A STUDY OF WORK ACTIVITIES FOR RANGE PREPARATION AREA PERSONNEL IN TWO UNIVERSITY RESIDENCE HALLS

By

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A PROBLEM

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INTRODUCTION

The rising cost of labor in relation to other costs has been a primary concern of food service management in the moderately inflationary post World War II economy. Formerly, raw food costs represented the largest single cost in food service operations but expenditures for labor in recent years have been demanding an increasing proportion of the total budget.

At a 1962 conference, Radigan, an economist with the National Restaurant Association, reported that a comparison of 1958 and 1954 Census statistics indicated that payroll in the restaurant industry has increased on an average of 5 per cent a year with a 4 per cent rise in the number of employees (13). The continued increase in cost of labor has been attributed to the enactment of the minimum wage law by federal and state legislation, the incremental increases in social security taxes, and the increase in wage rates which are mounting yearly in all industries. In commenting on the fact that rising labor cost is perhaps the most fiercely controversial subject in the food service industry today, Radigan also emphasized the need for further research and the formulation of acceptable standards to measure labor productivity in that industry.

To know how man power is being utilized and if it is being used effectively is becoming increasingly important to management of food service activities. Management has recognized that techniques must be developed and utilized to control labor costs and improve operations in food service establishments if the objectives of the organization are

to be realized; i.e., performing work in the most efficient and effective manner with the greatest possible value at minimum cost.

Prior to 1950, industrial engineers developed and refined standard time and motion study techniques to measure direct labor which in this context may be defined as a repetitive activity; i.e., each individual performs work on a piece that advances the piece toward ultimate specifications (12). The lack of established labor standards in food service operations has been due primarily to non-repetitive and irregularly occurring work assignments, described by industrial engineers as indirect labor, which characterize this particular industry. Since 1950 a technique known as work sampling has gained acceptance by industry for the measurement and analysis of non-repetitive and irregularly occurring activities where there is no established method or frequency description available. From a review of literature and reported research, work sampling appears to be a reliable technique for the quantitative analysis, in terms of time, of labor productivity in the food service industry (5, 7, 8, 14, 15, 18, 22, 23).

Close has suggested that efforts to reduce labor costs should be directed toward the area of the largest dollar sign, and the golden rule of thumb is to consider those items that show the highest percentage of the total cost of the operation (4). Since cooks usually constitute the greatest total labor cost of non-supervisory personnel in the food service organization, a study of the productive time of the range preparation area personnel in two university residence halls may provide information valuable to persons concerned with food service management.

The purpose of this study was to employ the work sampling technique to classify and analyze work activities of range preparation area personnel in two university residence halls that differed in respect to a) number of meals served per day; (b) organization of range staff; and c) layout and design of food service facilities.

WORK SAMPLING--A REVIEW

The theory of the work sampling technique is that in accord with the fundamental laws of probability, the percentage distribution of the various elements of an operation or task performed or observed during a sampling period, will tend to equal the percentage distribution of the performed tasks which would have been revealed through continuous observation. The degree of accuracy contained in the results of a sampling study lies in the number of observations made; the larger the number made, the greater is the degree of accuracy. As the number of observations increases, the sample more closely approximates the entire activity under study and the possibility of the unobserved portion of the activity exerting a distorting influence on the sample findings is thereby minimized (6).

An essential condition of work sampling is that observations are to be taken at random. Randomness in the statistical sense means the condition that any given instant of time has an equal chance of selection at the time for observation with any other instant, that there is no apparent order to the times of observation, and thus that one time of observation is independent of all other times of observation. Another condition to ascertain inferences of known reliability from work sampling is that the entire period from which samples are taken must be subject to selection as the random times of observation are drawn (1, 2).

Tippett (17) of the Shirley Institute of the British Cotton Industry Research Association is generally credited with the origination of the work sampling technique. In 1935 he reported a "snap-reading" method as a statistical approach to determine running time and idle time on large numbers of machines and workers spread over an extensive floor

area in an English textile mill. Five years later, Murrow (10) introduced this approach to work analysis in the United States under the term "ratio-delay" to study the activities and delays of men and machines in three different industries.

In 1952 Brisley (3) discussed the merits of ratio-delay and reported example jobs on which this technique had been used: analysis of clerical operations, work load and duties; studying work methods for possible improvement; and determining time study allowances. The expanded application of the ratio-delay method prompted H. L. Waddell (20), editor of Factory Management and Maintenance, to propose the term work sampling for the broader concept of ratio-delay. Barnes (2) believed that the name, work sampling, was a more descriptive technique because the method was no longer restricted to delay allowances but included measurement of human activity and production operations.

MacNiece (9) tested the reliability and validity of the ratio-delay technique for obtaining information concerning inactivity time for maintenance crews and reported in 1953 that it was a usable method. To validate performance standards by the work sampling technique, Barnes (1, 2) compared and tested its results with the accepted time study method for measuring work in a large refining industry. One conclusion drawn from the study was that work sampling combined with performance rating gives final results substantially the same as those determined from time studies.

With the recognition of the reliability of results from work sampling and the successful application of this method for measuring indirect factory labor, the ratio-delay method was adapted to the measurement of indirect or non-repetitive types of work in other industries. One of the largest department stores in the United States employed the work sampling technique to check utilization of floor managers (16). Using a random

sampling method, over 2,000 observations were made for 19 floor managers during a twenty-one day period. The findings indicated that, in a work day, floor managers were spending only one-third of their time with their essential task of assisting customers and the remaining two-thirds of their time in supervisory and detailed tasks. As a result of the study, the number of floor walkers was doubled to accomplish the necessary functions of that position.

Jaske (7) used work sampling to improve the maintenance performance of employees in a large manufacturing company which consisted of some 80 operating units. Two three-men teams made over 15,500 random observations during a thirty-day period. By establishing a performance rating using the point-hour system, the observations were converted to show the monthly average performance of the maintenance workers. Tabulations of the work sampling data provided management knowledge of relative performance of the operating units and indicated areas of low productivity.

