual workers, then it could bargain with unions for increases in productivity standards or it could experiment with increasing job satisfaction. In addition, different techniques could be weighed against one another in order to determine which resulted in the higher worker productivity. Once it is feasible to measure worker productivity, the question becomes one of how to increase it.

Increasing Worker Productivity

Two schools of thought offer suggestions for increasing worker productivity. Scientific management approaches the subject from the viewpoint of industrial engineering and work design. Human relations partisans offer a second set of ideas by highlighting consideration of the laborer. In some ways, these two sets of ideas are opposites. The former group
generally focuses attention on the job while the latter group focuses attention on the worker.

Scientific Management

Scientific management began with Frederick Taylor. He emphasized the needs for job planning, time studies, specialization, etc. This concept, however, led to a disdain of the laborer. Taylor's disdain is reflected in the following statement:

There is no question that the average individual accomplishes the most when . . . someone else assigns him a definite task, namely, a given amount of work which he must do within a given time. . . . Most of us remain, . . . in this respect, grown up children.

Thus Taylor became a convenient target for opponents.

Specialization over the years has spurred the tremendous productivity of industry. Consequently, a basic assumption of scientific management is that, "the content of each job in an organization is fixed by the requirements of the production process and the organization structure." 1 Job designing attempts to meet a criterion of minimizing immediate costs. Six rules are specified in designing content:

1. Specialize skills.
2. Minimize skill requirements.
3. Minimize learning time.

---


4. Equalize workloads.
5. Provide for the workers' satisfaction (no specific criteria for job satisfaction are known to be in use, however).
6. Conform to the layout of equipment or facilities or, where they exist, to union restrictions on work assignments.\(^1\)

Repetition and simplification are the keystones of job design and, beyond satisfying basic needs, the above rules reflect an absence of concern for the worker. In industrial engineering the production process and economic efficiency govern what the worker will do. The highest productivity will be achieved in this manner.

**Human Relations**

Numerous critics have questioned the scientific management view of achieving optimum productivity. These critics believe that worker attitudes, job satisfaction, and other human relations ideas will lead to a higher productivity because there will be less absenteeism, work sabotage, slow downs, etc. Douglas McGregor\(^2\) advocated his Theory Y where he claimed that people are not passive, that people can assume responsibility and that people can make their goals congruent with company goals. He emphasized that management must structure its organization and methods of operations

---

\(^1\)Ibid., p. 307.

so that people can achieve their own goals as well as company goals. McGregor believed that people must be able to satisfy their higher needs on the job. Decentralization, job enlargement, and participative management are three methods for increasing worker productivity and for allowing individual growth.

Rensis Likert\(^1\) also believed that the value of the individual must be accounted for in order to increase productivity. He questioned whether putting pressure on an organization to increase short run productivity (profits, sales, etc.) is worth the deterioration of the human assets incurred. This deterioration is evidenced in the long run by increased hostilities, greater use of management authority, declining loyalty, worker slow-downs, etc. The main problem, Likert contended, is that top management looks only at short term profits, sales, and productivity measurements. Consequently, middle managers are forced to coerce their workers and to use authoritarian leadership in order to increase profits. Likert calls for recognition of that valuable asset, the work force.

**Which Technique**

How does one choose which ideas to put into practice in any given situation? The type of job will dictate whether

scientific management or human relations ideas will yield the highest worker productivity. For example, in a clerical department or in an office comprised of junior executives, human relations ideas should function well. However, on an assembly line, there may be no way to implement human relations ideas. The ultimate answer to these latter situations, where the work is so menial and simple as to preclude some worker oriented device, is to automate the job into oblivion. This answer, however, requires large outlays in capital equipment and destroys jobs, an outcome which is anathema to unions. Thus, another answer is needed.

