COST COMPARISON OF DISPOSABLE SERVICEWARE WITH PERMANENT SERVICEWARE IN SCHOOL FOODSERVICE

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF SCIENCE

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

COLLEGE OF NUTRITION, TEXTILES,
AND HUMAN DEVELOPMENT

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MAY 1982

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April 2, 1982

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ACKNOWLEDGEMENTS

The author deeply appreciates the efforts of the chairman and members of the graduate committee who provided assistance during the course of this research project.

To Dr. Carol Shanklin, advisor and chairman of the graduate committee, for all the professional and personal help she extended during the entire graduate study. For her continual enthusiasm, encouragement, patience, and guidance, all of which helped in the completion of this project and made the period at TWU an enriching experience.

To Dr. Florence Langford for her services as a graduate committee member and her constructive advice. For her kindness, understanding, and many hours spent on editing this project.

To Dr. Elwood Reber for his services as a committee member and for his guidance and support.

To Ms, Barbara Clark, Foodservice Director of Arlington Independent School District, for originating the idea for this project and the assistance she provided for setting up the project, and for her continual encouragement and cooperation.

To Ms. Betty Burk, Foodservice Director of Denton Independent School District, for her cooperation, assistance and patience throughout the study.

To her husband, Mayur Mehta, for investing in her education, for his love, trust, patience, and understanding which made studying a rewarding and fulfilling experience. For his guidance and assistance in the statistical analysis of this project.

To her family members and her parents, Mr. and Mrs. V. J. Mehta, for their moral support.

To the faculty members, fellow students at TWU, and all the others who contributed to the completion of this study.

To Ms. Doris Laing, upon whose typing skills the author relied entirely.

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CHAPTER I

INTRODUCTION

Increasing labor, energy, material and equipment costs are some of the major concerns of the foodservice industry (1). With operating costs rising, foodservice operators are attempting to identify ways to lower the cost while maintaining high quality standards (2). The use of "single-use" or "disposable" serviceware is an alternative widely considered to reduce the costs of labor and energy (2). To continue using permanent serviceware or to convert to disposable serviceware are the questions many foodservice operations are asking (3).

Some cost comparison studies have been conducted to compare cost of the permanent and disposable serviceware. However, in most cases the results remained inconclusive (1, 3). Disposable serviceware is now available in increasing variety and improved quality (1). With advances in technology, there will be better products produced at cheaper cost (4). The prices of disposables is declining steadily whereas the cost of chinaware is continuously rising (1).

For years people have been using disposables because they were convenient. Disposables may offer an economic advantage (4). Current trends in modern mass feeding have created a need for disposable serviceware (5). The attitude of today's society towards work and leisure has promoted definite changes in the foodservice operators approach. With increasing income and mobility, the customers demand more flexibility. Use of single-service disposable items offers the flexibility to fit into almost all the foodservice operations (2). The 1973 single-service survey indicated that institutional and commercial foodservice operations were searching for alternative ways to merchandise with disposable items (6).

Benefits that are claimed from the use of disposables include: reduced expense of dishwashing machine operation and upkeep, including replacements, repairs, and chemicals used. Additional savings are also realized by the elimination of labor necessary to operate the dishmachine and to transport dishes to storage and service-areas (7). In addition to the capital investment and labor savings, disposables offer the advantages of: sanitation, when used correctly; convenience; safety; flexibility and reduced noise level. Savings can also be

realized with conservation of energy and water. Disposable serviceware stores easily and pilferage is low (2).

Results of a survey conducted by the Permanent Ware Institute suggested that customers perferred permanent ware mainly for gratification. Other benefits mentioned in favor of permanent ware were cost and availability of items. Lack of storage space and infrequent delivery of serviceware were the reasons given for not using the disposable serviceware (7, 8).

Discarding of the disposable waste is one of the major drawbacks of using disposable ware. In metropolitan areas there has been a shortage of dump sites. Restrictive federal, state, and municipal requirements for on-site processing of waste and strict government control of air and water pollution limit the disposal process. Although incineration and pulping of waste is possible, compaction has gained attention and is used most commonly. Compaction reduces the volume of waste by a ratio of six to one (7).

A current study comparing the cost of permanent and disposable serviceware is needed. The purpose of this study is to compare the costs of disposable serviceware with permanent serviceware in selected elementary schools. The objective of the study is to compare the labor cost,

the utility cost and the material cost of the two types of serviceware in elementary schools in two school districts (Appendix A).

CHAPTER II

REVIEW OF LITERATURE

Introduction

In recent years the trend for the use of disposable ware has increased considerably (6). The concept of disposable items is old but its products and applications are relatively new. Disposable serviceware has been used in various forms for several years (4). Foodservice professionals predict that the utilization of disposable serviceware will continue to increase. The cost of disposable serviceware seems to be comparable to the cost of permanent serviceware. In spite of its popularity, foodservice operators resist changing from permanent system without full assurance that the disposable system will be cost effective (6). Some foodservice operators have not accepted the fact that using a product just once and then disposing of it may be cheaper than maintaining a similar permanent item (4). Before converting to a disposable system, present investment in the current system must also be considered (6).

The control of energy expenditure has become important because of the rise in energy costs and the potential

decrease in availability. Knowledge of where and how much energy is consumed in the establishment has become very important. By conducting an energy audit, the amount of energy spent in each area and process can be recorded. Thus, when energy availability is limited, the least energy intensive methods can be applied for the economical running of the operation (9).

Disposable Ware

Advantages

Product improvement and wide acceptance underlie the increasing trend toward the use of disposable serviceware. Overall advantages of using disposable ware include the elimination of the cost for expensive machinery, china, dish dispensers, and other serviceware-handling equipment. This includes the cost of interest on capital investment and insurance on equipment as well as the utility and material costs (2, 7, 9, 10, 11). Reduced space requirements and lower handling cost are also advantages. Although the cost of dry storage space is necessary, it is approximately half the cost of ware washing space (7). The cost for breakage and replacement of items is also greatly reduced (9, 10).

Disposable serviceware has been generally found to be convenient to use, handle, and store. Disposables

store compactly and can be placed on higher shelves than permanent serviceware because of its light weight (7, 10, 12). Trays containing disposables are easier to transport and require less physical demand from the foodservice and nursing personnel who must transport trays to the patients' rooms (10, 13). The number of accidents related to transporting, delivery or sanitation of permanent ware have declinced in facilities using disposable serviceware (7, 9). Inventory of disposable ware is simplified because it is packaged in "sleeves" of standard count (13).

Additional advantages attributed to disposable ware include reduced labor time, decreased turnover of personnel, decreased pilferage and increased sanitation. With the use of disposable serviceware, the dishwashing task is eliminated. This results in a significant saving in time and labor, as well as decreased labor turnover rate (2, 10, 9, 13). According to Mueller (13), coffee remained hotter in plastic-coated paper cups for a longer time than in china cups. A spot test by a thermometer indicated an initial heat loss of $20^{\circ}F$ to $25^{\circ}F$ when coffee was poured at $180^{\circ}F$ in china cups but no heat loss was indicated in the paper cups. Disposable ware is sanitized upon receipt, therefore, with proper handling increased sanitation can result. According to Walker and Price (14), 80 percent of

the health professionals agree that single-use items can reduce the possibility of cross-infection.

