DEVELOPMENT OF A METHOD TO ESTABLISH TIME STANDARDS FOR VEGETABLE PREPREPARATION

by

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INTRODUCTION

Foodservice is a major industry in the United States employing over eight million Americans and consisting of over 550 thousand establishments that provide a variety of opportunities to eat away from home (1). Expenditures for food away from home averaged nearly $90 billion in 1981 for an increase of 11.7 percent since 1980. Of this percentage, nine was attributable to higher prices, one to population growth, and the remaining 1.7 to a continuing increase in food consumed away from home (2).

Measurement and control of costs are essential for the survival of any business. Crossan and Nance (3) stated that controls can be no better than the measurements upon which they are based and without some kind of measurement, control is impossible. Lack of knowledge concerning optimum labor requirements and acceptable levels of performance contributed significantly to the financial collapse of many foodservice establishments in the past decade (4). Economic uncertainties that affect the costs of food, labor, and other resources increase the need for cost information (5). The foodservice industry as a whole has been caught up in an "increase services . . . reduce cost" crunch. This has resulted in the need to provide improved and more personalized services, while increasing productivity and management effectiveness to reduce costs associated with providing these services (6).

Too often the practice has been, wherever human activities are organized, to accept opinion in place of fact resulting in decisions based upon what was believed true, rather than what was known to be true. The function of work study is to obtain facts about work and to

use them as a means of improvement. Work study may be regarded principally as a procedure to determine the truth about activities concerning people, facilities, and equipment as a means to improve those activities (7).

Work study assists management in obtaining optimum use of available human and material resources for accomplishing its work. Two distinct, yet interdependent, approaches are used in work study. Method study refers to the way in which work is done and work measurement to the value or work content of a particular task. Occurrence sampling is one technique used in work measurement to determine the standard number of minutes that a qualified, properly trained, and experienced person should take to perform a specific task or operation when working at a normal pace. The time standard may be used for planning and scheduling work, cost estimation, labor cost control, or as a basis for a wage incentive plan (8, 9).

Effective utilization of human resources is a responsibility of management. Before foodservice managers can allocate system resources effectively, the time required to produce menu items to meet forecasted demand must be determined. Estimates of total preparation time for each menu item could assist management in planning the menu mix, scheduling production personnel, and predicting labor cost per unit of production (10).

Objectives of this study were to (a) develop a method for determining time standards in a large residence hall foodservice using occurrence sampling, (b) analyze work functions in a vegetable prepreparation unit, and (c) establish cleaning times for selected vegetables.

REVIEW OF LITERATURE

The study of work is composed of two distinct techniques. Method or motion study pertains to the way work is done and work measurement or time study to the value or work content of the task (8, 9).

Method Study

Method study is the systemic recording, analysis, and critical examination of the methods and movements involved in the performance of existing or proposed ways of doing work. The purpose of method study is to develop easier and more productive procedures by eliminating unnecessary motions, avoidable delays, and other forms of wasted effort (8). Techniques include a flow process chart, flow diagram, operation chart, man machine chart, or an activity chart. Objectives of method study include analysis of the facts concerning the situation, critical examination, and determination of the best solution under the circumstances (8).

Work Measurement

Barnes (9) defined work measurement as a procedure to determine the time required by a qualified and well trained person, working at a normal pace, to do a specified task. This time is called the standard time for the operation.

Neibel (11) stated that work measurement often is referred to as a method of determining a fair day's work. He defined a fair day's work specifically as the amount that can be produced by a qualified employee working at a normal pace and effectively utilizing time without

restrictions by process limitations. A qualified employee is a representative average of those employees qualified by training and experience to perform satisfactorily any and all phases of the work. A normal pace is the effective rate of performance of a conscientious, self-paced, qualified employee when working neither fast nor slow and giving due consideration to the physical, mental, or visual requirements of the specific job (11).

The exact procedure used for work measurement may vary depending upon the type of operation being studied and the application that is to be made of the data obtained. Currie (7) indicated that these steps are usually required:

- select the work or worker to be measured;
- define the method to be used and break the job into elements;
- measure the work or worker by

  pre-determination using methods time measurement or Master Standard Data or

  direct observation which includes stopwatch study or occurrence sampling;
- determine allowances; and
- establish standard time for the defined method.

Since the pioneering work of Frederick W. Taylor (9, 11), who developed work measurement, various methods to determine standard times for operations in the foodservice industry have emerged: stopwatch study, methods-time measurement, Master Standard Data, and occurrence sampling. Selected studies describing these methods are presented.

Stopwatch Study

Stopwatch time study has been defined by Mundel (8) as a procedure in which the performance of a task is observed directly and continuously

for a limited period of time. Data are recorded concerning the work time and the associated work count together with an appraisal of the performance in comparison with the expected performance. An allowance for the nonwork time is usually added in conformance with policies that have been established by the organization. All of these data are used to compute a standard time. Three different procedures for reading the stopwatch and recording elemental times are continuous timing, repetitive or snapback timing, and accumulative timing (8).

In continuous timing the watch runs continuously throughout the study. The time is recorded at the end of each element or subdivision of a work cycle. Individual element times are obtained by successive subtractions after the study is completed.

In repetitive or snapback timing the watch is started at the beginning of the first element being timed and is simultaneously read and snapped back to zero at the completion of the first and each subsequent element. This allows element times to be entered directly on the time study sheet without need for subtractions.

Accumulative timing involves two watches that are mounted in a special holder with a mechanical linkage between them. For continuous timing the linkage is manipulated so that at the end of each element one watch is stopped and the other restarted. The stopped watch is read and element times are obtained later by subtracting alternate readings. For repetitive timing the stopped watch is returned to zero after each reading and element times are read directly from the clock.

Montag, McKinley, and Kleinschmidt (12) used continuous timing to compare the cost of specific pieces of labor-saving equipment with the cost of the labor that each piece of equipment replaces to determine the

point at which the cost of the equipment is offset by possible savings in labor expense. Their research provided a factual basis for economic decisions regarding the addition of labor or the acquisition of labor-saving machines.

Heinemeyer and Ostenso (13) used stopwatch time study to compare labor time and cost in centralized versus conventional methods of food production materials handling in a 475-bed federal hospital. Results indicated significant differences in five direct work function categories. The researchers concluded that the central ingredient unit could lead to more effective use of manpower resources if management prepares for use and control of the skilled labor time saved.

Continuous time study and fixed interval approach to work sampling were used by Clemence and Montag (14) to develop a mathematical model identifying the relationship between labor time and volume of dishes washed and to obtain machine time data in six hospitals. Employee time and machine time per 100 items washed were calculated. Employee time was also compared on the basis of productive and non-productive time, produc-time and productive plus forced delay time, and time for set-up, do, and put-away tasks.

Connelly (15) reported a study designed to estimate the relationship of recipe processing time to number of servings and the number of servings to pan sizes. The continuous method of stopwatch timing was used to measure the labor time required to perform two recipe processing steps: (a) panning pork chops and (b) dredging and panning cubed meat. Labor time required for the processing steps varied according to the number of servings. The variation was not proportional and conversion factors

were utilized. Specific times for number of servings, pan size, and employee could be read from established regression line models.

Hauge and Knickrehm (16) used repetitive or snapback timing to collect time data for preparation of eight kinds of salads over a three-month period. The primary objective of the study was to determine the relationship between total production times for various salads to the number of servings prepared in a university residence hall foodservice. Statistical analysis of the time data showed that the change in quantity was not always the factor most associated with change in production time although the relationship was significant in most cases. Salads that involved prepreparation of fresh fruits and vegetables contributed most to variation in production time.

Methods-time Measurement

Methods-time measurement (MTM) is a procedure that analyzes any manual operation or method into the basic motions required to perform it. Each motion is assigned a predetermined time standard, which is determined by the nature of the motion and the conditions under which it is performed (17). Beach and Ostenso (18) used MTM and stopwatch time study to determine normal performance times for entree serving cycles in a cafeteria. Four serving elements were synthesized using MTM, and six entree serving cycle groups based on the element time values were established. To validate the accuracy of MTM data as an estimate of entree performance time, the mean stopwatch serving time of individual entrees in each group was compared with the MTM serving time obtained by adding the element values composing the serving cycle for the entrees in the group.

After testing a Productivity Index derived by using MTM, Fannan (19) concluded that MTM is not an acceptable method for analysis of vegetable prepreparation tasks because of many variables involved in vegetable prepreparation. The results of the study indicated that MTM derived times and the actual seconds identified in stopwatch studies did not agree for vegetable cleaning and prepreparation tasks in most cases. She also pointed out that use of MTM requires lengthy training and a thorough understanding of the system.