As a part of an extensive study to improve operations within a hospital, Wright (23) employed the work sampling technique to measure the patient-care time spent by hospital personnel in the Harper Hospital in Detroit. Three hospital ward units were selected for study and all professional nursing and ancillary personnel involved in the direct care of the patient in each ward were sampled to determine time spent performing various activities. Observations were recorded in 29 categories of activity during thirty-minute periods of the three eight-hour shifts for a period of seven days. The report provided information for developing a staffing guide for improvement in patient care.

Although widely used in business and industry to measure indirect labor, relatively few studies of work sampling as a technique in measuring work activities in food service operations have been reported.

Wilson (21) conducted a work sampling study in two university residence halls over a four-week period of four days each during the two-hour evening meal to determine the explanation for dissimilarity in student payrolls in similar residence halls. A comparison of activity percentages for the two groups indicated that difference in payrolls was due to difference in equipment and kitchen layout.

Johnson (8) developed and tested a work sampling technique for classifying and analyzing management activities of dietitians as food production managers performing at the middle management level. Activities were classified in four management categories: planning and organizing, controlling, procurement and inventory, and conference and evaluation; and three non-management categories: direct labor, personal time and miscellaneous. Evaluation of the technique indicated that work sampling was a feasible method for analyzing managerial activities of dietitians.

Sanford (14) applied work sampling to study time distribution of activities of college food service managers. Over 1,000 stratified sample observations for each of the three food service managers were made and recorded during a forty-day working period. The study showed that the work sampling technique was suitable for measuring managerial activity and the information could be used as a basis for improved personnel utilization and cost control procedures.

In conducting a study of hospital food service Wise (22) adapted the work sampling technique for observation of seven employees and analysis of time spent in each of nine work categories. The findings provided information for more effective employee classification and scheduling.

Schell (15) utilized the work sampling technique to investigate the time spent in the preparation and service of food in six federal institutions. A determination of those activities in the food service operation

which would lend themselves to measurement showed that the tasks performed by cooks, bakers, meat cutters and food service workers could be measured in terms of minutes per ration served. The findings were evaluated to establish standards for staffing and provided management with a tool for analyzing a single operation or comparing productivity in similar institutions.

METHOD

Fundamental principles of work sampling have been established as defining categories of work activity, assuring randomness in making observations of activities, determining the number of observations for a given degree of accuracy, and recording instantaneous observations of activities (1, 2, 6). Hansen (5) has suggested ten rather definite steps to be taken in making a work sampling study for production and performance analysis. The procedure for the data gathering function of this study is an adaptation of Hansen's basic plan for work sampling.

* Define the objectives of the study.
* Select the area(s) for study.
* Orientate the subject(s) undergoing study.
* Define the categories of work activity.
* Determine the required number of observations for reliability.
* Establish the time period of the study.
* Select randomized times for making observations.
* Design the observation record.
* Describe the technique for making observations.
* Record observations.

Definition of Objectives

This study was concerned with the investigation of work activities of range preparation area personnel. The objectives were to classify types of range work activities and compute the amount of time spent by personnel in the performance of these activities in two university residence halls which differed in respect to 1) number of meals served

per day; 2) range staff organization; and 3) layout and design of food service facilities.

The data may provide residence hall managers with information pertinent to scheduling, controlling and forecasting man power and work load requirements.

Area for Study

The Residence Hall Department of the Dormitories and Food Services Division, Michigan State University, consisted of 16 residence halls in the spring quarter of 1964. Exhibit 1 shows the organizational framework for the Dormitories and Food Services Division. Supplementary information has been summarized below:

	Operational Information	
Residence Hall	Year Completed	Normal Census
Mayo	1931	240
Williams	1936	260
Campbell	1939	300
Mason-Abbot	1942	825
Snyder-Phillips	1942	875
Landon	1946	325
Yakeley	1947	325
Gilchrist	1948	200
Shaw	1950	1,100
*Brody Group	1955	3,000
Van Hoosen	1957	140
Owen Graduate Center	1960	475
Case	1961	1,040
*Wilson	1962	1,125
McDonel	1963	1,130
Wonders	1963	1,130

*Selected for study.

