8-1977

Behavior Systems Analysis of a Worker Managed Bakery

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BEHAVIOR SYSTEMS ANALYSIS OF A WORKER MANAGED BAKERY

by

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A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment
of the
Degree of Master of Arts

Western Michigan University
Kalamazoo, Michigan
August 1977

BEHAVIOR SYSTEMS ANALYSIS OF A WORKER-MANAGED BAKERY

The present series of studies is a behavioral systems analysis of the problems of job performance, promptness at work, and cost control. Many studies surveyed in the business and industrial literature have methodological problems, and those employing good experimental control have not addressed the cost effectiveness of the procedures they evaluated (Pommer and Streedbeck, 1974; Hermann et. al., 1974). Those studies employing quasi-experimental designs generate inadequate data and also often fail to address the cost effectiveness of the procedures used (Brobst, 1976; Kent, 1974; Schnelle and Lee, 1974; Campbell and Stanley, 1966; Baer, Wolf and Risley, 1969). A major reason for these deficiencies in such studies is the additional time and money involved in doing a more adequate study. These same studies also lack client participation in the design, which is often desirable for ethical and practical reasons (Kent, 1974).

In the present studies, we used time-series quasi-experimental designs (Campbell and Stanley, 1966) combined with a behavioral systems approach (Malott, 1972). The critical difference between true and quasi-experimental designs is that with a true experimental design, the researcher controls the random assignment of the sample population to treatment and no-treatment conditions. We employed a single group in each of these studies, making numerous observations in each of at least two successive conditions. The greatest single

threat to internal validity in this time-series design is the possibility of some uncontrolled simultaneous event actually causing the changes observed. Schnelle, Kirchner, McNees, and Lawler (1975) used the time-series analysis when it was impossible to gain full experimental control. We used a time-series analysis for similar reasons. A further source of confounding in these studies was that we conducted them concurrently so that at one point three independent variables were implemented simultaneously. Table 1 shows the schedule of independent variables.

ACKNOWLEDGEMENTS

I am deeply indebted to Dr. Richard Malott for the many hours of guidance and frequent encouragement during the course of this study and throughout my academic career at Western Michigan University. And I am indebted to Mr. Harry Kent for his support and encouragement and for introducing me to the psychology of behavior as taught at Western. And I would like to thank my committee members, Dr. Howard Farris, Dr. Brian Iwata, and Dr. J. Michael Keenan, for their constructive criticism of my work; it was appreciated. I also would like to thank Ms. Lisa Jesmore for assisting me in conducting these studies and for typing the final manuscript, and Western Michigan University and the Psychology Department for the financial support during the course of my studies. It has been a great pleasure to be associated with the faculty in the Psychology Department.

I owe thanks to the members of the People's Food Co-operative of Kalamazoo and to the bakers for allowing me to conduct these studies and for participating.

Marie Louise Greening

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Schedule of Dependent and Independent Variables

Study	Dependent Variable	Independent Variable	Dates
I	Original Cleaning Tasks	Baseline	Feb. 12, 1976
		Contingent-Pay	Feb. 20, 1976
		Contingent-Pay-with-Improved-Task-Description	Feb. 27, 1976
	New Cleaning Tasks	Baseline	Feb. 12, 1976
		Contingent-Pay-with-Improved-Task-Description	Feb. 27, 1976
II	Percentage Prompt	Bonus	Jan. 4, 1976
		No bonus	Feb. 27, 1976
III	Value (Amount) of Goods Produced	Baseline	Oct. 23, 1975
		Bonus	Nov. 12, 1975
	Total Worker Hours	Cleaning Pay Added	Dec. 4, 1975
	Value (Amount) of Goods Produced per Worker Hour	Contingent Pay for Cleaning	Feb. 20, 1976
		Cost Control	Feb. 27, 1976
	Mean Worker Hour		
	Wage-product Ratio		

BEHAVIORAL SYSTEMS ANALYSIS

The "systems approach" developed as a decision making process where logic led to successful decisions - successful in terms of the achievement of the goals of the system (Churchman, 1968). The behavioral systems approach described by Malott (1972) is outlined below:

Step 1: Analyze the existing system, using the concepts and principles of behavior, and describe the response, the consequences, and the contingencies. After completing the behavioral systems analysis of the existing system, design the new system by proceeding through the following steps of systems analysis.

Step 2: State the overall behavioral objectives, and describe the dependent variables. The objectives must be attainable, observable, and functional. If the objective is attainable, most of the people involved have a higher probability of success. If the behavior is observable, the response can be consequated and the system evaluated. And if the behavior is functional, the response will produce more consequences immediately, and the system will be maintained in the future.

Step 3: Design the behavioral system to accomplish the objectives stated, and describe the independent variables. Specify both positive and aversive consequences and the contingencies between the response and these consequences.

Step 4: Implement the system. Explain to the participants what the desired behavior is, what consequences are programmed, and

what the contingencies are for performing and not performing the desired response. Get the participants' consent to participate. Consistently observe the behavior specified in the design, never moderating in the delivery of the consequences according to the contingencies.

Step 5: Evaluate the system, and measure the achievement of the objectives. Is the overall objective being met? Evaluate the achievement of the objectives once the procedures are properly implemented, and people are making the specified response at the desired rates.

Step 6: Recycle through the steps of systems analysis, if the overall objectives are not being achieved. Start over, reconsidering each step, examining the original analysis, examining the feasibility of the behavioral objectives, redesigning the system if necessary, implementing the new design, and re-evaluating the new system.

THE SETTING

The present project took place in a small bakery - a self-managed production unit of a producer-consumer food co-operative. The worker-members managed the grocery store and the bakery, holding weekly general business meetings. The members of the total organization had veto power over the bakery decisions at the weekly business meetings. These members also set one unusual constraint: the bakery was to produce food which did not use refined sugar, lard or artificial preservatives, emphasizing those foods of high

nutritional value rather than those appealing to the larger mass market.

The bakers also attended their own weekly meetings. At that meeting, they co-ordinated activities, and discussed and resolved problems. Each baker had the opportunity to vote on any proposed changes in the bakery at the bakers' meeting as well as the general business meetings. The organization paid the bakers $1.50 for attending the bakery meetings, usually lasting one hour.

Baking shifts began at 5:00 a.m. Monday through Friday, and also at 3:00 p.m. Friday, lasting from six to ten hours, with one to five people working on each shift. The bakers prepared six to ten different items during the first three to six hours. They spent the remaining time cleaning the bakery and packaging the products.

Table 2 shows how much the bakers earned in commission, based on the number and class of items produced each day. The paymaster computed the individual commission by dividing the commission by the number of hours each person spent preparing food, adding a base pay of fifty cents per hour worked to the individual production commission.

On a typical shift three workers baked six to ten items. The production often included two batches of bread, and one batch of vegie turnovers, cookies, cakes and energy bars. The commission for that output would be as shown in Table 2.

Table 2

Bakery Production Commission

Item	Commission per Unit	Units per Batch	Commission per Batch
Bread	$.10	60	$6.00
Granola	$.10	70	$5.00
Vegie Turnovers	$.15	50	$6.00
Potato Kugel	$.03	36	$1.08
Cookies	$.02	200	$4.00
Yeasted Cakes	$.04	40	$1.60
Other Cakes	$.03	36	$1.08
Energy Bars	$.02	72	$1.44
		Total	$26.20

If all the bakers arrived at 5:00 a.m., and had everything ready for the oven by 9:00 a.m., they each had four baking hours for a total of twelve man-hours. The total commission would then be divided by twelve, yielding $2.18 per hour for the baking hours. To finish the baking shift, they each cleaned and packaged for three to five hours at $1.00 per hour.

As a result of these studies, however, the pay changed so that the bakers' average wage rose from $1.43 per hour at the beginning of the project to $2.28 per hour at its highest point.

Prior to this project the bakers had recorded attendance, production, and cleaning done on each baking shift but they had never critically evaluated the information. They did little financial planning. Nor did anyone do an analysis of the costs of labor for baking, and cleaning and packaging, or of the tasks completed, or of the accuracy of reporting production. As various needs emerged, (e.g., for new ovens, for a small mixer, for training, for higher wages), it became apparent that the bakers would have to take a closer look at their operation.

Several reinforcers may have helped maintain people staying and working in the bakery. These reinforcers included money, control over the quality of the products sold and over working conditions, and social approval for eating, producing and selling natural foods. The bakers functioned as a group that delivered mutual social attention.

I served in a variety of functions while conducting these studies. They included collecting promptness data, counting goods produced, observing completed cleaning tasks, computing payroll,

and updating production.