Master Standard Data

Crossan and Nance (3) developed Master Standard Data (MSD) as an alternative to methods-time measurement. The basic unit of time on which MSD was based is the time measurement unit (TMU) which is 0.0006 minutes per unit. The seven basic elements of MSD are obtain, place, rotate, use, finger shift, exert force, and body motions. The basic elements were assigned normal TMU values for various degrees of motion within the specific element, depending on such variables as distance, destination, and number of alignments. A basic feature of MSD is the construction of an alpha-mnemonic code which incorporates the seven basic elements into more comprehensive elements. Several studies using MSD to develop standard time data for foodservice operations have been reported (20, 21, 22, and 23).

Montag, McKinley, and Klinschmidt (20) applied MSD to small-scale food production and suggested that the method was applicable to develop coded standard data elements with universal application in foodservice. MSD would need to be used in conjunction with time study until standard data for process times were developed.

To facilitate the development and use of production time data in quantity foodservice, Waldvogel and Ostenso (21) used MSD to determine the feasibility of developing a standard code for synthesizing and predetermining production times. Observations were made in a 2,000 meals-per-day foodservice system to determine basic elements common to the production of single-entrees, defined as entrees requiring individual handling of each portion. The use of MSD was verified by stopwatch time studies. The research (22) was designed also to provide insight into the relationship between production time per portion and total volume for two standardized entree formulas. Labor time per portion was shown to decrease as total production volume increased. The decrease in time per portion was not directly proportional to the increase in volume; rather it resembles an exponential relationship. As volume approached system capacity, the decrease in production time per portion began to stabilize.

Matthews, Waldvogel, Mahaffey, and Zemel (23) analyzed preparation procedures of standardized quantity formulas for similarities and differences in production activities. Three entree classifications, single-item, combination, and roast entree, were developed. Preparation procedures were divided into elements of production and the MSD Quantity Food Production Code was applied. Macro elements not included in the Code were simulated, coded, assigned associated time measurement units, and added to the MSD Quantity Food Production Code.

Occurrence Sampling

Occurrence sampling was introduced into the United States about 1940 under the name "ratio delay" since it is used to study the ratios of various delays in work (17). It is also known as work sampling since the times sampled often are times of people working (24). More correct,

however, is the term occurrence sampling since what are sampled are occurrences of various types of events. These events can be delays or work tasks but also can be types of occurrences (25).

Three main uses have been identified for occurrence sampling: activity and delay sampling to measure the activities and delays of workers or machines; performance sampling to measure working time and nonworking time of a person on a manual task, and to establish a performance index or performance level for the person during his or her working time; and work measurement to measure a manual task and establish a time standard for an operation (9).

Occurrence sampling is based on the laws of probability, which means that data taken from a sample chosen at random from a large group, tend to have the same characteristics as those of the group as a whole (9). Specifically, occurrence sampling consists of a large number of observations taken at random intervals; in taking the observations, 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 proportions of observations in each category, inferences are drawn concerning the total activity under study (26).

When compared with stopwatch time study procedures, occurrence sampling does not require continuous observation of the operator by the analyst over a long period of time, and several operators can be studied simultaneously by a single analyst. The total manhours expended by the analyst usually are fewer, and the clerical time needed to calculate the results of an occurrence sampling study is less than with direct time study (11).

One of the earliest applications of occurrence sampling studies in the foodservice industry was reported by Wilson (27) in 1956 at a Purdue University residence hall foodservice operation. This study was undertaken to determine why payroll of students in one unit was greater than that of other units. Findings indicated that this unit would continue to have a greater payroll as long as differences in equipment and kitchen layout remained unchanged. Wilson recommended job analysis for all full-time and part-time employees leading to redistribution of work load for full-time labor, thus reducing student labor hours.

A study was conducted by Wise and Donaldson (28) to establish a procedure to be used for analyzing work activities of hospital foodservice employees. An analysis of the percentages of time spent in nine work categories provided information for more effective classification and scheduling of employees. The data revealed that employees with higher classification performed more supervisory and clerical work than others with lower classification. As classification decreased, cleaning activities increased. Percentages for personal time were greatest for the highest employee classification and least for the lowest classification.

Schell (29) stated that it was increasingly important to know how manhours are being expended if human resources were to be utilized most effectively. The purpose of this study was to develop standards for use by dietitians and managers to analyze their operations and compare them with others. Using occurrence sampling, time standards were developed for functions performed by dietetic employees.

Although most foodservice and dietetic related research using occurrence sampling has been reported for the foodservice worker, two

studies in the early 1960's investigated activities of the dietitian and foodservice manager (30, 31). Stanford and Cutlar (30) provided evidence that occurrence sampling could be applied effectively to analyze the work of college foodservice managers. The objective of the study was to identify the proportion of time spent by the managers in various activities.

Marteney and Ohlson (31) reported a study analyzing and measuring general activities of professional dietitians using occurrence sampling. Results of this study showed that half of the professional staff members' time was involved with patient factors and supervision.

Recent occurrence sampling research in foodservice management analyzes percentage labor time for direct, indirect, and delay activities. In an early study of this type, conducted in a meat and vegetable cookery unit at a university residence hall, Brown (32) found that food production activities represented from thirty-six to forty-one percent, food support activities from thirty-three to thirty-seven percent, and unproductive activities from twenty-two to twenty-seven percent of time based on observations among five positions.

Pyles (33) conducted a study to determine the percentage distribution of work function activities and labor minutes per meal produced and served in a school foodservice system. Total activities spent in direct work were 80.46 percent, in indirect work 5.61 percent, and in delay time 13.95 percent. Labor minutes required to prepare and serve each meal were 5.85. Time per meal devoted to direct and indirect work functions and to delay were 4.71, 0.324, and 0.816 minutes, respectively.

Zolber and Donaldson (34) examined work function activities of foodservice personnel in hospitals using assembly-serve foodservice

systems and compared the results with data reported in conventional production systems. Findings indicated that significantly less total time was expended in two of the three assembly-serve than the conventional production systems and that total direct labor time was significantly less for the assembly-serve than for the conventional production units.

Occurrence sampling was used by Bryant (35) to analyze the time distribution among direct labor, indirect labor, and delays in the production area of a university foodservice. Sixty-two percent of the activities were assigned to the direct category, thirty-two percent to the indirect category, and six percent to delays.

Ho and Matthews (36) examined the distribution of labor time in foodservice systems of two Wisconsin nursing homes with similar organizational and operational characteristics. In both homes approximately eighty-one, nine, and ten percent of total labor time were spent in direct work, indirect work, and delays, respectively. Mean labor minutes per meal equivalent were 7.48 in Home X and 7.43 in Home Y.

Yung, Matthews, Johnson, and Johnson (37) reported mean percentages of 72.6, 9.7, and 17.7 for total labor time spent in direct work, indirect work, and delays, respectively, in foodservice systems of fourteen Wisconsin nursing homes of similar characteristics. Mean total minutes per meal equivalent in the homes ranged from 7.13 to 18.95; the mean was 11.25 minutes.

Elliston (38) studied distribution of dietary labor time in two phases at a university hospital. Objectives in Phase 1 were to determine labor time and cost by position in twenty work functions of a hospital foodservice system using occurrence sampling and to compare data from the

study with data from a previous labor time study in the same hospital, utilizing the same sampling methodology. In Phase 2 of the study the objective was to determine what effect the incorporation of a materials handling ingredient procedure had on the distribution of dietary labor time.

Data from Phase 1 suggested that changes in the division of labor time, delegating functions requiring less skill to lower paid positions, and improving the quality of supervision might improve productivity. Phase 2 of the study was conducted after operational changes were made that included implementing a materials handling ingredient procedure, realigning job descriptions, and training dietary technicians as production supervisors for all scheduled work hours.

Although findings did not show a significant effect on the percentage distribution of time, mean minutes per meal were significantly reduced to 9.73 minutes in Phase 2 compared with 13.67 minutes in Phase 1. The decrease of 3.94 mean minutes per meal occurred in the major category of direct work, primarily in the functions of prepreparation, service, empty transportation, and cleaning. Elliston concluded that additional studies were needed before guidelines to set standards could be developed.

METHODOLOGY

Time standards for vegetable prepreparation would be valuable in scheduling personnel and equipment and are useful elements for recipe production times in computer applications. This investigation developed a method using occurrence sampling in a vegetable prepreparation area, analyzed work functions within the area, and applied the method to establish cleaning times for selected vegetables.

Six vegetables frequently used in recipes in residence hall foodservice at Kansas State University were selected for study. Those chosen were carrots, celery, head lettuce, leaf lettuce, mature yellow onions, and red and white potatoes.

Observation of Work Functions

Occurrence sampling was chosen as the method to analyze work functions in the vegetable prepreparation area, and data were collected by observations at random intervals. Specific reasons for using this method were: several operators can be studied simultaneously by a single observer; nonrepetitive work can be analyzed effectively; activities, delays, work, and nonworking time can be measured; and a performance standard for an operation can be established (9, 11).

The Study Site

The study was conducted in Derby Food Center, the largest residence hall foodservice at Kansas State University, in which an average of 4,600 meals per day were served at the time of the study. Meal service was

cafeteria style, and three meals were served daily except for Sunday when two meals were served.