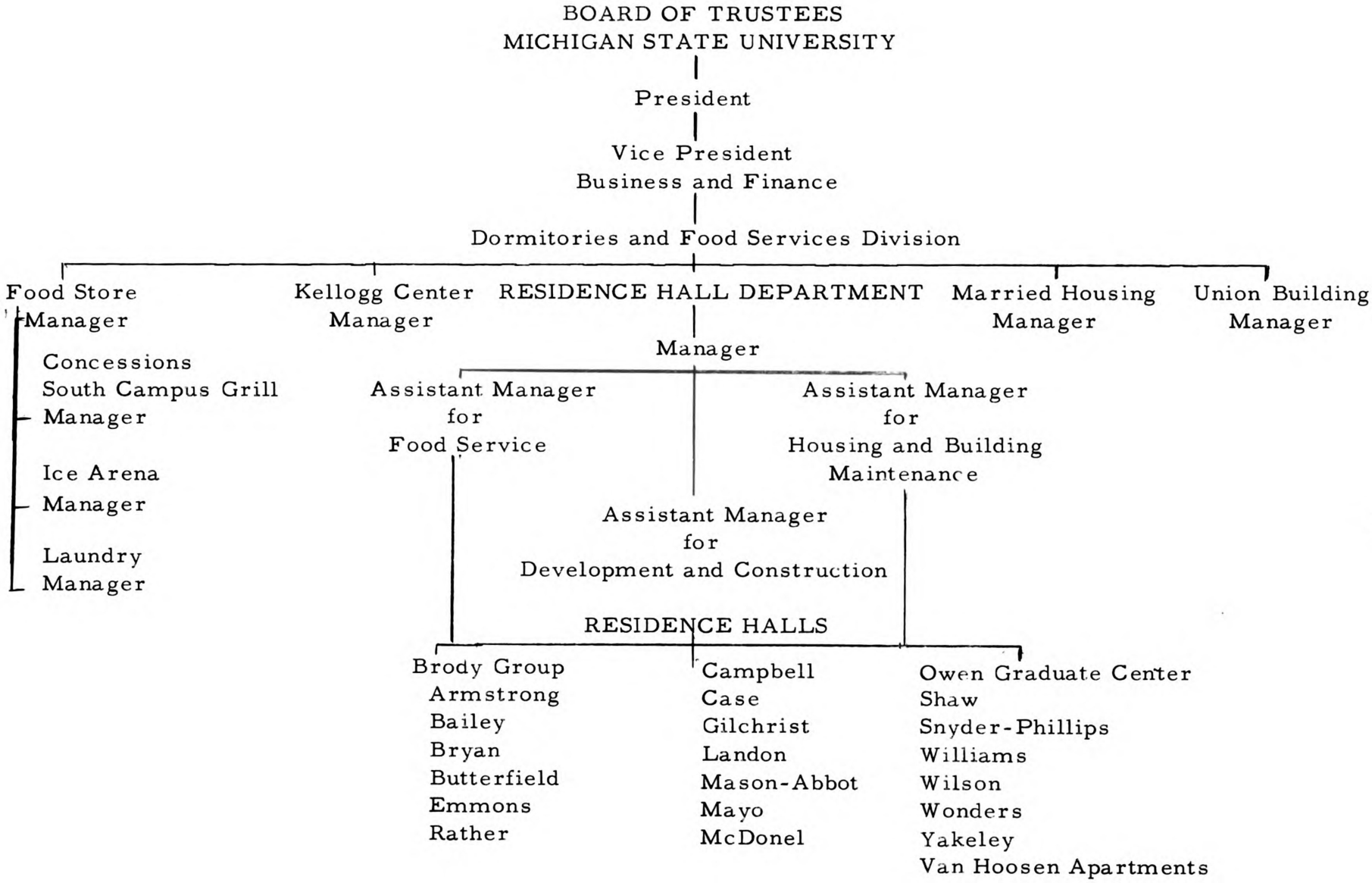

EXHIBIT 1.--Organization of residence hall department, dormitories and food services division, Michigan State University. Adapted from organization chart dated October 1, 1962.

The range preparation areas at the Brody Group and Wilson residence halls were arbitrarily selected for study. The food service activities of both halls were similar in several respects: a clientele of young men and women; cafeteria type service; comparable cycle menus, standardized recipes and portion control procedures. Although the menus might differ as to type of food served, the number of items served was usually identical.

The two residence halls differed in size and layout of food service facilities, the number of meals served per day, and the number of personnel employed. During spring quarter 1964 the Brody Group food service facilities employed 71 full-time personnel and served approximately 4, 500 meals per day; Wilson Hall employed 37 full-time personnel to product food and service for 1, 700 meals per day.

At the time of the study meal service hours for both residence halls followed essentially the same schedule:

Breakfast	7:00 A.M. - 8:00 A.M.
Late Breakfast	8:15 A.M. - 9:00 A.M.
Early Lunch (Brody only)	10:30 A.M. -11:15 A.M.
Lunch	11:15 A.M. - 12:30 P.M.
Late Lunch	12:30 P.M. - 1:30 P.M.
Dinner	5:00 P.M. - 6:45 P.M.

Subjects for Study

Prior to spring quarter, 1964, permission was obtained from the Assistant Manager for Food Service, Residence Hall Department, and from the Food Service Managers in the Brody Group and Wilson residence halls, to assure cooperation and assistance during the period of the study.

The subjects selected for participation were the ten regularly employed cooks, one kitchen assistant and the equivalent of five student cooks working in the range preparation area of the Brody Group and Wilson residence halls. Distribution of cooks by classification in the two residence halls follows:

Title	Classification	Distribution	
		Brody Group	Wilson
Head Cook	Class IV	1	0
Second Cook	Class III	1	1
Cook	Class II	3	4
*Student Cook	--	3.4	1.8
Kitchen Assistant	Food Service Helper II	1	0

The job descriptions and work requirements for cooks and kitchen helpers at Michigan State University according to classification are included in the Appendix, Exhibit 3.

Cooks were scheduled to staff the early and late shifts with one or two cooks comprising the early shift and one to three cooks on the late shift. Student cooks were scheduled to maintain the number of personnel necessary to complete the work load for both shifts. Hours of work for the regularly employed cooks in both residence halls were scheduled in two nine-hour shifts. Each shift included two thirty-minute meal periods.

	Shift 1	Shift 2
Weekdays	5:30 A.M. - 2:30 P.M.	10:30 A.M. - 7:30 P.M.
Week end	6:00 A.M. - 3:00 P.M.	10:30 A.M. - 7:30 P.M.

The kitchen assistant employed at the Brody Group worked from 8:00 A.M. to 4:30 P.M., Monday through Friday.

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*Since the number of students employed each day varied, the cook equivalent was calculated by dividing total student hours for each day by eight, the number of hours in a normal shift for each full-time employee.

Selling the work sampling technique to management and workers alike cannot be overestimated if the findings are to indicate the true activities of labor payroll personnel. The best policy is for the analyst to be honest, forthright, open and above board in the explanation of the technique. The purpose of this study was discussed with management and the workers during an informal group meeting in each residence hall. In these conferences, the work sampling technique was presented and the method was explained to eliminate any suspicion of "spying" that management might entertain and to assure the worker that this study would not eliminate his job. Comments and suggestions offered by the two groups proved invaluable to the analyst.

Preliminary observations of range area activities orientated the employees in both residence halls to sampling techniques. During the study the subjects accepted the analyst as an area supervisor.

Classification of Work Activities

Since work sampling provides information meaningful to management on percentages of time spent in various categories of the total work activity, the selection of these categories should be related to the objectives of the study and predefined with care. As a general rule, detailed categories may be subsequently combined, but activities not identified when making the study cannot be segregated later. With this fact in mind, detailed categorization is less likely to cause difficulty in the interpretation of findings than broad classification of work activities.

Categories for this study were based on information obtained from the literature, from reviewing job descriptions and by observing the cooks in both residence halls for a three-month period to determine if activities not included in the job descriptions should be listed.

The following classification of work activities into four major categories was developed and defined for range area personnel in Michigan State University residence halls and was used in the work sampling study.