Throughout the studies, the co-op employed eleven bakers, with seven working at any one time. These bakers worked mostly part-time, but depended on this job for their income. The nine women and two men ranged in age from nineteen to twenty-nine, seven being college graduates, three others having some college education and one having some high school education. Each baker signed a contract where they agreed to work for a minimum of three months. They each went through a ten session training period, preparing each item produced with the supervision of an experienced baker. Three bakers worked during all of the studies.

STUDY I: CONTINGENT PAY FOR CLEANING

Step 1: Analysis of the Existing System

The bakery was located in a city that licenses food service operations. Using the sanitary condition of the operation as the main criterion for granting or revoking privileges, the inspectors use a checklist that itemizes point losses for unsanitary conditions. In the fall of 1975, the local health inspector reminded us that the same problems existed on this inspection as the last inspection. The bakers discussed the inspection report and said they were willing to do more cleaning. But no system existed to implement the inspectors' recommendations.

Following the discussion of the report, the bakers drew up a list of cleaning tasks they thought should be done regularly. However, they did not list everything the inspectors recommended; only those tasks that they would all agree to do each day. The bakers then assigned pay values for each task at $1.00 per hour. The bakers computed their pay on the basis of the items checked off as completed each day and added the total to the base rate of $1.00 per hour.

At that time we had no plans to directly observe task completion, nor to add consequences for incorrect reporting. Later, we made some informal observations to evaluate the effectiveness of the cleaning done. We noted that less was being done than was being reported done. We compiled a new list based on the health inspectors' report. The new list added cleanliness of the equipment, utensils,

and kitchen, and disposing of the garbage, and protecting the food. For analysis, the tasks were sorted into high-and-low-effort tasks. High-effort tasks were worth $.25 or more and took fifteen minutes or longer to complete. For example, all utensils washed and rinsed and sanitized and put away took an hour and was worth $1.00. Low-effort tasks were worth less than $.25 and took less than fifteen minutes to complete. For example, sweeping the floor took twelve minutes to complete and was worth $.20.

Step 2: Specification of the Behavioral Objectives

Our goal was to increase the cleanliness of the bakery. We measured the percent completion of eight high-effort tasks and seven low-effort tasks on the original cleaning list plus four high-effort and six low-effort tasks added to the new list. Table 3 shows the original list and Table 4 shows the new list.

Step 3: Design of the System

Cleaning pay for each task on the original list was contingent on completion as reported by an independent observer. We saw a discrepancy between the bakers' self-report of work done and our observations of the same items. And we thought that contingent pay would either increase the amount of cleaning done or increase the bakers' accuracy of reporting.

Table 3

Original List of Tasks

High-Effort Tasks	Pay
Inventory goods on hand	.25
All utensils washed, rinsed, sanitized and put away	1.00
Bread bowl washed and oiled and replaced in the mixer	.25
Tables scraped, washed and sanitized	.25
All ingredients put away	.25
Sinks cleaned with cleanser	.25
Mill cleaned	.58
Wash all trays and replace on rack	.25
Low-Effort Tasks	**Pay**
Compost emptied	.20
Mixing machine cleaned	.10
Pallets cleaned	.10
Bags closed	.05
Baked goods put in cooler	.10
List of stock placed in storefront	.05

Table 4

New List of Tasks

Original High-Effort Tasks	Pay
All utensils washed, rinsed, sanitized in clean, hot soapy water, and put away right. This includes pots, pans, spoons, mixing utensils, cups. Put away means nothing left on the drainboard.	$1.00
Bread bowl washed and oiled and replaced on the mixer. This includes the outside of the bowl being free of flour and dough.	.25
Tables scraped, washed, sanitized, and covered with a clean tablecloth.	.25
All ingredients put away. This means every ingredient is enclosed in labeled tubs in the kitchen, or in a closed labeled container in the walk-in cooler.	.25
Mill cleaned, vacuumed - motor, hopper, table, and inside cabinet.	.35
Inventory baked goods.	.25
Wash all trays and place tray on rack.	.05ea

Original Low-Effort Tasks	Pay
Sweep kitchen floor. This includes picking up pieces of dough and dried fruit that may be stuck to the floor. This includes sweeping under tables, ovens, proof box and sink.	.20
Compost emptied every day. Can washed, rinsed, sanitized, inside and outside.	.15
Pallet swept, over and under.	.10
Bags closed and sitting on pallet.	.05
Bakery stock put in walk-in cooler. Nothing should be left on the cooling rack in the kitchen.	.15
Stock list put in front of the inside of the glass display case and on the baker's bulletin board.	.05

Table 4, continued

New List of Tasks

New High-Effort Tasks	Pay
Mop floor if stains remain after sweeping.	.25
Walls in mill area clean - free of dust, spots of food and dough.	.25
Wash visible food particles and stains from the kitchen walls.	.40
Thoroughly clean grinder, small mixer, blender and table top. There should be no crumbs or stains on any appliances. Take out any removable part and clean inside.	.25

New Low-Effort Tasks	Pay
Hand sink scrubbed with cleanser. This includes around the faucets.	.05
Wash and sanitize sponges. No food or stains should be left on any sponge. Dispose of any disintegrated sponges.	.05
Wash food particles out of metal scrubbers.	.05
All bins closed and dusted. No visible loose flour or seeds or anything on the bins. This includes the top as well as the lids and sides.	.05
Containers closed and wiped. These are the peanut butter tubs containing bakery stock.	.05
Floor clean within a two foot radius of the mixer. There should be no spots, stains, food, flour or dirt at the base of the mixer.	.15

Step 4: Implementation of the System

We proposed at a baker's meeting that the pay for cleaning be made contingent on completion of the tasks and that one experimenter be the observer of the tasks completed. The bakers approved the proposal. Later the same week the rest of the staff approved the proposal at the weekly general business meeting.

Baseline Phase

The bakers used the original checklist and we paid them according to the value for each task checked off on the list. We began observation of the completion of the original tasks for seven shifts and the new tasks for thirteen shifts. The new tasks were familiar to the bakers since the general classes of tasks were listed on the health inspectors' reports and each baker attended meetings where the report was discussed. So it seemed reasonable to expect the completion of some new tasks. However, the bakers received only $1.00 per hour for completing the unlisted tasks.

Contingent-Pay Phase

With the implementation of contingent pay we completed observations of the original tasks and the new tasks as before and also recorded whether each of the original tasks was done or not done on the bakers' checklist for six shifts. The new tasks were still in baseline phase.

Reliability

We trained another observer prior to recording baseline data.

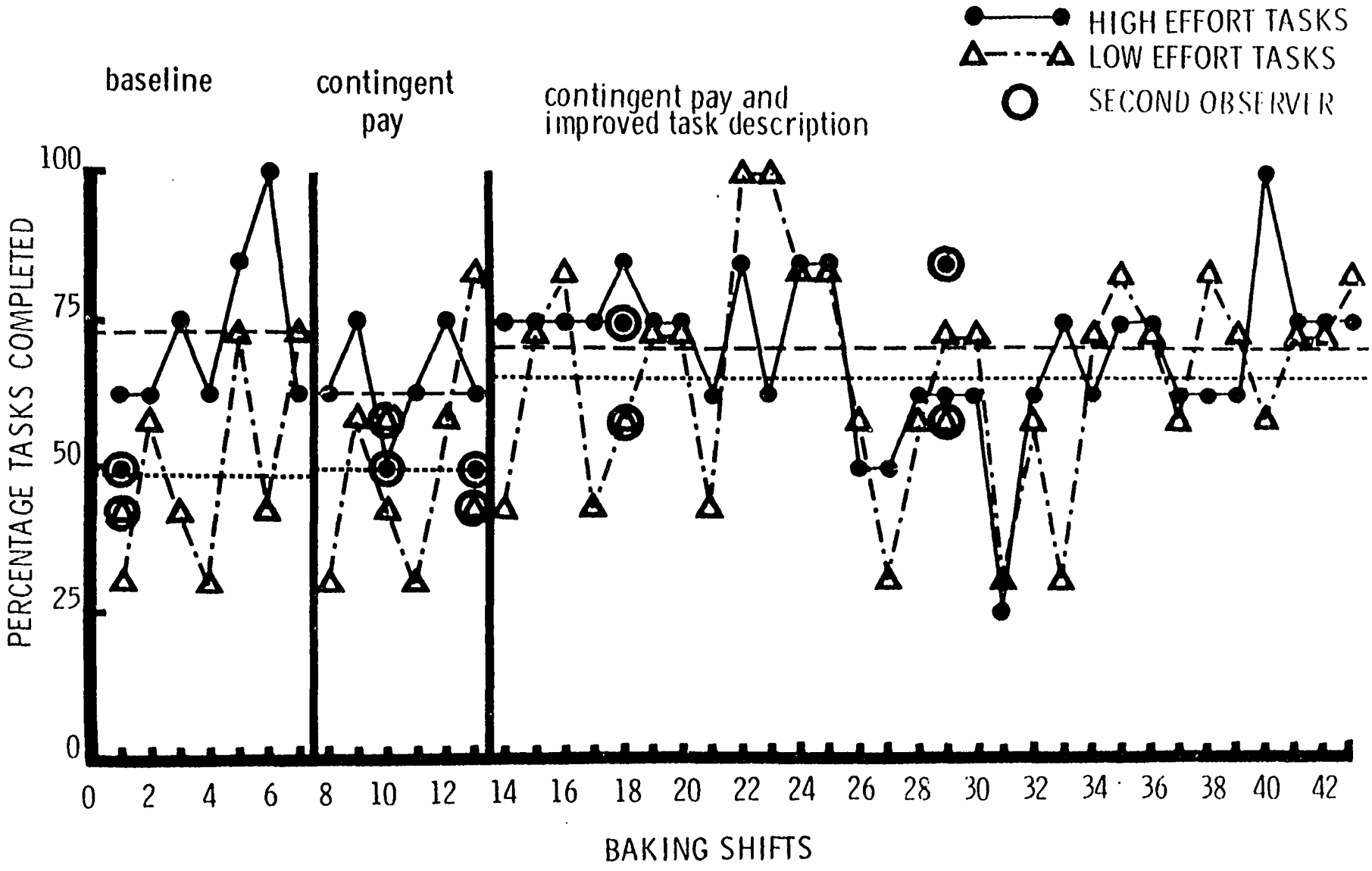
Then the other observer made reliability observations at least once during each phase. We conducted these observations simultaneously but independently by using the following procedure: Each observer, with a separate checklist, observed each item listed while taking care not to observe the same items at the same time as the other observer. Each observer had to respond to each item on the checklist, so observer bias toward scored or unscored items was prevented. I computed reliability by dividing the agreements by the sum of the agreements and disagreements.