One part-time and three full-time foodservice workers were assigned to the vegetable prepreparation area. In addition, one student was scheduled to work seven and a half hours each week.

The first shift was scheduled from 6:20 a.m. to 3:00 p.m., the second from 7:20 a.m. to 4:00 p.m., and the third from 9:20 a.m. to 6:00 p.m. Employees followed a two week cycle working every other weekend with scheduled days off during the week (Appendix A). The student was scheduled every Monday from 11:45 a.m. to 4:00 p.m. and 4:30 p.m. to 5:30 p.m., and every Wednesday from 2:45 p.m. to 4:00 p.m. and 4:30 p.m. to 5:30 p.m.

Work Function Categories

Work function classification and definitions, developed by Donaldson et al. (39) to analyze foodservice work in hospitals, were used as a basis for the study. Direct work functions were defined as any essential activity which contributes directly to the production of the end product, indirect work functions as any catalytic activity which contributes to production of the end product, and delays include all time when an employee is scheduled to be working and is not engaged in either direct or indirect work functions. Some modification was required to adapt the functions to a university residence hall foodservice. The three work function categories remained the same as in the Wisconsin model. Components of the categories were modified to tasks specific to vegetable prepreparation in a residence hall foodservice (Appendix B).

Number of Observations

Each observation consisted of a recording for each employee in the work area. The number of observations required was calculated using the following formula reported by Konz (25):

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

where:

p = mean percent occurrence, decimal
A = absolute accuracy desired, decimal
z = number of standard deviations for confidence level desired
n = number of observations

To estimate percentage working time expended in actual cleaning for each of the six vegetables so that the number of observations could be computed, scheduled labor hours and 1981 vegetable usage were used (refer to Table 4, Appendix C). Data needed to calculate percent labor time spent in cleaning each vegetable, the mean percent occurrence, included average vegetable usage per week, approximate preparation time for the cleaning process, and total labor hours available.

The total number of recordings required for each of the six vegetables to ensure a confidence level of 0.90 and a ± 0.20 relative accuracy were:

vegetable	number of recordings
carrots	2,174
celery	1,614
head lettuce	605
leaf lettuce	1,973
onions	4,151
potatoes	381

Since 2,174 recordings would meet or exceed the requirements for all vegetables except onions, this number was accepted as the basis for

observations. The total number of recordings for the study, 2,174, was divided by the length of the study, fourteen days, to determine how many recordings had to be taken each day. The researcher estimated that an average of two recordings would be obtained each time one observation was made, one for each worker present. The number of recordings per day, 155, was divided by two and rounded to eighty observations per day. A computer program was utilized to obtain randomized times in sequential order. Twenty-four hour time was used to differentiate between a.m. and p.m.

Development of the Recording Procedure

Coding Guide

The coding guide consisted of eleven work functions with 102 elements occurring in vegetable prepreparation (Appendix D). An element is a subdivision of the work cycle composed of one or a sequence of several basic motions which are distinct, describable, and measurable (24). Each element was assigned a four digit code number. The first two digits indicated the work function and the third and fourth indicated the element within the function. Similar elements within the vegetable prepreparation function were assigned the same last two digit code numbers to simplify data collection and increase flexibility. Any elements not listed could be added under a specific function and coded during data collection. Such flexibility would be beneficial to a researcher who was unfamiliar with the detailed breakdown of functions under study or if an unexpected activity occurred during data collection.

Optical Mark Reader Cards

Optical mark reader (OMR) cards were used to record the data. Information noted on each card included code number of employee observed in column one, day of study in columns two and three, time of observation in columns four through seven, and element in columns eight through eleven. A card was used for each employee for each recording. Since each recording was tied to various strata or subgroups, by being on a separate card, a detailed analysis of the data could be made (25).

Employee Orientation

An orientation session was conducted for all employees involved with the study. The purpose and time of the project and the occurrence sampling technique were explained. The researcher emphasized the importance of working at a normal pace and explained that the data would not be representative of the actual situation if they worked more rapidly or more slowly than normal. Employees were shown the coded work activity form and the OMR card used for recording the data. The researcher presented several examples. A question and answer period followed the orientation.

Selection and Training Observers

The primary observer was the researcher, although other observers including a Registered Dietitian, senior dietetic student, supervisor, and cook were trained to use the occurrence sampling procedure. All observers were instructed by the researcher to ensure agreement in observing and recording procedures. Use of the coding guide and optical mark

reader cards required minimal amounts of time by the researcher to train observers in the recording procedure.

Pilot Study

In a pilot study conducted at the study site, observations were made at random times during one day as indicated on the preliminary data processing printout. Data indicating employee code number, day of study, and time of observation were recorded on the day prior to collection of data. Element, noted at the time an employee became visible, was recorded by code number on the card by the observer. In general, one observation route was followed because of the location and physical layout of the vegetable prepreparation area. Observations were made between 6:20 a.m. and 6:00 p.m. Elements were expanded, code numbers were revised, and the final coding guide consisted of the initial eleven work functions and 122 elements (Appendix E). Total "as purchased" amounts of the selected vegetables cleaned during the day and total labor time for the day were recorded. Preliminary data were checked for completeness and accuracy.

Data Collection

Data were collected in early spring for fourteen consecutive days. Care was taken to select a typical two week period with a minimum of special events. Total labor hours increased from the projected time as employees from other departments were assigned to the vegetable preprep-aration area for short periods of time on an irregular basis, and a student worked each Friday afternoon from 1:00 p.m. to 4:00 p.m. and 4:30 p.m. to 5:30 p.m. Total hours worked were 349.35 or 20,961

minutes, and 2,578 observations were recorded. Procedures for recording data as described in the pilot study were followed. Regardless of the observer, no difficulties were experienced in the recording procedure. The total amount of the six vegetables prepared during the fourteen day period was determined.

Data Analysis

Programs in the Statistical Analysis System (SAS) were used to calculate cumulative recordings for the elements and work functions (40). The cumulative recordings were expressed as the mean percentage of time and labor minutes spent in each work function. Analysis of variance was performed to determine if the time spent by day in the eleven work functions differed over the fourteen consecutive days.

RESULTS AND DISCUSSION

Eleven work functions were classified into three major categories; direct work, indirect work, and delays. A breakdown into elements for each of the three categories provided detailed information regarding the tasks performed. Detailed responses are included in Table 5 in Appendix C. Percentage distribution of the number of elements in each work function identified how labor time was spent.

Analysis of Work Functions

The distribution of labor time by work function in the three categories is reported as a percentage of total recordings for each category (refer to Table 1). The cumulative percentage for direct work was 57.5 percent; indirect work 14.8 percent; and delay time, 27.7 percent.

Some variation existed when analyzing work by three major categories of direct, indirect, and delay by day for the fourteen day period (refer to Fig. 1). To evaluate consistency of work functions by day, analysis of variance indicated no significant differences at the 0.05 level in proportion of time spent in the eleven work functions over the fourteen consecutive days. The mean and standard error of work functions by day are reported in Table 6, Appendix C.

Direct Work

Of the total time, 56.4 percent was spent in prepreparation or preliminary processing. Prepreparation of carrots, celery, head lettuce,

Table 1. Percentage distribution and total minutes of labor time expended by work function.

work function	labor time		
	percent	standard error	minutes
1. prepreparation	56.4	± 0.98	11,823
carrots	7.9	± 0.53	1,659
celery	6.8	± 0.50	1,431
lettuce, head	4.8	± 0.42	1,016
lettuce, leaf	0.8	± 0.18	163
onions, yellow mature	3.6	± 0.37	764
potatoes, red and white	19.2	± 0.78	4,009
all other fruits and vegetables	13.3	± 0.67	2,781
2. transportation of food	1.1	± 0.21	228
total direct work	57.5	± 0.97	12,051
3. transportation of equipment or supplies	2.5	± 0.31	528
4. transportation empty	3.7	± 0.37	772
5. pot and pan washing	0.6	± 0.15	122
6. housekeeping	2.6	± 0.31	553
7. instruction	5.1	± 0.43	1,073
8. appraisal	0.3	± 0.11	57
total indirect work	14.8	± 0.70	3,105
9. forced delay	0.4	± 0.12	73
10. personal delay	25.1	± 0.85	5,260
authorized not paid (meals)	6.8	± 0.50	1,420
authorized paid (breaks)	8.7	± 0.56	1,825
unauthorized paid	9.6	± 0.58	2,015
11. idle time	2.2	± 0.29	472
total delay time	27.7	± 0.88	5,805
grand totals	100.0		20,961

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Fig. 1. Percentage of time spent in direct work, indirect work, and delay time for a fourteen consecutive day study in a university residence hall vegetable prepreparation unit.

