/OCCURRENCE SAMPLING TO MEASURE ENTREE PRODUCTION IN A UNIVERSITY RESIDENCE HALL FOODSERVICE/

by

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INTRODUCTION

In the late nineteenth century, Frederick Taylor (1), the father of scientific management, said "to manage we first must measure." Work measurement has been recognized by industry for many years as one of the powerful tools in auditing labor and machine utilization. Without measurement, the manager cannot exert effective corrective control (2).

The foodservice industry is a labor intensive industry. Together with other major industries, foodservice is facing pressure from the constant economic, political, social, and technological changes. These changes demand increased productivity. Foodservice administrators today need to improve productivity through the optimum utilization of both human and material resources (3). Channon (4) emphasized that for maximum effect, productivity must become a way of life for every manager.

In comparison with other industries, foodservice lags in identifying production labor times (5). Rose (6) asserted that labor costs are the single most significant expense in a hospital foodservice operating budget. He stated that indirect labor costs such as training, turnover, and unproductive practices are seldom measured, but in these categories dramatic savings frequently may be realized. Increasing labor costs and demand for quality production and service require foodservice administrators to collect data on labor utilization for purposes of increasing productivity. The foodservice industry should adopt industrial work measurement techniques to establish a data base on labor utilization in foodservice operations.

Work measurement is a technique to establish an equitable relationship between the amount of work performed and the manpower expended (7). Numerous work measurement techniques exist; some provide only quick estimates and others yield highly accurate data. The selection of an appropriate technique depends on the nature of work being measured, the degree of precision desired, and the availability of human and technical resources (8). Work measurement can be applied to foodservice operations for a variety of purposes. Data from work measurement can be used to calculate, control, and evaluate labor and material costs, establish staffing requirements, set production time standards, and schedule work (7, 9).

In the limited literature on work measurement in the foodservice industry, few studies are reported on measurement of work functions in entree production. Assessment of time requirements with particular emphasis on analysis of work within the entree production unit is needed.

The purpose of this study was to measure work functions involved in entree production. Specific objectives were:

- to apply occurrence sampling to measure the work distribution in entree production in a university residence hall foodservice,
- to analyze work functions in entree production, and
- to establish time requirements for selected entrees.

REVIEW OF LITERATURE

Coulomb, as early as the eighteenth century, used a stopwatch to establish the time required to perform a given task. Early in the twentieth century, Taylor developed the first definitive approach to work measurement (2). Frank and Lillian Gilbreth invented the name "therblig," their name spelled backwards, to describe the basic elements of an operation. Therbligs led to the classification for work measurement as it is known today (10).

Freshwater and Bragg (12) stated that the standard unit of measurement for employee productivity is man-hour or man-minutes. They maintained that labor productivity measures must be expressed in terms of minutes or hours to achieve stability. Output of foodservice work measurements may be expressed as minutes of labor time per meal served, meals per man-hour, output per sales dollar, or output per full time equivalent worker (7, 13).

David (7) defined work measurement as a method to establish an equitable relationship between the amount of work performed and the manpower used to complete that work. Tucker and Lennon (11) described work measurement as a technique to determine the amount of time required to perform a task or produce a unit of output. The major concepts in both definitions are time and output.

Several approaches to work measurement in foodservice management are described in the literature. The three principal methods of work measurement are time study, predetermined time systems, and occurrence sampling (10). These methods are reviewed in this paper.

Time Study

Time study is one of the most widely used work measurement techniques associated with foodservice system management. In time study the observer uses a stopwatch to determine the amount of time required to perform a specific task by a trained employee working at a normal pace (3). This method involves recording the time of a series of sequential observations (10).

Three types of stopwatch time studies are reported: continuous one-watch system, snapback one-watch system, and three-watch system. Continuous one-watch system involves the use of one watch with continuous hand movement. Snapback one-watch system is repetitive timing which uses one watch with snapback, and three-watch system yields accumulative timing using three watches with snapback (10, 35). The use of the continuous one-watch system requires the observer to subtract finished time from beginning time. Times are recorded directly by the observer in the snapback one-watch system and no subtraction is needed. Using the snapback one-watch system may result in not having a complete account of all the times, especially for tasks with a short cycle. The three-watch system involves the use of three watches controlled by the same lever. In recording a task, the first watch moves to zero, the second watch starts recording, and the third watch stops at a time. The three-watch system yields better recording accuracy than the continuous one-watch or snapback one-watch system (10). Two basic requirements to establish standard data using a time study method are selecting an average experienced worker and rating the speed or performance of the worker. Standard data are then developed by adjusting the recorded time using a rating factor (10, 11).

Time study can provide detail and accurate information about work activities but may be time-consuming and costly, and employees may object to working against a stopwatch (8). A review of work measurement studies in foodservice using time study is presented in Table 1. Content of the tables in the review of literature is to summarize the objectives and results of the research.

Predetermined Time Systems

The primary purpose of Predetermined time systems (PTS) is to provide a method of establishing the cycle time of an operation without actually performing the task. Predetermined times for the basic motions that comprise the cycle are summed (23). PTS are an organized body of information procedures and techniques employed in the study and evaluation of work elements. Components of PTS include method or motions used, their general and specific nature, the conditions under which they occur, and the application of prestandardized or predetermined times which their performance requires (2).

Stokes (8) stated that PTS can yield highly precise data and be made with a minimum amount of disturbance to the employee in the course of his/her duties. However, PTS is a time-consuming and expensive technique, especially when the system is developed, and requires specific training.

Several types of PTS are reported. The most popular systems used in foodservice operations are Methods-Time Measurement (MTM) and Master Standard Date (MSD).

Methods-Time Measurement

The original Methods-Time Measurement (MTM) technique, MTM1, was developed in 1948. Motions were divided into ten categories: reach, move,

Table 1. Summary of selected studies using time study to measure work in foodservice systems

researcher/year	foodservice system	objective(s)	results
Enoch and Yoder/1932 (14)	hospital	To measure the quality and quantity of work in a dish-washing unit by full-time and part-time employees.	Quality and quantity of work done by full-time employees was superior to that done by the part-time employees.
Stumpf and Donaldson/1957 (15)	hospital	To investigate the feasibility of using work measurement technique to control labor time in food production.	Percentage distribution for production time by type of work in vegetable, entree, and salad items was similar.
Mastin and Ferrell/1964 (16)	hospital	To measure cafeteria labor activities.	Job descriptions were changed and job efficiency improved in cafeteria activities.
Montag et al./ 1967 (17)	hospital	To compare economic advantages between labor and selected labor saving machines.	A procedure was developed for comparing labor and machine.
Heinemeyer and Ostenso/1968 (18)	hospital	To assess whether or not central inventory control system saved labor time in food production.	Significant differences were reported in five direct work function categories between conventional and central methods of inventory control systems. Initiation of a central ingredient unit caused a shift of direct labor time to delay time for cook positions.

Table 1. (cont.)

researcher/year	foodservice system	objective(s)	results
Smith/1972 (19)	university foodservice	To develop a standard time for selected elements involved in preparing roast beef sandwiches.	The time required for assembling twenty-four roast beef sandwiches was 9.58 minutes.
Connelly/1972 (20)	university foodservice	To estimate, through the use of elemental time, the relationship of time, volume, and pan size to selected recipe processing steps.	Effects of number of cooks and servings had significant influences on the average time required in selected processing steps.
Lebeau/1974 (21)	university foodservice	To compare labor time estimates derived by time study with those developed by conceptual estimation for the performance of selected food production tasks.	Major differences existed between the two methods and consistent results were not reported.
Hauge and Knickrehm/1979 (22)	university foodservice	To evaluate the relationship between total production time for various salads and the number of servings prepared.	Changes in quantity was not consistently the factor most associated with changes in production time; quality and the type of ingredients also influenced amount of time required.

turn, apply pressure, grasp, position, release, disengage, body motions, and eye motions. Times for each of these are recorded in time measurement units (TMU). One TMU is .000010 hour, and one minute consists of 1,667 TMU (10).

General Purpose Data MTM system (MTM-GPD) was developed in 1963. MTM2 is similar to MTM1, and the two key motions are categorized as get and put. This special technique is best suited for work activities that are not highly repetitive. MTM3 is suitable for long cycle, short-run activities, with handle and transport as the two major motions (10, 24).

Konz (10) stated that occasional work, compared to repetitive work, will not meet the MTM standard. He suggested additional time be given to any work consisting of less than 2,000 cycles. A cycle is defined as a series of work elements in a production process; each time the series is repeated another cycle has been completed (11).

Master Standard Data

Master Standard Data (MSD) was developed by Crossan and Nance in 1962 (25). MSD is a consistent, economical technique with a built-in performance rating factor suitable for usage on long cycle, nonrepetitive work (26). Based on MTM, MSD involves constructing an alpha-mnemonic code using seven basic elements: obtain, place, rotate, use, finger shift, exert force, and body motions (25). The procedure for using MSD involves recording motions of the operator and assigning symbols and time to each motion (26).

Other PTS include the work factor system developed in 1938, the basic motion time study (BMT) in 1953 in Canada, and the modular arrangement of predetermined time standards in 1966 (24). Predetermined time system is becoming more popular in foodservice system work measurement, especially

in developing standards for specific work function activities. Waldvogel (27) developed an universal alpha-mnemonic code for quantity food entree production. Production activities were divided into general categories, each of which was assigned one letter of the alphabet to describe and identify the basic element. Second and third letters were added to the code. The second letter described the tool or ingredient used and the third letter identified the place from which the item was obtained. A synopsis of work measurement studies in foodservice system management using PTS is presented in Table 2.

