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AN ECONOMIC ANALYSIS OF THE FEASIBILITY OF THE RETORT POUCH FOR PACKAGING FRUIT AND VEGETABLE COMMODITIES IN AN ENVIRONMENT OF RISING ENERGY PRICES

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AN ECONOMIC ANALYSIS OF THE FEASIBILITY OF THE RETORT POUCH FOR PACKAGING FRUIT AND VEGETABLE COMMODITIES IN AN ENVIRONMENT OF RISING ENERGY PRICES

By

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ABSTRACT

AN ECONOMIC ANALYSIS OF THE FEASIBILITY OF THE RETORT POUCH FOR PACKAGING FRUIT AND VEGETABLE COMMODITIES IN AN ENVIRONMENT OF RISING ENERGY PRICES

By

Jeffery Robert Williams

The economic feasibility of the retort pouch for processing, packaging and distributing processed fruit and vegetable products in a period of rising real energy prices is examined. The study focuses on the feasibility of replacing existing fruit and vegetable can packaging systems with a retort pouch packaging system or with a new can packaging system.

Food processing industries are relatively energy intensive in their operations and presently use a greater amount of energy per dollar of value added than any other sector of the food system. Development of technologies which are economic and reduce consumption of direct and indirect energy inputs is of importance to food processing and other food system sectors. Evaluation of new energy saving technologies, such as the retort pouch, requires the development of an approach for determining if and when the new technology can replace existing technology. The approach used identifies the level of energy prices, container prices, freight costs and other production costs which make the retort pouch system the minimum cost packaging system among the alternatives

considered, given the required investments in the new durable processing and packaging equipment.

Three systems models are used to estimate the costs associated with two existing canning systems and their possible replacements: a retort pouch or a can packaging system. A model is used to estimate the costs which are associated with acquiring and maintaining a new technologically advanced set of durable equipment for processing retort pouches. Another is used to estimate these costs for a new canning equipment complement. The models also use the data in an economic replacement routine to determine the optimal economic life of the new durable equipment complements which could replace the existing canning equipment complement. The models are used for estimating the cash flows associated with other operating requirements of the new replacement packaging systems such as container, freight, labor and energy expenses. A third model is used to estimate the costs associated with the operation of the existing can packaging systems and the maintenance of their durable equipment complement. The total costs of each system are then compared to determine the minimum cost packaging system. Different operating scenarios which consist of various combinations of equipment components, energy requirements, container prices, energy prices and other input prices are used to generate a range of operating costs for comparing the systems costs under a range of feasible operating conditions.

The retort pouch packaging system was the minimum cost packaging system among the alternatives considered. A retort pouch packaging system was cheaper than the new can packaging system and could currently replace the existing can packaging systems which were examined. Although the costs associated with acquiring and maintaining the durable machinery complement for retort pouches is significantly greater than that of either a new canning equipment complement or the existing canning system, the other operating expenditures are considerably smaller. In the future as real energy prices rise and the costs of cans, cartons, retort pouches, labor and freight increase at their current rates, the operating cost advantage a retort pouch system has will increase.

Lower freight costs, attributed to the lighter weight and smaller volume of pouches, and the comparatively lower purchase price of retort pouches than cans are the major contributors to the cost effectiveness of the retort pouch packaging system. Energy savings in processing the pouch versus the can is of little significance, but the comparatively lower amount of energy used in transportation and container manufacture has an important role in the cost effectiveness of the retort pouch. A substantial reduction of energy used for processing the retort pouch versus the can did not influence the comparative cost analysis to any significant extent.

With love for my mother who instilled in me a desire to achieve and my wife for encouragement during times of little inspiration.

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CHAPTER I

INTRODUCTION

Energy, both directly and indirectly, plays an important role in producing, processing and delivering food for consumption. Dwindling fossil fuel energy supplies and their rising real prices have lead to a re-examination of the role of energy in the food systems as well as other parts of the economy. It is expected that energy input prices will continue to increase relatively faster than prices of other inputs. Managers in the respective sectors of the food system will try to substitute less expensive inputs for energy, reduce energy use and search out less energy intensive technologies for delivering food from farm to consumer.