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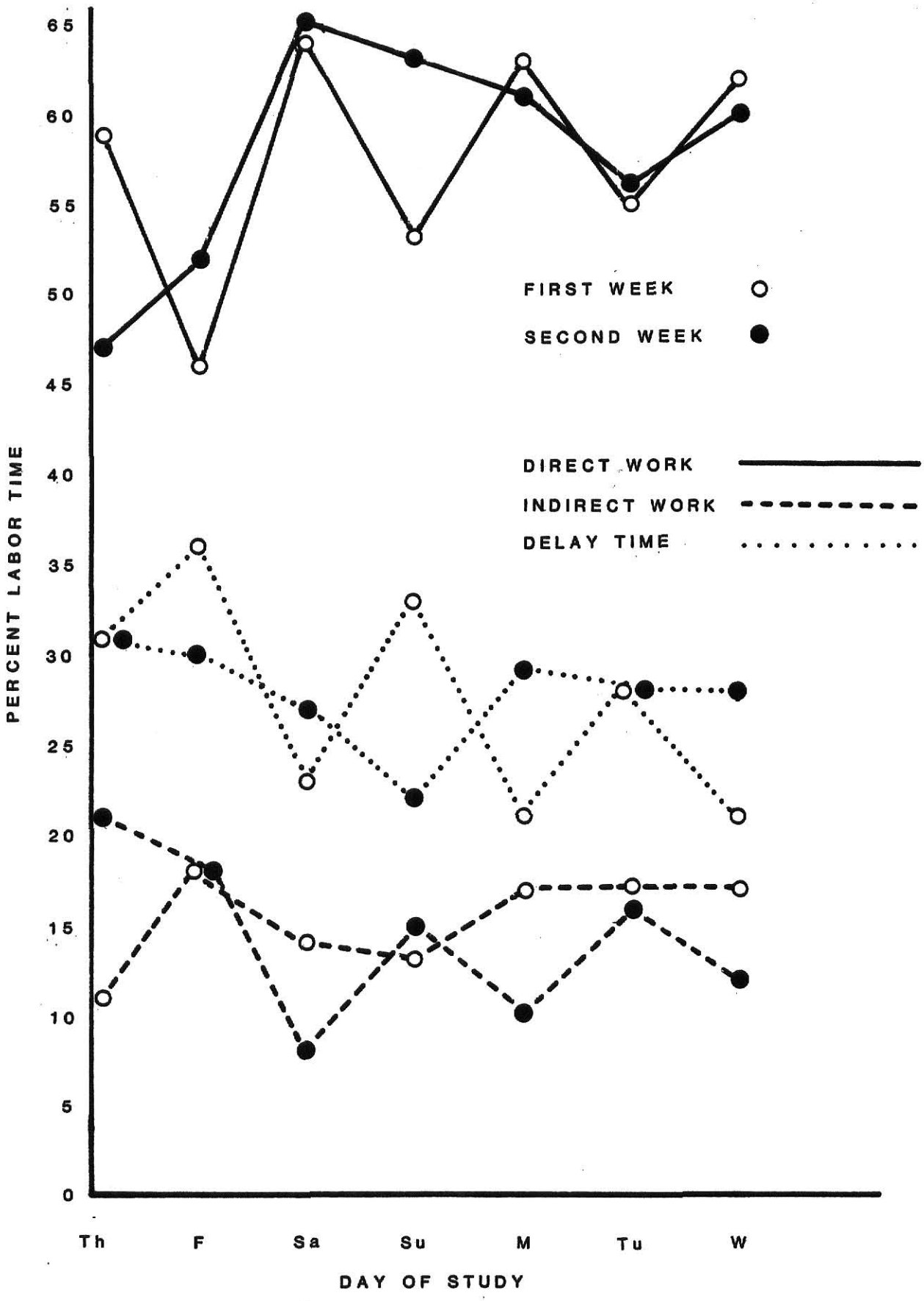
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DAY OF STUDY

leaf lettuce, yellow onions, and potatoes consumed over 43 percent of the time spent in direct work. Approximately 13 percent of the time in direct work involved processing for all other fruits and vegetables.

Transportation of food consumed 1.1 percent of total labor time. This low percentage reflects effective communication and good organization within the facility.

Indirect Work

Total labor time spent in indirect work functions was 14.8 percent. Instruction was the work function in which the greatest time was spent, with transportation empty, housekeeping, transportation of equipment or supplies, pot and pan washing, and appraisal occurring in decreasing amounts of time.

Delay Time

Total delay time was 27.7 percent with 25.1 percent in personal delays and included authorized but not paid periods for meals and authorized paid periods that included rest periods and time for changing attire. Only 2.2 percent of time was spent in idle time and 0.4 percent in forced delays. Investigation of the 9.6 percent of time reflected in the unauthorized paid category may require study.

Vegetable Cleaning Times

Elements concerned with the cleaning process of the selected vegetables were separated from other elements (refer to Table 2). The number of recordings was used to calculate percentage distribution and minutes of labor expended for the cleaning elements of the selected vegetables. Total cleaning labor minutes were divided by total pounds

Table 2. Number of recordings and labor time expended in vegetable cleaning elements.*

elements	recordings	labor time†	
	N	%	min.
carrots			
nub and peel	151	5.86	1,229
wash	3	0.12	25
place into container	1	0.04	8
total	155	6.02	1,262
celery			
brush and rinse	38	1.47	308
trim leaves and ends	102	3.96	830
place into container	1	0.04	8
total	141	5.47	1,146
lettuce, head			
remove head and hit core	28	1.09	228
remove leaves and core	53	2.05	432
wash and drain	28	1.09	228
place into container	11	0.43	90
total	120	4.66	978
lettuce, leaf			
remove stem	11	0.43	90
wash and sort	5	0.19	40
drain and pan	3	0.12	25
total	19	0.74	155
onions, yellow mature			
wash and peel	87	3.38	705
place into container	0	0.00	0
total	87	3.38	705
potatoes, red and white			
peel (machine)	67	2.60	545
eye and cut	363	14.08	2,944
place into container	2	0.08	17
total	432	16.76	3,506

*All vegetable cleaning was manual except for peeling potatoes.

†Based on 2,578 recordings and 20,961 labor minutes.

of "as purchased" vegetables prepared to calculate an average cleaning time for each of the selected vegetables and was reported as mean minutes per pound and per purchase unit (refer to Table 3).

Head lettuce required the least amount of labor time per pound for preparation with potatoes, onions, celery, carrots, and leaf lettuce requiring increasing amounts of labor time. Approximately one-half of the leaf lettuce that was ordered did not meet the specifications and was refused by the receiving clerk. The decreased weight of 40 pounds, compared to the estimated 80 pounds per week, resulted in an average cleaning time with greater deviation.

Although this study was concerned specifically with cleaning time of vegetables, the method of data collection provided information to analyze percentage distribution of labor time by work function and day, by work function and employee, by work function, employee, and day (refer to Tables 7-9, Appendix C). Labor costs could be examined by work function, element, and employee. Analyses of labor time and cost by supervisor, by shift, before and after lunch, or at other specified time intervals throughout the workday could provide valuable data.

Table 3. Vegetable cleaning* time for minutes per pound and per purchase unit for a university residence hall vegetable prepreparation unit.

vegetable	total cleaning labor time†	total "as purchased" quantity prepared†	purchase unit	average labor time	
				minutes per pound	minutes per purchase unit
	min.	lb.	lb.	mean range‡	mean range‡
lettuce, head	978	3,510	45	0.28 ± 0.04	12.6 ± 1.8
potatoes, red and white	3,506	5,942	100	0.59 ± 0.04	59.0 ± 4.2
onions, yellow mature	705	950	50	0.74 ± 0.13	37.1 ± 6.4
celery	1,146	1,329	45	0.86 ± 0.12	38.8 ± 5.5
carrots	1,262	762	50	1.66 ± 0.21	82.8 ± 10.6
lettuce, leaf	155	40	20	3.88 ± 1.44	77.5 ± 28.8

*All vegetable cleaning was manual except for peeling potatoes.

†Cumulative time and quantity for fourteen consecutive days.

‡Relative accuracy at 90% confidence level (± 1.64 standard deviation).

SUMMARY, CONCLUDING STATEMENTS AND RECOMMENDATIONS

Summary

An occurrence sampling study was conducted in a vegetable prepreparation unit located in a large university residence hall foodservice to analyze work functions and to establish cleaning times for selected vegetables. Work function classification and definitions, developed at the University of Wisconsin for study of hospital foodservice, were modified for the study. A coding guide was developed and optical mark reader cards were used to record the data.

The vegetable prepreparation unit was staffed with one part-time and three full time employees. One student was scheduled to work seven and a half hours each week. Meal service was cafeteria style, and three meals were served daily except for Sunday when two meals were served.

For the fourteen day study the calculated number of recordings, 2,240, was based on the estimated percentage of working time expended in cleaning the six vegetables. Each observation consisted of a recording for each employee in the work area. Eighty observations were required each day for a confidence level of 0.90 and ± 0.20 relative accuracy.

An employee orientation session was conducted to acquaint employees with the purpose of the study. Observers were trained in recording techniques. A pilot study was conducted to check procedures and completeness of data.