**Studying the Company Alpha Problem**

**Situation**

At the Company Alpha parts warehouse a situation existed where increased worker productivity was desired but where human relations techniques were not utilized. A very strong union allowed each employee to work at his own pace. No required productivity standards existed. Workers could only be fired for sleeping, stealing, and the like. The jobs were boring and workers spent much time seeing how little work they could do. Workers said that there was no way the management could keep them on a schedule. How then could management attempt to increase worker productivity?
Suggestions for Improvement

Two solutions were available. The first was to institute some human relations techniques such as job rotation, or job enlargement. The second solution was to bargain with the union for the setting of productivity standards. For example, eight or six or ten packs of cards would be required to be picked with appropriate penalties being set for non-completion. A set number of parts would be required to be binned during a shift and a better method for output measurement would be developed and implemented. In regard to the bargaining, the company would be forced to consider both the types of standards and the savings which they would provide. These considerations are the basis for the experiment reported in this study.

Previous Research

The Hawthorne experiments\(^1\) were the first studies demonstrating that strict scientific management did not always lead to the highest productivity. In these studies, management found that subjects who were singled out and placed in a special room to measure the effect of light intensities on output were more productive than the average line

worker. Furthermore, productivity increased whether light intensities were increased or decreased. This was one of the first verifications of experimental bias. The girls chosen for the Relay Assembly Room test produced at higher levels because they were no longer under strict supervision and because they could have some say in how they would work. This experiment differed from the light experiment because the light experiment participants worked under normal supervision using regular techniques. These Relay Assembly Room girls thus felt themselves to be important and, despite admonitions to work as they were used to, they continued to increase their output.

In the Bank Wiring Room studies, it was discovered that worker groups formed against management for their own protection. The work group believed that if individual workers worked more efficiently and produced more output than the going rate, this new higher rate would be imposed by management. The work group thus suppressed the rate busters in their midst. This belief that management would change rates prevailed despite the fact that this practice had not occurred in the past.

Objectives of This Study

In this study an experiment was designed to determine whether the setting of ideal output standards, currently attainable output standards or no output standards for workers in a monotonous task situation would lead to the highest
productivity. This experiment attempted to answer such ques-
tions as which set of standards has the best chance of being 
set, and which set of standards leads to the highest produc-
tivity. A firm such as Company Alpha, having the answers to 
these questions, could bargain with Labor for the setting 
of mandatory standards since they would now have an idea of 
how much of a wage increase could be offered for a given 
increase in productivity.
CHAPTER II

METHODOLOGY

Definitions

Several concepts used in this experiment require amplification. These concepts are worker productivity, monotonous tasks, ideal standards, and currently attainable standards.

Worker productivity is defined as output per time period. Output is the tangible result of a worker’s efforts. In this experiment, one completed sheet of paper was one unit of output. Thus, the number of sheets completed within a twenty minute time period reflected the productivity of a worker.

Monotonous means tediously uniform. The repetitive performance of a simple, menial task created the monotony in this experiment. Monotony was desired because it characterizes the many physically menial, boring jobs which the task was designed to simulate.

Charles T. Horngren discusses ideal and currently attainable standards. He says, "Perfection (ideal) standard costs are the absolute minimum costs that are possible under the best conceivable operating conditions, using existing
specifications and equipment. Ideal standards of output, then, occur where workers perform at their best conceivable efficiency and speed. In this experiment, the output quota per person was set at an ideal standard level and coupled with the assumption of a good salary. This high quota or ideal standard was set to discover if the ideal standard would motivate workers to work at their highest efficiency and greatest speed.

Horngren states, "Currently attainable standard costs are the costs that should be incurred under forthcoming efficient operating conditions." In the context of this experiment, a considerably lower output quota (currently attainable output standard) per person than the ideal standard level was imposed on a second group. This lower standard was also coupled with the assumption of a good salary. This standard allowed for a slower pace and for less concentration. Thus participants would be required to work efficiently but not at their best conceivable efficiency.

The basic difference between the two standards is the difference in likelihood of attainment. Ideal standards require constant high efficiency, while currently attainable standards allow for machine breakdowns, lost time, realistically paced workers, etc. Whether workers could meet one, both, or neither of these standards was tested in the present experiment.


2Ibid., p. 188.
General Format

Each group was given a background briefing. The briefing included an output quota (if applicable) and also instructions for performing the task. Group one was asked to produce a currently attainable output standard, group two an ideal output standard, and group three was asked to perform at their own discretion (no output standard). The background briefing stressed the following points: (1) workers belonged to a strong union, (2) the required outputs were set forth in a bargaining agreement (for groups one and two), (3) noncompletion of the required output would result in a small monetary penalty, and (4) workers received a good salary. The participants worked individually at their tasks for twenty minutes.