I. Productive Time

a. Food Preparation

All activities associated with the preparation of food, excluding pre-preparation of food items: weighing, measuring, seasoning, slicing, mixing, stirring, basting, tasting, as well as the process of cooking and baking.

b. Cleaning Equipment and Work Surfaces

Any activity concerned with the cleaning of equipment or work surfaces after use in the range area: meat slicers, deep fat fryers, grill tops, oven shelves, table and work surfaces.

c. Supervision

Any activity which involved disseminating oral instructions to subordinates.

d. Processing Papers and Records

All activities related to the functions of the range food preparation area: processing requisitions; maintenance of records and cooks' worksheets.

e. Conferences and Discussions

Any activity concerned with informal discussion or formally scheduled conferences or meetings.

f. Operation of Equipment

All activities concerned with the operation of equipment such as electric and steam machines, revolving oven, meat slicers, french fryers, grills, steam kettles and scales.

g. Reading Recipes and Cooks' Worksheets

Any activity concerned with reading directives for quantity of food to be prepared, for number of servings required at any period of the serving hour, and for methods of food preparation.

h. Checking Refrigerator or Storeroom

Any activity concerned with the storage and inventory of food items and sanitation inspection.

i. Watching Food Cook

Any activity concerned with preparation of food: tending the deep fat fryer and grill as foods cook; tending the mixer while foods are being mixed; waiting for water to run into containers or kettles until the required capacity is reached.

II. Productive Support Time

Pre-preparation of Food

All processes concerned with slicing, chopping, cutting, grating, dicing, panning, flaking, mixing, cracking, peeling and opening cans or cases.

III. Personal Time

Any activity concerned with time spent for physical requirements: restroom visits, coffee breaks.

IV. Non-Productive Time

a. Idle

Any activity which does not contribute to food production and service objectives.

b. Search

Any non-activity concerned with locating an item of food or equipment for food preparation.

c. Transporting

Any activity concerned with moving material by a wheeled vehicle or pushing an empty vehicle.

d. Walking Without a Load

Self-explanatory

e. Walking With a Load

Self-explanatory

f. Janitorial Work

Any activity concerned with cleaning the range food preparation area other than work surfaces: range floor area, exterior surface of stoves and ovens, refrigerators, storeroom, steam kettles, mixers, food conveyors and pots or pans.

To ascertain the completeness and appropriateness of the categories, a one-day continuous observation was made in each residence hall. From these observations, the listed activities were deemed adequately inclusive.

Design of Study

Sampling Size

Barnes (1, 2) states that the confidence level considered satisfactory for most studies of direct and indirect work is 95 per cent. This means the probability is that 95 per cent of the time the random observations will represent the percentage of the activity performed and that 5 per cent of the time they will not.

An absolute error or desired absolute accuracy of ± 3 per cent has been accepted as adequate for most work sampling studies (5, 6) and has been the degree of accuracy adopted for recent productivity studies in the food service industry (8, 14, 15).

To determine the number of observations required for a 95 per cent confidence level and a desired accuracy of ± 3 per cent, a preliminary sampling of 200 observations of range preparation area activities was made during a one-day period in each residence hall. Table 1 shows the percentage of time in the specific categorized activities. The largest percentage of time recorded for any one activity was food preparation: 41.5 per cent for the Brody Group and 45 per cent for Wilson Hall. These percentages were considered the predicted occurrence of activity (p) for the formula in determining sample size for the respective residence halls; i.e., p = 41.5 for the Brody Group and 45 for Wilson Hall.

The number of observations required to meet the desired precision level of ± 3 per cent at the 95 per cent confidence level was determined using the formula:

$$I = \pm \frac{2\sqrt{100\,p\,(100 - 100\,p)}}{\sqrt{n}}$$

I = Desired confidence interval
p = Per cent predicted occurrence of activity
n = Number of observations required

The number of observations for the Brody Group and Wilson Hall were calculated as follows:

TABLE 1.--Percentage distribution of time by activity categories for range preparation area personnel based on 200 observations*

Activity Category	Residence Halls	
	Brody Group Per Cent Time	Wilson Hall Per Cent Time
PRODUCTIVE TIME	68.5	61.2
Food Preparation	41.5	45.0
Cleaning Equipment and Work Surfaces	6.0	5.1
Supervision	1.5	.5
Processing Papers and Records	2.0	.5
Conference and Discussions	5.5	.5
Operation of Equipment	5.5	1.0
Reading Recipes and Cooks' Worksheets	1.5	.5
Checking Refrigerator or Storeroom	1.5	3.5
Watching Food Cook	3.5	4.6
PRODUCTIVE SUPPORT TIME		
Pre-preparation of Food	5.0	4.0
PERSONAL TIME	4.0	4.0
NON-PRODUCTIVE TIME	22.5	30.8
Idle	2.0	4.0
Search	2.0	1.5
Transporting	4.0	6.1
Walking Without a Load	4.0	7.1
Walking With a Load	3.5	3.5
Janitorial Work	7.0	8.6

*All percentages rounded off to one decimal place.

Brody Group

$$\pm 3 = \pm \frac{2\sqrt{(41.5)(58.5)}}{\sqrt{n}}$$

$$n = \frac{4(2427.75)}{9}$$

$$n = 4(0269.75)$$

$$n = 1079 \text{ observations}$$

Wilson

$$\pm 3 = \pm \frac{2\sqrt{(45)(55)}}{\sqrt{n}}$$

$$n = \frac{4(2475)}{9}$$

$$n = 4(275)$$

$$n = 1100 \text{ observations}$$

Thus, it could be assumed that 1000 observations were required for the Brody Group and also for Wilson Hall at the 95 per cent confidence level with the desired accuracy of ± 3 per cent. This number of observations (1000) is generally accepted as requisite for reliability of sampling results (1, 5, 6). The total number of observations was dispersed over group performance in each residence hall.

Period for Study

Observations for work sampling should be taken at random intervals during a predetermined cycle of activity. In reviewing the duties and responsibilities of range area personnel, the cycle of work activities for the subjects was considered to be a week.

The days selected as representative of the cycle of work activity for normal residence hall operation during the academic year were Monday, Wednesday, Thursday and Saturday. Observation dates for the Brody Group were April 29, May 1, 2 and 4; for Wilson Hall, May 4, 6, 9 and 11.

The total number of observations (1000) divided by four determined the minimum number of observations (250) that would be made each day over the fourteen-hour work span that range preparation area personnel were on duty.