Data were collected in early spring. Total hours worked were 349.35 or 20,961 minutes, and 2,578 recordings were made. Total pounds

prepared for each of the six vegetables during the study was determined.

Percentage distribution of the number of elements in each work function identified how labor time was spent. Cumulative percentage of labor time for direct work was 57.5 percent; indirect work 14.8 percent; and delay time, 27.7 percent. Analysis of variance indicated no significant differences at the 0.05 level in proportion of time spent in the eleven work functions over the two week period.

Elements concerned with the cleaning process of the selected vegetables were separated from the other elements. Number of recordings, percentage distribution, and minutes of labor time expended in the vegetable cleaning elements were calculated. Total cleaning labor minutes were divided by total pounds of "as purchased" vegetables to establish an average time for each of the selected vegetables. Average cleaning times were: head lettuce, 0.28 minutes per pound; red and white potatoes, 0.6 minutes per pound; yellow onions, 0.75 minutes per pound; celery, 0.9 minutes per pound; carrots, 1.7 minutes per pound; and leaf lettuce, 3.9 minutes per pound. Time per purchase unit was calculated also for the selected vegetables.

Concluding Statements and Recommendations

Work function classification and definitions, used initially to analyze foodservice work in hospitals, were adapted successfully to a university residence hall foodservice. The results of this study indicated that occurrence sampling can be used to analyze work functions in a vegetable prepreparation area and establish times for vegetable prepreparation.

The researcher recommends that the vegetable cleaning times established in this study be implemented at Derby Food Center. With modification of work functions and elements, the method of analysis developed for this study could be used in other areas in the foodservice system. Time standards for specific processes used in food preparation would be valuable to schedule production of menu items. For service and sanitation areas, time standards and detailed labor cost analyses would provide needed information.

Managers are concerned with effective and efficient use of resources yet are striving for quality assurance in foodservice systems. Analyses of labor time and cost are essential to know how manhours are utilized. Time standards need to be audited periodically to be assured that the standard continues to be reliable.

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APPENDIXES

APPENDIX A

Vegetable Prepreparation Employee Schedule

KSU RESIDENCE HALL FOOD SERVICE

Employee Schedule

VEGETABLE PREPARATION

Week I — Week II

JOB	HOURS	NAME	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
	7:20 A.M. - 4:00 P.M.	EMPLOYEE 1	X*				X					X				X
	6:20 A.M. - 3:00 P.M.	EMPLOYEE 2			X				X	X				X		
	9:20 A.M. - 6:00 P.M.	EMPLOYEE 3	X					X					X			X
	6:20 A.M. - 3:00 P.M. RELIEF	EMPLOYEE 4	X	X		X		X	X	X	X		X		X	
		STUDENT 5	-	11:45 A.M. 4:00 P.M.	-	2:45 P.M. 4:00 P.M.				-	11:45 A.M. 4:00 P.M.	-	2:45 P.M. 4:00 P.M.			
			-	4:30 P.M. 5:30 P.M.	-	4:30 P.M. 5:30 P.M.				-	4:30 P.M. 5:30 P.M.	-	4:30 P.M. 5:30 P.M.			

*X INDICATES DAY OFF OR DAYS ASSIGNED TO ANOTHER WORK AREA.

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APPENDIX B

Work Function Classification and Definitions

WORK FUNCTION CLASSIFICATION AND DEFINITIONS*

DIRECT WORK FUNCTIONS

Any essential activity which contributes directly to the production of the end product.

1. Prepreparation or preliminary processing

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

brushing	opening containers	rinsing
coining	panning	slicing
coring	peeling	sorting
covering	removing nub	stemming
cutting	removing outer leaves	trimming
draining		washing
eyeing		weighing

   moving food out of storage
   moving food into storage
   moving food onto storage racks
   moving food into or out of storage containers
   moving food to the scale

2. Transporting of food

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

   delivery of food to appropriate department
   moving unused food back to department

*Adapted from Methodology Manual for Work Sampling. Productivity of Dietary Personnel. Madison: Dept. of Foods and Nutr., Univ. of Wisconsin, 1967.

INDIRECT WORK FUNCTIONS

Any catalytic activity which contributes to production of the end product. These are operations which precede, follow, or complement vegetable cleaning activities.

3. 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.

moving cutting board to work area
moving food containers or tables to work area
moving soiled equipment to washing area
moving clean equipment to area
moving paper goods and other supplies
moving garbage or trash

4. Transportation empty

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

unladen locomotion

5. Pot and pan washing

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

running water into sink
washing containers and utensils
putting away containers and utensils
draining water from sink

6. Housekeeping

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

cleaning walls
cleaning carts and food trucks
cleaning installed equipment
cleaning work counters
cleaning sinks
using garbage disposal
oiling equipment
adjusting equipment
sweeping or mopping floors

7. Instruction or teaching

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

on the job training
giving instructions
receiving instructions
reading directives from administration
reading menu
reading issue reports
trying out new equipment
writing

8. Appraisal

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

checking dishes or containers for cleanliness
inspection of area--sanitation and safety
inspection of food preparation
inspection of leftovers
tasting food
inspection of produce for quality
taking inventory

DELAYS

Delays include all time when an employee is scheduled to be working and is not engaged in either direct or indirect work functions.

9. Forced delay

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

power failure
faulty equipment
called to work in another department
waiting for the elevator

10. Personal delays

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

- meal breaks
- rest breaks
- adjusting hairnet
- putting on apron
- putting on or taking off uniform
- drinking fountain
- health and related activities such as washing hands
- waiting to check out

11. 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

Supplemental Tables

(Tables 4-9)

Table 4. Estimated weekly labor time for cleaning vegetables in 1982 based on 1981 data.

vegetable	purchase unit	average units used per week*	cleaning time per unit†	total cleaning time per week‡	
			hr.	hr.	%
potatoes	100 lb. sack	22	1.08	24.0	15.0
head lettuce	24 head crate	32	0.50	16.0	10.0
celery	45 lb. crate	5	1.25	6.3	4.0
leaf lettuce	10 lb. crate	8	0.66	5.3	3.3
carrots	50 lb. sack	6	0.83	5.0	3.0
onions	50 lb. sack	6	0.42	2.5	1.6

*Based on 7 days per week for 12 weeks in spring 1981 for Derby Food Center.

†Unvalidated vegetable cleaning records for Derby Food Center.

‡Based on 159 scheduled labor hours including meal periods and breaks, spring 1982, in the vegetable prepreparation unit.

Table 5. Number of recordings and percentage distribution of work in categories and elements.

work categories and elements	number of recordings	percent
direct work		
prepreparation		
carrots		
0101 move out of storage	2	0.078
0102 open sack	1	0.039
0103 remove from sack	13	0.504
0104 nub and peel	151	5.855
0105 wash	3	0.116
0106 place into barrel	1	0.039
0107 cover	5	0.194
0108 move into storage	2	0.078
0109 move onto rack	1	0.039
0110 weigh	8	0.310
0111 remove from barrel	4	0.155
0112 coin	12	0.465
0114 move to scale	0	0.000
0117 cut into sticks	1	0.039
celery		
0201 move out of storage	5	0.194
0202 open crate	0	0.000
0203 remove from crate	3	0.116
0204 brush and rinse	38	1.474
0205 trim leaves and ends	102	3.956
0206 place into storage container	1	0.039
0207 cover	10	0.388
0208 move into storage	0	0.000
0209 move onto rack	0	0.000
0210 weigh	8	0.310
0214 move to scale	0	0.000
0216 wash leaves	3	0.116
0217 cut into sticks	4	0.155
0218 slice using machine	2	0.078
leaf lettuce		
0301 move out of storage	0	0.000
0302 open crate	1	0.039
0303 remove from crate	0	0.000
0304 remove stem	12	0.465
0305 wash and sort	5	0.194
0306 drain and pan	3	0.116
0307 cover	0	0.000
0308 move into storage	0	0.000
0309 move onto rack	0	0.000

Table 5. (cont.)

work categories and elements	number of recordings	percent
head lettuce		
0401 move out of storage	3	0.116
0402 open crate	1	0.039
0403 remove head and hit core	28	1.086
0404 remove outer leaves and core	53	2.056
0405 wash and drain	28	1.086
0406 place into barrel	11	0.427
0407 cover	0	0.000
0408 move into storage	1	0.039
0409 move onto rack	0	0.000
onions, yellow mature		
0501 move from storage area	0	0.000
0502 open sack	0	0.000
0503 remove from sack	0	0.000
0504 wash and peel	87	3.375
0506 place into container	0	0.000
0507 cover	2	0.078
0508 move into storage	0	0.000
0509 move onto rack	0	0.000
0510 weigh	5	0.194
0514 move to scale	0	0.000
potatoes, red and white		
0601 move from storage area	2	0.078
0602 open sack	4	0.155
0603 move into bucket/machine	11	0.427
0604 peel (machine)	67	2.599
0605 eye and cut	363	14.081
0606 place eyed and cut into container	2	0.078
0607 cover	1	0.039
0608 move into storage	3	0.116
0610 weigh	1	0.039
0611 remove peeled from barrel	16	0.621
0612 fill barrel with water	16	0.621
0613 rinse and barrel	5	0.194
0614 move to scale	1	0.039
0615 move peeled into barrel	2	0.078
other fruits and vegetables		
0701 operations which precede, complement, or follow cleaning activities	342	13.266