Occurrence Sampling

Occurrence sampling, a work measurement technique, is known also as work sampling and activity sampling (34). This method involves non-sequential observations at random times (10). First used by Tippet in the British textile industry, occurrence sampling was introduced into the United States under the name of "ratio delay" in 1940 (24). A large number of instantaneous observations are required for this technique. The state or condition of the object of study is noted and this state is classified into predefined categories of activity pertinent to the particular work situation. From the proportion of observations in each category, inferences are drawn concerning the total work activity under study (35). The underlying theory of occurrence sampling is based on the statistical evidence that unbiased samples reveal the same distribution of time that would have been observed during a complete time study (7). Occurrence sampling usually consists of making observations at random time intervals. Some research has been reported for non-repetitive situations using a fixed interval time for observations (36).

Table 2. Summary of selected studies using predetermined time systems to measure work in foodservice systems

researcher/year	foodservice system	objective(s)	results
Beach and Ostenso/1969 (28)	hospital	To test the hypothesis that Methods Time Measurement (MTM) could be used to accurately estimate normal performance time for entree serving cycles in a cafeteria.	The sum of MTM mean element times composing each serving cycle was equivalent to the mean stopwatch time.
Fannan/1973 (29)	university foodservice	To develop a foodservice productivity index using MTM.	MTM allowed times and actual seconds required for the performance of vegetable preparation tasks in most cases did not agree. MTM time appeared to be less than the actual time.
Waldvogel and Ostenso/1977 (30)	university laboratory	To apply Master Standard Data (MSD) Quantity Food Production Codes to establish relationship between production time and total volume for two entrees.	Labor time per portion decreased as total production volume increased. Decrease in time per portion related to volume increase in an exponential manner.
Matthews et al./ 1978 (27)	university laboratory	To predetermine production labor time required using MSD Quantity Food Production Codes.	Macro elements developed for this study were applied to entree formulas to determine production time requirements.

Table 2. (cont.)

researcher/year	foodservice system	objective(s)	results
Matthews et al./ 1978 (31)	university laboratory	To predict production time requirements for different quantities of menu items and to assess the feasibility of producing different menu item mixes by utilizing MSD.	Roast and single-item entrees required greater average handling times than combination entrees. Process time for combination and single-item entrees increased as forecasted demand increased. The time for the single-item classification doubled for quantity menu items exceeding oven capacity.
Zemel and Matthews/1982 (32)	hospital	To estimate labor production time for roast entrees in hospital foodservice by using MSD.	Increases in labor time occurred for 125, 225, and 325 portions and were due to increased handling of containers and pans by employees.
Zemel and Matthews/1982 (33)	hospital	To apply MSD Quantity Food Production Codes to production of roast entrees.	Median production times by stopwatch for 200 portions of roast entrees exceeded MSD-predicted time by 25 minutes.

Occurrence sampling is widely used because it gives a representative sample in a short period of time with reasonable cost (10). This work measurement technique can usually be completed in seven to fourteen days, the observer requires minimum training, and accuracy of data can be determined. Since observations may be included for inadequately trained and unmotivated employees, standards established by this technique may include inefficiencies (12).

In occurrence sampling, the researcher must have some training in sample size determination and in the interpretation of sample results. Also, the observer must be able to identify the activities being performed at the time the observation is made (37). According to Barnes (24), occurrence sampling is a fact finding tool with three major uses that include activity and delay sampling, performance sampling, and the establishment of a time standard of an operation.

In studies associated with efficiency in foodservice systems, occurrence sampling is reported frequently in the literature. In 1967, the Department of Foods and Nutrition at the University of Wisconsin published a methodology manual for work sampling of dietary personnel (37). This manual has been widely adopted by foodservice systems in measuring work. A summary of work measurement studies using occurrence sampling in foodservice systems is presented in Table 3.

A review of the literature indicated that little research has been reported on the measurement of entree production tasks using the occurrence sampling technique. Most of the studies of entree production have used time study or PTS techniques and have focused on a small number of specific entree items (26, 27, 30, 50).

Table 3. Summary of selected studies using occurrence sampling to measure work in foodservice systems

researcher/year	foodservice system	objective(s)	results
Schell/1962 (38)	hospital	To obtain detailed analysis of labor requirements in food preparation and service.	The factors which influenced the required number of minutes per ration were size of hospital and type of tray service.
Schell and Korstad/1964 (39)	hospital	To test the feasibility of measuring work of food-service personnel in two hospitals.	Occurrence sampling was feasible for measuring work of foodservice personnel. Measurement of work was similar in the major work function categories in the two hospitals.
Sanford and Cutlar/1964 (40)	university foodservice	To assess the feasibility of using occurrence sampling to measure time distribution for activities of foodser-vice managers.	Occurrence sampling technique was suitable for measuring managerial activity.
Marteney and Ohlson/1964 (41)	hospital	To measure and analyze the activities of professional dietitians.	Half of the time spent by dietitians was involved with supervision and patient care factors.

Table 3. (cont.)

researcher/year	foodservice system	objective(s)	results
Brown/1964 (42)	university foodservice	To investigate the effectiveness of work sampling as a technique for use in residence hall foodservice and to determine the division of employee labor time in the cooking unit.	Little difference existed among positions in the amount of time expended in the three major categories; food production activities ranged from 36.1 to 41.1%, support activities 33.6 to 37.2%, and unproductive activities 22.6 to 26.8%.
Bonini et al./ 1967 (43)	hospital	To measure time hospital dietary employees spent in productive, nonproductive, and personal activities, and to improve staffing patterns.	Sixty-five percent of employees' total time was spent on productive activities, 14% and 21% on nonproductive and personal activities, respectively.
Zolber and Donaldson/1970 (44)	hospital	To compare percentage distribution of work function activities and labor time in three with different production systems.	Significantly less total time was expended in two of the three assembly-serve systems than in the conventional production system.
Pyles/1970 (45)	school foodservice	To apply occurrence sampling technique to school foodservice and to calculate the percentage distribution of work functions and labor minutes per meal.	Occurrence sampling technique was feasible for use in a school foodservice. Time spent in direct work, indirect work, and delays were 80.5%, 5.6%, and 14%, respectively.

Table 3. (cont.)

researcher/year	foodservice system	objective(s)	results
Bryant/1977 (46)	university foodservice	To test adaptability of an occurrence sampling methodology to the staffing analysis of a university foodservice.	Time spent in direct work was 62%, indirect work was 32%, and delays were 6%.
Ho and Matthews/ 1978 (34)	nursing home	To examine the distribution of labor time in foodservice systems in two nursing homes with similar characteristics.	In both homes, approximately 81%, 9%, and 10% of total labor time was spent in direct work, indirect work, and delays, respectively. Mean labor minutes per meal equivalent were similar.
Carroll and Montag/1979 (36)	hospital	To determine labor time required to prepare 59 selected menu items in cook-freeze and cook-serve systems.	A reduction of one-tenth of a minute per serving in labor time was reported for the cook-freeze system. The time spent on productive and non-productive activities for the cook-freeze system was 84% and 16%; for the cook-serve system, 89% and 11%, respectively.

Table 3. (cont.)

researcher/year	foodservice system	objective(s)	results
Elliston/1980 (47)	hospital	To identify labor time distribution and to measure labor and cost by position for 20 work functions.	Phase I study in 1969 reported direct work as 84.9%, indirect work as 6.3%, and delays as 8.8%; phase II in 1980 identified major work functions as 83%, 7%, and 10%, respectively.
Yung et al./1980 (48)	nursing homes	To compare the relationship in minutes per meal equivalent for similar foodservice systems.	Significant differences were reported in minutes per meal equivalent for the three major work categories. Mean time spent in direct work was 72.6%, indirect work was 9.7%, and delays were 17.7%.
Block/1982 (49)	university foodservice	To develop a method to establish time standards for vegetable preparation.	Time standards were established for minutes per pound and minutes per purchase unit for cleaning of six vegetables. Time spent on direct work was 57.5%, indirect work was 14.8%, and delays were 27.7%.

Connelly (20) employed continuous stopwatch time studies in collecting data on the panning of pork chops and dredging and panning of cubed meat. The purpose of her study was to estimate, through the use of elemental times, the relationship of time to volume and pan sizes.

Ruf and Matthews (26) utilized MSD to synthesize total production times for preparing hot soya-beef sandwich. Waldvogel and Ostenso (30, 50) developed a MSD Quantity Production Code that could be used to predetermine labor time in quantity food production. These codes were applied to calculate labor time for preparing baked liver, breaded baked pork chops, and meat balls with mushroom sauce. The procedure was used also to determine the relationship between volume and labor time required.

Matthews (27) applied the MSD Quantity Production Code to the production of six hot entree formulas. Hot entrees were divided into three classifications: single-item, combination, and roasts. The six entree formulas studied were oven fried liver, oven-fried chicken, baked beef macaroni, spaghetti neapolitan, roast beef, and roast pork. Average production time for each entree classification was calculated and related to volume.

Carroll and Montag (36) used fixed interval work sampling and stopwatch time study to determine labor time for preparing 59 selected entree items in cook-freeze and cook-serve systems of food production, and compared scheduled labor time per serving of all items produced in each system. Zemel and Matthews (32, 33) applied the MSD Quantity Food Production Code to entree production in an actual foodservice operation and compared MSD derived production times with times from stopwatch studies of roast beef, veal, lamb, pork, turkey, and ham produced by foodservice personnel under usual operating conditions. Results were

compared with other published times for producing roast entrees in foodservice.