Selection of Randomized Times

The objective of randomized time selection is to avoid all types of bias on the part of the observer as well as of the observed, whether conscious or unconscious. Work sampling to be statistically acceptable requires that each individual moment have an equal opportunity of being chosen (1, 2).

A lottery type drawing was used to select the observation periods. Slips of paper, numbered from 1 to 480 to correspond to the 480 minutes of a normal eight-hour working day, were prepared and placed in a container which was thoroughly shaken to shuffle the papers. The slips were drawn singly and recorded. The drawn slip was then returned to the container prior to drawing the next number so that chances of selection were 1 to 480 at all times. The container was thoroughly shaken before each drawing. Whenever a number was drawn twice, it was counted as two numbers and two observations were recorded, although in actuality only one observation could be made. The same selected random times were utilized in both residence halls. Sixty numbers were drawn for each of the two eight-hour daily shifts.

After the drawing was completed, the numbers were converted to the equivalent minutes of the day for the four-day period of study. An example of conversion to equivalent minutes follows: if the number drawn was one and the shift of personnel came on duty at 5:30 A.M., the time of the day represented by the drawn number one, accordingly was one minute later, or 5:31 A.M. Since employees were scheduled straight nine-hour shifts with two thirty-minute meal periods included in each shift, adjustment for meal periods was essential. A meal period adjustment example follows: if a number drawn for the second shift was 361 and the scheduled meal hour was 4:30 to 5:00 P.M., the time of the day represented by the drawn number 361, accordingly was 5:01

P.M. rather than 4:31 P.M. The same procedure was followed for the two eight-hour working shifts of the four-day observation periods.

Design of Observation Record Form

The observation form should be simple and designed to facilitate recording and summarizing data. Appendix Exhibit 4 illustrates the observation record form for this study.

The form, drawn on an $8\frac{1}{2}$ x 11 inch tablet sheet of paper, was headed with the date and the name of the residence hall being observed. The names of the regularly employed cooks and numbers for the student cooks were placed on one axis and randomized times on the other. A legend of 17 activities appeared on the far right portion of the sheet, each having a designated number for identification and for recording purposes.

Each entry of the observed activity performed by a worker at the randomized time was recorded by the designated number at the converging point of the two axes. If a worker was not present at the time the observation was made, a dash was entered. Space was left on the right side of the listed activities to tabulate the daily number of observations. The lower portion of the form had a section for comments.

This form was pre-tested to delete, add or modify activities for proper classification and to test the construction of the form for ease in recording the observations. Pre-testing the form also gave the analyst experience in the observation technique.

Description of Technique

In making observations of the performance of activities by a worker or workers, efforts to reduce conscious and unconscious bias of the observed or the observer must be designed as part of the study.

Worker bias proved to be no problem due to the informal contacts of analyst and employees during the six months prior to the study as well as the number of observations required over the four-day period.

To minimize bias of the analyst, a position was selected in the range area where all subjects were clearly visible. At the randomized time, using a large wrist watch with a second hand, an observation was made of what each individual in the range area was doing at the moment the second hand reached the sixty-second point of the prescribed minute.

The daily tally of work activities was recorded on the observation record form and then transferred to a summary sheet.

Preliminary Observations

From a preliminary study, computation of percentage of time spent by range preparation area personnel in the predetermined and predefined activities indicated that the number of observations for 12 of the 17 activities was too small for desired accuracy of final results. For this reason, the original classification of work activities was revised by regrouping the 17 activities listed on page 18. The original four work categories, productive time, productive support time, personal time and non-productive time, were retained.

In the productive time component seven work activities were regrouped in two new categories:

1) Directing, coordinating and controlling

   Formerly: supervision; processing papers and records; and conferences and discussions.

2) Range related activities

   Formerly: Operation of equipment; reading recipes and cooks' worksheets; checking refrigerator or storeroom; and watching food cook.

Similar non-productive work activities were combined: idle and search; and walking and transporting. Regrouped activities appear in Table 3, page 27 as nine major activity categories: food preparation; cleaning equipment and work surfaces; directing, coordinating, and controlling; range related activities; pre-preparation of food; personal time; walking and transporting; idle and search; and janitorial work.

RESULTS AND DISCUSSION

The purpose of this section of the study was to evaluate the accuracy of the work sampling findings and to present a profile of activity time distribution for range personnel in two Michigan State University residence halls.

Sampling Error Determination

The accuracy of the work sampling results was validated to determine whether the sampling error fell within the ± 3 per cent absolute degree of accuracy at the 95 per cent confidence level. In the design of the study, the size of the sample necessary for reliability of results in the Brody Group and Wilson residence halls had been determined as 1000 recorded observations for each hall. After the data had been compiled and results of time percentages computed, calculations were made to determine whether the results were within the desired accuracy, using the following formula:

$$X = 2\sqrt{\frac{p\,(1-p)}{n}}$$

X = Desired confidence interval (I)

p = Per cent predicted occurrence of activity

n = Number of random observations or sample size

The absolute degree of accuracy for each of the categorized activities for the Brody Group and Wilson Hall is shown in Table 2. In this study, the sampling error fell within the desired confidence interval for the nine major activity categories: food preparation; cleaning equipment and work surfaces; directing, coordinating, and controlling; range related

TABLE 2.--Sampling error for the number of observations in the major activity categories for Brody Group and Wilson Hall range preparation area personnel at the 95 per cent confidence level*

Activity Categories	Brody Group		Wilson Hall	
	Activity Time Per Cent	Sampling Error Per Cent	Activity Time Per Cent	Sampling Error Per Cent
PRODUCTIVE TIME				
Food Preparation	41.3	± 2.4	39.4	± 2.8
Cleaning Equipment and Work Surfaces	10.5	± 1.5	6.4	± 1.5
Directing, Coordinating and Controlling	8.8	± 1.4	5.4	± 1.3
Range Related Activities	6.7	± 1.2	6.0	± 1.4
PRODUCTIVE SUPPORT TIME				
Pre-preparation of Food	8.1	± 1.3	6.1	± 1.4
PERSONAL TIME	7.0	± 1.2	6.0	± 1.4
NON-PRODUCTIVE TIME				
Walking and Transporting	11.6	± 1.5	17.0	± 2.2
Idle and Search	3.6	± .9	3.7	± 1.1
Janitorial Work	2.4	± .7	10.0	± 1.8

*All percentages rounded off to one decimal place.

activities; pre-preparation of food; personal time; walking and transporting; idle and search; and janitorial work.