Table 5. (cont.)

work categories and elements	number of recordings	percent
transportation of food		
0801 delivery to appropriate dept.	26	1.008
0802 delivery of unused back to dept.	2	0.078
total direct work	1,484	57.565
indirect work		
transportation of equipment or supplies		
0901 move cutting board to work area	2	0.078
0902 move container or table to work area	30	1.164
0903 move soiled to washing area	9	0.349
0904 return clean to area	4	0.155
0905 move paper goods, supplies, utensils	14	0.543
0906 move garbage or trash	6	0.233
transportation empty		
1001 unladen locomotion	95	3.685
pot and pan washing		
1101 running water into sink	4	0.155
1102 washing container or utensils	7	0.272
1103 putting away container or utensils	4	0.155
1104 draining water from sink	0	0.000
housekeeping		
1201 cleaning walls	0	0.000
1202 cleaning carts or food trucks	1	0.039
1203 cleaning installed equipment	14	0.543
1204 cleaning counters	12	0.465
1205 cleaning sinks	26	1.008
1206 sweeping or mopping floors	12	0.465
1207 using garbage disposal	2	0.078
1208 oiling or adjusting equipment	1	0.039
instruction or teaching		
1301 on the job training	13	0.504
1302 giving instructions	25	0.969
1303 receiving instructions	27	1.047
1304 reading directives from admin.	5	0.194
1305 reading menu	1	0.039
1306 reading issue reports or tickets	24	0.931
1307 trying out new equipment	0	0.000
1308 writing	31	1.202
1309 demonstrating to students	5	0.194

Table 5. (cont.)

work categories and elements	number of recordings	percent
appraisal		
1401 checking dishes for cleanliness	0	0.000
1402 inspection of area - sant./safety	1	0.039
1403 inspection of food preprep.	1	0.039
1404 inspection of leftovers	3	0.116
1405 tasting	0	0.000
1406 inspection of produce	2	0.078
1407 taking inventory		
total indirect work	381	14.778
delays		
forced delay		
1501 power failure	0	0.000
1502 faulty equipment	0	0.000
1503 called to work in another dept.	6	0.233
1504 waiting for elevator	3	0.116
personal delay		
1601 meal break	314	12.180
1602 rest break	216	8.379
1603 adjusting hairnet	0	0.000
1604 putting on apron	1	0.039
1605 putting on/taking off uniform	45	1.746
1606 health and related activities	69	2.676
1607 waiting to check out	1	0.039
idle time		
1701 conversation not pertaining to work	26	1.008
1702 reading newspaper	1	0.039
1703 loafing	31	1.202
total delays	713	27.657
grand totals	2,578	100.000

Table 6. Mean* and standard error of work functions by day.

day	work functions									
	prepreparation		transportation of food		transportation of equipment		transportation empty		pot and pan washing	
	mean	standard error	mean	standard error	mean	standard error	mean	standard error	mean	standard error
	%	%	%	%	%	%	%	%	%	%
1	64.44	10.99	0.00	0.64	0.84	2.57	2.80	2.35	0.00	0.45
2	48.97	12.70	0.00	0.74	3.31	2.97	1.35	2.71	0.45	0.52
3	67.56	12.70	0.00	0.74	0.42	2.97	1.38	2.71	0.00	0.52
4	67.31	9.83	1.22	0.57	1.27	2.30	4.45	2.10	0.00	0.40
5	69.47	9.83	2.56	0.57	3.20	2.30	2.25	2.10	0.71	0.40
6	49.62	10.99	0.45	0.64	8.71	2.57	12.87	2.35	0.37	0.45
7	80.61	9.83	0.70	0.57	1.34	2.30	1.64	2.10	1.02	0.40
8	48.23	12.70	0.00	0.74	1.21	2.97	5.07	2.71	1.82	0.52
9	53.02	10.99	3.01	0.64	3.37	2.57	1.68	2.35	0.83	0.45
10	64.81	9.83	0.75	0.57	1.01	2.30	0.75	2.10	0.00	0.40
11	72.85	9.83	0.25	0.57	2.62	2.30	3.22	2.10	0.00	0.40
12	62.49	10.99	0.88	0.64	1.66	2.57	2.16	2.35	0.81	0.45
13	55.45	12.70	0.50	0.74	4.43	2.97	3.74	2.71	0.50	0.52
14	64.76	10.99	1.23	0.64	4.00	2.57	2.89	2.35	0.00	0.45

*No significant difference at the 0.05 level.

Table 6. (cont.)

day	work functions											
	housekeeping		instruction		appraisal		forced delay		personal delay		idle time	
	mean	standard error	mean	standard error	mean	standard error	mean	standard error	mean	standard error	mean	standard error
	%	%	%	%	%	%	%	%	%	%	%	%
1	5.05	1.13	2.29	2.96	0.46	0.33	0.00	0.52	22.19	8.64	1.89	1.38
2	3.76	1.31	7.20	3.42	0.00	0.38	0.00	0.60	31.32	9.98	3.60	1.59
3	3.03	1.31	5.60	3.42	0.84	0.38	0.00	0.60	18.95	9.98	2.19	1.59
4	1.77	1.01	0.25	2.65	0.00	0.29	1.22	0.46	17.67	7.73	4.81	1.23
5	1.02	1.01	5.17	2.65	0.00	0.29	0.00	0.46	14.87	7.73	0.91	1.23
6	3.86	1.13	2.72	2.96	0.00	0.33	0.00	0.52	20.45	8.64	0.90	1.38
7	0.35	1.01	3.92	2.65	0.00	0.29	0.00	0.46	9.10	7.73	1.29	1.23
8	1.82	1.31	9.78	3.42	1.05	0.38	0.00	0.60	29.32	9.98	1.65	1.59
9	1.35	1.13	6.57	2.96	0.67	0.33	0.00	0.52	26.43	8.64	3.01	1.38
10	1.01	1.01	0.50	2.65	0.00	0.29	0.00	0.46	30.12	7.73	1.01	1.23
11	0.50	1.01	1.44	2.65	0.00	0.29	0.00	0.46	17.47	7.73	1.63	1.23
12	2.16	1.13	2.15	2.96	0.00	0.33	0.00	0.52	24.82	8.64	2.82	1.38
13	3.93	1.31	3.74	3.42	0.00	0.38	1.19	0.60	26.47	9.98	0.00	1.59
14	1.99	1.13	2.85	2.96	0.00	0.33	1.58	0.52	19.42	8.64	1.23	1.38

Table 7. Percentage distribution of labor time by work function and day.

work functions	day													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
prepreparation	57.9	45.9	63.9	51.6	59.9	54.7	55.0	47.4	49.5	63.6	62.2	60.3	55.6	58.4
transportation of food	0.0	0.0	0.0	1.5	2.8	0.6	1.3	0.0	2.6	1.8	0.7	1.0	0.5	1.6
total direct work	57.9	45.9	63.9	53.1	62.7	55.3	56.3	47.4	52.1	65.4	62.9	61.3	56.1	60.0
transportation of equipment and supplies	1.1	2.9	0.5	2.5	4.2	1.1	2.7	1.2	4.4	2.4	4.1	1.9	4.3	1.6
transportation empty	3.8	1.8	1.6	7.0	2.8	6.7	3.4	5.2	2.2	1.8	6.2	2.4	3.8	3.7
pot and pan washing	0.0	0.6	0.0	0.0	0.9	0.6	2.0	1.7	0.9	0.0	0.0	1.0	0.5	0.0
housekeeping	3.2	3.5	3.3	3.5	1.4	5.0	6.7	1.7	1.8	2.4	1.4	2.4	3.8	2.6
instruction	2.7	9.4	7.1	0.5	7.5	3.4	8.1	10.4	8.3	1.2	3.4	2.4	3.8	3.7
appraisal	0.5	0.0	1.1	0.0	0.0	0.0	0.0	1.2	0.9	0.0	0.0	0.0	0.0	0.0
total indirect work	11.3	18.2	13.6	13.5	16.8	16.8	22.9	21.4	18.5	7.8	15.1	10.1	16.2	11.6
forced delay	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.1
personal delay	28.1	31.2	20.3	28.4	19.6	26.8	18.1	29.5	26.8	24.4	18.6	26.2	26.6	24.7
idle time	2.7	4.7	2.2	3.5	0.9	1.1	2.7	1.7	2.6	2.4	3.4	2.4	0.0	1.6
total delays	30.8	35.9	22.5	33.4	20.5	27.9	20.8	31.2	29.4	26.8	22.0	28.6	27.7	28.4
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

Table 8. Percentage distribution of total labor time by work function and employee.