Investigations concerning potential adjustments to rising energy prices that take a system's perspective as opposed to an individual firm's perspective are needed in post farm gate sectors. This research is necessary because these sectors use a greater amount of energy per dollar value added than the agricultural production sector. In 1975, the food system accounted for 16.5 percent of total U. S. energy consumption, 82 percent of which was consumed in the post farm gate sectors. Farm production accounted for 2.9 percent, food processing 4.8 percent, marketing and distribution 1.7 percent, restaurants 2.8 percent and home preparation 4.3 percent of the aggregate energy consumption in the U. S. in 1975 (USDA, 1978). The ratio of the percent of energy use in the food system to percent value added in the respective sectors of the food system provides a measure of energy intensiveness (Table 1-1). The food processing sector uses more energy in total and per dollar value of product than any other sector of the food system.

Table 1-1--Ratio of Food System Energy Intensity to Value Added

Sector	% Energy Consumed of Total Food System / % Value Added of Total Food System
Farm Production	.56
Processing	1.46
Marketing and Distribution	.30
Restaurants	1.13

Food processing industries are, collectively, a major energy user in the U. S., currently ranking sixth among all major industrial groups in the total annual utilization of energy. Food processing operations depend heavily on natural gas and oil. Processors also require energy intensive inputs such as metal cans and other containers. Development of technologies which are economical and could reduce these as well as other direct and indirect energy inputs are of importance to food processing and other post farm gate sectors. Adoption of such technology should improve the performance of the food system.

The limited number of studies which have been conducted on energy related issues in the post farm gate sectors have primarily focused on describing energy use. Little work has been undertaken delineating economic adjustments including evaluation of new energy efficient technologies. A review of the work which has been completed can be found in DPRA (1974), Henig and Schoen (1976), Olabode (1977), Rao (1977), Singh (1979), Unger (1975), and USDA (1979).

The identification of new and emerging post farm gate technologies expected to have significant impacts on the U. S. food system was the focus of a recent study by the Office of Technology Assessment (1978). The retortable pouch, a multi-layer plastic and aluminum package that will withstand heat processing at high temperatures and produce shelf stable products which need no refrigeration before use and are of equal or greater quality than cans was a prominent candidate. Studies by Hoddinott (1975), and OTA (1978), indicate retort pouch packaging systems offer potential savings of energy in production, food processing, transportation and home preparation of food products. Additionally, the retort pouch is currently cheaper to purchase and transport than its comparable size counterpart, the metal food can.

Although the retort pouch does have unique advantages as a substitute package, the question of whether or not it can be economically competitive with the can remains to be answered. This study addresses the economic feasibility of adoption of the retort pouch as a processed fruit and vegetable packaging system.

The major components of a packaging system for processed fruits and vegetables, which will have an influence on the economic feasibility of retort pouches being adapted as an alternative package to replace the metal food can, are outlined in figure 1-1. This subsystem