Physical Description

Experiment Devices

The experiment involved pasting squares, circles, and triangles onto a sheet of paper. The participants were seated at their desks with instruction sheets, scissors, and glue. The participants had to leave their desks, pick two of each figure, return to their desks, cut out the figures, paste them on the instruction sheet, number the sheet, and place the time on the sheet. Subjects completed one sheet at a time; the completed sheet represented one unit of output.
A sample of the output sheet is shown in Figure 1. The number of output sheets completed by a person in the twenty minutes became a measure of that person's productivity.

Output Testing

The output quotas for the first two groups were established through test runs by the experimenter. Using a comfortable pace, the currently attainable standard was determined to be eight units of output. Performing the task as quickly as possible set the ideal standard at fourteen units.

Location

The experiment was performed in a normal classroom which measured approximately twenty feet by forty feet. Two rows of four desks each were set up with two to three feet between desks and four feet between the two rows. The rows ran lengthwise across the room. One box containing one of the devices to be cut out was placed in each of three corners of the room. The experimenter remained in the front of the room so that he could observe and so that he could place the time on a blackboard in front of the participants.

Participants

Twenty-one Air Force officers, all but three of whom are students in the AFIT MBA Program at Malmstrom Air Force Base, participated in the experiment. The twenty-one volunteers were randomly assigned to the three groups, seven to a group.
OUTPUT

1. PICK TWO CIRCLES.
2. PICK TWO SQUARES.
3. PICK TWO TRIANGLES.
4. RETURN TO YOUR WORK STATION.
5. CUT OUT THE FIGURES.
6. PASTE FIGURES UNDER APPROPRIATE HEADING.
7. NUMBER THIS OUTPUT IN SPACE PROVIDED.
8. PLACE TIME (MINUTES) IN SPACE PROVIDED.
9. PLACE IN OUTPUT PILE.

NUMBER______ TIME______

SQUARE          CIRCLE

TRIANGLE          SQUARE

TRIANGLE          CIRCLE

Figure 1.—Output
The groups were the currently attainable standard group, the ideal standard group and the no-quota group.

Events Schedule

A calendar of the important experimental events and a step by step schedule of instructions for the day of the experiment are presented in the Appendix.

Questionnaire

All the participants answered a questionnaire at the end of the experiment. The purposes of the questionnaire were (1) to learn how the participants viewed the task, (2) to reveal the success of the simulation, and (3) to show how much experimental bias was involved.
CHAPTER III

RESULTS

Output Analysis

The currently attainable group was asked to produce eight units of output and the ideal group fourteen. The no-quota group was not given a production quota. Means were computed for the three different groups and analyzed using variance analysis. Tables 1 and 2 present the output results and the summary of the variance analysis.

TABLE 1
UNITS OF COMPLETED OUTPUT

<table>
<thead>
<tr>
<th>Worker</th>
<th>Currently Attainable</th>
<th>Ideal</th>
<th>No Quota</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>14</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>14</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>21</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>14</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>14</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>14</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>14</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>105</td>
<td>63</td>
<td>229</td>
</tr>
<tr>
<td>Number</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>Mean</td>
<td>8.7</td>
<td>15.0</td>
<td>9.0</td>
<td>10.9</td>
</tr>
</tbody>
</table>
### TABLE 2
SUMMARY TABLE AND F VALUE CALCULATION

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between treatments</td>
<td>176.38</td>
<td>2</td>
<td>88.19</td>
<td>20.51*</td>
</tr>
<tr>
<td>Within treatments</td>
<td>77.43</td>
<td>18</td>
<td>4.30</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>253.81</td>
<td>20</td>
<td>92.49</td>
<td></td>
</tr>
</tbody>
</table>

*p<.01

The hypothesis of the equality of the three means is therefore rejected. This indicates that assigning two different groups different output quotas and the third group no quota did in fact cause a difference among the means of the three groups. Observing the means, it appears that the difference exists between the currently attainable and ideal means and also between the no-quota and ideal means. There appears to be no difference evident between the currently attainable and no-quota means.