Discussion of Findings

The work sampling technique was utilized to study the activities of 11 regularly employed range area personnel and the equivalent of five student cooks in two residence halls at Michigan State University. The mechanics of work sampling require that the analyst record data by observing the subjects being studied and by classifying the activities of these persons into one of several predetermined and predefined categories. Table 3 shows the number of observations and percentage time distribution for work activities of range preparation area personnel in the Brody Group and Wilson residence halls. Exhibit 2 illustrates these time distributions.

Three components of food production, pre-preparation of food, range related activities and food preparation, involved more than 50 per cent of the total activity time for range area personnel in the Brody Group and Wilson halls. Percentages of these combined food production activities were 56.1 for the Brody Group and 51.5 for Wilson Hall.

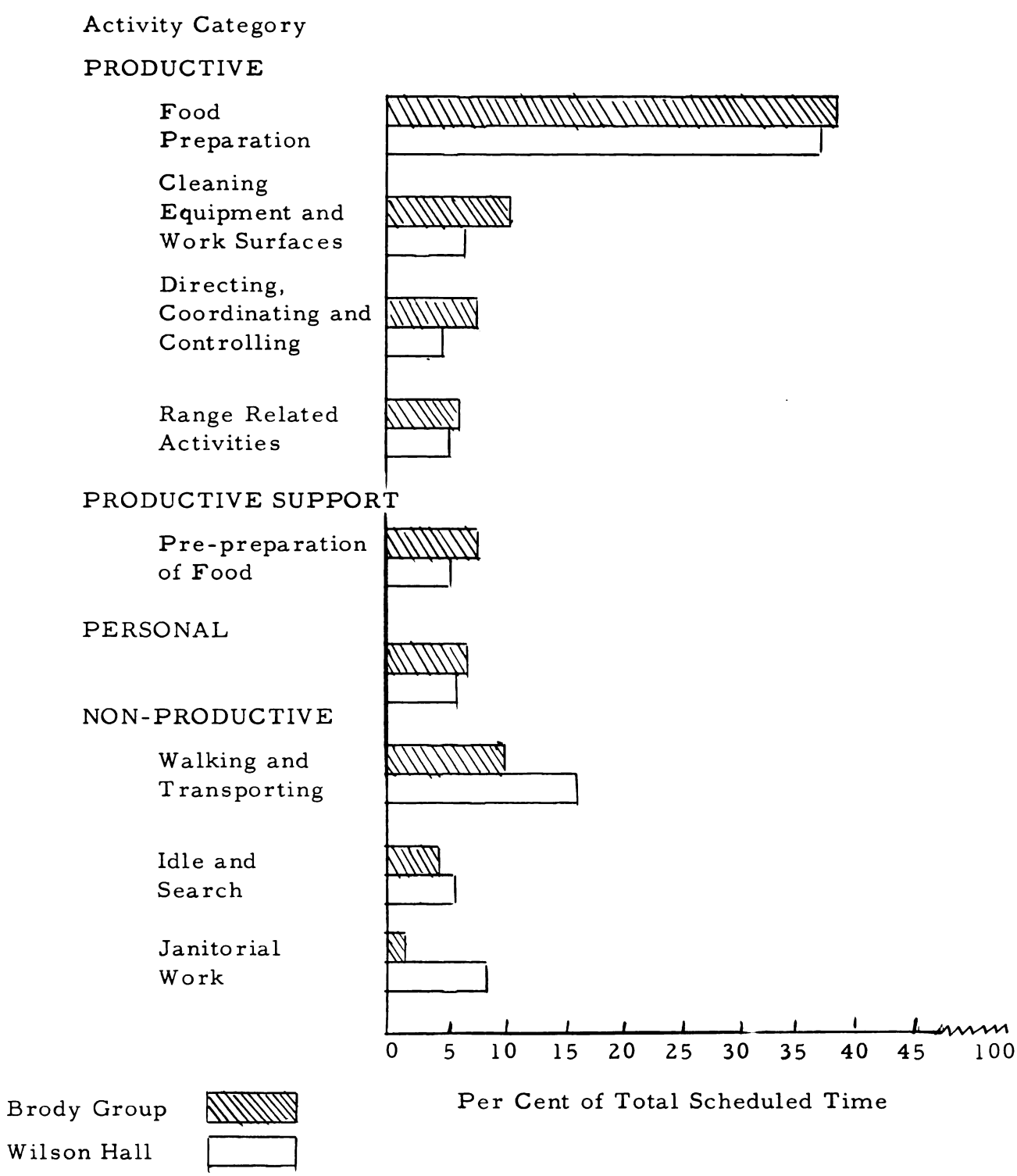
Range personnel in both residence halls spent approximately 40 per cent of their time in food preparation: weighing, measuring, seasoning, slicing, mixing, stirring, basting, tasting as well as the process of cooking and baking. For the Brody Group this activity comprised 41.3 per cent of the scheduled time and for Wilson Hall 39.4 per cent. Pre-preparation time for food included slicing, chopping, cutting, grating, dicing, panning, flaking, mixing, cracking, peeling and opening cases or cans. Range personnel time involved with this activity was 8.1 per cent for the Brody Group and 6.1 per cent for Wilson Hall. Operation of equipment, watching food cook, reading

TABLE 9. Percentage distribution of observations of work activities for Brody Group and Wilson Hall range area personnel in the work sampling study*

Activity Category	Brody Group		Wilson Hall	
	Number of Observations	Percentage of Time	Number of Observations	Percentage of Time
PRODUCTIVE TIME				
Food Preparation	718	41.3	443	39.4
Cleaning Equipment and Work Surfaces	184	10.5	72	6.4
Directing, Coordinating, and Controlling	154	8.8	61	5.4
Supervision	30	1.7	9	.8
Processing Papers and Records	14	.8	6	.5
Conferences and Discussions	110	6.3	46	4.1
Range Related Activities	117	6.7	67	6.0
Operation of Equipment	31	1.8	16	1.4
Reading Recipes and Cooks' Work-sheets	23	1.3	17	1.5
Checking Refrigerator or Storeroom	26	1.5	30	2.7
Watching Food Cook	37	2.1	4	.4
PRODUCTIVE SUPPORT TIME				
Pre-preparation of Food	140	8.1	69	6.1
PERSONAL TIME	121	7.0	67	6.0
NON-PRODUCTIVE TIME				
Walking and Transporting	200	11.6	192	17.0
Transporting	39	2.4	24	2.1
Walking Without a Load	129	7.4	140	12.4
Walking With a Load	32	1.8	28	2.5
Idle and Search	62	3.6	42	3.7
Idle	42	2.4	24	2.1
Search	20	1.2	18	1.6
Janitorial Work	42	2.4	112	10.0
Grand Total	1738	100.0	1125	100.0
Total Productive Time	1313	75.4	712	63.3
Total Personal Time	121	7.0	67	6.0
Total Non-Productive Time	304	17.6	346	30.7

*All percentages rounded off to one decimal place.