METHODOLOGY

Occurrence sampling was chosen as the method of work measurement for the study because the procedure can be accomplished in a short period of time and a representative sample can be obtained at a reasonable cost (10, 12). Distribution of work functions in a production area was analyzed using the technique developed by the Department of Foods and Nutrition at the University of Wisconsin (37). Observations were recorded and coded for all work activities in the production area. Menu items included hot entree items, vegetables, soups, and salad plates. Production time requirements were estimated for hot entrees.

Hot entree items were classified and coded into three categories for the purpose of data analysis. Entree classification was based on the research conducted by Matthews et al. (27) to apply Master Standard Data Quantity Production Code to the preparation of six entree formulas. Entrees were classified as single-item, combination, or roast. A single-item entree was defined as a menu item requiring individual handling of each portion. A combination entree was defined as one composed of multi-ingredients requiring various handling procedures in preparation. A roast was defined as a large cut of meat that was baked whole and then portioned. All entree items were reviewed and classified into the three categories.

Sixteen entrees were selected for study. Single-item entrees investigated were baked pork chop, baked pork steak, chicken cutlet, country fried steak, fish sandwich, french fried fish, and liver with onions. Combination entrees were beef burger pie with cheese puff

topping, beef noodle casserole, beef stew, cheese souffle, chimichanga, and tacos. Roasts included beef, turkey roll, and smoked beef. A copy of the menu for the observation period is included in Appendix A.

Work Functions

The work functions of this study were those used in the Wisconsin methodology manual (37). A copy of the work functions classification and definitions are included in Appendix B.

The three major work functions are direct work, indirect work, and delays. Direct work functions are defined as any essential activity contributing directly to the production of the end product (37). For this study, direct work functions included prepreparation, preparation, service, and transportation of food.

Indirect work functions are defined as any catalytic activity which contributes to production of the end product (37). The indirect work function for this study consisted of transportation of objects other than food, transportation empty, and activities related to clerical or communication, cleaning, housekeeping, instruction or teaching, and appraisal.

Delays are defined as any time any employee is scheduled to be working and is not engaged in either direct or indirect work functions (37). Delays include categories of forced delays, personal delays, and idle time. Forced delays are time an employee is not working due to an interruption beyond his/her control in the performance of direct or indirect work functions. For example, delays due to power failure or faulty equipment were classified as forced delays. Personal delays are time an employee is not working and is away from his/her work area. Examples

of personal delays were meal breaks and coffee breaks. Idle time is any avoidable delays other than forced or personal delay that occurred for which the employee is responsible. Conversation not pertaining to work was an example of idle time.

Work function categories are composed of elements which are a group of similar activities that may be recognized by sight and may be considered homogenous to production (37). For this study, the elements were work activities that the observer recognized when the instantaneous observation was made. Examples of work function elements were adjusting cooking equipment, measuring, portioning, carving, moving food, cleaning counters, and meal breaks.

Development of Research Instrument

The research instrument was adapted from the Block (49) study method for establishing time standards for vegetable prepreparation. After preliminary observations and study, the research and recording instruments were developed.

Coding Guide

Codes were developed to identify employee number, work function category and element, ingredient, equipment, utensil, product number, and product category. The first set of codes identified the employee. Each employee was assigned a two digit code number. Employee numbers were assigned on the first day of observation and the same numbers were used for the employees for the total observation period. The next set of codes consisted of thirteen work function categories composed of 110 elements involved in food production in the cook's area. Each element was assigned

a four digit code number. The first two digits designated the work function category and the third and fourth designated the element within the category.

The third set of codes identified thirteen types of ingredients. Each type of ingredient was assigned a two digit code number. The fourth set of codes consisted of sixteen two digit code numbers for the equipment used in the production area. The fifth set of codes identified whether or not utensils were used when the element was performed and consisted of a one digit code number. The sixth set of codes identified the products prepared during the observation period. Each product was assigned a three digit code number. A total of 143 products were recorded. The last set of codes specified the three entree categories which were single item entree, combination entree, and roast; each category was assigned a one digit code number. A copy of the coding guide for the study is included in Appendix C.

Recording Methods

An instrument was developed to record data at each observation using the seven sets of codes in the coding guide. Spaces also were provided to enter the observation number, date, time and comments. The recording form had twenty-five columns:

Column	1 - 4	observation number
	5 - 6	observation date
	7 - 10	observation time
	11 - 12	employee number
	13 - 14	work function category
	15 - 16	work function element

17 - 18 ingredient

19 - 20 equipment

21 utensil

22 - 24 product number

25 product category

A copy of the observation recording form is included in Appendix D.

The second recording instrument consisted of a product information form and was developed to gather data on the entrees prepared during the data collection period. Product information was obtained from the computerized recipe and the daily production sheet in the cook's area in Kramer Food Center at Kansas State University. The product information form identified the product number which corresponded to the number on the observation recording form. Other data on the product information form included number of the computerized recipe, name of the recipe, number of portions, portion size, total recipe weight, and total number of portions prepared. A copy of the product information form is included in Appendix D.

Study Site

The study was conducted at Kramer Food Center at Kansas State University. Kramer Food Center provides meal service for 1,200 students who live in three adjacent residence halls. Three meals are served daily except for Sunday when only two meals are served. In the cook's area, six full time equivalents (FTEs) are scheduled for each weekday. On every other Friday, an additional worker is utilized. Four FTEs are scheduled on Saturday, and three FTEs on Sunday. In the cook's area, the first

shift is scheduled from 5:30 a.m. to 2:10 p.m., the second shift from 7:00 a.m. to 3:40 p.m., and the third shift from 10:20 a.m. to 7:00 p.m. On every other Friday, the seventh FTE is scheduled to work from 6:00 a.m. to 2:40 p.m. Students are scheduled to assist the full-time employees. Employees work every other weekend with days off during the week. Scheduled time away from the work center for each full-time employee includes two 20 minute meal periods, two 15 minute coffee breaks, and two 10 minute periods for uniform change. The meal periods are scheduled and unpaid, but the coffee breaks and time for uniform change are scheduled and paid. A copy of the work schedule in the cook's area for the period of data collection is included in Appendix E.

Pilot Study

Two pilot studies were conducted consisting of a one hour study in March and a five hour study in April. Data were collected according to the method described. Several modifications were made on the coding guide and data recording forms after the pilot studies for ease of use. Two new elements were added to prepreparation, one to preparation, and one to cleaning.

Data Analysis

Observations from the pilot study were entered into the computer; product information data were merged with the observation information. The purpose of integrating these two data sets was to relate the time and work function distribution to the entrees in establishing time requirements for producing the menu items. This was made possible by first calculating the total labor minutes and the total number of observations.

Direct work function elements were grouped by product numbers. Where elements could not be identified with a particular product number, the elements were allocated to the products according to the percentage of their occurrence during the period of observation as reported by Carroll and Montag (36).

The data on the product information form permitted the researcher to establish time requirements for specific entrees and to report the time requirements as minutes per serving or minutes per weight. During the pilot study, groupings by entree category could not be done since only a small sample was collected and only one entree item, turkey tetrazzini, was analyzed according to the above method. The pilot study consisted of a total of 2,043 labor minutes and 376 readings.

Statistical Analysis System (SAS), a packaged computer program, was used for data analysis (51). Frequencies obtained for each work function, element, and category were related to the product numbers. Cumulative recordings for each element and work function category were expressed as percentage of time and labor minutes spent in each of the three work functions.

Results

The results of the pilot study indicated that 64.6 percent of the total recordings during the observation period was allocated to direct work, 21.0 to indirect work, and 14.4 percent to delays. A detailed breakdown of distribution of labor time for each work function category and element is included in Appendix F. In the pilot study, 84.1 percent of the total labor time was worked by full-time employees, and 15.0 percent was by student helpers.

Data analysis of the pilot study indicated that 15.3 percent of the total recordings were related to the entree item, turkey tetrazzini, which was classified as a combination entree. Based on the product information form for turkey tetrazzini, the total time required to prepare 700 servings of turkey tetrazzini was 315 minutes. Further calculation indicated that it required 0.5 minute for one serving (.6 lb). A summary of labor time distribution in preparing turkey tetrazzini is included in Appendix F.

Number of Observations

The number of observations needed was calculated based on the results of the pilot study and the following formula (10):

$$A = z\sqrt{p\frac{(1 - p)}{n}}$$

where A = absolute accuracy desired

z = number of standard deviations for confidence level desired

p = mean percent occurrence

n = number of observations.

Delay percentage 14.4 was chosen as the mean percent occurrence because it was the limiting category and provided the greatest confidence. To maintain a confidence level of .95 with a relative accuracy of ± .90 when delay activities were 14 percent, the minimum number of readings required was 3258. The required number of readings was rounded to 3500 for ease of calculation and to ensure that the desired confidence and accuracy level was obtained.

A period of five days over two weeks time was selected for data collection. The five days were chosen to give a representative distribution of the three entree categories: single-item entree, combination entree and roast.

Dividing the 3500 readings by five days gave the required readings needed daily (700). Based on the pilot study, the researcher estimated that an average of four readings would be obtained each time an observation was made. Therefore, 175 observations were needed per day, with an average of one observation every five minutes. A computer program was used to generate 175 random times per day between 5:30 a.m. and 7:00 p.m. Military time was used in recording the observations.

Employee Orientation

An employee orientation session was conducted on September 12 at Kramer Food Center. The outline and format of the orientation were adapted from the suggestions in the Wisconsin methodology manual (37). The production dietitian, production supervisor, and cooks attended the session. The purpose of the orientation was to explain the objectives of the study and demonstrate how occurrence sampling works. The researcher emphasized in the orientation that it was not the purpose of the study to time how fast the employees were working. The employees were reassured that the purpose of the study was to observe the work activities involved in food production in the cook's area. A brief written summary identifying the main points of the orientation was given to each participant. Copies of the content outline of the orientation and the summary presented to the employees are included in Appendix G.