**Questionnaire Analysis**

The first question (see Figure 2) was asked to determine how well a monotonous task was simulated. The question was based on semantic differential. For each description, the spaces were assigned values of one through five from left to right. The responses of the seven participants in each
1. The following words can describe the task that you performed in the experiment. Place an X in the space that you think is most appropriate concerning the task performed.

<table>
<thead>
<tr>
<th>Description</th>
<th>Very Bad</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physically difficult</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Physically easy</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Requiring concentration</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Physically fatiguing</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Mentally fatiguing</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Interesting</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Boring</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Challenging</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Tedious</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Enjoyable</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
<tr>
<td>Rewarding</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td></td>
</tr>
</tbody>
</table>

2. Do you feel that as the experiment progressed you became more proficient at performing the task? _________

3. Do you feel that you could have performed the task in a more proficient manner had you been able to plan your own techniques? _________

4. Did you feel any pressure to perform the task quickly? If so, was that because of the background briefing or because you felt that you must perform well to help the experimenter to get good results? ________________________________

5. What do you think was the purpose of the experiment? ________________________________

Figure 2.—Questionnaire
group were then compiled, the values totaled, and this total divided by seven. The resulting average, then, represented how the group as a whole rated the description in relation to the task performed. The averages for each group were themselves averaged to determine how all the participants rated a word. Table 3 shows the results.

TABLE 3
ANALYSIS OF QUESTION ONE

<table>
<thead>
<tr>
<th>Description</th>
<th>Current Attain.</th>
<th>Ideal</th>
<th>No Quota</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physically difficult</td>
<td>2.3</td>
<td>2.4</td>
<td>1.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Physically easy</td>
<td>3.3</td>
<td>3.9</td>
<td>4.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Requiring concentration</td>
<td>2.7</td>
<td>3.3</td>
<td>2.4</td>
<td>2.8</td>
</tr>
<tr>
<td>Physically fatiguing</td>
<td>2.9</td>
<td>2.9</td>
<td>2.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Mentally fatiguing</td>
<td>3.1</td>
<td>4.3</td>
<td>2.6</td>
<td>3.3</td>
</tr>
<tr>
<td>Interesting</td>
<td>1.9</td>
<td>1.1</td>
<td>1.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Boring</td>
<td>2.7</td>
<td>5.0</td>
<td>4.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Challenging</td>
<td>2.6</td>
<td>1.3</td>
<td>1.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Tedious</td>
<td>4.0</td>
<td>4.3</td>
<td>4.3</td>
<td>4.2</td>
</tr>
<tr>
<td>Enjoyable</td>
<td>2.3</td>
<td>1.1</td>
<td>2.0</td>
<td>1.7</td>
</tr>
<tr>
<td>Rewarding</td>
<td>1.7</td>
<td>1.0</td>
<td>2.3</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Note: 1 = very bad description, 5 = very good description.

The results show that the simulation of a monotonous, boring task occurred. Physically difficult, interesting, challenging, enjoyable, rewarding all received low values revealing that most participants considered these words to be very bad descriptions of the task. Physically easy, boring,
and tedious, in contrast, received high values showing that participants regarded these words as good descriptions of the task.

Comparing the ideal group to the other groups reveals two significant points. First, regarding the description mentally fatiguing, the ideal group rated it at 4.3 showing that this group, in fact, regarded the task to be so. The other two groups, in contrast, rated this description near 3. Secondly, the ideal group demonstrated more extreme ratings of some descriptions (averages closer to 1 and 5) than the other two groups, especially interesting, boring, enjoyable, and rewarding. The ideal group may have responded in these ways to reflect either the greater speed required of them or the greater pressure that they experienced.

The second question attempted to determine whether any learning occurred. All but one of the responses were yes. The third question was asked to determine if participants could develop a better work technique than that proposed by the experimenter. Again all but a few answered yes.

The fourth question was asked to determine if participants felt compelled to work quickly and if so why they felt that way. Most felt compelled to work quickly and the reasons given varied. A few patterns, however, emerged. In the currently attainable group, three said the background briefing caused them to hurry. Five participants in the ideal group answered the same. In the no-quota group, four
mentioned group pressure as a reason for working quickly. Four of the twenty-one participants felt that they should work quickly to help the experimenter get good results.