EXHIBIT 2.--Percentage of total time spent by Brody Group and Wilson Hall range area personnel in nine categories of activities



recipes and cooks' worksheets and checking refrigerator or storeroom were considered range related activities and comprised approximately 6.7 per cent of range personnel activity time for the Brody Group and 6 per cent for Wilson Hall.

Activities considered non-productive consumed the second largest amount of time. For the Brody Group, range personnel spent 11.6 per cent of their time walking with or without a load or transporting materials on a wheeled vehicle. In Wilson Hall this percentage was 17 which appears high in view of the efficient layout and design of that residence hall kitchen.

Search and idle time are always considered significant in a profile of work activities. For the range area personnel these non-productive elements constituted approximately 3.5 per cent of the total time and were observed when unavoidable delays occurred and at the end of the eight-hour work period.

The percentage of time spent in cleaning equipment and work surfaces was 10.5 per cent for Brody Group and 6.4 per cent for Wilson Hall. This did not include maintenance of range floor area, refrigerators or storeroom which was considered janitorial work. For Brody Group the janitorial activity percentage was 2.4; for Wilson Hall 10.

Directing, coordinating and controlling which included supervision, conferences and processing records accounted for 8.8 and 5.4 per cent of range activity time in the Brody Group and Wilson Hall, respectively. Range area personnel in both residence halls spent approximately 5 per cent of their time in conferences and discussion, 6.3 per cent in the Brody Group and 4.1 per cent in Wilson Hall. Supervision involved 1.7 per cent of the Brody Group range personnel activities each day and .8 per cent at Wilson Hall. For both residence halls processing records accounted for less than 1 per cent of the time categorized as directing, coordinating, and controlling.

Personal activity included time spent by the subjects in taking care of personal needs and in two ten-minute coffee break allowances per day. This activity consumed 7 and 6 per cent of range personnel time for the Brody Group and Wilson residence halls respectively. Niebel (12) reported that detailed production checks in industry have demonstrated a 5 per cent allowance for personal time or approximately 24 minutes in an eight-hour day is appropriate for male and female workers for typical working conditions.

The productive and non-productive components of total activity time are considered indicators of personnel performance. For Brody Group range preparation area personnel, the productive time percentage was 75.4, for Wilson Hall 63.3; the non-productive time percentages were 17.6 and 30.7 for Brody Group and Wilson Hall respectively.

OBSERVATIONS

The data from this study covered a one-week normal activity cycle for residence hall range area personnel at Michigan State University. The opening and closing of each term in a university food service presents many unique problems, problems that are meaningful in over-all labor analysis. For management decisions on residence hall layout and design, staffing, scheduling work loads and methods improvement, a work sampling study at Michigan State University should be programmed for a ten-week term.

Interpretation of these data could be thrown into sharper focus by calculating the cost per day per student for the respective work activities of range area personnel at Brody Group and Wilson Halls.

Range area work activity categories developed for this investigation could be modified for work sampling studies of range area personnel in other institutions.

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APPENDIX

EXHIBIT 3.--Michigan State University job descriptions*

I. JOB TITLE: Head Cook

II. CLASSIFICATION: Cook IV

III. PRODUCTION CENTER: 05

IV. RESPONSIBLE TO: Production Supervisor

V. HOURS OF WORK: Flexible; alternate weekends, or weekends as necessary. Normal hours, which may vary, are:

Weekdays: 5:30 A.M. - 2:30 P.M. or 10:30 A.M. - 7:30 P.M.
Weekends: 6:30 A.M. - 3:30 P.M. or 10:30 A.M. - 7:30 P.M.

VI. REQUIREMENTS:

A. One year's experience as Cook III or equivalent; good record.
B. Outstanding leadership and organizational abilities.
C. Educational qualifications to meet standards needed.
D. Ability to work flexible schedule.
E. Neat appearance; personal cleanliness; good general health.

VII. DUTIES:

A. Directs all kitchen activities, including:

1. Utilizing and completing work sheets.
2. Requisitioning, storing, freezing, labeling and maintaining kitchen supplies and products.
3. Organizing work situations.
4. Maintaining maximum standards of sanitation and safety.

B. Directs all kitchen personnel supervision, including:

1. Training, guiding and organizing regular and student personnel.
2. Scheduling meal times of kitchen personnel.
3. Training students from University classes in Brody kitchen.

C. Assists production supervisors in:

1. Reporting deficiencies in quantity or quality of supplies or kitchen products.
2. Utilizing left-overs.
3. Recommending equipment repairs and improvements.
4. Testing new or revised recipes.
5. Rating kitchen employees.

D. Works in food preparation and production, including:

1. Preparing, helping to prepare, or being able to prepare all kitchen menu items, using standardized recipes. Checking recipes; recommending changes.
2. Testing all prepared kitchen products to maintain standards.

E. Performs related duties as assigned by production supervisor.

*Source: Michigan State University Personnel Center

EXHIBIT 3. --(Continued)

I. JOB TITLE: Second Cook

II. CLASSIFICATION: Cook III

III. PRODUCTION CENTER: 05

IV. RESPONSIBLE TO: Head Cook

V. HOURS OF WORK: Flexible; alternate weekends, or weekends as necessary. Normal hours, which may vary, are:

Weekdays: 5:30 A.M. - 2:30 P.M. or 10:30 A.M. - 7:30 P.M.
Weekends: 6:30 A.M. - 3:30 P.M. or 10:30 A.M. - 7:30 P.M.