Step 5: Evaluation of the System

Original Tasks

Figure 1 shows the percentage of original tasks completed during each phase for high-and-low-effort tasks. The mean percent of high-effort tasks completed during baseline was 73.2%, and during contingent pay was 63.6%. The mean percentage of low-effort tasks completed during baseline was 49.1%, and during contingent-pay, was 50%. With contingent-pay, completion of high-effort tasks decreased 9.6%, and completion of low-effort tasks increased .9%.

Figure 1. Percentage of original high and low effort tasks completed for each baking shift.



Reliability

Reliability for original high-effort tasks during baseline was 66% and 90% during contingent pay. Reliability for original low-effort tasks during baseline was 50% and was 91% during contingent pay. Reliability for new high-effort tasks during baseline was 79%, and reliability for new low-effort tasks during baseline was 75%. The mean reliability during baseline for all tasks was 77%. The low reliability could theoretically account for the effect reported. So, we don't know whether a systematic bias during baseline was present.

Step 6: Recycle Through the System

The results of contingent pay showed no overall improvement in the completion of tasks. When we implemented the pay contingency, the bakers asked what the criterion were, asking to have the task process and the criterion for completion of tasks specified. Then they could know exactly what we were looking at in observing the completion of tasks.

Step 3: Design of the System

We compiled a more complete specification of the tasks on the checklist, and in some cases, divided the tasks into smaller components. The list included new as well as original tasks. The pay contingency was to remain in effect.

Step 4: Implementation of the System

Contingent-Pay-with-Improved-and-Additional-Task-Description-Phase

We introduced a revised checklist that described the process and criteria for completion of the original and new tasks, while the bakers' pay remained contingent on completion of each of the tasks as monitored by an independent observer for twenty-seven shifts. We told the bakers that all of the tasks had to be completed for the bakery to be considered clean, since some of the tasks were often incomplete and needed to be done regularly.

We presented this change in conditions at the baker's meeting, and they approved the new checklist. Later in the same week, we presented this change to the general meeting and the staff approved it also.

Step 5: Evaluation of the System

Original Tasks

Figure 1 shows the percent of original tasks completed during the contingent-pay-with-improved-and-additional-task-description phase for high-and-low-effort tasks. The mean percent of high-effort tasks completed during this phase was 70%. The completion of high-effort tasks increased 6.4% from the contingent-pay phase but was still below the baseline mean by 3.2%. The mean percent of low-effort tasks completed during the last phase was 65.8%. The completion of low-effort tasks increased 15.8% from the contingent-pay phase and was above the baseline mean by 16.4%.

New Tasks

Figure 2 shows the percent of new tasks completed during the contingent-pay-with-improved-and-additional-task-description phase for high-and-low-effort tasks. The mean percent of high-effort tasks completed during this phase was 25%, an increase of 15.4% over the baseline mean. The mean percent of low-effort tasks completed during the last phase was 66.7%, an increase of 38.5% over the baseline mean.

Reliability

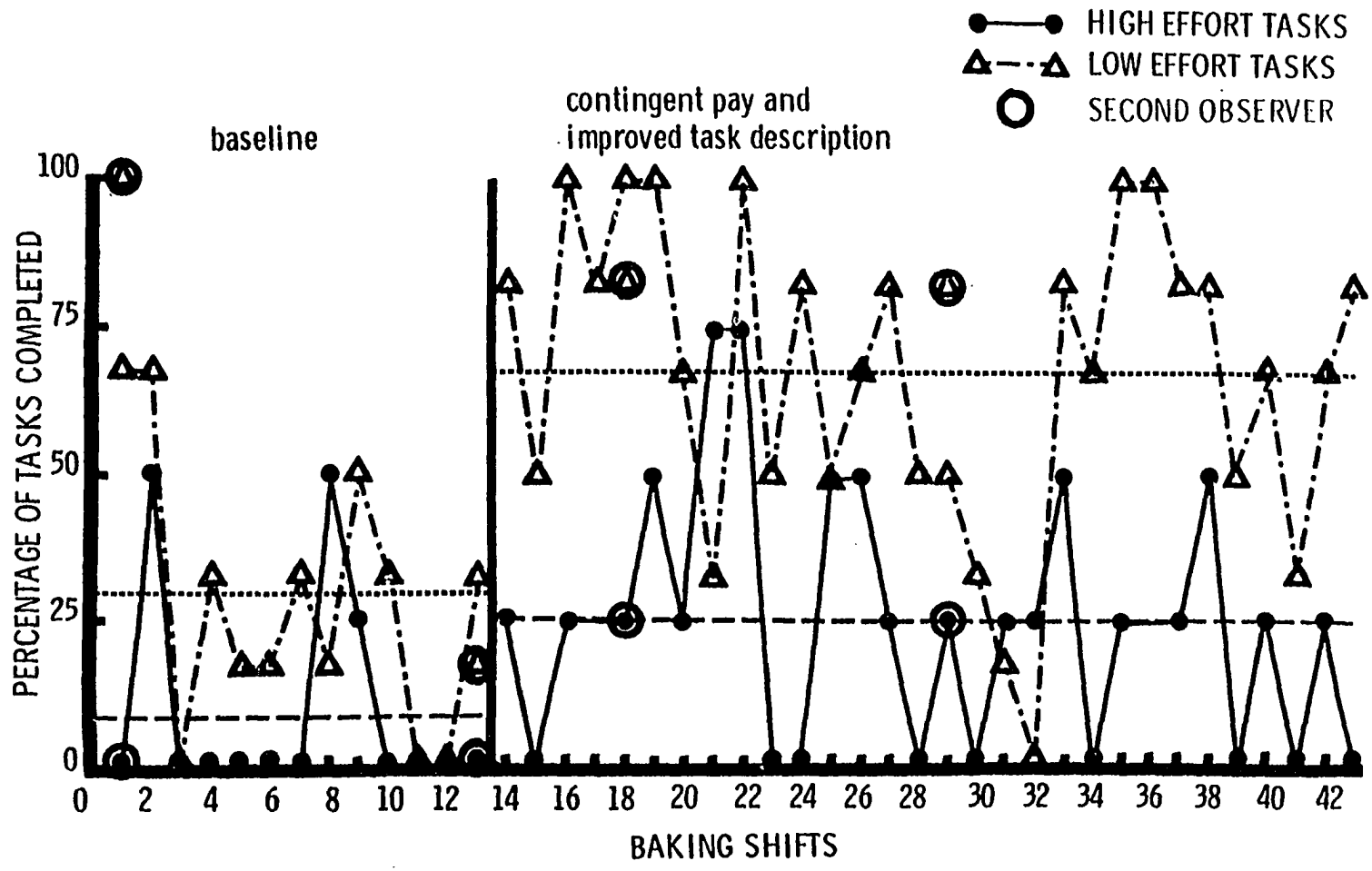
Mean reliability was 80% for original high-and-low-effort tasks during the last phase. For new tasks, mean reliability was 80% for new high-and-low-effort tasks.