Acceptability

The availability of attractive, durable plastic and paper disposable serviceware is proving to be appealing and acceptable to both the operators and the customers (2). Acceptance by customers is high because disposable ware is fully sanitized and free from dust, finger prints and soiling, if handled properly (7, 10). According to Mueller (13), patients at Elmhurst Hospital responded positively to disposable serviceware. Results of studies by Ward and Clark (3) and Kiino, Pollard and Verzi (1), also indicated increased patient satisfaction with the use of disposable serviceware. Results of a survey of a selected group of young people to evaluate acceptability of disposable ware suggested that disposables were most acceptable in fast food operations (15).

Disadvantages

The main disadvantage in the use of disposable serviceware is the disposal of waste material. Environmentalists express concern about elimination of the solid waste (7, 14). The most common method for disposal of waste is the utilization of a service contract with an

ouside agency to pick up waste at regular intervals. To reduce the volume of solid waste, many foodservice operators use compactors. Compaction reduces the volume of waste by a ratio of six to one. Other less frequently used methods of waste disposal include incineration and waste pulping (7, 12, 13).

The cost of waste disposal was found to be higher for disposable serviceware (1, 9). The cost of disposable serviceware items also contributes to the high cost of a disposable system (9, 13, 16). According to Montag, McMillen and Henry (17), the cost of the ware itself accounted for 2.5 percent of the permanent ware but 62.5 percent for the disposable ware. Lack of storage space and infrequent delivery of supplies were other limitations that were encountered when a disposable system was used (6). Some cost conscious foodservice managers are attempting to reduce the cost by reusing the disposable items. This would increase the labor cost and could add to the possibility of food borne illness (7).

Permanent Ware

Advantages

It is questionable if the convenience of disposable ware is justified by the additional cost of the system.

Several studies have found that the cost of permanent serviceware was significantly lower than that of disposable serviceware (1, 3, 17, 18). Permanent serviceware was found to have an economical advantage. When permanent ware was used, a large inventory of serviceware was unnecessary, thus reducing the cost of storage space (8). Results of a survey by the Permanent Ware Institute indicated that meals remained warmer with the permanent serviceware (3, 8). Ward and Clark (3) found no bacterial growth on either the permanent or the disposable serviceware.

A preference for the use of permanent ware was exhibited by tableservice restaurants' operators. Results of a survey conducted by the Permanent Ware Institute indicated that 76.8 percent of the foodservice operators preferred to use permanent ware, 3.2 percent preferred disposable ware and 20.0 percent preferred a mixture of both the systems. The majority (93.9 percent) of tableservice and booth restaurants and 87.8 percent of hotels preferred to use permanent serviceware. Caterers and clubs almost exclusively utilized permanent ware. Drug stores, cafeterias, and factories used a combination of both. Motels used disposable ware for room service (8).

Acceptability

One of the major reasons for preferring permanent ware by customers is gratification (8). Results of a survey for acceptance of permanent ware among the youths suggested a definite appreciation for china was present for "an elegant table top setting at a restaurant for dinner." Paper placemats and napkins may be accepted but preference for china, silver, and glassware was expressed for food and drinks (15).

Disadvantages

The major concerns about permanent serviceware are the health hazards that may be caused because of improper sanitation. Since the early 1900's, medical literature has shown that saliva-borne diseases can be transmitted through eating utensils. In 1974, 185 restaurants in nine metropolitan cities were inspected. Inspectors found 90 percent of these to be "unsanitary" and 54 percent without adequate washing or sanitizing facilities (19). Results of a four-year study in sixty-six hotels indicated that 90 percent of the reusable beverage glasses were "unacceptable". Pathogenic micro-organisms were found on 50 percent of them (12). Therefore, it is important to consider the potential health hazards when comparative studies between disposable and permanent serviceware are conducted (19).

Comparison Studies

In a one hundred room hotel and motel, the use of disposable beverage ware could eliminate one employee entirely or free a substantial part of his or her time for other duties (10). According to Mueller (13), a labor cost of 15.5 to 19.5 man-hours per day were saved with the use of disposable serviceware in a hospital serving 174 patients. Kesner (9) found that labor cost was significantly lower in operations using disposable serviceware. A total saving of $0.29 per patient per day was made when disposable serviceware was used.

Mid-west Research Institute conducted an energy study showing definite saving in utility costs when disposable ware was used (2). Molzahn and Montag (5) compared the cost of utilities for washing tableware by the meters (precise) method and an indirect (approximate) method. The precision obtained by the accurate method did not outweigh the high labor cost that was spent for installing the meters. The results obtained by both the precise and the approximate methods were acceptable and were not significantly different.

Cannon (18) conducted a study to compare the cost of disposable and reusable plastic compartmented trays. The results varied widely because of the employees, their

working conditions and the lay-out of the facilities. The cost of disposable ware was found to be approximately five times more than the cost of the permanent ware. The average cost of a reusable plastic tray was $0.007 as compared to $0.04 when a disposable tray was used. According to Montag, McMillen and Henry (17), permanent ware was found to have an economic advantage. The unit cost of permanent ware was $0.04 and $0.10 for disposable ware. Kiino, Pollard and Verzi (1) found that one complete disposable unit costs $0.23. Ward and Clark (3) reported the cost of one place setting of permanent ware to be $0.1423.

Burger and Montag (16) compared the real cost of permanent and disposable ware in a hospital using a combination of both systems. The cost of permanent ware comprised of the cost of the serviceware and the cost of dishwashing. The cost of disposable ware contained the cost of serviceware and the cost of waste removal. Results of the study indicated that labor contributed 61.3 percent to the cost of permanent ware. The cost of the serviceware itself contributed 89.0 percent to the cost of disposable system. Therefore, the major cost in permanent ware is the cost of labor but for disposable ware the major cost was the cost of serviceware itself.

Rippe and Montag (20) evaluated the average service life of seven institutional china tableware items. Two methods, the turnover method and the simulated plant-record method, were used to evaluate the service life of these items. The results suggested that the average service life by both methods varied very little. The average service life was significantly less than the generalized allowances published by the U. S. Treasury Department in "Depreciation Guidelines and Rules" and "Bulletin F", publications commonly used by foodservice managers.

In conclusion, for any facility, the decision to use disposable serviceware or to expand its use, requires thought and planning. The potential for its use must be examined and all aspects carefully evaluated (10).

CHAPTER III

PROCEDURE

Two school districts, one using permanent serviceware and the other using disposable serviceware, were selected for this study. The cost of permanent ware was determined for two elementary schools in the Denton Independent School District. The cost of disposable ware was determined in two elementary schools in the Arlington Independent School District. Elementary schools were preferred because they served only "type A" school lunch; therefore, variables were more controllable. The schools selected in the Denton district were the Frank Borman Elementary School (D-I) and the Robert E. Lee Elementary School (D-2). In the Arlington district, the two schools chosen were the Miller Elementary School (A-I) and the Wood Elementary School (A-2).