Data Collection

Data collection began on the second week of September 1983 for a period of five days over a two week span. On each of the five days, observation took place from 5:30 a.m. to 7:00 p.m. The five days for data collection were September 14, 16, 19, 20, and 22. The researcher was the principal observer and a senior dietetic student at Kansas State University was trained to be an assistant observer.

During the data collection period, a total of 3891 observations were made and 17,820 labor minutes (297 hours) worked. A total of 143 products were observed, and data concerning sixteen hot entrees were recorded. The sixteen hot entrees included seven single-item entrees, six combination entrees, and three roast entrees.

Data Analysis

The SAS program was utilized to analyze the data. To calculate work function distribution and to estimate the time requirements for the entrees, this procedure was used:

1. Calculate the total labor minutes worked during the observation period.
2. Sort each work function element recorded into the three major work functions, i.e., direct work, indirect work, and delays.
3. Express the sorted data as a percentage of total work and labor minutes spent in each work function category.
4. Calculate the occurrence percentage for each product and the percentage of observed direct and indirect work. Delays were allocated to each product according to its occurrence percentage.

5. Express the percentages of work functions for each product as percentages of labor minutes per serving.
6. Calculate the total labor minutes requirement for each product.
7. Sort the sixteen entrees into the three entree categories, i.e., single item, combination, and roast.
8. Calculate the percentage of work functions for each entree category and express them as percentages of direct and indirect work function and category and labor minutes.
9. Calculate total labor minutes worked as percentage of time worked by classification of employee.

RESULTS AND DISCUSSION

Cumulative recordings of work function elements were calculated and classified into thirteen work function categories and then into three major work functions: direct work, indirect work, and delays. Analysis of work functions provided information on percentage distribution of labor time in the production area and time requirements for entree production tasks.

Analysis of Work Functions

Analysis of labor time distribution showed that the largest percentage of time was spent in direct work. The percentage of labor time expended in direct work was 59.2 percent; indirect work 23.3 percent; and delays 17.5 percent (Table 4).

Percentage distribution for the three major work functions in the present study was proportionally similar to that reported by other researchers (34, 42, 45, 46, 47, 48). All of these studies reported the largest percentage of time in direct work, followed by indirect work, and delay. One difference in the present study was the classification of transportation of objects other than food, cleaning, and clerical activities as indirect work rather than direct work as in some of the preceding studies. This change would explain some of the higher percentages reported for direct work in earlier studies.

In this study, prepreparation and preparation categories represented the highest percentages of labor time. Since these activities contributed

Table 4. Percentage distribution and total minutes of labor time expended by work function and category

work function and category	N*	labor time	
		%	minutes
prepreparation	1,068	27.5	4,900
preparation	978	25.1	4,473
service	169	4.3	766
transportation (food)	91	2.3	410
total direct work	2,306	59.2	10,549
transportation (others)	100	2.6	463
transportation empty	24	0.6	107
clerical/communication	337	8.7	1,550
cleaning	99	2.5	445
housekeeping	329	8.5	1,515
instruction/teaching	6	0.2	36
appraisal	8	0.2	36
total indirect work	903	23.3	4,152
forced delays	27	0.7	125
personal delays	646	16.6	2,958
idle time	9	0.2	36
total delays	682	17.5	3,119
grand totals	3,891	100.0	17,820

*N = number of observations.

expressly to the production of menu items, it was expected they would consume the greatest amount of time.

Clerical or communication, housekeeping, transportation, service, and cleaning categories required decreasing amounts of time. This rank order was similar to the results of the research by Elliston (47) concerning cook's positions. Exceptions were that transportation required a higher percentage of time than preparation, and service was higher than clerical or communication. In other studies using similar techniques, transportation and cleaning usually represented the two highest percentages of labor time. This difference might be explained by the fact that the present study was conducted in only the cook's area while most other studies were conducted in all units of the foodservice facilities. Although the study was conducted without prior evaluation of the efficiency of work methods and generalizations should not be made on the basis of the results from a five-day sample, the relatively low percentage of all transportation activities (5.5%) as compared to similar studies suggested that planning and layout in the cook's area are efficient.

The Block study (49), a similar study conducted in the vegetable prepreparation area of a residence hall foodservice at the same university, reported lower percentages in both direct and indirect work, 57.5% and 14.8%, respectively, and a higher percentage in delays, 27.7%.

Direct Work

Of the total time, 27.5 percent and 25.1 percent were spent on prepreparation and preparation activities. These two categories consumed most of the time spent in direct work activities, and represented over 50 percent of the total labor time.

Indirect Work

Clerical or communication and housekeeping activities consumed most of the time in indirect work activities. These two categories represented more than two-thirds of the time expended by all indirect work activities.

Further analysis of the work function elements in the clerical or communication category revealed that the highest percentage of labor time was spent in talking related to work (3.8%), followed by reading recipes or the menu (2.3%) (Table 11, Appendix H). The considerable amount of time in work-related talk may either indicate an effective communication system within the cook's area to clarify information and reduce redundant work, or it may suggest unfamiliarity with production procedures requiring excessive verbal communication. Clarification of the reason for the amount of talking is needed. In the housekeeping category, cleaning installed equipment required the greatest amount of labor time. The relative large percentage of time consumed for this element (5.7%) may suggest a need to study effective use of the cook's time in cleaning activities. Cleaning counters represented 2.1 percent of the total labor time; few readings were recorded for other indirect work activities (Table 11, Appendix H).

Delays

Personal delays represented the highest percentage of time spent in delays (16.6%). In this study, personal delays were divided into scheduled unpaid (meal breaks), scheduled paid (uniform change, coffee breaks), and unscheduled paid (health related activities, apron change, adjusting hairnet). Limited readings were recorded for forced delays and idle time with a combined total of less than one percent.

A breakdown of scheduled personal delays is presented in Table 5. Percentage of labor time allowed for uniform change and meal and coffee

breaks were compared to the observed percentages. Employees did not fully utilize the 3.5 percent of allowed time for uniform change; only 1.1 percent was used. The data showed a 1.9 percent excess time spent in meal breaks, but the same percentage (1.9%) was short in time spent on coffee breaks. This may suggest that the employees combined the time allowed for meal and coffee breaks and took longer meal periods and shorter coffee breaks. Detailed percentage distribution of the number of elements in each work function are included in Table 11, Appendix H.

Table 5. Percentage distribution of labor time expended in scheduled personal delays.

work function category	observed labor time	allowed labor time	difference
		%	
personal delays			
scheduled unpaid			
meal breaks	9.9	8.0	+1.9
scheduled paid			
uniform change	1.1	3.5	-2.4
coffee breaks	3.3	5.2	-1.9
total	14.3	16.7	-2.4

Entree Production Times

Cumulative recordings of work function elements related to the sixteen entrees were identified. Percentage of labor time expended in direct and indirect work functions were calculated. Analysis of direct

and indirect labor time distribution revealed that the mean percentage expended in direct work was 96.3 percent and indirect work 3.7 percent (Table 6). Preparation (45.6%) represented the highest mean percentage of labor time spent in the production of the sixteen entrees, followed by prepreparation time (34.8%), and service (14.6%).

For both single-item and roast entrees, the largest percentage of labor time was spent in preparation, 60.4 percent, and 45.4 percent, respectively, but prepreparation consumed the highest percentage of time for the combination entrees (55.2%). For roast entrees, 38.8 percent of the labor time spent was in the service category. A breakdown of service activities for roast entrees revealed most of the time was spent slicing the finished product. A detailed percentage distribution of the number of elements in each work function for individual entrees are reported in Table 12, Appendix H.

To establish time requirements for the sixteen entrees, total labor minutes were divided by total number of portions prepared for each entree. Delay time was allocated to the estimated production times for each entree according to the occurrence percentage of the individual entree (Table 7).

The mean production time per serving for the sixteen entrees was 0.9 minutes. Minutes per serving for the sixteen entrees ranged from 0.4 to 3.5. Mean minutes per serving was similar to that found by Carroll and Montag (36). In a cook-serve system, they reported a mean minute per serving of 0.9 for 59 menu items.

The three products requiring the greatest amount of labor time were all in the combination entree category. Distribution of minutes per serving for the sixteen entrees is graphically presented in Figure 1. Fourteen of the sixteen entrees required a minute or less per serving

Table 6. Percentage of labor time distribution for sixteen entrees

work function and category	labor time: single-item entree		combination entree		roast entree		mean	std. error
	N*	%	N	%	N	%	%	%
prepreparation	82	33.5	257	55.2	29	15.8	34.8	11.6
preparation	148	60.4	145	31.1	83	45.4	45.6	8.6
service	2	0.8	18	3.9	71	38.8	14.6	12.4
transportation (food)	3	1.2	13	2.8	0	0.0	1.3	0.8
total direct work	235	95.9	433	93.0	183	100.0	96.3	2.1
transportation (others)	0	0.0	4	0.9	0	0.0	0.3	0.3
transportation empty	0	0.0	0	0.0	0	0.0	0.0	0.0
clerical/ communication	6	2.5	10	2.1	0	0.0	1.5	0.8
cleaning	0	0.0	3	0.6	0	0.0	0.2	0.2
housekeeping	4	1.6	16	3.4	0	0.0	1.7	1.0
instruction/ teaching	0	0.0	0	0.0	0	0.0	0.0	0.0
appraisal	0	0.0	0	0.0	0	0.0	0.0	0.0
total indirect work	10	4.1	33	7.0	0	0.0	3.7	2.1
grand totals	245	100.0	466	100.0	183	100.0	100.0	

*N = number of observations.