Step 6: Recycle Through the System

The results show little overall increase in the amount of work completed. The bakers completed the tasks requiring less effort with less pay rather than completing tasks requiring more effort with more pay. And, the observer reliability needed to be improved.

The bakers completed a larger number of smaller tasks but did not develop a work routine that included the completion of high-effort tasks. The self-recording of task completion may have contributed to completion of low-effort tasks. The act of checking each item off on the list may have served as a conditioned reinforcer for completing the task as well as a discriminative stimulus for starting the

Figure 2. Percentage of new tasks completed for each baking shift.



next task on the list (Skinner and Ferster, 1957). This would increase the relative density of reinforcement for low-effort tasks.

The higher pay for high-effort tasks may not have been sufficient for completing the tasks, and the high-effort tasks not only took longer but also occurred during the last half of the baking shift, when the bakers were most likely to be tired. The bakers usually worked the entire shift without taking a break, so apparently the bakers completed the low-effort tasks and then quit for the day.

In the future, three problems still need solutions: Increasing the completion of high-effort tasks, reducing the variability of the completion of low-effort tasks, and improving the reliability of the observation of completion of cleaning tasks. By reducing the high-effort tasks into smaller components, the bakers could more easily incorporate the tasks into their work routine. For example, "thoroughly clean the grinder, the small mixer, and the table top" could be divided into separate tasks. Each component would then be a smaller task to complete. Then, to reduce the variability of the completion of the low-effort tasks, a bonus for completion of 95% of each day's tasks could be added to the total pay available for that day. For the system to continue, it will be vital to improve the observer reliability. This could be done by further specifying tasks where disagreement occurs.

STUDY II - IMPROVING PROMPTNESS AT WORK

Step 1: Analysis of the Existing System

In September, 1975, only 40% of the bakers came to work by 5:00 a.m., according to self-report. We specified promptness at work as arriving at or before 5:00 a.m. This allowed the bakers four hours to complete the preparation and baking and to put the products out for sale by 9:00 a.m., when the store opened.

At the start of each baking shift the bakers had to light the ovens, start a batch of bread, and inventory the products on hand to decide if everything on the schedule was needed for that day. Having everyone present at 5:00 a.m. facilitated getting these things done and the work underway.

Much of the preparation time in baking was fixed. Thus, if a baker was late, the bread would not be started as soon as usual, and the whole shift would take longer to complete. This was further complicated by the fact that the baker baked other items while the bread was rising. These items would have to be baked at the end of the shift if they did not get into and out of the ovens before the bread completed rising. Thus, if a baker was late, these other items were not done on time. Furthermore, the bakers needed help to move heavy bags of flour, so if someone was late, this problem could delay bakery work. Also, a late start meant bakers were still in the preparation phase when the store workers were walking through the kitchen. In sum, when a baker was late, baking was delayed often longer than the time he or she was late.

In October, the staff implemented a procedure where anyone who was tardy worked without pay for the amount of time equal to the number of minutes they were late. According to self-report, promptness improved for three weeks and then became variable again. The mean promptness was 59%. We devised a new procedure.

Step 3: Design of the System

Each baker received $1.00 for each day he or she arrived on time. The contingency was that the baker be in the building by 5:00 a.m., when the observer telephoned to verify who was present. We left the bonus in effect until promptness reached a median of 100% for one week, then removed the bonus, to wait until promptness decreased to 60%, then reimplement the bonus. The removal of the bonus coincided with the last phase of the first study, which was implementation of contingent-pay-with-improved-and-additional-task-description.

Step 4: Implementation of the System

The promptness bonus was in effect at the start of this study. For twenty seven shifts, we telephoned the bakery each morning at 5:00 a.m. to verify who was present and earned the $1.00 bonus. In addition, the bakers circled their names on the daily report form to confirm their bonus. We recorded a weekly summary of the total number of days each baker was entitled to a bonus and added it to the bakers' regular weekly paycheck. The bonus was not reinstated because promptness remained at high levels for forty one shifts.

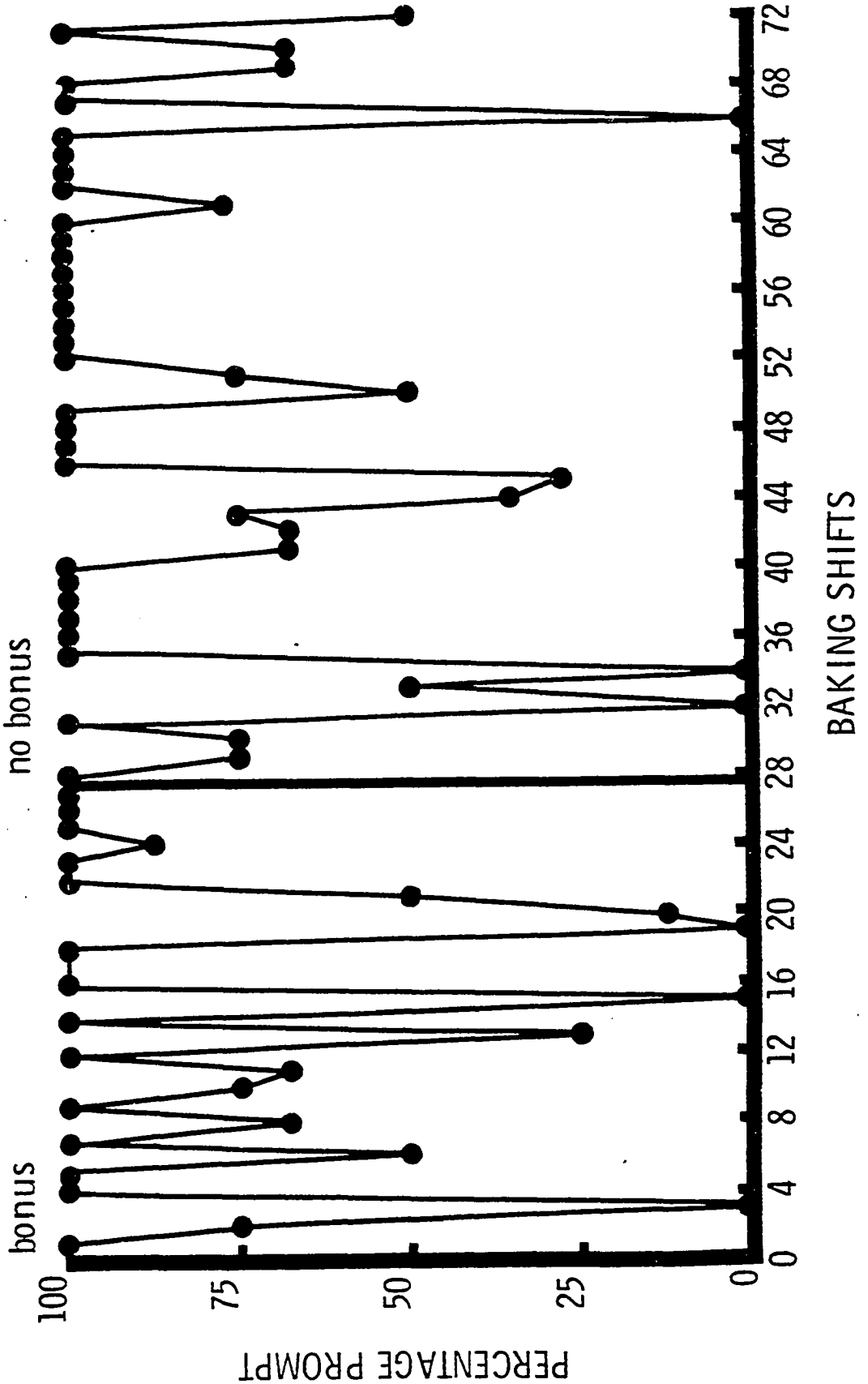
Step 5: Evaluation of the System

Figure 3 shows that for the first twenty seven baking shifts after we removed the bonus, no change occurred in the percent daily promptness per shift. However, promptness improved during the last fourteen shifts staying at a median of 100%. For that reason, we did not reimplement the bonus procedure. Table 4 provides the individual data for the bonus and no bonus phases. During the bonus phase the mean percent promptness was 67.6%. Following the removal of the bonus, promptness showed a mean increase of 8.17%, with six out of seven bakers increasing and one decreasing in promptness.