Menus were obtained from the schools in both school districts to compare the food items served. Similar menu items were selected in both districts for data collection. The uniformity of the menu items was selected to minimize the degree of variability. Seven menus with the same entree were selected. The entree items included Burger,

Burrito, Pizza, Chicken Fried Steak, Taco, Corny Dog, and Fish. The menus selected for both school districts are presented in Appendix B. Observations were made for all seven menu items in each of the four facilities. A total of twenty-eight days was spent for data collection. A form was developed to record the appropriate information. A copy of the form is presented in Appendix C.

Utilities

Electricity

The amount of electricity consumed by the Hobart C-44 dishmachines in the Denton schools and the AMF-Wyott waste compactors in the Arlington schools was measured using the Duncan Portable Electic Meters. The meter measures the amount of watt-hours consumed by the equipment. The meter has a maximum capacity of measuring electrical consumption up to one hundred thousand watt-hours. In the Denton schools, the meters were wired into the electrical circuit beside the panels which contained the breaker switches for the dishmachine. In the Arlington schools, the meters were wired directly into the waste compactors.

The meter was reset at zero at the beginning of each work day. At the end of the day the reading was taken from the meter to determine the electrical consumption for

that day. Since the utility rates are computed on the kilowatt-hour basis, the meter readings had to be converted from watt-hours to kilowatt-hours.

Meters were not connected to the garbage disposal and the exhaust system in the Denton schools. To compute the electrical consumption of this equipment, the approximate method suggested by Molzahn and Montag (5) was used. The running time for this equipment in both the Denton schools was recorded using a stopwatch. The exhaust system in both schools started and shut off automatically with the use of the dishmachine.

Amount of electricity consumed in kilowatt-hours	=	Machine running time in hours x 0.746 x Horsepower rating of the motor

The horsepower rating of the garbage disposal at D-I was 2.0 and at D-2 was 1.5. The exhaust system in both the Denton schools had a horsepower capacity of 2.0.

To calculate the cost of electricity consumed, current utility rates for commercial operations were obtained from the utility departments of the cities of Arlington and Denton. The electricity rate for Arlington was $0.0425 per kilowatt-hour and $0.0385 per kilowatt-hour for Denton.

Water

The water consumption was considered only for the Denton schools since dishwashing task was eliminated in the Arlington schools. Information about the amount of water consumption was derived from the dishmachine manufacturer's specifications. The Hobart C-44 dishmachine used 450 gallons of water for every one hour of running time (21). The total running time of the dishmachine was recorded with the use of a stopwatch. To calculate the total amount of water consumed by the dishmachine, the running time in hours was multiplied by 450. To calculate the cost of water consumed, current water rates for commercial operations was obtained from the City of Denton Utilities Department. The cost of water was found to be $0.94 per one thousand gallons.

The amount of water consumed for pre-washing of the serviceware and the water used in the garbage disposal were not measured. This amount of water was considered to be negligible when compared to the amount of water used in the dishmachine.

The amount of gas used to heat the water and to produce steam has not been accounted for in this study. There was no accurate way in the present management to collect data for the gas consumption. The cost of gas would

have accounted for a higher cost in the use of permanent serviceware. This factor must be taken into consideration when making a decision between the permanent and the disposable ware systems.

Labor

A record of the labor time spent for the dishwashing, sorting of the silverware and storing of the serviceware items was determined for the Denton schools by using a stopwatch. In D-I, there were two employees working in the dishwashing area versus one employee in D-2. The total number of hours spent by the employees in the dishwashing and related activities was recorded. The average hourly salary ($4.45) for the Denton schools was obtained from the management. The amount of fringe benefits given to these employees was calculated to be 19 percent. Specific calculations are shown in Appendix D. The sum of an average hourly salary and the dollar value of the fringe benefits was used to determine the labor cost ($5.30).

In Arlington there was no labor time spent in the dishwashing activity. Time was involved in lining the garbage cans of the waste compactor, tying the garbage bags, carrying the bags to the pick-up site and cleaning the waste compactor. Although this required less time than the dishwashing activities, a record of the time was

kept using a stopwatch. The amount of labor time was used to calculate the labor cost for Arlington schools. The average hourly salary ($4.44) and the percent fringe benefits (20 percent) were obtained from the management. The cost of labor was determined by multiplying the number of total labor hours and the average hourly salary including fringe benefits ($5.33).

Labor Cost = Number of labor hours x Average hourly salary including fringe benefits.

Materials

In Denton schools, the materials used for dishwashing were the detergent and the de-liming agent. The de-liming agent (one cup) was used on the last day of the week after the dishwashing was completed. The amount of detergent that was used had to be estimated. It was not feasible to measure the initial and the final volume of the detergent on each day. However, it was observed that one gallon of detergent was used for approximately three days in both the facilities in Denton. Therefore, the cost of 0.333 gallons of detergent was calculated for each day. The cost of one gallon of detergent was obtained from the management, which was found to be $8.82. The cost of detergent and the de-liming agent are presented in Appendix E.

Garbage bags were used in both the Arlington and the Denton schools. At the end of each work day, the number of bags used were recorded. The cost of garbage bags was obtained from the management in both districts and the cost was calculated for each facility.

The average number of plastic compartmented trays of size 10" x 14.5" and the amount of silverware that had to be replaced each year in Denton schools were obtained from the management. The daily cost for replacement of trays, spoons and forks is illustrated in Appendix F. For the Arlington schools the cost of "foam double laminated" compartmented trays and "white medium weight plastic" flatware was obtained from the management. The cost of one tray ($0.0312), one spoon ($0.0075), and one fork ($0.0080) was calculated for each meal served. Therefore, the total of $0.0467 was multiplied by the meal count to compute the cost of ware in the Arlington schools.

Miscellaneous

Depreciation costs of the dishmachine and the waste compactor were derived on a straight line method of depreciation. It was assumed that the equipment did not have any salvage value. The IRS guidelines and life expectancy of the dishmachine as given by the manufacturers was twenty years. The life expectancy of the waste compactor

was given as twelve years. The depreciation rate of the compactor was computed on a twelve-year basis. Depreciation was calculated using the formula given below:

$$\text{Depreciation} = \frac{1 \times \text{Value of the equipment}}{\text{Expected life in years}}$$

The specific calculations for depreciation and cost of depreciation for each day are presented in Appendix G. The depreciation rates for the garbage disposal and the exhaust system in the Denton schools were not considered.

The cost of refuse removal service was obtained from the management for both school districts. The ratio of the average number of garbage bags from the lunch area to the total number of bags from the whole school was estimated. Only the cost of waste from the lunch area was taken into account for this study. The cost was included for each day as the cost for refuse removal. The calculations for the cost of refuse removal from Denton and Arlington schools are presented in Appendix H.

The cost for each menu item considering the utilities, labor, material, serviceware, depreciation, and refuse removal was computed for all four schools. To determine the cost per meal for each menu item, the total cost for each day was divided by the number of meals served for that day.

$$\text{Cost per meal} = \frac{\text{Total cost for the day}}{\text{Number of meals served}}$$

The number of meals served for each day was obtained from the management at the end of each work day. Comparison of the costs of each factor was made between two schools within the same school districts. The average overall cost of the Denton schools was compared with the Arlington schools.