The last question's purpose was to ascertain if people knew the purpose of the experiment. If they had, they would have been biased to either meet or avoid the desired results. Answers revealed that no participant knew the purpose and, more importantly, that no participant knew that he was a member of a group different from the other two groups. No participant bias, then, existed.

In summary, questionnaire results showed that the desired simulation occurred, that the ideal group considered the task to be mentally fatiguing, that reasons for working quickly were varied, and that participants were not biased by knowledge of the experiment's purpose.

Observations

Observing the three groups revealed contrasting characteristics. In the currently attainable group, participants hurried and did not notice other participants. There was some laughing, but jokes about the task lasted only a few minutes. Participants required six minutes to discover the more efficient technique of folding object strips before cutting. Three participants hurried to make the quota. Two of these early finishers continued to work after asking questions about a possible bonus for extra completed output
(they were told only that the time was theirs). The third left the room after he completed his eighth unit of output in the eleventh minute. Four participants, however, needed nearly the full twenty minutes to fulfill their quota. This group was the most precise in their work habits.

The ideal group hurried throughout the twenty minute period; indeed, a few participants ran between boxes to fulfill their high quota as the end of the period approached. Only four minutes passed before this group learned the more effective method of cutting in contrast to six and nine minutes for the other two groups. At the beginning of the period, some jokes about the task were made. For the duration, however, the participants remained quiet and worked quickly. Five participants completed their output quota in the twentieth minute, one in the eighteenth, and one in the thirteenth (he continued and completed twenty-one units). This was the quietest group.

The no-quota group displayed the widest range of output per person, from six to eleven units. This group worked slowly and was the most relaxed. This group required at least nine minutes to learn the more efficient cutting method. Participants talked and joked during the whole period. Only this group commented about rate busters and mentioned quitting early to clean up. This group displayed the least discipline.

Relating these observations to questionnaire results explains some of them. The ideal group was the quietest and
fastest working. This could explain the consequent high rating of mentally fatiguing and the overall more extreme ratings observed. The no-quota group mentioned group pressure as a stimulant for working quickly. This relates with the observed banter and talking in this group. Finally, since no participant seemed too fascinated with what he was doing, this observation reinforces the questionnaire results that showed a desired simulation occurred.
The purpose of this experiment was to determine whether the setting of ideal standard quotas, currently attainable standard quotas, or no output quotas would cause workers in a monotonous, boring job to produce the most output. The assumptions used in the research were that Air Force officers would display the same reactions toward a menial, boring task as the worker population and that the desired tedious task could be simulated in a twenty minute period.

Conclusions

In this experiment the setting of an ideal standard output requirement led to the greatest productivity. All the subjects in both the ideal group and the currently attainable group, however, completed at least the required quota. In contrast to these two groups, the no-quota group produced the widest range of individual outputs. The no-quota group was also the only group to mention rate busters and cleanup time. Several implications arise from these conclusions.
For the monotonous, boring work situation, management should set ideal standard output quotas for its workers. This contradicts Horngren who stated, "Currently attainable standards are the most widely used because they usually have the most desirable motivational impact."\(^1\)

A second implication is that management should not allow workers to produce at their own pace. Without the motivational effect of output quotas, individual workers produce different amounts of output and workers organize to suppress the efforts of faster workers and to keep production at a comfortable pace.

**Weaknesses of the Study**

Birnberg and Nath\(^2\) divided laboratory experimentation into two areas, subject variables and environmental variables. Using their discussion as a guide, the following areas will be examined: the subjects, the task, and the lack of an explicit reward structure.

One assumption of the design was that students would react to the experimental environment in the same manner as real world workers react to their job environment. Birnberg and Nath stated that two weaknesses of this assumption are,

\(^1\)Horngren, *Cost Accounting*, p. 211.

"(1) a lack of common skills and experience between the two groups, and (2) a lack of comparable basic personality traits."\(^1\) The task was designed to be simple; no special skills, therefore, were required. The lack of common experience, however, is a relevant weakness. Concerning the second weakness mentioned, Birnberg and Nath believe that psychologists are correct in their assumption that, "the behavior of a random sample of college students, ..., is not dissimilar in any readily apparent way from the behavior of the population as a whole."\(^2\)

The task was supposed to simulate a monotonous, boring job. The questionnaire analysis supports the simulation. The task was simple enough to preclude special skills; intrinsic interest would have dissipated quickly because of the simpleness. However, different results may have occurred if the time period of the experiment would have been of a longer duration. This is a possible weakness of the research.