Step 6: Recycle Through the System

The promptness may have brought the bakers into contact with some of the natural consequences. The bakers' promptness may have been controlled to some extent by the telephone calls, and later by learning how they could finish work early and avoid interference from the store workers. If they arrived on time, the bakers would also avoid criticism from the other bakers and have their choice of tasks. The bakers' average hourly wages had increased, so that the removal of the bonus may not have been a significant loss. If the bakers' wage for a day was $14.00 and the bonus was no longer available, that would constitute a 7.2% decrease in wages. Therefore, once having made contact with the consequences of being on time, the consequences mentioned above apparently gained control of promptness.

Figure 3. Percentage promptness per baking shift.



Factors to consider for maintenance of promptness are the schedule of the consequences and the various sources of consequences available. For example, we can use contingent attention, approval, and other social rewards like "these workers were prompt this month (naming them)", and more tangible reinforcers such as food credit and money. The actual schedule of reinforcement is an important factor. A continuous schedule of reinforcement can maintain more behavior than any other schedule. But the key is to actually monitor the implementation of a consequence, to ensure that consequences exist for a person's behavior.

The variability of the results obtained could be attributed to the fact that some of the bakers shared rides to work, but since they each worked on slightly different schedules, it was impossible to separate reliably who was riding with whom.

STUDY III - COST CONTROL FOR SYSTEM MAINTENANCE

Step 1: Analysis of the Existing System

In October, 1975, the workers raised the bakers' average hourly wage to $2.00 per hour, by initiating the bonus for promptness and adding pay for cleaning as described in Studies I and II. The bookkeeper reported that the bakery was losing money. No one controlled costs in the bakery although 30% of production was budgeted for wages.

To analyze the existing system, we looked at several production factors: The value of goods produced per week, the total worker hours per week, the mean value of goods produced per worker hour per week, the mean hourly pay per worker per week, and the mean wage-product ratio per week.

The mean wage product ratio per week was a conversion of the percent of production paid toward wages. This ratio could be compared with the 30% budgeted for wages.

The mean value of goods produced per worker hour per week was used to compare the value of the goods produced with the time spent in production. If the data showed an increase in production per hour, then there could also be a decrease in the wage product ratio.

Early in February 1976, we compiled the data from the beginning of September 1975. All of the changes described and implemented in Studies I and II were analyzed in terms of the production and cost factors listed above, constituting baseline data for this study.

Step 2: Specification of the Behavioral Objectives

Our general objective was to increase the cost effectiveness of the bakery production. The specific objective was to lower the wage-product ratio to 30. Though no direct behavioral measure was used, we used the efficiency formulas described above to measure cost-effectiveness.

Step 3: The Design of the System

Limiting the number of bakers on a shift to three trained people was the independent variable. This attempt at cost control was to be implemented concurrently with removal of the bonus for promptness in Study II and implementation of contingent-pay-for-cleaning-with-increased-task-description in Study I. So, all the variables affected cost control.

Step 4: The Implementation of the System

One person quit baking at this time after missing three shifts of bakery work. We decided not to fill this position, automatically implementing the three person limit. The bakers approved this proposal at their meeting. Also, the store workers supported the bakers' decision.

An independent observer made reliability observations of goods produced during each phase. A second observer counted the amount of baked goods produced at least once during each condition. Reliability for the bakery production was 99%. We computed reliability by dividing

the larger number observed into the smaller number and multiplying by 100.

Step 5: Evaluation of the System

Table 5 shows the mean value of goods produced per worker hour for different-size groups of workers for each condition of the earlier studies. The group with three bakers shows the largest improvement during the cost control condition with a mean of $7.11 for the value of the goods produced per worker hour. The other group in the last condition is split shifts. Also on these occasions only three trained bakers worked.

Figure 4 shows the value of goods produced per week for each phase was: baseline, $581; bonus, $603; bonus and cleaning pay, $508; and cost control, $697. The value of goods produced decreased during the first four weeks after the implementation of cost controls, due to spring holidays; then the value rose to new high levels.

Figure 5 shows the total worker hours per week for each phase. The mean total worker hours for each phase was: baseline, 131 hours; bonus, 122 hours; bonus plus cleaning pay, 120 hours; cost control, 106 hours. The total number of hours worked each week decreased immediately after the implementation of cost controls. This was most likely due to the three worker limit.

Figure 6 shows the mean value of goods produced per worker hour per week for each phase. The mean for each phase was: baseline, $4.70; bonus, $5.02; bonus plus cleaning pay, $4.79; cost control, $6.56.

Table 5

The Mean Value of Goods Produced Per Worker Hour for Different Sized Groups of Workers

Phase	Number of Workers 3 (N)	4(N)
Baseline (no bonus, no cleaning pay)	$4.24 (9)	$4.60 (5)
Bonus (no cleaning pay)	$5.10 (5)	$5.24 (7)
Bonus, additional cleaning pay	$5.17 (28)	$4.05 (19)
No bonus, contingent cleaning pay	$7.11 (28)	- - - - - -

(N) indicates number of shifts.

Figure 4. Value (amount) of goods produced per week.

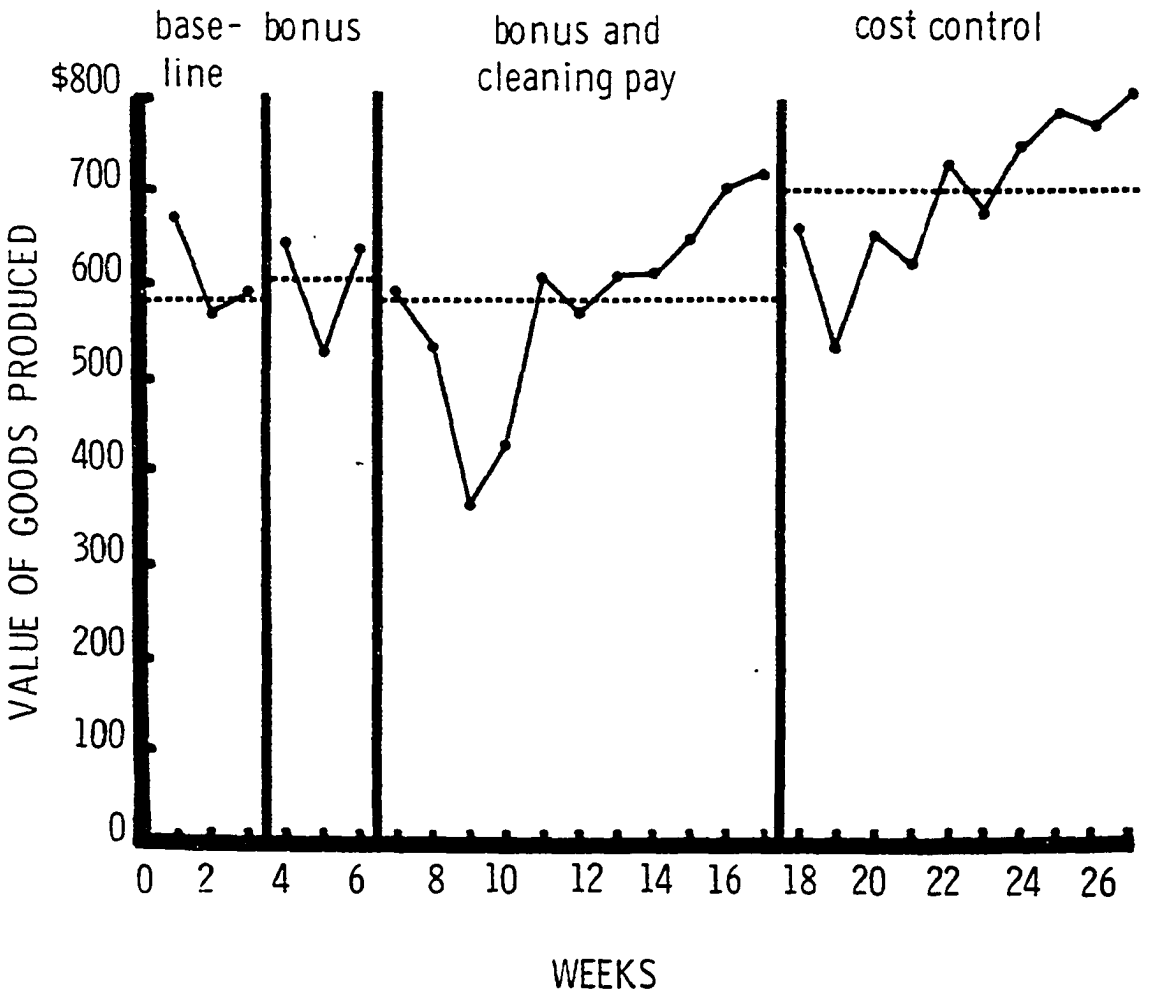


Figure 5. Total worker hours per week.