Statistical Analysis

Student's t was utilized to determine if there was a statistical difference among the schools within the same school district in relation to the cost of utility consumption, labor, serviceware, overall cost, and cost per meal. Student's t test was also utilized to determine if there was a statistical significant difference among the two school districts in relation to the above factors. A significant level of $p \leqslant 0.05$ (two tail) was used to infer significant differences.

One way analysis of variance was utilized to determine if there was a statistical significant difference between the two school districts in relation to overall cost and cost per meal. A randomized block design was used to evaluate this difference. The schools were the blocks

and overall cost and cost per meal were the repeated measures in the analysis. A significant level of $p \leqslant 0.05$ was used to infer the significant difference.

CHAPTER IV

RESULTS AND DISCUSSION

A cost comparison study of disposable serviceware versus permanent serviceware was conducted in four elementary schools. The factors that were considered in the study were utility, labor, material and serviceware costs, the depreciation of the major equipment and the cost of refuse removal. Energy was measured using the Duncan portable electric meters whenever possible. The approximate method developed by Molzahn and Montag (5) was used to measure energy for the equipment which was not metered. Water consumption was estimated by using the manufacturer's specifications. The cost for labor was based on time studies and financial information provided by the management. Information about the cost of materials, serviceware, and refuse removal was provided by the management. Data were collected for seven selected days when specific menu items (Appendix 2) were served in each of the four elementary schools. Two of these schools used permanent serviceware and the other two used disposable serviceware. Only the sanitation sub-system was evaluated since this is the aspect of a food service operation which varies with the use of disposable or permanent serviceware.

Permanent Serviceware

In Frank Borman Elementary School (D-I), the total enrollment at the time of data collection was 653. The school lunch participation was 63.58 percent. In Robert E. Lee Elementary School (D-2), the total enrollment was 622 and the school lunch participation was 72.83 percent. For the purpose of comparison the cost per meal for the sanitation sub-system was compared for both the facilities.

The total cost for all the factors and the cost per meal for each of the seven days for the Denton schools are illustrated in Tables 1 and 2. The lowest cost per meal in D-I was found when burgers ($0.0496) were served, and the highest cost when fish ($0.0595) was served. The lowest cost per meal in D-2 was also when burgers ($0.0346) were served, but the highest cost was when burritos ($0.0401) were served. In D-I, labor cost was highest on the day when pizza ($20.2990) was served and in D-2, when burritos ($13.1440) were served. The lowest labor cost in D-I was found when chicken fried steaks ($18.8680) were served and in D-2 when corny dogs ($9.7520) were served. Although there was not a direct relationship between the cost per meal for the sanitation sub-system and the cost for labor, Tables 1 and 2 illustrate a close relationship between the number of meals served and the cost per meal. When

Table 1

THE COST FOR ELECTRICITY, WATER, LABOR, MATERIAL, DEPRECIATION, REFUSE REMOVAL AND COST PER MEAL IN THE SANITATION SUB-SYSTEM FOR BORMAN ELEMENTARY SCHOOL (D-I) IN DENTON INDEPENDENT SCHOOL DISTRICT.

Factor	Cost in Dollars						
	Burger	Burrito	Chicken Fried Steak	Corny Dog	Fish	Pizza	Taco
Electricity	0.1053	0.1119	0.1026	0.1144	0.1045	0.1189	0.1061
Water	0.5562	0.5414	0.4865	0.5839	0.5203	0.5711	0.5414
Utility (Electricity & Water)	0.6615	0.6533	0.5891	0.6981	0.6248	0.6900	0.6975
Labor	20.0610	18.9740	18.8680	19.2920	19.3980	20.2990	19.5570
Material - Garbage Bags	0.0920	0.1380	0.1380	0.0920	0.0920	0.0920	0.1380
- Detergent + De-liming Agent	3.0470	3.0470	3.0470	3.0470	3.0470	3.0470	3.0470
- Replacement Cost	0.4458	0.4458	0.4458	0.4458	0.4458	0.4458	0.4458
Depreciation	1.5923	1.5923	1.5923	1.5923	1.5923	1.5923	1.5923
Refuse Removal	0.3123	0.4167	0.4167	0.3125	0.3125	0.3125	0.4167
Overall Total Cost	26.2121	25.2671	25.0969	25.4797	25.5124	26.4786	25.8443
Cost Per Meal	0.0496	0.0554	0.0572	0.0598	0.0595	0.0562	0.0572
Number of Meals Served	528	456	439	426	429	471	452

Table 2

THE COST FOR ELECTRICITY, WATER, LABOR, MATERIAL, DEPRECIATION, REFUSE REMOVAL AND COST PER MEAL IN THE SANITATION SUB-SYSTEM FOR LEE ELEMENTARY SCHOOL (D-2) IN DENTON INDEPENDENT SCHOOL DISTRICT

Factor	Cost in Dollars						
	Burger	Burrito	Chicken Fried Steak	Corny Dog	Fish	Pizza	Taco
Electricity	0.1066	0.0812	0.1214	0.1090	0.0961	0.1188	0.1319
Water	0.4590	0.3215	0.5753	0.4738	0.4061	0.5372	0.4907
Utility (Electricity & Water)	0.5656	0.4027	0.6967	0.5828	0.5022	0.6560	0.6226
Labor	11.3420	13.1440	11.4400	9.7520	10.3880	12.0840	11.9250
Material - Garbage Bags	0.0920	0.1380	0.1380	0.1380	0.1380	0.1380	0.0920
- Detergent + De-liming Agent	3.0470	3.0470	3.0470	3.0470	3.0470	3.0470	3.0470
- Replacement Cost	0.4458	0.4458	0.4458	0.4458	0.4458	0.4458	0.4458
Depreciation	1.5923	1.5923	1.5923	1.5923	1.5923	1.5923	1.5923
Refuse Removal	0.3125	0.4167	0.4167	0.4167	0.4167	0.4167	0.3125
Overall Total Cost	17.3972	19.1865	17.7765	15.9746	16.5300	18.3798	18.0372
Cost Per Meal	0.0346	0.0401	0.0385	0.0353	0.0368	0.0374	0.0364
Number of Meals Served	503	479	462	452	449	491	495

fewer meals were served, the cost per meal for the sanitation sub-system increased. The cost for depreciation, detergent, replacement and refuse removal remained constant and added to the total cost and the cost per meal.