VI. REQUIREMENTS:

A. Two years' experience as Cook II or equivalent; good record.
B. Leadership and organizational abilities.
C. Educational qualifications to meet standards needed.
D. Ability to work flexible schedule.
E. Neat appearance; personal cleanliness; good general health.

VII. DUTIES:

A. Works in food preparation and production, including:

1. Preparing, helping to prepare, or being able to prepare all kitchen menu items, using standardized recipes. Checking recipes.
2. Testing prepared kitchen products to maintain standards.
3. Reporting to head cook or production supervisor, deficiencies in quantity or quality of kitchen products.

B. Performs duties of sanitation and safety, including:

1. Assisting in cleaning of kitchen and equipment.
2. Maintaining personal cleanliness.
3. Maintaining personal safety practices.

C. Performs kitchen supervisory duties, including:

1. Assisting head cook in direction of activities and personnel.
2. Directing all kitchen activities and personnel in absence of head cook.

D. Performs related duties as assigned by head cook or production supervisor.

E. Works with custodial crew during vacation periods, if assigned.

EXHIBIT 3 --(Continued)

I. JOB TITLE: Cook

II. CLASSIFICATION: Cook II

III. PRODUCTION CENTER: 05

IV. RESPONSIBLE TO: Head cook or second cook, or in their absences, production supervisor.

V. HOURS OF WORK: Flexible, alternate weekends, or weekends as necessary. Normal hours, which may vary, are:

Weekdays: 5:30 A.M. - 2:30 P.M. or 10:30 A.M. - 7:30 P.M.
Weekends: 6:30 A.M. - 3:30 P.M. or 10:30 A.M. - 7:30 P.M.

VI. REQUIREMENTS:

A. Food production experience; good record.
B. Educational qualifications to meet standards needed.
C. Ability to work flexible schedule.
D. Neat appearance; personal cleanliness; good general health.

VII. DUTIES:

A. Works in food preparation and production, including:

1. Preparing, helping to prepare, or being able to prepare all kitchen menu items, using standardized recipes. Checking recipes.
2. Testing prepared kitchen products to maintain standards.
3. Reporting to head cook, second cook or production supervisor, deficiencies in quantity or quality of kitchen products.

B. Performs duties of sanitation and safety, including:

1. Assisting in cleaning of kitchen and equipment.
2. Maintaining personal cleanliness.
3. Maintaining personal safety practices.

C. Performs kitchen supervisory duties, including:

1. Assisting head cook and second cook in direction of kitchen assistants, kitchen porter and student kitchen personnel.
2. Directing necessary activities in absence of head cook and second cook, as assigned by production supervisor.

D. Performs related duties or assists in other departments as assigned by head cook, second cook or production supervisor.

E. Works with custodial crew during vacation periods, if assigned.

EXHIBIT 3. --(Continued)

I. JOB TITLE: Kitchen assistant

II. CLASSIFICATION: F.S.H. II

III. PRODUCTION CENTER: 05

IV. RESPONSIBLE TO: Senior cook

V. HOURS OF WORK: Flexible; weekends as necessary. Normal hours, which may vary, are:

Weekdays: 7:00 A.M. - 3:30 P.M. or 8:00 A.M. - 4:30 P.M.

VI. REQUIREMENTS:

A. Previous work experience, preferably in food industry; good record.
B. Ability to work flexible schedule.
C. Neat appearance; personal cleanliness; good general health; ability to stand for long periods.

VII. DUTIES:

A. Assists in food preparation and production, including:

1. Slicing, chopping, cutting, grating, dicing, panning, flaking and mixing food items, cracking, cooking and peeling eggs and opening cans and cases to be used in the kitchen.
2. Assisting in less heavy production work of breakfast and lunch items, and preparation of dinner items, using standardized recipes and procedures; testing of prepared products to maintain standards.
3. Panning finished products, portioning meats, making sandwiches.
4. Working on pre-preparation of kitchen items as designated on pre-preparation sheet; labeling and storing items.
5. Preparing and labeling goods for freezer.
6. Reporting to senior cook, deficiencies in quantity or quality of kitchen products.

B. Assists in duties of sanitation and safety, including:

1. Less heavy cleaning of kitchen and equipment.
2. Maintaining personal cleanliness.
3. Maintaining personal safety practices.

C. Performs related duties or assists in other departments as assigned by senior cook.

EXHIBIT 3.--(Continued)

I. JOB TITLE: Student Cook

II. PRODUCTION CENTER: 05

III. RESPONSIBLE TO: Senior cook

IV. HOURS OF WORK: As scheduled

V. REQUIREMENTS:

A. Previous work experience and good record, preferably food service experience.
B. Ability to work flexible schedule.
C. Neat appearance; personal cleanliness; good general health.

VI. DUTIES:

A. Punch in at scheduled time, in uniform.
B. Do general cooking duties as assigned by senior cook:

1. Work on pre-preparation of kitchen items.
2. Work on preparation and production of kitchen items.
3. Assume responsibility for counts of items, portions, pans, dishes, weights and measurements.
4. Use standardized procedures and maintain accepted standards.

C. Assist other cooks in cleaning of kitchen and equipment.
D. Do other duties or assist in other departments as assigned by senior cook.
E. Eat in employees' dining room, punched out and in uniform, at time specified by senior cook.
F. Punch out at scheduled time or when directed to do so by senior cook.

EXHIBIT 4.--Work sampling observation record and tally sheet

Residence Hall _____

Date _____

Shift	Staff Member Observed					
Random Time						

Work Activity	Tally	
	Cooks	Students
1 Food Preparation		
2 Cleaning Equipment and Work Surfaces		
3 Supervision		
4 Processing Papers and Records		
5 Conferences and Discussions		
6 Operation of Equipment		
7 Reading Recipes and Cooks' Worksheets		
8 Checking Refrigerator or Storeroom		
9 Watching Food Cook		
10 Pre-preparation of Food		
11 Personal Time		
12 Idle		
13 Search		
14 Transporting		
15 Walking With a Load		
16 Walking Without a Load		
17 Janitorial Work		
Totals		

Comments _____

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