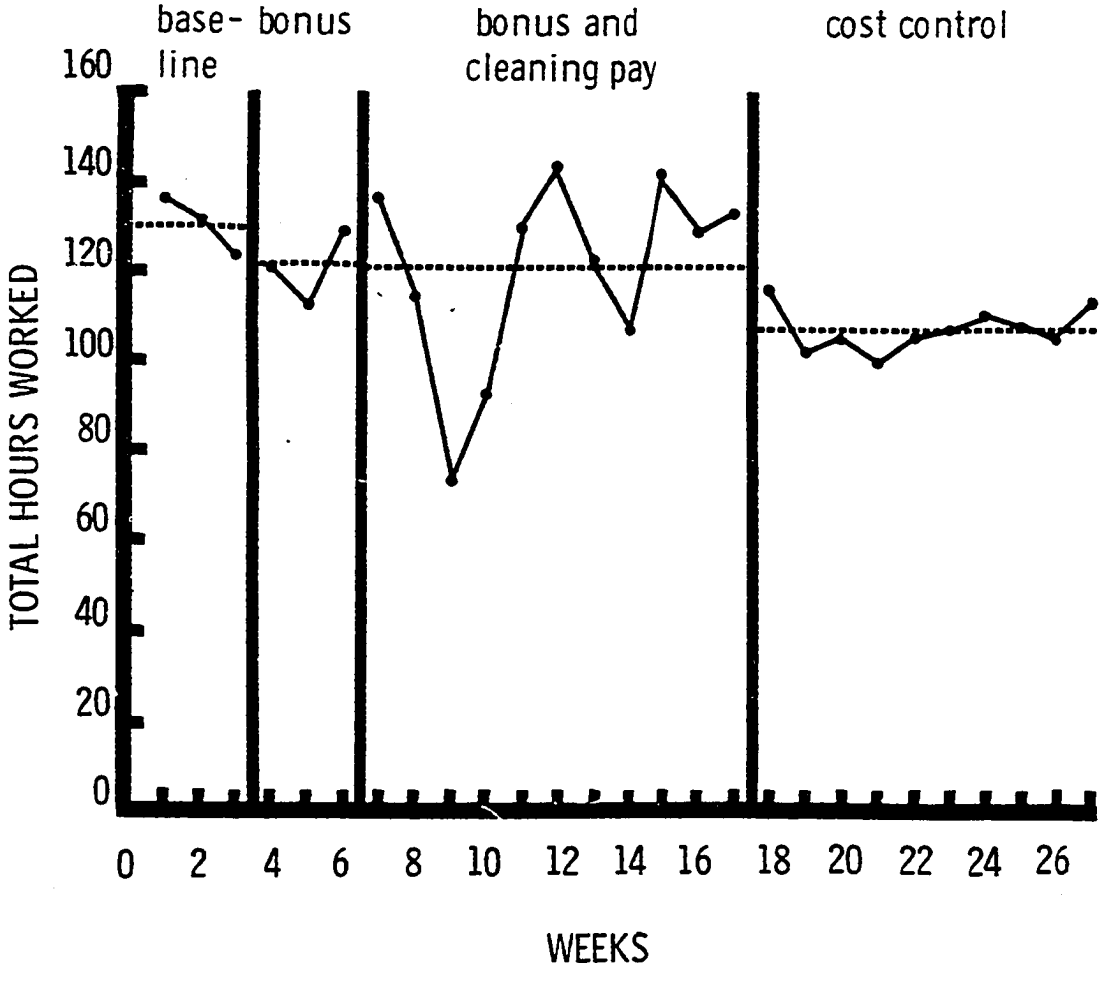
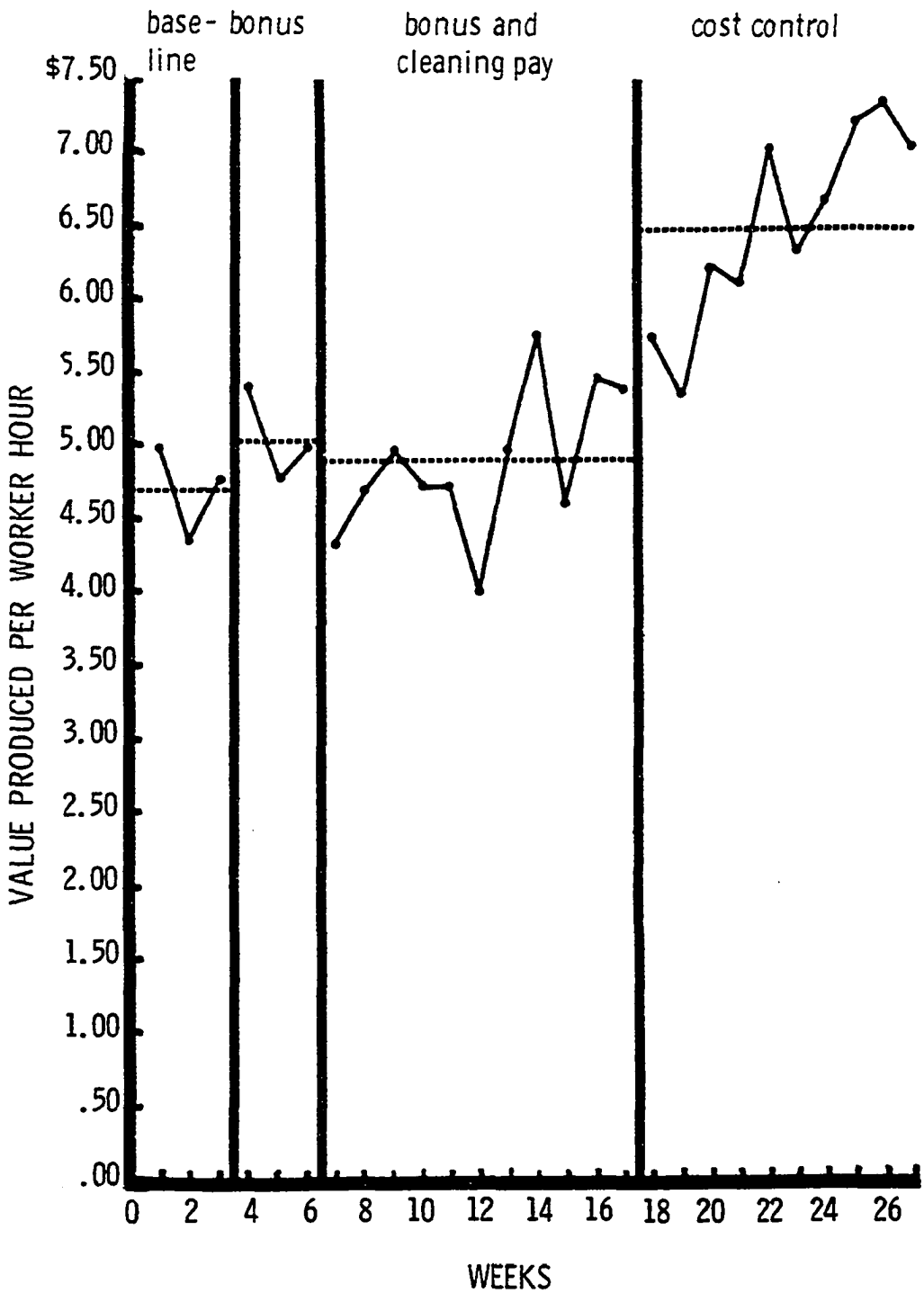


Figure 6. Mean value of goods produced per worker hour per week.



The value of goods produced per worker hour rose steeply after the implementation of cost controls. This was due to both working fewer hours and to an initial decrease in production.

Figure 7 shows the mean hourly wage per week for each phase. The mean for each phase was: baseline, $1.48; bonus, $1.63; bonus plus cleaning pay, $1.95; cost control, $2.10. The mean hourly pay decreased after the implementation of cost controls but rose in four weeks to a new high level after the implementation of cost controls.

Figure 8 shows the mean wage-product ratio per week for each phase. The mean for each phase was: baseline, .318; bonus, .33; bonus plus cleaning pay, .408; cost controls, .358. The wage-product ratio declined after the implementation of cost controls.

Each figure shows some improvement during the cost control phase. Price changes could have confounded the data using the value of goods produced. The price changed for one item. The difference between the original price and the new price for that item was excluded from the data. For other products, some of the yields were standardized to make evaluation easier, and some of the yields were increased to make production more efficient. The value of the difference between the original yield and the new yield were also excluded from the data.