Table 3 illustrates the average cost of permanent ware (D-I + D-2) and the percent cost for each factor. The average cost per meal for D-I was $0.0564 as compared to the average cost per meal in D-2 of $0.0370. Therefore, the cost per meal of permanent ware was $0.0467 or 4.67 cents. The average cost per meal in D-I was approximately $0.0190 (1.9 cents) higher than that of D-2. The results of this study are comparable to those reported by Montag, McMillen and Henry (17) who also evaluated the cost of permanent ware in school foodservice. Montag, et al. (17) evaluated the cost of utilities, labor, materials, equipments and refuse removal and found the unit cost of permanent serviceware to be $0.04 in secondary schools. The unit cost of permanent serviceware in this study was $0.0467. Montag, et al. (17) had included the cost of steam and gas which were not included in this study. However, considering the above factors and the current economic situation with its inflation, the results remain fairly close. Cannon (18) indicated the cost of permanent ware to be $0.007 in elementary schools. The study

Table 3

AVERAGE COST AND PERCENT COST OF PERMANENT SERVICEWARE FOR BORMAN ELEMENTARY AND LEE ELEMENTARY (D-I and D-2)

Factor	D-I	D-2	Average Cost	Percent Cost
Electricity	0.1091	0.1093	0.1092	0.50
Water	0.5429	0.4662	0.5046	2.33
Utility (Electricity + Water)	0.6520	0.5755	0.6138	2.83
Labor*	19.4930	11.4393	15.4662	71.42
Materials	3.6048	3.6178	3.6113	16.68
Depreciation	1.5923	1.5923	1.5923	7.35
Refuse Removal	0.3572	0.3869	0.3721	1.21
Overall Total Cost*	25.6987	17.6117	21.6552	--
Cost Per Meal*	0.0564	0.0370	0.0467	--

*Significantly different at $p \leq 0.05$ (2 tail significance)

was conducted in 1972 and the results varied widely from this study.

Labor was the major factor contributing to the cost of permanent ware. Table 3 illustrates that labor cost was 71.42 percent of the overall cost of permanent serviceware. The cost of materials was 16.68 percent. Within materials, the cost for detergent and de-liming agent was about five times more than the cost of garbage bags and replacement cost combined. The third major factor contributing to the cost of permanent ware was depreciation of the dishmachine (7.35 percent). Utilities represented only about 2.83 percent of the total overall cost. The cost for water used in the dishmachine was about five times more than the cost of electricity consumed by the dishmachine, the garbage disposal and the exaust system combined. The cost of refuse removal for permanent ware system (1.72 percent) contributed least to overall cost.

The cost of utilities for the two schools in Denton was not significantly different at $p \leq 0.05$. The cost of electricity was also not significantly different, but the cost of water was found to be significantly different. Labor cost was found to be significantly different at $p \leq 0.05$. The overall cost and the cost per meal were found to be significantly different.

The labor cost for the schools was significantly different ($p \leq 0.05$). This was attributed to the varying degree of speed and efficiency at which the employees worked. In D-I, there were two employees working in the sanitation area as compared to one employee in D-2. The overall and average labor time in D-I was thus much greater that that of D-2. However, in D-I, the utensils used for the production and service sub-systems were washed in the dishmachine together with the school serviceware. Since these utensils were not washed all at one time or in any particular order it was not possible to determine the difference in labor time spent for the school lunch activity alone. Therefore the labor time in D-I included some additional time related to other sub-system than the one under study.

Disposable Serviceware

The total enrollment in Miller Elementary School (A-I) during the time of the study was 704 and the school lunch participation was 41.45 percent. In Wood Elementary School (A-2), the total enrollment was 644 and lunch participation was 42.05 percent.

The total cost for all the factors and the cost per meal for various entrees for the Arlington schools are presented in Tables 4 and 5. The lowest cost per meal in A-I was when pizza ($0.0634) was served; whereas, in A-2 was when burgers ($0.0634) were served. The highest cost per meal for the sanitation sub-system in both schools was the day when fish ($0.0700 for A-I and $0.7320 for A-2) was served. When fewer meals were served the cost per meal increased. The cost for depreciation and refuse removal remained constant and added to the total cost which resulted in an increased cost per meal. The total cost was related to the number of meals served since the cost of serviceware contributed to a large extent to the cost of disposable serviceware system. The average cost per meal for A-I was $0.0663 and for A-2 was $0.0676. Therefore, the average cost per meal for disposable serviceware system (A-I + A-2) was $0.0670 or 6.70 cents. The average cost for all the factors and the percent cost of disposable serviceware are presented in Table 6.

The results of this study show that the cost per meal of disposable serviceware in elementary schools was $0.0670. Montag, McMillen and Henry (17) found the cost of a disposable serviceware to be $0.10. The results of this study indicated lower cost than that presented by

Table 4

THE COST FOR ELECTRICITY, LABOR, GARBAGE BAGS, SERVICEWARE, DEPRECIATION, REFUSE REMOVAL AND COST PER MEAL FOR SANITATION SUB-SYSTEM FOR MILLER ELEMENTARY SCHOOL (A-I) IN ARLINGTON INDEPENDENT SCHOOL DISTRICT.

Factor	Cost in Dollars						
	Burger	Burrito	Chicken Fried Steak	Corny Dog	Fish	Pizza	Taco
Electricity	0.0211	0.0160	0.0139	0.0176	0.0114	0.0175	0.0144
Labor	2.5051	2.4518	2.1320	1.8122	2.1320	2.0787	2.1853
Material - Garbage Bags	0.5120	0.5120	0.5120	0.5120	0.4480	0.4480	0.4480
- Service-ware (trays & spoons & forks)	19.2404	17.0455	13.8699	16.1115	13.5430	18.7267	17.5592
Depreciation	2.2823	2.2823	2.2823	2.2823	2.2823	2.2823	2.2823
Refuse Removal	1.8868	1.8868	1.8868	1.8868	1.8868	1.8868	1.8868
Overall Total Cost	26.4477	24.1944	20.6969	22.6224	20.3035	25.4400	24.3760
Cost Per Meal	0.0642	0.0663	0.0697	0.0656	0.0700	0.0634	0.0648
Number of Meals Served	412	365	297	345	290	401	376

Table 5

THE COST FOR ELECTRICITY, LABOR, GARBAGE BAGS, SERVICEWARE, DEPRECIATION, REFUSE REMOVAL AND COST PER MEAL FOR SANITATION SUB-SYSTEM FOR WOOD ELEMENTARY SCHOOL (A-2) IN ARLINGTON INDEPENDENT SCHOOL DISTRICT.