Table 7. Labor production times for sixteen entrees by category

entree category	portions prepared	minutes per product	minutes per serving	weight per serving (lb)	mean minutes per serving	standard error of mean
single-item entree					0.6	0.06
country fried steak	480	378	0.8	0.3		
liver with onions*	200	170	0.8	0.3		
baked pork steak	240	170	0.7	0.3		
baked pork chop	467	301	0.6	0.4		
fish sandwich†	500	278	0.6	0.2		
french fried fish	590	286	0.5	0.3		
chicken cutlet	598	232	0.4	0.3		
combination entree					1.4	0.49
cheese souffle	144	510	3.5	0.3		
chimichanga	665	1,428	2.1	0.3		
beef burger pie with cheese puff topping	600	610	1.0	0.4		
beef stew	350	239	0.7	0.6		
tacos	1,000	618	0.6	0.2		
beef noodle casserole	600	270	0.4	0.6		
roast entree					0.5	0.06
roast turkey roll	705	455	0.6	0.2		
smoked roast beef	1,050	540	0.5	0.2		
roast beef	984	417	0.4	0.2		
all sixteen entrees					0.9	0.20

*Production times for liver only.

†Production times for fish only.

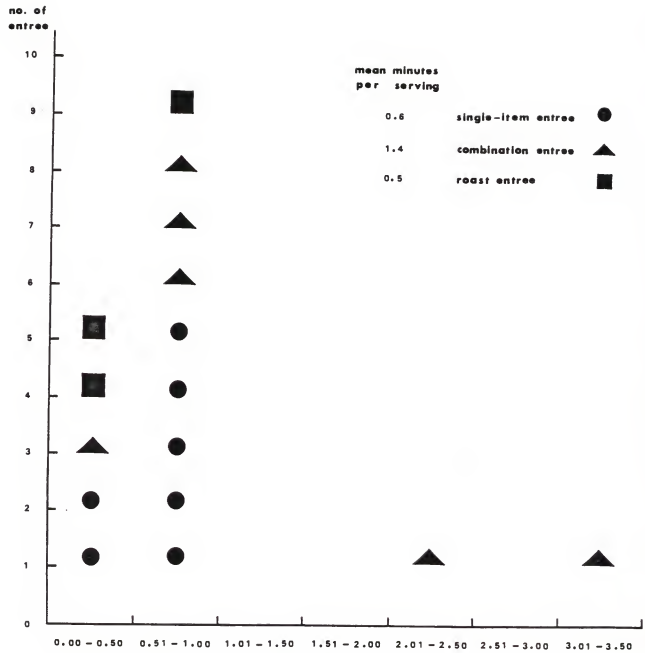

FIG. 1 Labor time requirements for sixteen entrees

(0.4 to 1.0 minutes). Two of the combination entrees required from 2 to 3.5 minutes per serving. Analysis of variance of minutes per serving for the three entree categories indicated that, at the 5 percent level, there were no significant differences in minutes per serving (Table 8).

Table 8. Analysis of variance for labor time spent in minutes per serving for three entree categories*

	degrees of freedom	mean square	F value
entree categories	2	1.24	2.15
error	15	0.58	
total	17		

*Single-item entree, combination entree, and roast.

Single-item entrees had a mean time per serving of 0.6 minute. Chicken cutlet required the least time (0.4 minute per serving), while country fried steak and liver with onions required the most time (0.8 minute per serving) for single-item entrees.

The mean minutes per serving for combination entrees was 1.4 minutes, the highest of the three entree categories. Beef noodle casserole had the lowest time requirement in this group (0.4 minute per serving), while cheese souffle (3.5 minutes per serving) and chimichanga (2.1 minutes per serving) were the two most time consuming items in this group and in all three entree categories. These two entrees contributed to the high mean minutes per serving for the combination entrees. Because of the time requirement per serving for cheese souffle and chimichanga, a need for further investigation of these two menu items is suggested. Extra

handling procedures and unfamiliarity with the recipe for both menu items, and the small number of servings for cheese souffle, could be some of the factors associated with the high production time requirements for these two entrees.

Roast items appeared to be the category with least variability. Roast entrees had a mean time requirement per serving of 0.5 minutes with a range of 0.4 to 0.6 minutes. Zemel and Matthews (32, 33) applied the Master Standard Data (MSD) Quantity Food Production Code to roast entree production in an actual foodservice operation and compared MSD derived production times with times from stopwatch studies of several roast entrees. They reported a mean of 49 minutes for 200 servings of roast entree (0.2 minute per serving). Matthews et al. (31) found roast and single-item entrees required greater average handling times than combination entrees. This does not agree with the findings in the present study which indicated the combination entrees had the highest mean minutes per serving of the three entree categories.

The study provided other information on the distribution of labor time in the main production area. The data revealed that 91 percent of the total labor time was contributed by full-time employees, 6.6 percent by student workers, and 2.4 percent by supervisory personnel. Over 50 percent of the time worked by supervisory personnel in the production area was observed between 11:00 a.m. to 1:00 p.m. and 4:00 p.m. to 6:00 p.m. This finding suggests a need for further study in staffing and scheduling, especially around serving times. Data from this study may also be utilized in establishing labor cost in relation to work function, entree categories, and individual entrees. Labor time requirements for

menu items other than the sixteen entrees prepared within the observation period are included in Table 13, Appendix H.

Results of the study indicated that occurrence sampling can be applied successfully to investigate work in a production unit in a university residence hall foodservice. The technique appeared to be useful in establishing time requirements for entree production. Information from this study could serve as a data base to develop time standards for entree production.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Occurrence sampling was applied in the main production area of a university residence hall foodservice to measure and analyze work function distribution and to establish time requirements for selected entrees. Work function classification was based on that developed at the University of Wisconsin (37). Entrees were classified into single-item entree, combination entree, and roast. The entree classification was adapted from research conducted by Matthews et al. (31). Seven single-item entrees, six combination entrees, and three roast entrees were investigated in the five-day study. Coding guides and observation recording forms were developed for data collection.

The production area was staffed by six full-time employees on weekdays with an additional employee scheduled every other Friday. Students were scheduled to assist the full-time employees.

A pilot study was conducted to evaluate the data collection technique and to provide information to determine the number of observations needed for the study. A total number of 3500 recordings were needed to maintain a confidence level of 0.95 with a relative accuracy of ± 0.90. Observers were trained prior to data collection. An employee orientation was conducted to introduce the objectives of the study and to demonstrate the principles of occurrence sampling.

Data collection covered a period of five days over a two week span in September. A total of 3,891 observations were made and 17,820 labor

minutes (297 hours) worked. Data for a total of 143 products were collected. Sixteen entrees, categorized into three groups, were further examined to establish production time requirements. A computer program was utilized to analyze the data. Cumulative percentage of labor time spent in work functions and related to the sixteen entrees was studied.

Results of the study indicated 59.2 percent of the total labor time was spent in direct work functions, 23.3 percent in indirect work functions, and 17.5 percent in delays. Examination of entree production times revealed that the preparation category represented the highest percentage of labor time spent for both single-item and roast entrees, but the pre-preparation category consumed the greatest amount of time for combination entrees.

The mean production time per serving for the sixteen entrees was 0.9 minute with a range of 0.4 to 3.5 and a standard error of ± 0.20. Mean time per serving for combination entrees was 1.4 minutes per serving, which was the highest among the three groups of entrees. Single-item entrees and roast entrees had mean times per serving of 0.6 and 0.5 minute, respectively. Analysis of variance indicated no significant differences at the five percent level for minutes per serving for the three entree categories.

Conclusions and Recommendations

Results from the study indicated the feasibility of using occurrence sampling to measure work function distribution in a university residence hall foodservice. Additional studies are recommended to investigate the work functions that may reflect a need for improvement, such as the relative high percentage of time spent in clerical or communication and

housekeeping activities. The researcher suggests the information from the study be utilized as a data base to establish time standards for entree production. Such standards would be beneficial for menu planning, production scheduling, and staffing. Further studies should cover a longer data collection period, preferably on consecutive days, to examine possible differences in labor time distribution due to variances in day of the week or menu. For comparison, collection and analysis of data from other types of foodservice operations is recommended.

Conclusive generalizations from the study are not recommended without further investigation. Studies using the same technique are recommended for different areas in residence hall foodservice to provide a composite picture of labor time distribution and to establish time requirements for various tasks.

Data for labor time distribution and production time requirements reflected productivity of the work unit studied. A manager needs to obtain such data periodically to maintain a current data base for efficient labor utilization and productivity.