Step 6: Recycle Through the System

The overall objective of lowering the wage-product ratio to .30 was approximated by decreasing from .408 to .358. The three

Figure 7. Mean hourly wage per week.

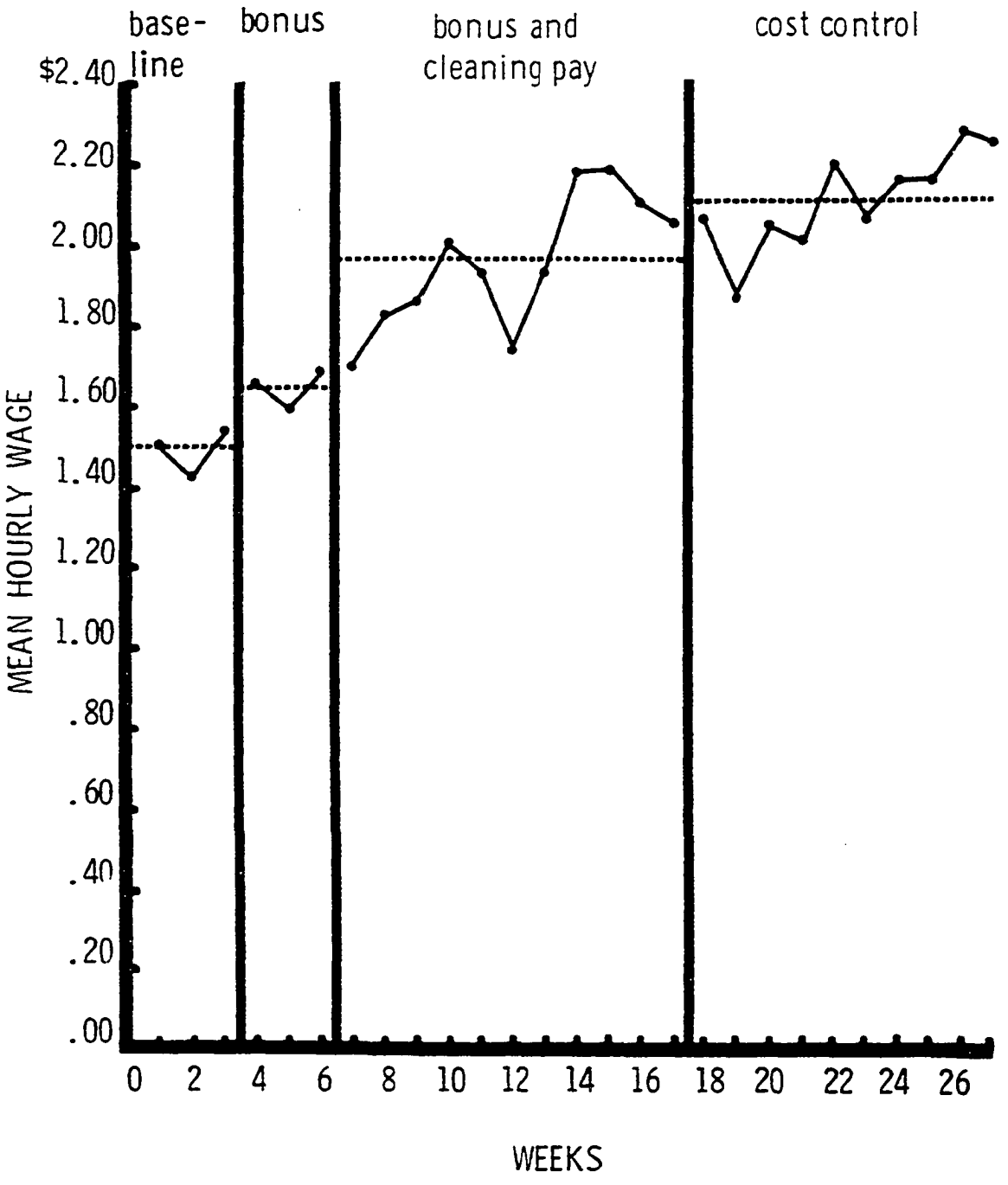
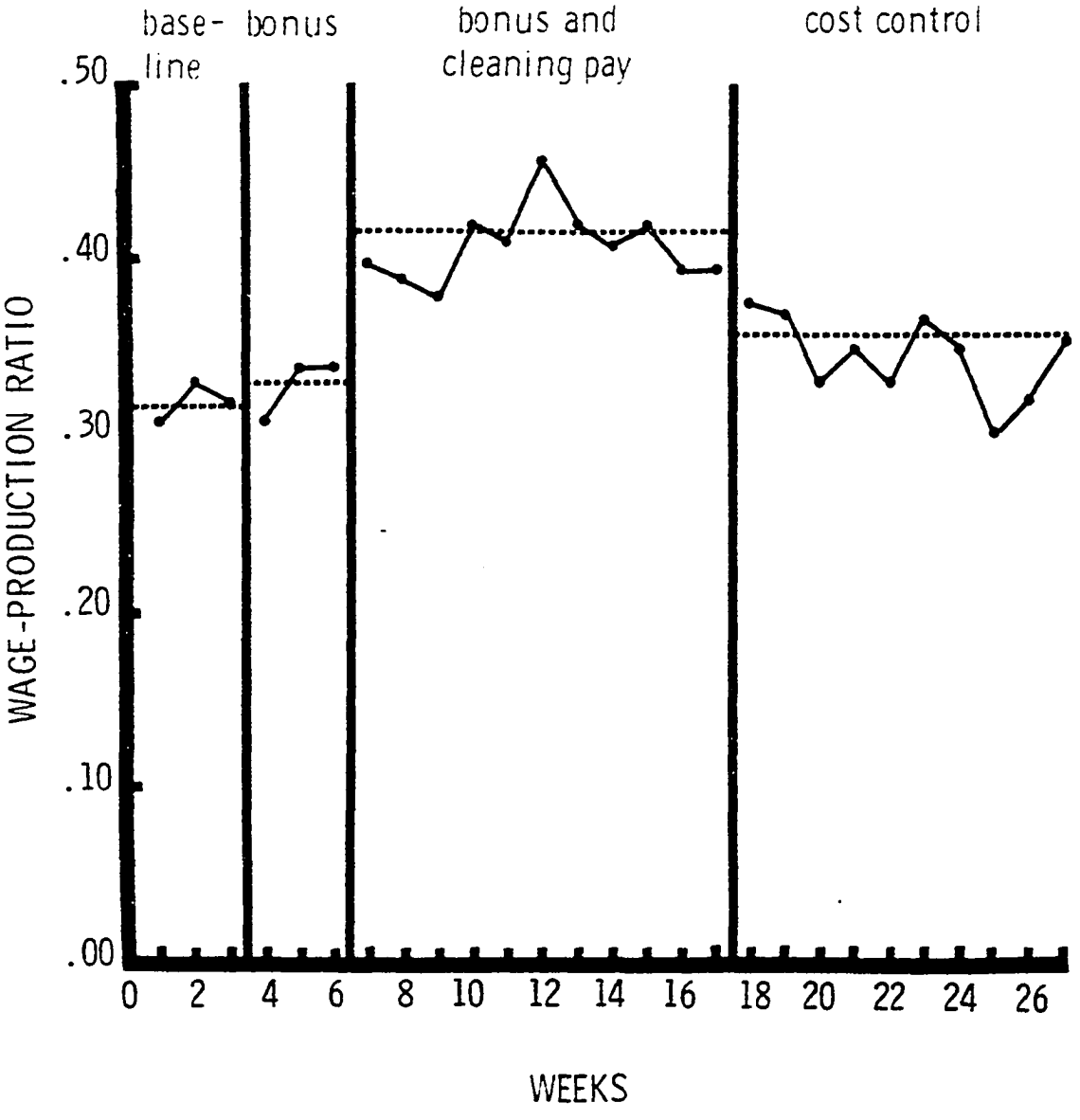


Figure 8. Mean wage-product ratio per week.



worker limit resulted in a change on 40% of the baking shifts. Further improvements are needed to bring costs down in relation to production. Behavioral changes could be brought about by improving the training so that the most efficient responses are used. And by simplifying the complexity of some of these tasks, the bakers could learn the tasks easily and, thus, increase their speed of performing the tasks. It may be reasonable to consider some technological improvements to reduce the cost per unit produced while keeping wages tied to production as before as an incentive to work. An ingredient and task analysis of the goods produced may help decide if some goods should be eliminated from production due to the higher relative cost of production.