work functions	employee							
	1	2	3	4	5	6	7	8
	%	%	%	%	%	%	%	%
prepreparation	44.4	52.8	60.7	58.9	79.2	88.6	71.7	84.6
transportation of food	0.8	2.4	0.6	0.0	1.1	0.0	1.1	0.0
total direct work	45.2	55.2	61.3	58.9	80.3	88.6	72.8	84.6
transportation of equipment	2.5	4.4	1.4	2.0	0.6	6.8	1.1	0.0
transportation empty	4.4	3.2	4.2	3.0	0.6	2.3	7.6	0.0
pot and pan washing	0.4	0.6	1.1	0.3	0.0	0.0	0.0	0.0
housekeeping	2.5	2.5	3.0	4.3	1.2	2.3	0.0	0.0
instruction	12.6	4.7	0.9	3.0	0.0	0.0	1.1	0.0
appraisal	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0
total indirect work	23.0	15.9	10.6	12.6	2.4	11.4	9.8	0.0
forced delay	0.1	0.0	0.8	0.7	0.0	0.0	1.1	0.0
personal delay	28.6	26.7	25.8	26.8	14.3	0.0	13.0	0.0
idle time	3.1	2.2	1.5	1.0	3.0	0.0	3.3	15.4
total delays	31.8	28.9	28.1	28.5	17.3	0.0	17.4	15.4
grand totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 9. Percentage distribution of labor time by work function, employee, and day.

work functions	day 1				day 2			day 3			day 4				
	employee														
	2	3	4	6	1	2	5	1	3	5	1	3	6	7	9
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
prepreparation	51.7	54.5	62.4	98.9	47.3	40.4	59.0	45.6	74.2	83.0	42.3	52.2	100.0	57.1	98.5
transportation of food	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.0	3.6	0.0
total direct work	51.7	54.5	62.4	98.9	47.3	40.4	59.0	45.6	74.2	83.0	43.6	53.5	100.0	60.7	98.5
transportation of equipment or supplies	1.9	1.5	0.0	0.0	0.0	5.4	4.6	1.3	0.0	0.0	5.1	1.3	0.0	0.0	0.0
transportation empty	1.9	7.6	1.8	0.0	2.7	1.4	0.0	2.5	1.6	0.0	5.1	10.0	0.0	7.1	0.0
pot and pan washing	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
housekeeping	5.6	0.0	3.6	1.1	2.7	4.1	4.6	5.1	1.6	2.4	5.1	3.8	0.0	0.0	0.0
instruction	7.4	0.0	1.8	0.0	10.8	10.8	0.0	15.2	1.6	0.0	0.0	1.3	0.0	0.0	0.0
appraisal	1.9	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total indirect work	18.7	9.1	7.2	1.1	16.2	23.1	9.2	26.6	4.8	2.4	15.3	16.4	0.0	7.1	0.0
forced delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.0	3.6	0.0
personal delay	29.6	28.8	30.4	0.0	31.1	31.1	31.8	25.3	19.4	12.2	35.9	27.5	0.0	25.0	0.0
idle time	0.0	7.6	0.0	0.0	5.4	5.4	0.0	2.5	1.6	2.4	3.9	1.3	0.0	3.6	1.5
total delays	29.6	36.4	30.4	0.0	36.5	36.5	31.8	27.8	21.0	14.6	41.1	30.1	0.0	32.2	1.5
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

Table 9. (cont.)

work functions	day 5					day 6				day 7				
	employee													
	1	2	3	5	7	2	3	4	6	1	2	5	6	7
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
preparation	41.2	61.3	63.2	81.9	100.0	47.2	56.0	61.8	93.4	45.1	57.8	100.0	100.0	100.0
transportation of food	3.2	4.1	1.5	3.0	0.0	1.8	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0
total direct work	44.4	65.4	64.7	84.9	100.0	49.0	56.0	61.8	93.4	45.1	61.3	100.0	100.0	100.0
transportation of equipment or supplies	4.8	8.2	3.1	0.0	0.0	0.0	1.5	0.0	3.3	3.2	3.5	0.0	0.0	0.0
transportation empty	1.6	2.0	4.6	3.0	0.0	7.3	9.1	1.8	3.3	6.5	1.8	0.0	0.0	0.0
pot and pan washing	0.0	2.0	1.5	0.0	0.0	0.0	1.5	0.0	0.0	1.6	3.5	0.0	0.0	0.0
housekeeping	0.0	2.0	3.1	0.0	0.0	5.5	4.6	5.5	0.0	0.0	1.8	0.0	0.0	0.0
instruction	23.8	2.0	0.0	0.0	0.0	9.1	0.0	1.8	0.0	16.1	3.5	0.0	0.0	0.0
appraisal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total indirect work	30.2	16.2	12.3	3.0	0.0	21.9	16.7	9.1	6.6	27.4	14.1	0.0	0.0	0.0
forced delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
personal delay	25.4	18.4	21.5	9.1	0.0	25.5	27.3	29.1	0.0	21.0	24.6	0.0	0.0	0.0
idle time	0.0	0.0	1.5	3.0	0.0	3.6	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0
total delays	25.4	18.4	23.0	12.1	0.0	29.1	27.3	29.1	0.0	27.5	24.6	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

Table 9. (cont.)

work functions	day 8			day 9				day 10				day 11				
	employee															
	1	3	4	1	2	3	5	2	4	6	7	1	2	3	6	7
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
prepreparation	30.2	57.4	57.1	37.7	45.8	63.4	65.0	64.5	59.4	100.0	100.0	50.0	51.1	100.0	94.1	79.0
transportation of food	0.0	0.0	0.0	0.0	5.4	1.7	5.0	3.8	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0
total direct work	30.2	57.4	57.1	37.7	51.2	65.1	70.0	68.3	59.4	100.0	100.0	50.0	52.4	100.0	94.1	79.0
transportation of equipment or supplies	0.0	1.9	1.8	4.1	9.5	0.0	0.0	3.8	1.3	0.0	0.0	0.0	5.0	0.0	5.9	2.2
transportation empty	7.9	3.7	3.6	1.4	5.4	0.0	0.0	0.0	3.8	0.0	0.0	0.0	5.0	0.0	0.0	1.1
pot and pan washing	0.0	3.7	1.8	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
housekeeping	0.0	3.7	1.8	4.1	1.4	0.0	0.0	0.0	5.1	0.0	0.0	0.0	2.5	0.0	0.0	0.0
instruction	22.2	0.0	7.1	18.9	4.1	3.3	0.0	1.3	1.3	0.0	0.0	0.0	5.0	0.0	0.0	2.2
appraisal	3.2	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total indirect work	33.3	13.0	16.1	28.5	23.1	6.6	0.0	5.1	11.5	0.0	0.0	0.0	17.5	0.0	5.9	5.5
forced delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
personal delay	33.3	29.6	25.0	29.7	24.3	26.6	25.0	24.1	26.6	0.0	0.0	50.0	26.3	0.0	0.0	11.1
idle time	3.2	0.0	1.8	4.1	1.4	1.7	5.0	2.5	2.5	0.0	0.0	0.0	3.8	0.0	0.0	4.4
total delays	36.5	29.6	26.8	33.8	25.7	28.3	30.0	26.6	29.1	0.0	0.0	50.0	30.1	0.0	0.0	15.5
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 9. (cont.)

work functions	day 12				day 13			day 14			
	employee										
	1	2	3	5	1	3	4	1	2	3	6
	%	%	%	%	%	%	%	%	%	%	%
prepreparation	52.5	49.8	65.5	81.8	51.4	61.3	53.5	51.6	59.5	60.2	98.7
transportation of food	1.7	1.9	0.0	0.0	1.5	0.0	0.0	1.6	1.8	1.6	0.0
total direct work	54.2	51.7	65.5	81.8	52.9	61.3	53.5	53.2	61.3	61.8	98.7
transportation of equipment or supplies	1.7	1.9	3.1	0.0	4.6	1.6	7.1	0.0	3.5	0.0	1.3
transportation empty	3.4	3.7	1.6	0.0	6.1	1.6	3.6	8.1	3.5	0.0	0.0
pot and pan washing	1.7	0.0	1.6	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
housekeeping	3.4	3.7	1.6	0.0	0.0	6.5	5.4	3.2	0.0	4.8	0.0
instruction	6.8	1.9	0.0	0.0	6.1	1.6	3.6	8.1	1.8	1.6	0.0
appraisal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total indirect work	17.0	11.2	7.9	0.0	18.3	11.3	19.7	19.4	8.8	6.4	1.3
forced delay	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	6.4	0.0
personal delay	25.4	35.2	26.6	12.1	28.8	27.4	23.2	25.8	28.1	23.8	0.0
idle time	3.4	1.9	0.0	6.1	0.0	0.0	0.0	1.6	1.8	1.6	0.0
total delays	28.8	37.1	26.6	18.2	28.8	27.4	26.8	27.4	29.9	31.8	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