The lack of an explicit reward structure was a weakness. Birnberg and Nath cited two reasons for the importance of a reward structure, "It is the experiment's analogue of the real world ..., it is likely to be one factor determining the extent of the subject's involvement."\(^3\) Paying the

\(^1\)Ibid., p. 26
\(^2\)Ibid., p. 24.
\(^3\)Ibid., p. 32.
participants for their performance, however, could not simulate a worker receiving a weekly check. A worker's life depends on his salary, a token payment could never mean as much to a participant. Even awarding grade credit to students could not elicit the same meaning. In this experiment, the background briefing explained the money reward. If the simulation occurred, then the participants understood the value of a large salary. Further rewards to the participants were probably implicit. Curiosity and a desire to aid the experimenter are two such implicit awards. In this experiment, then, a token payment for participation would not have served the desired ends. The emphasis of a good salary in the background briefing had to suffice.

Two further weaknesses existed in the design. The first was that same experimental bias as mentioned in the Hawthorne studies. The environment of the experiment inhibited the normal responses of the participants. Four subjects acknowledged this bias explicitly in the questionnaire. The second weakness was that the standards were set too low. This second weakness, however, could be corrected in further trials of the experiment and is not really a problem with the design.

The important weaknesses of the research, in summary, were (1) the lack of common background experience between participants and workers, (2) too short a duration of the experiment, (3) lack of an explicit reward structure, and (4) experimental bias as discussed in the Hawthorne studies.
Suggestions for Further Research

Two directions for further research evolve from the results of this experiment. The first path utilizes the design formulated for this research. First, an experimenter could test quota limits above the fourteen required in this study. The ideal group found this task to be mentally fatiguing and marked various questionnaire words in a more extreme manner than the other two groups. They met their quota, however. Research could follow to determine at what level the raising of the limits becomes counterproductive, to determine where the subjects rebel against the required quotas. Secondly, the present design could be modified by extending the time limit of the experiment. Then, time periods within the duration could be compared and general effects of time could be studied. Finally, utilizing the present design, the no-quota group could be allowed to work as a team after being given time to plan how the task would be done. They would be simulating human relations ideas such as job enlargement or job rotation in a monotonous, boring work situation. Their output results would again be compared with the results of the other two groups.

The second path for future research would be to go to the actual situation (the assembly line, the warehouse, the factory) to observe patterns of communication, informal organization, worker attitudes, etc. After becoming familiar
with the environment, a researcher, with a company's approval, could modify the system to see what would happen to long run productivity.

Summary

Two problems of worker productivity, measuring and increasing, were discussed in Chapter I. Advocates of scientific management and human relations ideas offer different means of increasing worker productivity. The former discipline centers on the improvement of job technique while the latter centers on the improvement of the worker's plight. Each specific work situation determines which set of ideas to use to increase worker productivity.

In Chapter II, the methodology of the research was presented. Three groups of subjects performed a monotonous, boring task. The currently attainable standards group was asked to complete a moderate amount of output per person. The ideal standards group was asked to complete a large amount of output. The no-quota group had no quota to meet.

Variance analysis showed a statistically significant difference among the means of the three groups. The ideal standards group was much higher than the other two groups. Questionnaire analysis showed that the desired simulation of a monotonous, boring task occurred and that subjects did not know the purpose of the experiment.
The experiment's results have the following implications: (1) management should set ideal standard quotas for its workers in a monotonous, boring work situation, and (2) management should not allow workers in this situation to set their own pace. Weaknesses of the research included: (1) lack of similar environmental experience between subjects and workers, (2) possible too short time period of the experiment, (3) lack of an explicit reward structure, and (4) experimental bias as mentioned in the Hawthorne studies. Two suggestions were offered for further research, one utilizing the design presented here and one involving case studies of actual situations.
APPENDIX

EVENTS SCHEDULE

January 27, 1973

On this day, the volunteer request was made to seven AFIT MBA classes. It was read verbatim to insure that no purposes of the experiment were revealed.