GENERAL DISCUSSION

The concurrent implementation of three independent variables was a major problem with these studies. Dependent variables in Study I were the completion of original and newly specified cleaning tasks. Dependent variable in Study II was the percentage prompt of the bakers. Dependent variables in Study III were the value of goods produced, the total hours worked per week, the mean hourly wage per week, the value of goods produced per worker hour, and the wage-product ratio.

Since the concurrent implementation at one point of three independent variables was a possible source of confounding with these studies, we should look at the possible effects each independent variable might have on each dependent variable.

First, promptness should decrease with the removal of the bonus. Since promptness did not decrease, we can hypothesize briefly about what may have maintained it. The aversive contingencies for arriving promptly may have increased, with the implementation of the three worker limit and the contingent pay with improved task description. Now 40% of the shifts changed from four or more to three bakers. Shifts with only three workers would require more promptness because they have fewer people to do the work. So the bakers might encounter aversive consequences from the other bakers if they were not prompt and interference from the store staff if they had to work late. Thus, while the removal of the bonus may have reduced the incentive for being prompt, the three worker limit probably did affect the shifts

which previously had four bakers. But the aversive conditions did not change for the shifts which previously had three bakers.

It is hard to see how the addition of contingent pay with improved task description could affect promptness much, if at all. Second, the percentage of cleaning tasks completed would supposedly increase with the implementation of contingent pay and improved and additional task description. Since the percentage of cleaning tasks completed increased in three out of four categories, we should consider possible confounding factors affecting those categories that increased and the one category that did not increase. Previously, the bakers marked every item on the original list to get paid for completing each task. But now, the bakers completed more original tasks and more new tasks, perhaps as a means of increasing wages, since they no longer had the bonus for promptness available. So it seems that the pay contingency for cleaning made the bakers clean more effectively.

The addition of improved and additional task description could also have helped the bakers do a more effective job. Since they did complete more tasks, we can only say that improved and additional task descriptions probably helped the bakers, while contingent pay provided some incentive to do the tasks more effectively.

Additionally, the three worker limit may have indirectly improved cleaning task completion by offering the possibility of increased wages to divide among those present, and less task interference from having too many people in the kitchen. On the other hand,

this was not likely for cleaning tasks, since the bakers had sufficient cleaning equipment and once something was cleaned, that task was completed. Also, the use of equipment or space usually did not overlap in completing cleaning tasks. Therefore, it would seem that the increase in task completion can be attributed mainly to the combination of contingent pay and improved and additional task description, slightly to the removal of the bonus and minimally to the three worker limit.

Third, general economic measures should improve with cost control. Since they did, we will consider how much each independent variable may have affected each measure.

The value of goods produced increased from $580 to $697 per week. The three worker limit probably affected the value (amount) of goods produced most because, with fewer workers, the bakers could work more effectively, since less task interference occurred with three workers. However, some of the improvement in production might be attributed to increased contingencies on the bakers to produce more and always follow the production schedule. And, in addition, they developed the behavioral topography to do so.

The removal of the bonus for promptness could also affect the value (amount) of goods produced, because no bonus resulted in a reduction in wages, and production commission could compensate for this, if the bakers produced more. Thus, an incentive existed to increase wages coming from production and cleaning tasks.

On the other hand, it is hard to see how the addition of contingent pay for cleaning task completion could increase the value of goods produced at all.

The total worker hours per week decreased from 120 to 106, most likely due to the three worker limit, because the difference of fourteen hours would account for two shifts for one baker which was the number of person shifts that decreased in staff. One could say that the removal of the bonus for promptness could have affected the decrease in total hours worked per week, but this would only be the case if promptness decreased, and it did not.

The addition of contingent pay and improved task description for cleaning may have tended to increase the number of hours worked per week, but since the number of hours decreased, and the tasks were never 100% completed, this may not have been a strong effect.

The mean hourly wage increased from $1.95 to $2.10, mainly due to the three worker limit, which helped improve production and the dividing of the commission among three instead of four, since production determined more than half of the wages. The contingent pay with improved and additional task description added tasks which improved the potential pay for completion of cleaning tasks.

It is unlikely that the removal of the bonus for promptness could have caused an increase in mean hourly wages per worker hour.

We computed the value (amount) of the goods produced per worker hour by dividing the value of goods produced by the total number of hours worked per week. The value of goods produced per worker hour increased from $4.79 to $6.57 as the value of the goods produced increased. Thus, the value of goods produced per worker hour increased for the same reason as those affecting the two components of that ratio. The three worker limit affected this variable in the same way. The

removal of the bonus may have increased the incentive value of the production commission. It seems unlikely that the contingent pay and improved task description affected the value of goods produced per worker hour any more than it affected the decrease in the number of hours worked.

We computed the wage-product ratio by dividing the wages by the value of goods produced. The mean wage-product ratio decreased from .408 to .358, moving in the desired direction. The removal of the bonus, the implementation of contingent pay with improved task description, and the three worker limit helped improve the value (amount) of goods produced as described above. And the removal of the bonus for promptness and the contingency for pay decreased the wages, while the additional tasks increased wages, as described above. However, the increase in production accounted for most of the increase in wages. And since the wages were mainly from production, the wage-product ratio decreased 5%.

CONCLUSIONS

Each of the studies described used the behavior systems approach to analyze a problem and evaluate a solution. The systems approach required analysis, specification of the behavioral objectives, a design, implementation of the system, and recycling through the system.

Study I reported the effect of contingent pay, and improved and additional task description. The contingent pay phase had insufficient data to describe an effect on the original tasks.

Contingent pay with improved and additional task description showed improvements for both high-and-low-effort original tasks and for both newly specified high-and-low-effort tasks. However, the original high-effort tasks did not improve greatly. Further research is yet to be done on the separate effects of contingent pay and improved and additional task description.

Study II reported the effect of a bonus and the removal of the bonus on 5:00 a.m. promptness of attending work. The results showed no effect with the removal of the bonus. The promptness was confounded by other factors in the setting, including the implementation of contingent pay and improved task description, the three baker limit, car pooling, and the advance of nicer spring weather.

Study III reported the effects on general economic measures of three factors: contingent pay with improved and additional task descriptions, removal of the bonus for promptness, and the limit of three bakers to a shift. The value of goods produced improved, the number of hours worked decreased, and the wage-product ratio decreased 5%. The bonus, contingent pay with improved task description, and the three worker limit can account for most of the financial improvement. The remainder can be attributed to the increase in the production of goods apparently due to the improved effectiveness of the bakers and the improved skills the bakers developed as they became more experienced.

While this was a correlational study, the behavior systems approach provided a framework for implementing various procedures and evaluation of the program. Contingent pay with improved task

description, and the three worker limit seemed to be the effective independent variables. The bakers worked less total hours and improved production and wages. And the overall setting improved in cleanliness and in the wage-product ratio. Thus, this systems analysis project could be described as successful.

BIBLIOGRAPHY

Baer, D., Wolf, M., and Risley, T. "Some Current Dimensions of Applied Behavior Analysis." Journal of Applied Behavior Analysis, 1968, 1, 91-97.

Brobst, R. W., "An Experimental Investigation of Job Tardiness Using a Standardized Job Shop Simulation Model." Dissertation Abstracts International, Louisiana Technological University, January 1976, 36:4600A.

Campbell, D. and Stanley, J. C., Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally College Publishing Company, 1968.

Churchman, C. W., The Systems Approach. New York: Dell Publishing Company, 1968.

Hermann, J. A., de Montes, A. I., Dominguez, B., Montes, F., and Hopkins, B. L., "Effects of Bonuses for Punctuality on the Tardiness of Industrial Workers." Journal of Applied Behavior Analysis, 1973, 6, 563-570.

Kent, H. M. "A Behavioral-Analysis, Systems Approach in a University Based, Food Co-operative." Unpublished master's thesis, Western Michigan University, Kalamazoo, Michigan, 1974.

Malott, R. W., Contingency Management. Kalamazoo, Michigan: Behaviordelia, 1972.

Pommer, D. A. and Streedbeck, D., "Motivating Staff Performance in an Operant Learning Program for Children." Journal of Applied Behavior Analysis, 1974, 7, 217-221.

Schnelle, J. F. and Lee, F. J., "A Quasi-Experimental Retrospective Evaluation of a Prison Policy Change." Journal of Applied Behavior Analysis, 1974, 483-493.

Schnelle, J. F., Kirchner, R. E., McNees, M. P. and Lawler, J. M., "Social Evaluation Research: The Evaluation of Two Police Patrolling Strategies." Journal of Applied Behavior Analysis, 1975, 8, 353-366.

Skinner, B. F. and Ferster, C. B., Schedules of Reinforcement. New York: Appleton-Century-Crofts, 1957, 1-390.