Factor	Cost in Dollars						
	Burger	Burrito	Chicken Fried Steak	Corny Dog	Fish	Pizza	Taco
Electricity	0.0284	0.0213	0.0146	0.0188	0.0125	0.0214	0.0218
Labor	1.9721	2.0254	1.8122	1.7589	1.7589	2.0254	2.1320
Materials - Garbage Bags	0.5760	0.5760	0.5760	0.5760	0.5760	0.5760	0.5120
- Service-ware (trays & spoons & forks)	18.8668	18.0262	11.8151	12.8892	11.4882	18.7734	16.6252
Depreciation	2.2823	2.2823	2.2823	2.2823	2.2823	2.2823	2.2823
Refuse Removal	1.8868	1.8868	1.8868	1.8868	1.8868	1.8868	1.8868
Overall Total Cost	25.6124	24.8180	18.3870	19.4120	18.0047	25.5653	23.4601
Cost Per Meal	0.0634	0.0643	0.0727	0.0703	0.0732	0.0636	0.0659
Number of Meals Served	404	386	253	276	246	402	356

Table 6

AVERAGE COST AND PERCENT COST OF DISPOSABLE SERVICEWARE FOR MILLER ELEMENTARY AND WOOD ELEMENTARY (A-I and A-2)

Factor	A-I	A-2	Average Cost	Percent Cost
Electricity	0.0160	0.0198	0.0179	0.08
Labor*	2.1853	1.9264	2.0559	9.00
Garbage Bags	0.4846	0.5669	0.5258	2.31
Serviceware (trays + spoons + forks)	16.5852	15.4977	16.0415	70.33
Depreciation	2.2823	2.2823	2.2823	10.01
Refuse Removal	1.8868	1.8868	1.8868	8.27
Overall Total Cost	23.4401	22.1799	22.8100	--
Cost Per Meal	0.0663	0.0676	0.0670	--

*Significantly different at $p \leq 0.05$ (2 tail significance)

Montag, et al. (17). However, Montag, et al. (17) conducted the study in secondary schools where more variety of food was probably served and thus there were more serviceware items used. In the Arlington School District where this study was performed, a central purchasing system was used. Because of the central purchasing system, the cost of serviceware may be lower, which in turn can reduce the overall cost of disposable system. The quality of serviceware that was used can also make a difference. Hinged styrofoam trays were used in the study conducted by Montag, et al. (17), whereas foam double laminated compartmented trays were used for this study.

Table 6 illustrated that the cost of serviceware represented 70.33 percent of the overall cost of disposable serviceware system. According to Burger and Montag (16), the cost of ware was found to be 89 percent in a hospital setting. Since this study was conducted in elementary schools, the total number of serviceware used were less than that used in hospitals. The second major factor contributing to the cost of disposable ware was depreciation of the compactor (10.01 percent) followed by the labor cost of 9.00 percent. The cost of refuse removal contributed about 8.27 percent of the overall cost of disposable

serviceware system. The cost of garbage bags represented 2.31 percent and the utility cost was less than one percent (0.08 percent).

The cost of electricity for the two schools in Arlington was not significantly different at $p \leq 0.05$. The overall cost and the cost per meal for the two schools were also not significantly different. However, the cost of labor was found to be significant at $p \leq 0.05$.

Comparison Between Permanent and Disposable Serviceware

The cost of disposable ware was found to be approximately $0.0203 or 2.03 cents more than the cost of permanent serviceware in elementary schools. The cost of labor was the major contributing factor for permanent ware (71.42 percent). However, the cost of serviceware was the major contributing factor to the cost for disposable ware (70.33 percent). Studies by Burger and Montag (16) and Montag, McMillen and Henry (17), also indicated labor to be the major cost of permanent ware and the cost of serviceware to be the major factor for disposable ware. The cost of labor for permanent ware was about eight times more than the cost of labor for disposable ware. The cost of materials which included, the cleaning supplies, the garbage bags and the replacement cost was the second most important contributing factor

to the cost of permanent ware, followed by the cost of depreciation of the dishmachine. The cost of depreciation of the waste compactor was the second highest factor contributing to the cost of disposable serviceware. Depreciation of the compactor was based on a service-life of twelve years, whereas the depreciation of the dishmachine was based on twenty years of service-life.

The cost of utilities was greater for permanent ware (2.83 percent) than that for disposable ware (0.08 percent). The utility cost in permanent ware included water and electricity. The cost of steam and gas was not included in this study. If the cost for gas had been included, the utility cost for permanent ware would have been higher. The utility cost in disposable ware included only electricity that was consumed by the compactor. Utilities did not contribute to a large extent to the overall cost of either of the two systems.

The cost of refuse removal was about five times greater for the disposable ware than that of permanent ware. The cost of refuse removal contributed less than ten (8.27) percent of the overall cost of disposable serviceware. The dishwashing materials used for the washing of permanent ware items included the detergent for washing serviceware and the de-liming agent. A drying agent used in the rinse

to dry serviceware was not used in the Denton Schools. The cost of drying agent would have increased the cost of permanent ware. The depreciation cost for only the dishmachine was considered in the cost of permanent ware. In the permanent ware system, other major pieces of equipment are also involved in the dishwashing activities, such as, the garbage disposal and the exhaust system. If the depreciation of all the equipment were included the cost of permanent ware may have increased. However, for the disposable system, the only major equipment involved was the waste compactor and its depreciation cost was included in this study. The maintenance cost of all the equipment was another factor that was not included in this study. Since permanent ware utilizes more pieces of equipment, the cost of maintenance for the permanent system would be more than that of disposable system.

The compactors in Arlington schools were not used to their maximum capacity since the styrofoam crays sprung up to their original volume and waste was not compacted. Therefore, more garbage bags were used and the cost for refuse removal increased. If the compactors were not used, savings in the cost of electrical consumption and labor time would be realized. Although more garbage bags would have to be used, the cost of labor and utility would offset the cost of extra garbage bags. The cost of disposable

system would thus be lower than what the results of this study indicated.

Both, student t and one-way analysis of variance indicated the overall cost between the two school districts not to be significantly different at $p \leq 0.05$. However, the cost per meal between the two school districts was found to be significantly different. The cost of electricity between the school districts was also found to be significantly different at $p \leq 0.05$. The cost of labor was found to be significantly different. The cost of materials was significantly different for the two systems. The material cost for permanent ware included the cost of garbage bags, the cost of washing supplies and the replacement cost for serviceware. For disposable ware, the material cost included the cost of garbage bags and the cost of serviceware.

Average cost of permanent ware (Denton school district, D-I + D-2) and disposable ware (Arlington school district, A-I + A-2) are presented in Table 7.

Table 7

AVERAGE COST OF PERMANENT WARE AND DISPOSABLE WARE FOR ELECTRICITY, LABOR, MATERIAL, TOTAL COST AND COST PER MEAL

	Permanent Ware	Disposable Ware
Electricity*	0.1092	0.0179
Labor*	15.4662	2.0559
Material*	3.6113	16.5673
Total Cost	21.6552	22.8100
Cost Per Meal*	0.0467	0.0670

*Significantly different at $p \leqslant 0.05$ (2 tail significance)

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

A comparison of the cost for utilities, labor, material, serviceware, depreciation, and refuse removal was made between disposable and permanent serviceware systems within selected elementary schools. Results of the study indicated that the disposable serviceware was more expensive than the permanent serviceware. The cost per meal of the disposable serviceware was found to be 2.03 cents more than the cost per meal of the permanent serviceware. Although the cost of energy consumed by the permanent system was more than the disposable system, the cost of energy did not contribute to a large extent to the overall cost of either of the two systems. The cost of labor was the most critical factor in the permanent system. A reduction in the labor time may directly decrease the cost of permanent serviceware system. On the other hand, the cost of serviceware items had a direct effect on the overall cost of the disposable ware system. Disposable ware items are available at various cost levels and the cost of the disposable system can be influenced by the quality of the serviceware selected.

When deciding to implement a particular serviceware system, all aspects of the system and the facility in which it would be implemented should be considered. Energy is one of the factors that contribute to the cost of the system, therefore, consideration should be given to this factor. This study indicated that labor and serviceware cost were the major factors that contributed to the total cost (Tables 3 and 6).