APPENDIX D

Initial Coding Guide

WORK FUNCTIONS AND ELEMENT CODES

I. PREPREPARATION

CARROTS
0101 Move out of storage
0102 Open sack and remove
0103 Nub and peel
0104 Wash
0105 Place into barrel
0106 Cover
0107 Move into storage
0108 Move onto rack
0109 Weigh
0110 Remove from barrel
0111 Coin

CELERY
0201 Move out of storage
0202 Open crate and remove
0203 Nub and sort
0204 Brush and rinse
0205 Place into storage container
0206 Cover
0207 Move into storage
0208 Move onto rack
0209 Weigh

LEAF LETTUCE
0301 Move out of storage
0302 Open crate and remove
0303 Remove stem
0304 Wash and sort
0305 Drain and pan
0306 Cover
0307 Move into storage
0308 Move onto rack

HEAD LETTUCE
0401 Move out of storage
0402 Open and remove heads
0403 Remove outer leaves and core
0404 Wash and drain
0405 Place into barrel or container
0406 Cover
0407 Move into storage
0408 Move onto rack

ONIONS, YELLOW MATURE
0501 Move from storage area
0502 Open sack and remove
0503 Wash and peel
0505 Place in container
0506 Cover
0507 Move into storage
0508 Move onto rack

POTATOES
0601 Move from storage area
0602 Open sack and move into bucket
0603 Peel
0604 Eye and cut
0605 Place eyed and cut into container
0606 Cover
0607 Move into storage
0609 Weigh
0610 Remove peeled from barrel
0611 Fill barrel with water
0612 Rinse and barrel

OTHER FRUITS AND VEGETABLES
0701 Operations which precede, complement, or follow cleaning activities

II. TRANSPORTATION OF FOOD
0801 Delivery to appropriate dept.
0802 Delivery of unused back to dept.

III. TRANSPORTATION OF EQUIPMENT, SUPPLIES, AND OTHER
0901 Move cutting board to work area
0902 Move containers to work area
0903 Move soiled equipment to washing area
0904 Return clean to area
0905 Move paper goods and supplies
0906 Move garbage or trash

IV. TRANSPORTATION EMPTY
1001 Unladen locomotion

V. POT AND PAN WASHING
1101 Running water into sink
1102 Washing container or utensils
1103 Putting away containers/utensils
1104 Draining water from sinks

VI. HOUSEKEEPING
1201 Cleaning walls
1202 Cleaning carts/food trucks
1203 Cleaning installed equipment
1204 Cleaning counters
1205 Sweeping/mopping floors
1206 Using garbage disposal
1207 Oiling/adjusting equipment

VII. INSTRUCTION OR TEACHING
1301 On the job training
1302 Giving instructions
1303 Receiving instructions
1304 Reading directives from admin.
1305 Reading menu
1306 Reading issue report
1307 Trying out new equipment
1308 Writing

VIII. APPRAISAL
1401 Checking dishes/containers for cleanliness
1402 Inspection of area-sant./safety
1403 Inspection of food preparation
1404 Inspection of leftovers
1405 Tasting food
1406 Inspection of produce
1407 Taking inventory

IX. FORCED DELAY
1501 Power failure
1502 Faulty equipment
1503 Called to work in another dept.

X. PERSONAL DELAYS
1601 Meal breaks
1602 Rest breaks
1603 Adjusting hairnet
1604 Putting on apron
1605 Putting on/taking off uniform
1606 Health and related activities

XI. IDLE TIME
1701 Conversation not pertaining to work
1702 Reading newspaper
1703 Loafing

APPENDIX E

Final Coding Guide

I. PREPREPARATION

CARROTS
0101 Move out of storage
0102 Open sack
0103 Remove from sack
0104 Nub and peel
0105 Wash
0106 Place into barrel/pan
0107 Cover
0108 Move into storage
0109 Move onto rack
0110 Weigh
0111 Remove from barrel/pan
0112 Coin
0114 Move to scale
0117 Cut into sticks

CELERY
0201 Move out of storage
0202 Open crate
0203 Remove from crate
0204 Brush and rinse
0205 Trim leaves and ends
0206 Place into storage container
0207 Cover
0208 Move into storage
0209 Move onto rack
0210 Weigh
0214 Move to scale
0216 Wash leaves
0217 Cut into sticks
0218 Slice using machine

LEAF LETTUCE
0301 Move out of storage
0302 Open crate
0303 Remove from crate
0304 Remove stem
0305 Wash and sort
0306 Drain and pan
0307 Cover
0308 Move into storage
0309 Move onto rack

HEAD LETTUCE
0401 Move out of storage
0402 Open crate
0403 Remove head and hit core
0404 Remove outer leaves and core
0405 Wash and drain
0406 Place into barrel/pan
0407 Cover
0408 Move into storage
0409 Move onto rack

ONIONS, YELLOW MATURE
0501 Move from storage area
0502 Open sack
0503 Remove from sack
0504 Wash and peel
0506 Place into container
0507 Cover
0508 Move into storage
0509 Move onto rack
0510 Weigh
0514 Move to scale

POTATOES
0601 Move from storage area
0602 Open sack
0603 Move into bucket/machine
0604 Peel
0605 Eye and cut
0607 Place eyed and cut into container
0607 Cover
0608 Move into storage
0610 Weigh
0611 Remove peeled from barrel
0612 Fill barrel with water
0613 Rinse and barrel
0614 Move to scale
0615 Move peeled into barrel

OTHER FRUITS AND VEGETABLES
0701 Operations which precede, complement, or follow cleaning activities

II. TRANSPORTATION OF FOOD
0801 Delivery to appropriate dept.
0802 Delivery of unused back to dept.

III. TRANSPORTATION OF EQUIPMENT/SUPPLIES
0901 Move cutting board to work area
0902 Move container/table to work area
0903 Move soiled to washing area
0904 Return clean to area
0905 Move paper goods/supplies/utensils
0906 Move garbage or trash

IV. TRANSPORTATION EMPTY
1001 Unladen locomotion

V. POT AND PAN WASHING
1101 Running water into sink
1102 Washing container/utensils
1103 Putting away container/utensils
1104 Draining water from sink

VI. HOUSEKEEPING
1201 Cleaning walls
1202 Cleaning carts/food trucks
1203 Cleaning installed equipment
1204 Cleaning counters
1205 Cleaning sinks
1206 Sweeping/mopping floors
1207 Using garbage disposal
1208 Oiling/adjusting equipment

VII. INSTRUCTION OR TEACHING
1301 On the job training
1302 Giving instructions
1303 Receiving instructions
1304 Reading directives from admin.
1305 Reading menu
1306 Reading issue reports/tickets
1307 Trying out new equipment
1308 Writing
1309 Demo. to Q.F. students

VIII. APPRAISAL
1401 Checking dishes/containers for clean
1402 Inspection of area - sant./safety
1403 Inspection of food preparation
1404 Inspection of leftovers
1405 Tasting
1406 Inspection of produce
1407 Taking inventory

IX. FORCED DELAY
1501 Power failure
1502 Faulty equipment
1503 Called to work in another dept.
1504 Waiting for elevator

X. PERSONAL DELAYS
1601 Meal breaks
1602 Rest breaks
1603 Adjusting hairnet
1604 Putting on apron
1605 Putting on/taking off uniform
1606 Health and related activities
1607 Waiting to check out

XI. IDLE TIME
1701 Conversation not pertaining to work
1702 Reading newspaper
1703 Loafing

DEVELOPMENT OF A METHOD TO ESTABLISH TIME STANDARDS FOR VEGETABLE PREPREPARATION

by

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ABSTRACT

Objectives of this study were to (a) develop a method for determining time standards in a large residence hall foodservice using occurrence sampling, (b) analyze work functions in a vegetable prepreparation unit, and (c) establish cleaning times for selected vegetables. The study was conducted in the vegetable prepreparation unit of a large state university residence hall serving approximately 4,600 meals per day. Work function classification and definitions developed at the University of Wisconsin for study of hospital foodservice were used as a basis for the research. Components of the categories were modified to tasks specific to vegetable prepreparation in a university residence hall foodservice. The coding guide consisted of eleven work functions with 122 elements occurring in vegetable prepreparation. Optical mark reader cards were used to record code number of employee observed, day of study, time of observation, and work element.

Prior to data collection, selected observers were trained by the researcher to use the occurrence sampling procedure. An orientation session was conducted for all employees involved with the study. Data were collected in early spring for fourteen consecutive days with care taken to select a typical two week period with a minimum of special events. To evaluate consistency of work functions by day, analysis of variance indicated no significant difference at the 0.05 level in proportion of time spent in the eleven work functions over the fourteen consecutive days.

Percentage distribution of the number of elements in each work function identified how labor time was spent in the vegetable preprep-aration unit and provided data for analysis of each work function. Percentage labor time and minutes expended were calculated for cleaning selected vegetables. Average cleaning times were established for minutes per pound and purchase unit for carrots, celery, head lettuce, leaf lettuce, yellow onions, and red and white potatoes.