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APPENDIXES

APPENDIX A

Menus for Meals Served During a Five Day Occurrence Sampling Study

Menus for Meals Served During a Five Day Occurrence Sampling Study*

Date	Breakfast		Entree	Potato or Substitute	Vegetable, Soup	Salad	Bread	Dessert
SEPT. 14 WED.	Orange or Blended Juice Ralston Breakfast Beef Patty Scrambled Eggs Orange Muffin Assorted Cold Cereal Toast, Jelly, Beverage	LUNCH	Fish Sandwich on a Bun w/ Lettuce Leaf & BBQ Chips Sarah's Salad Bowl		Fruit Shrub Fiesta Lima Beans	Salad Bar		Pumpkin Bar Popsicle Chilled Fresh Fruit
		DINNER	Roast Beef Beef Stew	Noodles Romanoff	Zucchini Squash Broccoli Spears	Salad Bar	Whole Wheat Rolls	Angel Delight Baked Apple
SEPT. 16 FRI.	Orange or Grape Juice Malt-O-Meal Sausage Patty Hash Browned Potatoes Bishop's Bread Assorted Cold Cereal Toast, Jelly, Beverage	LUNCH	Cheese Souffle Chicken Cutlet w/ Bun, Lettuce, & Potato Chips		Italian Tomato Soup Seasoned Cauliflower	Salad Bar		Coconut Cream Pudding Refresho Bar Chilled Fresh Fruit
		DINNER	Baked Pork Steak Chimichanga	Mexican Rice	Wax Beans Seasoned Peas	Salad Bar	French Bread	Fruit Pie Chilled Strawberries
SEPT. 19 MON.	Orange or Blended Juice Ralston Tator Tots Fried Eggs English Muffin Assorted Cold Cereal Toast, Jelly, Beverage	LUNCH	Beef Burger Pie w/ Cheese Puff Topping Summer Nut Tree Plate		Seasoned Carrots Corn Chowder	Salad Bar		Date Nut Bar Peanut Butter Chip Chocolate Pudding Chilled Fresh Fruit
		DINNER	Country Fried Steak Roast Turkey Roll	Whipped Potatoes w/ Gravy	Seasoned Peas Seasoned Turnips	Salad Bar	Hofman Rolls	Lemon Crunch Chilled Mixed Fruit
SEPT. 20 TUES.	Orange or Assorted Juices Oatmeal Sausage Links Pineapple Crunch Coffee Cake Fruit Plate Assorted Cold Cereal Toast, Jelly, Beverage	LUNCH	Beef Noodle Casserole Welch Rarebit		Chilled Lemonade Pepper Pot Soup	Salad Bar		Gingerbread w/ Whipped Topping Refresho Bar Chilled Fresh Fruit
		DINNER	Baked Pork Chop French Fried Fish	Rice Pilaf	Seasoned Asparagus Spears Vegetable Timbale w/ Mushroom Sauce	Salad Bar	Potato Rolls	Cream Pie Chilled Peach Slices
SEPT. 22 THUR.	Orange or Grape Juice Malt-O-Meal Egg a la Goldenrod Cinnamon Streusel Coffee Cake Canadian Bacon Assorted Cold Cereal Toast, Jelly, Beverage	LUNCH	Tacos Tuna Fish Salad Bowl		Chilled Apple Cider Refried Beans	Salad Bar		Vanilla Cream Pudding Fudgesicle Chilled Fresh Fruit
		DINNER	Smoked Beef Roast Liver & Onions	Tator Tots	Baked Acorn Squash Seasoned Italian Green Beans	Salad Bar	Poppy Seed Rolls	Cherry Cobbler Chilled Blackberries

*Kramer Food Center, Kansas State University.

APPENDIX B

Work Function Classification and Definitions

Work Function Classification and Definitions*

I. DIRECT WORK FUNCTIONS

Any essential activity contributing directly to the production of the end product (end product is total number of meals served per day).

A. Processing

Act of changing the appearance of a foodstuff by physical or chemical means.

1. Prepreparation or preliminary processing

Preliminary act or process of making ready for preparation, distribution, or service.

blanching	measuring	thawing
breading	mixing	washing
chopping	opening containers	weighing
coring	paring	looking in cupboard, refrigerator
cracking eggs	peeling	making salad dressing
cutting	shaping	portioning before preparation
dicing	shelling	preparing milk container for dispenser
eyeing	shredding	turning on coffee urn, steam table, or cooking equipment
grinding	sorting	
mashing		

2. Preparation or cooking

Final act or process of making ready for distribution or service.

braising	toasting
broiling	tossing salad
coffee making	putting ingredients in steam kettle
frying	putting product in cooking equipment such as: oven, steamer, steam kettles
grilling	removing product from cooking equipment
roasting	preparing leftovers for storage
seasoning	
stirring	

*Taken from the Methodology Manual for Work Sampling (37).

B. 3. Service

Act of preparing facilities for distribution and of portioning and assembling prepared food for distribution to patients and to cafeteria customers (to coffee shop also if dietary is responsible for operation of coffee shop).

setting up steam tables, cold counters, carts, trays, nourishment
securing ice for ward use
packaging eating utensils
folding napkins
portioning the finished product; carving
assembling trays
serving in cafeteria or tray service line
loading milk dispenser
loading trays on carts, dumb-waiter, or trayveyor

C. Transportation

Act of transporting food, supplies, or equipment from a location in one functional area to a designated location in another area within the department or to patients' wards.

4. Transportation of food

Act of moving food from a location in one functional area to a designated location in another area within the department.

delivery of food within the department
delivery of loaded food trucks to patient wards

5. Transportation of equipment, supplies, and other

Act of moving equipment, supplies, and other items from a location in one functional area to a designated location in another area within the department.

moving soiled equipment to washing area
removing dishes from tables in cafeteria

return of clean equipment to preparation or service area
moving paper goods and other supplies
moving garbage or trash
return of food trucks from patient wards
moving anything other than food or trays to patients or menu cards

6. Delivery of trays to patients (if this function is performed by dietary)

Act of removing patients' trays from food trucks, dumb-waiter or trayveyor, and carrying to patients' bedside.

delivery of tray to patients' room

7. Return of trays from patients (if this function is performed by dietary)

Act of removing trays from patients' bedside to food trucks; dumb-waiter on the ward.

return of tray from patients' rooms

8. Transportation empty

Act of moving without carrying or guiding anything from a location in one functional area to a designated location in another area within the department.

walking
unladen locomotion

D. 9. Clerical (routine)

Act of receiving, compiling, distributing, and storing of routine records of data and information necessary for operation of the department.

copy work
filing
maintenance request
payroll
posting
typewriting; use of other business machines
receiving messages by tube
recording time on time cards (signing in or out)
taking census
taking inventory
taking money in cafeteria
telephone calls (possibility of classification 14 or 20, if observer has some knowledge of conversation)

E. Cleaning

Act of removing soil or dirt to provide sanitary conditions for the use of equipment, facilities, and supplies.

10. Pot and pan washing

Act of scraping, washing, or rinsing quantity food containers and cooking utensils.

running water into pot and pan sink or machine
washing pots and pans
putting away clean pots and pans
draining water from pot and pan machine or sink

11. Dishwashing

Act of preparing for or removal of soil or dirt to provide sanitary conditions for use of tableware (china, silverware, glassware, and trays).

filling dish machine
stripping food trucks
scraping dishes
washing or rinsing silverware
operating dish machine
stacking dishes from dishrack
washing or rinsing glassware
washing trays
draining dish machine

12. Housekeeping

Act of removing soil or dirt to provide sanitary conditions for the use of installed and mobile equipment and facilities.

mopping and washing floors
preparing mop
cleaning walls
cleaning carts and food trucks
cleaning installed equipment
cleaning work counters
cleaning tables and chairs in dining rooms
dusting furniture
turning lights on or off
washing windows
sweeping floors
using garbage disposal (if separate from dish-washing procedure)
oiling equipment
adjusting equipment
sharpening equipment and tools
opening and closing windows
swatting flies
locking or unlocking doors and refrigerators

F. 13. Receiving

Act of acquiring, inspecting, and sorting food and/or supplies from an area outside the department.

inspection on delivery
storing
unpacking
reading bread orders
sorting and consolidating supplies

II. INDIRECT WORK FUNCTIONS

Any catalytic activity which contributes to production of the end product.

G. 14. Instruction or teaching

Act of directing or receiving direction by oral or written communication in a training or classroom situation or on the job.

on the job training
giving instructions
receiving instructions
teaching personnel in classroom
teaching patients in classroom
teaching staff or professional group in classroom
reading journals
reading directive from administration
reading menu
reading schedule
trying out new equipment

H. 15. Appraisal

Act of judging or estimating the value or amount of work in order to make decisions for future planning.

checking dishes for cleanliness
checking patient trays or trayline
inspection of area--sanitation and safety
inspection of food preparation
inspection of leftovers
researching for methods improvement
tasting food

I. 16. Conference

Act of oral communication with one or more persons in the form of a scheduled meeting.

counseling	meetings
interviews	meetings with salesmen

J. 17. Clerical (original or non-delegable)

Act of compiling and formulating management control records of data and information necessary for the operation of the department.

budget accounting	ordering food and supplies
menu and diet changes	time schedules
menu writing	writing specifications
diet writing	

III. DELAYS

All time when an employee is scheduled to be working and is not engaged in either a direct or an indirect work function.

K. 18. Forced delay

The time an employee is not working due to an interruption beyond his control in the performance of a direct or an indirect work function.

broken machine
power failure
faulty equipment
slow cafeteria line
assembly belt stops
wait for elevator
ward service--wait for assembling of trays

L. Personal and Idle Delays

The time an employee is not working due to personal delays or avoidable delays.