The availability of labor in the geographical area of the facility, the minimum wage level and the cost for fringe benefits are the factors that are associated with labor. In places where it is difficult to find sanitation personnel and where salary and fringe benefit levels are high, disposable system offers an alternative solution. A disposable system also offers the additional cost benefit of relief from supervisory responsibilities in the sanitation sub-system. In areas where labor is easily found, permanent ware may be a system of choice. With the elimination of the dishwashing task, related savings in utilities, detergent and other washing supplies, equipment maintenance and depreciation and replacement costs are also accrued.

The disposable system is claimed to be more sanitary if serviceware is stored and handled properly. In facilities where appropriate sanitation equipment is not

available, disposable serviceware would be a better choice. Facilities that have problems coping with the sanitation aspects may find the use of disposables useful and more profitable. The size of the foodservice facility, the availability of the dishwashing facility and the space limitation must also be considered. For a very large operation, the disposable system may be more appropriate because the operation would probably have the space and capital available for the sanitation area and equipment. However, for a smaller facility with limited capital and space, disposables are a good alternative. The amount of capital investment required for a permanent system is more than that required for a disposable system. More equipment and space are needed for the permanent system, which in turn leads to a higher cost than that required by the disposable system.

Because of the reduced noise level in the disposable system, higher productivity, increased morale and decreased turnover among the foodservice employees was observed (1). Pilferage and accidental loss of serviceware was greatly reduced. Therefore, employee preference and acceptability should be considered before implementation of any system. The ease with which the employees will be able to transport and handle the serviceware must be evaluated. The

preference of the customers is an important factor that must be evaluated and included in the implementation plans. The customers' expectations and acceptability of the serviceware must be met to increase the participation rates in school foodservice and profits in commercial operations.

Modern technology continues to improve the disposable serviceware items. New products to meet today's needs are being produced and increased acceptability among the customers has resulted. Prices of disposable ware are steadily declining, whereas, the cost of permanent ware continues to rise (1). In the future disposable serviceware may cost less and the disposable system may be a more economical choice. The quality of the disposable items selected can make a considerable difference in the cost of the system. Therefore, management has to make a decision regarding the best quality suitable for the facility since the cost of the disposable system is dependent upon the quality of the products selected. Future possibilities of recycling of disposable serviceware can reduce the cost of disposable system even more.

In places where disposal of solid waste is a major problem and where labor for sanitation activities can be found easily, permanent serviceware must be considered. However, ability to invest in equipment and space must also be available.

Management should determine the type of service-ware to be used only after all the factors are evaluated and their pros and cons considered. For any facility the decision for selection of either the disposable system or the permanent system requires thought and planning. Once all the factors are carefully evaluated, the most appropriate selection can be made.

APPENDIX A

LETTERS OF PERMISSION FROM THE FOODSERVICE DIRECTORS OF ARLINGTON AND DENTON SCHOOL DISTRICTS

ARLINGTON INDEPENDENT SCHOOL DISTRICT
1203 WEST PIONEER PARKWAY
ARLINGTON, TEXAS 76013

OFFICE OF:
Food Service Director

September 1, 1981

Dr. Pawloski
Department of Nutrition
and Food Sciences
Texas Woman's University
P.O. Box 24134
Denton, Texas 76204

Dear Dr. Pawloski:

I hereby give my permission for Vibha Mehta to collect the necessary data in Arlington Independent School District for completion of her study comparing the cost of permanent and disposable serviceware. It is my understanding that the student will inform me within two weeks prior to beginning data collection. The student will provide me with a copy of her perspectus and final paper.

Sincerely,

Barbara Clark

Barbara Clark, R.D.

BMC:bmc

DEPARTMENT OF NUTRITION AND FOOD SCIENCES
TEXAS WOMAN'S UNIVERSITY
P.O. BOX 24134
DENTON, TEXAS 76204

CURRICULUM AND ADMINISTRATION
(817) 382-5611

NUTRITION RESEARCH
(817) 382-2158
(817) 387-5305

September 1, 1981

Ms. Betty Burk
Director of Foodservices
Denton Independent School District
909 Linden
Denton, Texas 76201

Dear Dr. Pawloski:

I hereby give my permission for Vibha Mehta to collect the necessary data in Denton Independent School District elementary cafeterias for completion of her study comparing the cost of pemanent and disposable serviceware. It is my understanding that the student will inform me two weeks in advance before beginning the study. The student will provide me with a copy of her perspectus and final paper.

Sincerely,

Betty Burk

Betty Burk
Director of Foodservices
Denton Independent School
District

APPENDIX B

SCHOOL LUNCH MENUS SELECTED FOR THE STUDY IN DENTON AND ARLINGTON SCHOOL DISTRICTS

MENUS SELECTED FOR THE STUDY

DENTON DISTRICT	ARLINGTON DISTRICT
Beefburger	Bunch O'Burger
French Fries	Golden French Fries
Carrot Sticks	Glazed Carrots
Snicker Doodle Cookie	
	Mexican Style Burrito-
Beef/Bean Burrito	with Meat Sauce
Pinto Beans	Garlic Toast
Cheese/Apple Wedge	Pinto Beans Ole'
Peach Cobbler	Chilled Tossed Salad
Favorite Pizza	Italian Style Pizza
Mixed Vegetables	Tossed Green Salad
Garden Salad	Hot Peach Crisp
Sunshine Bars	
Chicken Fried Steak	Chicken Fried Steak-
Chipped Potato	with Gravy
English Peas	Fresh Hot Roll
Homemade Rolls	Fluffy Mashed Potato
Jewel Jell-O	Seasoned Green Beans
Giant Taco	Taco Supreme
Pinto Beans	Fresh Hot Roll
Lettuce with Grated Cheese	Pinto Beans Ole'
Cinderella Cake	Fruited Gelatin Salad
Super Corn Dog with Mustard	Super Corny Dog
Tator Rounds	Golden Tator Rounds
Rainbow Salad	Seasoned Green Beans
Banana Pudding	
Batter Fried Fish	Batter Dip Fish
Buttered Corn	Macroni and Cheese
Stuffed Celery	Buttered Sweet Peas
Whole Wheat Roll	Fruit Salad Surprise
Rust Applesauce	Batter Bread

*Milk was served in half-pint cartons in both districts with every meal.

APPENDIX C

FORM USED FOR DATA COLLECTION DURING THE STUDY

NAME: _____ Elementary School DATE: _____, 1981

ELECTRICITY

	Before	After	(kilowatts)
Meter #1 -	_____	_____	
Meter #2 -	_____	_____	
Meter #3 -	_____	_____	

MATERIALS

of Garbage Can Liners Used _____.