February 11, 1973

The seven classes previously met were canvassed for volunteers on this date. At this time names and telephone numbers were gathered so that random assignment could be made to the three groups before the experiment date. After the names were assigned, participants were called and given the time that they should arrive at the classroom.

February 15, 1973

The experiment was run on February 15 involving the three groups starting at 12:30, 1:30, and 2:30 p.m. The schedule will follow showing verbatim background and instruction briefings. The times will be T+ times, that is T hour will be the beginning time, either 12:30, 1:30, or 2:30 p.m. In order to point out the different instructions given to the different groups, the following codings will be used:
I. Indicating group one. Group one was the currently attainable group and was required to complete eight units of output.

II. Indicating group two. Group two was the ideal standards group and was required to complete fourteen units of output.

III. Indicating group three. Group three was given no required output quota.

All. Indicating that the instructions were given verbatim to all the groups.

The codings will be found immediately under the times on the schedule. The schedule follows:

<table>
<thead>
<tr>
<th>Time/coding</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Scheduled start of experiment.</td>
</tr>
<tr>
<td>T + 10 min.</td>
<td>Good afternoon, thank you for being here.</td>
</tr>
<tr>
<td>All.</td>
<td>This afternoon, I will ask you to perform a task with the following background in mind:</td>
</tr>
<tr>
<td>T + 11 min.</td>
<td>You are a semi-skilled worker in a large plant. You belong to a strong union. You are paid a relatively good salary. In your last contract, the company and union negotiated a quota of output per employee. This quota will be 8 for the twenty minute period. This quota can be met with normal effort. Failure to fill quota cannot be used as reason for dismissal; however, a small monetary penalty has been agreed upon by the union</td>
</tr>
</tbody>
</table>
and company for failure to meet this quota. You will be performing a repetitive manual task.

II.

You are a semi-skilled worker in a large plant. You belong to a strong union. You are paid a relatively good salary. In your last contract the company and union negotiated a quota of output per employee. This quota will be 14 for the twenty minute period. This quota requires you to work quickly with a minimum of wasted time. This diligent effort is well compensated. Failure to fill quota cannot be used as a reason for dismissal; however, a small monetary penalty has been agreed upon by the union and company for failure to meet this quota. You will be performing a repetitive manual task.

III.

You are a semi-skilled worker in a large plant. You belong to a strong union. You are paid a relatively good salary. There are no quotas for output during the twenty minute period. You will be performing a repetitive manual task.
T + 14 min. This is your background. Now for the instructions. You will notice that in each of three corners of the room is located a box with either squares, circles, or triangles in it. You will proceed to each box as instructed on your output sheet and pick two of each figure as instructed (notice that two of each figure are on one strip of paper—you will collect one strip of paper then for each output sheet).

When you return to your desk, you will then cut out the figures in the most expeditious way that you can devise. When you have all the figures cut out, paste them under the appropriate headings. Just a small blob of glue is enough. Then number the output and place the time in minutes in the space provided (I'll place the time on the blackboard for you to use).

After completing the output, repeat the whole procedure until time runs out.

To avoid initial congestion, I have placed the necessary figures at your desk to complete the first output sheet.

Are there any questions?
<table>
<thead>
<tr>
<th>Time</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>T + 17 min</td>
<td>Remember that you will work for twenty minutes and your quota is eight. Go ahead.</td>
</tr>
<tr>
<td>I.</td>
<td></td>
</tr>
<tr>
<td>T + 17 min</td>
<td>Remember that you will work for twenty minutes and your quota is fourteen. Go ahead.</td>
</tr>
<tr>
<td>II.</td>
<td></td>
</tr>
<tr>
<td>T + 17 min</td>
<td>Remember that you will work for twenty minutes.</td>
</tr>
<tr>
<td>III.</td>
<td>Go ahead.</td>
</tr>
<tr>
<td>T + 37 min</td>
<td>Stop. I have a short questionnaire for you to fill out. I cannot yet tell you the purpose of this experiment. Please do not discuss this experiment for one week with others. If you desire, leave your name and address on your questionnaire and I will mail you a short description of what I have attempted to do and the results I have attained. Again thank you.</td>
</tr>
</tbody>
</table>