19. Personal delays

The time an employee is not working due to time permitted away from his work area.

coffee breaks
rest room
adjusting hairnet
putting on apron
drinking fountain
health and related activities such as washing hands

20. Idle Time

Any avoidable delay (other than forced or personal delay) that occurs for which the employee is responsible.

conversation not pertaining to business
reading newspaper
loafing

APPENDIX C

Coding Guides

Work Functions and Element Codes

DIRECT WORK

I. PREPREPARATION

0101 Adjusting cooking equipment
0102 Arranging
0103 Assembling
0104 Breading
0105 Chopping
0106 Combining
0107 Covering
0108 Cracking eggs
0109 Cubing/dicing
0110 Cutting
0111 Dipping
0112 Draining
0113 Dredging
0114 Emptying
0139 Gathering utensils/equipment for preprepearation
0115 Greasing
0116 Grinding
0117 Heating
0118 Kneading
0119 Mashing
0120 Measuring
0121 Opening containers
0122 Panning ingredients
0123 Portioning before preparation
0124 Removing
1038 Removing from storage
0125 Rolling
0126 Scrapping
0127 Searching
0128 Separating
0129 Shredding
0130 Slicing
0131 Soaking
0132 Stirring
0133 Thawing
0134 Turning on/off cooking equipment
0135 Washing/rinsing
0136 Weighing
0137 Whipping

II. PREPARATION

0201 Basting
0202 Broiling
0203 Brushing
0204 Covering
0205 Frying
0206 Draining off fat/liquid
0208 Garnishing
0209 Grilling
0210 Inspection on cooking process
0211 Inspection on product temperature
0212 Panning/portioning food for service
0219 Panning for storage
0213 Preparing leftovers for storage/service/disposal
0214 Putting in cooking equipment
0215 Removing from cooking equipment
0216 Seasoning
0217 Tossing salad
0220 Trimming off fat
0218 Stirring while cooking

III. SERVICE

0306 Assembling sack lunch
0301 Carving/slicing
0305 Inspection of food for service
0302 Portioning the finished product
0304 Putting food into holding units/refrigerator
0303 Setting up steam tables/carts

IV.A. TRANSPORTATION OF FOOD

0401 Moving food

INDIRECT WORK

IV.B. TRANSPORTATION OF OTHERS

0402 Moving equipment/utensils
0403 Moving soiled to washing area
0404 Moving garbage or trash
0405 Moving anything other than food

V. TRANSPORTATION EMPTY

0501 Unladen locomotion

VI. CLERICAL OR COMMUNICATION

0601 Attending scheduled meeting
0602 Communication by intercom.
0603 Punching in/out on time cards
0604 Reading menu/memo/recipes/schedules/production sheet
0605 Taking census
0606 Taking inventory
0607 Writing
0608 Talking related to work

VII. CLEANING

0701 Washing cooking utensils
0702 Drying cooking utensils
0703 Putting away cooking utensils
0704 Gathering cleaning utensils

VIII. HOUSEKEEPING

0801 Cleaning carts
0802 Cleaning counters
0803 Cleaning installed equipment
0804 Cleaning walls
0805 Adjusting/assembling equipment after cleaning
0806 Sharpening equipment and utensils
0807 Sweeping/mopping floors
0808 Using garbage disposal

XI. INSTRUCTION OR TEACHING

0901 Giving instruction
0902 On the job training
0903 Receiving instruction
0904 Teaching dietetic students

X. APPRAISAL

1001 Checking dishes/equipment for cleanliness
1002 Inspection of food preparation
1003 Inspection of leftovers
1004 Tasting food

DELAYS

XI. FORCED DELAYS

1101 Called to work in another department
1102 Faulty equipment
1103 Power failure
1104 Waiting for elevator

XII. PERSONAL DELAYS

1201 Adjusting hairnet
1202 Health and related activities
1203 Meal breaks
1204 Putting on/taking off apron
1205 Putting on/taking off uniform
1206 Waiting to check out
1207 Coffee breaks

XIII. IOLE TIME

1301 Conversation not pertaining to work
1302 Reading newspaper
1303 Loafing

Ingredient, Equipment, Utensil, and Product Category Codes

Ingredient Codes

01 - meat
02 - eggs/cheese
03 - vegetable
04 - bread
05 - dry ingredient
06 - liquid ingredient
07 - mixed ingredient
08 - finished product
09 - pasta/rice/cereal
10 - fruit
11 - frozen ingredient
12 - no ingredient
13 - unknown ingredient
14 - canned ingredient

Equipment Codes

01 - grill
02 - deep fat fryer
03 - electric frying pan
04 - steam jacket kettle
05 - oven
06 - scale
07 - slicer
08 - refrigerator
09 - mixer
10 - can opener
11 - chopper
12 - cart
13 - container
14 - steamer
15 - no equipment

Utensil Codes

1 - yes
2 - no

Product Category Codes

1 - single-item entree
2 - combination entree
3 - roast

APPENDIX D

Observation Recording Form and

Product Information Form

Observation Recording Form

Comments																											
Prod. Category																											
Product Number																											
Utensil																											
Equipment																											
Ingredient																											
Work Function Element																											
Work Function Classification																											
Employee Number																											
OBSERVATION Time																											
OBSERVATION Date																											
OBSERVATION Number																											

Product Information Form

Product Number					
No. of Recipe					
Name of Recipe					
No. of Portions					
Portion Size					
Total Recipe Wt.					
Portions Prepared					

APPENDIX E

Cook's Area Employee Schedule

Cook's Area Employee Schedule*

work schedule	employee number	9/14 Wed	9/16 Fri	9/19 Mon	9/20 Tues	9/22 Thur
a.m. p.m. 5:30 - 2:10	1					
5:30 - 2:10	2				X	
10:20 - 7:00	5			X		
10:20 - 7:00	6		X			
10:20 - 7:00	7					X
7:00 - 3:40	9	X				X
10:20 - 7:00	10	X			X	
relief	3	7:00 - 3:40	6:00 - 2:40	X	5:30 - 2:10	7:00 - 3:40

*Kramer Food Center, Kansas State University.

APPENDIX F

Summary of Pilot Study Results

Table 9. Percentage distribution and total minutes of labor time expended by work function and category

work function and category	N*	labor time	
		%	minutes
prepreparation	188	50.0	1,022
preparation	44	11.7	239
service	2	0.5	11
transportation (food)	9	2.4	49
total direct work	243	64.6	1,321
transportation (other)	7	1.9	38
transportation empty	5	1.3	27
clerical/communication	26	6.9	141
cleaning	17	4.5	92
housekeeping	21	5.6	114
instruction/teaching	3	0.8	16
total indirect work	79	21.0	434
personal delays	54	14.4	294
meal breaks	47	12.5	255
other personal delays	7	1.9	39
total delays	54	14.4	294
grand total	376	100.0	2,043

*N = number of observations.

Table 10. Percentage distribution of work function category and element in the preparation of turkey tetrazzini*

work function category and element	labor time distribution
	%
prepreparation	70.8
adjusting cooking equipment	1.7
assembling	1.7
chopping	15.5
combining	1.7
draining	3.4
opening containers	8.7
shredding	1.7
slicing	12.1
weighing	6.9
removing from storage	3.4
preparation	19.0
inspection on cooking process	3.4
panning food for service	1.7
putting in cooking equipment	10.3
stirring while cooking	3.4
clerical/communication (reading recipes)	1.7
cleaning (washing utensils)	3.4
housekeeping	3.4
cleaning counters	1.7
cleaning installed equipment	1.7
instructing/teaching (receiving instruction)	1.7
total	100.0

*Servings prepared: 700
Labor minutes per 700 servings: 315
Labor minutes per serving (0.6 lb): 0.5

APPENDIX G

Employee Orientation Outline and Summary

Outline for Employee Orientation Session

1. Objectives of the study.
2. Methodology of the study.
3. Explanation of occurrence sampling technique.
4. Demonstration of how occurrence sampling works.
5. Reassurance of employee job security.
6. Schedule for data collection.
7. Introduction of persons collecting data.

Summary for Employee Orientation Session

KRAMER FOOD CENTER

OCCURRENCE SAMPLING STUDY

WHEN: 5:30 a.m. to 7:00 p.m.

Sept. 14 Wednesday

Sept. 16 Friday

Sept. 19 Monday

Sept. 20 Tuesday

Sept. 22 Thursday

WHERE: In the Cook's Area at Kramer Food Center

HOW: Occurrence sampling - instant observations

WHY: To determine the distribution of work activities in food production

WHO: Main observer - Vivien Choi

Assistant observer - Kim Potter

WHAT do you need to do?

1. Do your job as you always perform it.
2. Occasionally, help observers to clarify an observation by answering her questions.
3. Save the recipes; put them in the box.

THANK YOU

APPENDIX H

Supplemental Tables
(Tables 11-13)

Table 11. Number of recordings and percentage distribution of work in categories and elements

work function category and element	N	labor time (%)
prepreparation		
0103 assembling	169	4.3
0138 removing from storage	103	2.7
0139 gathering utensils/equipment	102	2.7
0122 panning ingredients	86	2.2
0106 combining	83	2.1
0121 opening containers	80	2.1
0130 slicing	59	1.5
0128 separating	52	1.3
0136 weighing	46	1.2
0104 breading	31	0.8
0105 chopping	33	0.8
0129 shredding	27	0.7
0112 draining	20	0.5
0120 measuring	21	0.5
0127 searching	20	0.5
0101 adjusting cooking equipment	14	0.4
0114 emptying	16	0.4
0115 greasing	16	0.4
0125 rolling	15	0.4
0108 cracking eggs	11	0.3
0111 dipping	8	0.2
0116 grinding	8	0.2
0117 heating	7	0.2
0102 arranging	3	0.1
0107 covering	3	0.1
0110 cutting	2	0.1
0119 mashing	3	0.1
0123 portioning before preparation	5	0.1
0124 removing	3	0.1
0131 soaking/marinating	5	0.1
0132 stirring	4	0.1
0133 thawing	3	0.1
0134 turning on/off cooking equipment	5	0.1
0137 whipping	5	0.1
total	1068	27.5
preparation		
0212 panning/portioning for service	197	5.1
0205 frying	183	4.7
0213 handling leftovers	168	4.3
0218 stirring while cooking	102	2.6

Table 11. (cont.)