	Before	After
Dishwashing detergent	_____	_____
Drying Agent	_____	_____
Others	_____	_____
	_____	_____
	_____	_____
	_____	_____

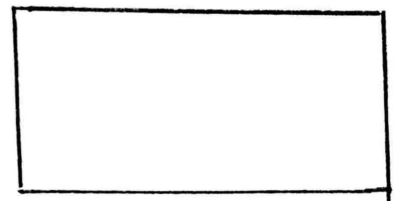
LABOR

	Starting time	Stopping time
Employee #1	_____	_____
Duties performed -	_____	
Employee #2	_____	_____
Duties performed -	_____	
Employee #3	_____	_____
Duties performed -	_____	

Today's Menu

_____
_____
_____
_____
_____
_____
_____
_____
_____

Layout of Food on Tray



Total # of trays served

_____

APPENDIX D

CALCULATIONS TO DETERMINE THE PERCENT FRINGE BENEFITS FOR DENTON DISTRICT

Calculations for the percent fringe benefits was determined from the relevant information provided by the Denton Foodservice management.

STEP 1 - Total dollar value of paid days off = The number of vacation (or Holidays) and sick leave days x The number of average hours worked per day x The average hourly salary.

Number of vacation or holidays = 10
Number of sick leave days = 10
20 days in a year

At an average an employee works for 8 hours a day. Average salary of the employee is $4.45 per hour.

Dollar value of paid days off = 20 x 8 x 4.45

= $712.0

STEP 2 - Dollar value of Teachers' Retirement Fund = Percent Teachers' Retirement Fund x Total yearly salary including the benefits.

Percent Teachers' Retirement Fund = 0.0665
Number of days worked = 176 per year

Number of hours worked in 1 year = 176 x 8
= 1408 hours in 1 year

Salary in 1 year = 1408 x 4.45
= $6265.6

Salary and Benefits in 1 year = $6265.6
+712.0
$6977.6

Dollar value of Teachers' Retirement Fund = 6977.6 x 0.0665
= $ 464.0

STEP 3 - Percent fringe benefits = Sum of Dollar values of Teachers' Retirement Fund + Dollar value of paid days off ÷ Yearly salary.

$$\text{Percent fringe benefits} = \frac{464.0 + 712.0}{6265.6}$$

$$= \frac{1176}{6265.6}$$

$$= 0.19 = 19 \text{ percent.}$$

The percent fringe benefits is approximately 19 percent.

The hourly salary for the employee is $4.45
Add 19 percent fringe benefits to it = $0.85

therefore the employee is paid $4.45 + $0.85 = $5.30 per hour.

APPENDIX E

CALCULATIONS TO DETERMINE THE DAILY COST OF DETERGENT AND DE-LIMING AGENT FOR DENTON DISTRICT

DETERGENT

1 gallon of detergent = $8.82
0.333 gallon of detergent is used in 1 day

Cost of detergent per day = 8.82 x 0.333

= $2.937 per day

DE-LIMING AGENT

1 gallon of de-liming agent = $8.75

1 cup of de-liming agent used in 5 days (1 week)
Total school days = 175 in 1 year
Total cups of de-liming agent used = $\frac{175}{5}$ = 35 cups in 1 year

16 cups = 1 gallon 35 cups = 2.2 gallons

Cost of de-liming agent per year = $ 8.75 x 2.2
= 19.25

Cost of de-liming agent per day = $\frac{\$19.75}{175}$

= $ 0.11 per day

Cost of detergent and de-liming agent = $2.937 + 0.11
= $3.047 per day.

APPENDIX F

CALCULATIONS TO DETERMINE THE DAILY COST FOR REPLACEMENT OF SERVICEWARE IN THE DENTON DISTRICT

REPLACEMENT COSTS

TRAYS

Average number of trays replaced in 1 year = 10
Cost of 1 tray = $ 3.17

Total cost of trays replaced in 1 year = $ 3.17 x 10 = $31.70

Replacement cost for 1 day = $\frac{\text{Total yearly cost}}{\text{Number of school days}}$

= $\frac{31.70}{175}$

= $0.1811 per day.

SPOONS

Average number of spoons replaced in 1 year = 12 dozen
Cost of 1 dozen spoons = $ 1.52

Total cost of spoons replaced in 1 year = $ 1.52 x 12 = $18.24

Replacement cost for 1 day = $\frac{\text{Total yearly cost}}{\text{Number of school days}}$

= $\frac{18.24}{175}$

= $0.1042 per day.

FORKS

Average number of forks replaced in 1 year = 12 dozen
Cost of 1 dozen forks = $ 2.34

Cost of forks replaced in 1 year = $ 2.34 x 12 = $28.08

$$\text{Replacement cost for 1 day} = \frac{\text{Total cost for the year}}{\text{Number of school days}}$$

$$= \frac{28.08}{175}$$

$$= \$0.1605 \text{ per day.}$$

TOTAL REPLACEMENT COST OF SERVICEWARE = \$0.1811 + \$0.1042 + \$0.1605

= \$0.4458 per day.

APPENDIX G

CALCULATIONS TO DETERMINE THE DAILY DEPRECIATION COST OF THE DISHMACHINE (DENTON DISTRICT) AND THE WASTE COMPACTOR (ARLINGTON DISTRICT)

DISHMACHINE

Current value of Hobart C-44 dishmachine = $5573.00
Expected service life of the dishmachine = 20 years
Number of school days = 175 days

$$\text{Depreciation per year} = \frac{1 \times \text{Value of the dishmachine}}{\text{Expected life in years}}$$

$$= \frac{5573}{20}$$

$$= \$278.65$$

$$\text{Depreciation per day} = \frac{\text{Depreciation cost per year}}{\text{Number of school days}}$$

$$= \frac{278.65}{175}$$

$$= \$1.5923 \text{ per day.}$$

WASTE COMPACTOR

Current value of AMF-Wyott waste compactor = $4875.00
Expected service life of waste compactor = 12 years
Number of school days = 178 days

$$\text{Depreciation per year} = \frac{1 \times \text{Value of waste compactor}}{\text{Expected life in years}}$$

$$= \frac{4875}{12}$$

$$= \$406.25$$

$$\text{Depreciation per day} = \frac{\text{Depreciation cost per year}}{\text{Number of school days}}$$

$$= \frac{406.25}{178}$$

$$= \$2.2823 \text{ per day.}$$

APPENDIX H

CALCULATIONS TO DETERMINE THE COST OF REFUSE REMOVAL FOR DENTON AND ARLINGTON DISTRICTS

DENTON DISTRICT

$$\text{Cost of refuse removal} = \frac{\text{(Average number of garbage bags from the lunch area)}}{\text{(Average number of garbage bags from the whole school)}} \times \text{The cost of garbage pick-up services per day.}$$

Average number of bags used in the schools was found to be 8 for D-I and 9 for D-2.
The cost for refuse removal for one day was found to be $1.25.

Depending on the number of bags used the cost was calculated for each day.

ARLINGTON DISTRICT

Cost of refuse removal for the foodservice per year = $27,000.00

Volume of refuse from the disposable serviceware = 2/3 x 27,000

= $18,00 per year

Cost of refuse removal for 1 month = $2,000 per mo.

Total of 53 schools in Arlington District.

Cost per school for each month $= \frac{2000}{53}$

= $37.7358

Cost per school for each day (20 days in 1 month) $= \frac{37.7358}{20}$

= $1.8868 per day.

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