work functions	N	labor time (%)
preparation (cont.)		
0214 putting in cooking equipment	95	2.4
0215 removing from cooking equipment	79	2.0
0210 inspection on cooking process	42	1.1
0211 inspection on product temperature	27	0.7
0204 covering	22	0.6
0208 garnishing	22	0.6
0220 trimming fat	16	0.4
0206 draining off fat/liquid	9	0.2
0216 seasoning	9	0.2
0219 panning for storage	7	0.2
total	978	25.1
service		
0301 carving/slicing	70	1.8
0304 putting food into holding units	51	1.3
0305 inspection of food for service	23	0.6
0303 setting up steam table/carts	15	0.4
0302 portioning finished product	6	0.1
0306 assembling sack lunches	4	0.1
total	169	4.3
transportation of food and others		
0401 moving food	91	2.3
0402 moving equipment/utensils	50	1.3
0403 moving soiled to washing area	46	1.2
0404 moving garbage or trash	4	0.1
total	191	4.9
transportation empty		
0501 unladen locomotion	24	0.6
total	24	0.6

Table 11. (cont.)

work functions	N	labor time (%)
clerical/communication		
0608 talking related to work	146	3.8
0604 reading menu/recipes	91	2.3
0601 attending scheduled meeting	48	1.2
0607 writing	38	1.0
0603 punching in/out on time cards	13	0.3
0602 communication by intercom.	1	0.1
total	337	8.7
cleaning		
0701 washing cooking utensils	75	1.9
0703 putting away cooking utensils	11	0.3
0704 gathering cleaning utensils	7	0.2
0702 drying cooking utensils	6	0.1
total	99	2.5
housekeeping		
0803 cleaning installed equipment	219	5.7
0802 cleaning counters	82	2.1
0807 sweeping/mopping floors	18	0.5
0801 cleaning carts	5	0.1
0805 adjusting/assembling equipment after cleaning	5	0.1
total	329	8.5
instruction or teaching		
0904 teaching dietetic students	6	0.2
total	6	0.2
appraisal		
1001 checking dishes/equipment for cleanliness	3	0.1
1004 tasting food	5	0.1
total	8	0.2

Table 11. (cont.)

work functions	N	labor time (%)
forced delays		
1101 called to work in another department	27	0.7
total	27	0.7
personal delays		
1203 meal breaks	387	9.9
1207 coffee breaks	128	3.3
1204 putting on/taking off apron	49	1.3
1205 putting on/taking off uniform/ adjusting hairnet	44	1.1
1202 health and related activities	37	1.0
total	646	16.6
idle time		
1301 conversation not pertaining to work	6	0.1
1303 loafing	3	0.1
total	9	0.2
grand totals	3891	100.0

Table 12. Percentage distribution of labor time by work function category and element for sixteen entrees

work function category and element	single-item entree							combination entree						roast		
	baked pork chop	baked pork steak	chicken cutlet	country fried steak	fish sandwich	french fried fish	liver with onions	beef burger pie with cheese puff topping	beef noodle casserole	beef stew	cheese souffle	chimichanga	tacos	roast beef	roast turkey roll	smoked beef roast
	%															
preprepration																
adjusting cooking equipment																1.4
assembling								16.5		3.2		60.5	1.3			
breading	18.0	45.5		16.3			27.4									
chopping								2.5		38.7						
combining								7.6	20.0	9.7	6.1		7.5			
draining										6.5			3.8	5.5		
gathering utensils/equipment			6.8	2.0				6.3	11.4		4.5	5.4	1.3			5.7
emptying											3.0					
greasing													1.3			
heating									2.9				2.5			
measuring								2.5			1.5					
opening containers/packages	7.7	4.5	16.7	6.1	11.1	8.1		3.8			3.0		1.3		11.9	
panning ingredients											1.5	1.1		5.5		
portioning before preparation										3.2						
removing from storage				2.0	2.8		4.5	1.3	2.9	3.2	3.0	1.1	3.8	11.1	3.4	
searching					2.8								1.3			
separating	10.3	13.6		10.2									2.5			
shredding												1.1	17.5			
weighing								15.2	17.0		7.6		1.3			4.3
whipping								2.5			1.5					
total	36.0	13.6	23.4	36.7	16.7	8.1	31.9	58.2	54.2	64.5	31.8	69.2	45.0	22.2	15.3	11.4
preparation																
covering	5.1	9.1		8.2									1.3		3.4	
frying	28.2	22.7	30.0	26.5	11.1	54.1	45.5					15.0				
draining off fat/liquid													1.3		1.7	
garnishing														1.9	1.7	
inspection on cooking process								1.3		3.2	13.6		1.3		1.7	10.0
inspection on product temperature	2.6		3.3	4.1	5.6							1.1		9.3	5.1	8.6
panning/portioning for service	10.3	4.5	16.7	20.5	16.7	24.3	9.1	1.3	2.9		3.0	3.2	4.3	3.7	5.1	1.4
handling leftovers							9.1	19.1		12.9	1.5		2.5	7.4	3.4	2.9
putting in cooking equipment	7.7		23.3	2.0	22.1			5.1	11.4		1.5	1.6	3.8	7.4	5.1	2.9
removing from cooking equipment						10.8		3.8			3.0	3.8		3.7	11.9	10.0
stirring while cooking								5.1	11.4	16.1	13.6		15.0			
panning for storage														1.9		
trimming off fat														7.4		17.1
total	53.8	36.4	73.3	61.3	55.6	89.2	63.6	35.5	25.7	32.3	36.4	24.8	35.0	42.6	39.0	52.9

Table 12 (cont.)

work function category and element	single-item entree							combination entree						roast		
	baked pork chop	baked pork steak	chicken cutlet	country fried steak	fish sandwich	french fried fish	liver with onions	beef burger pie with cheese puff topping	beef noodle casserole	beef stew	cheese soufflé	chimichanga	tacos	roast beef	roast turkey roll	smoked beef roast
	%															
service																
carving/slicing														35.2	40.6	35.7
putting food into holding units				2.0	8.3	2.7		2.5	2.9			3.8	6.2		5.1	
total	0.0	0.0	0.0	2.0	8.3	2.7	0.0	2.5	2.9	0.0	0.0	3.8	6.2	35.2	45.7	35.7
transportation of food and others																
moving food	5.1		3.3					2.5	5.7		7.6	0.5	3.8			
moving equipment/utensils													1.3			
moving soiled to washing area									2.9		1.5	0.5				
total	5.1	0.0	3.3	0.0	0.0	0.0	0.0	2.5	8.6	0.0	9.1	1.1	5.0	0.0	0.0	0.0
clerical/communication																
reading menu/recipes					5.6			1.3	2.9		4.5		1.3			
writing					2.8											
talking related to work					8.3						3.0	1.1				
total	0.0	0.0	0.0	0.0	16.7	0.0	0.0	1.3	2.9	0.0	7.6	1.1	1.3	0.0	0.0	0.0
cleaning																
washing cooking utensils										3.2	4.5					
total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	4.5	0.0	0.0	0.0	0.0	0.0
housekeeping																
cleaning installed equipment	5.1				2.8		4.5		5.7		10.6		7.5			
total	5.1	0.0	0.0	0.0	2.8	0.0	4.5	0.0	5.7	0.0	10.6	0.0	7.5	0.0	0.0	0.0
grand totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 13. Labor time requirements for selected menu items

menu item	portions prepared	minutes per product	minutes per serving
tuna fish salad bowl	30	185	6.2
summer nut tree plate	66	270	4.1
Sarah salad bowl	48	170	3.5
fruit plate	18	31	1.7
Welch rarebit	150	185	1.2
vegetable timbale	500	301	0.6
corn chowder	500	247	0.5
fried eggs	780	347	0.4
noodle romanoff	1000	432	0.4
refried beans	500	193	0.4
barbecue sauce	456	124	0.3
egg-ala-goldenrod	375	124	0.3
Italian tomato soup	400	124	0.3
whipped potato	1200	347	0.3
dressing	800	154	0.2
gravy for dressing	1000	162	0.2
Mexican rice	700	108	0.2
pepper pot soup	600	139	0.2
rice pilaf	600	139	0.2
scrambled egg	600	124	0.2
turkey rice soup	500	69	0.2
mushroom sauce for vegetable timbale	500	61	0.1
turkey gravy	1200	93	0.1

OCCURRENCE SAMPLING TO MEASURE ENTREE PRODUCTION IN A UNIVERSITY RESIDENCE HALL FOODSERVICE

by

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ABSTRACT

An occurrence sampling study was conducted in the production area of a university residence hall foodservice. The objectives of the study were to apply occurrence sampling to measure work distribution in entree production; to analyze work functions in entree production; and to establish time requirements for selected entrees. Work function classification was based on that developed at the University of Wisconsin (37). Elements were modified for the purpose of the study. Coding guides and data recording forms were developed. In the five day study, a total of 3,891 observations were made with 17,820 labor minutes (297 hours) worked.

Sixteen entrees, classified into three groups, were studied. Cumulative recordings of elements were expressed as percentage of labor time spent in work functions. Elements related to the sixteen entrees were separated and identified to analyze production time requirements.

Results indicated 59.2 percent of the total labor time was spent in direct work functions, 23.3 percent in indirect work functions, and 17.5 percent in delays. The mean production time per serving for the sixteen entrees was 0.9 minute with a range of 0.4 to 3.5 and a standard error of ± 0.20. Combination entrees required the highest mean minutes per serving, followed by single-item entrees, and roast entrees. Analysis of variance found no significant differences at the five percent level for minutes per serving for the three entree categories. The study indicated it was feasible to apply occurrence sampling to investigate work in a production unit in a university residence hall foodservice to analyze

distribution of work functions and to establish time requirements for entree production.