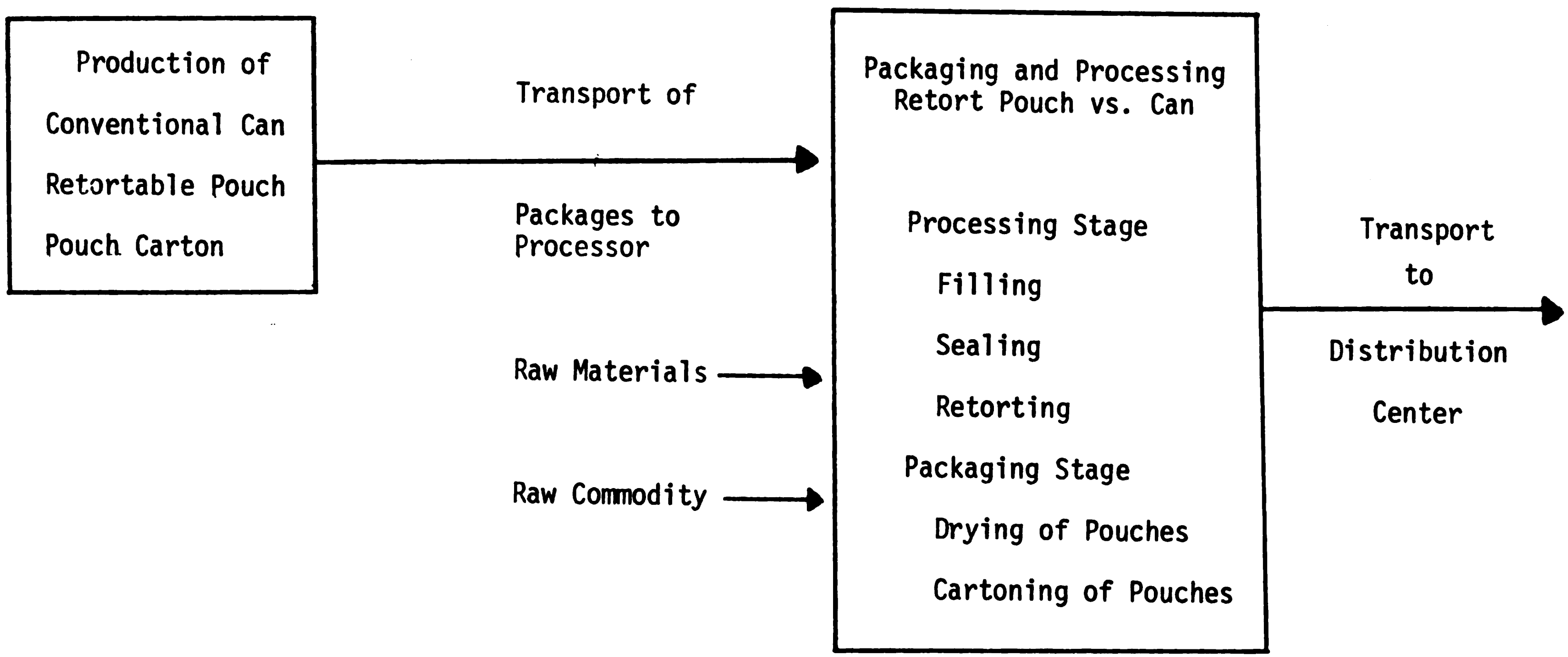

Figure 1-1--General Packaging System Outline.

of the larger food system is selected because the issues related to package costs, transportation costs, processing equipment investment requirements and operating costs are the primary components of the larger food delivery system to consider in an initial economic feasibility analysis of the retort pouch. Marketing and home preparation issues and costs are not considered in this subsystem. Although it is recognized that the cost of the pouch is influenced by retailing and home preparation considerations, the initial focus centers around the issue of whether pouch packaging costs are at least closely competitive with the can in the commodity processor's realm of operations.

Key non-energy costs which must be focused on in the search for a minimum cost packaging system for processed fruits and vegetables include:

1. The cost of purchasing cans, retort pouches and retort pouch cartons.
2. Transportation costs associated with moving containers and processed packages within the system.
3. Labor costs.
4. Costs associated with purchasing and maintaining processing and packaging machinery for canning and retort pouch packaging.

These costs are used to determine the minimum total cost packaging system for processed fruit and vegetable products. Although there are direct energy savings with the use of retort pouches as substitutes for cans, investment in the retort pouch technology cannot be justified strictly on reduced energy costs and flows alone. An evaluation must be conducted to determine if the new retort pouch packaging system is actually less expensive when the total costs of investment and operation are considered. The non-energy costs are different in a retort pouch system than in a can packaging system because of differential variable input and capital investment requirements.

This study does address these cost issues and the question of the economic feasibility of a retort pouch system by determining which system, cans or retort pouches, is the minimum cost system for processing fruit and vegetable products. Additional analysis in this study considers the costs associated with replacing an existing canning system with a new canning system and a new retort pouch packaging system. Although many costs are considered, the underlying motivation and focus of the study is the potential energy savings the retort pouch offers as a substitute for the cans in fruit and vegetable commodity packaging systems in an environment of rising real energy prices.

Problem Statement

The emphasis on energy aspects of this study is necessary for reasons previously discussed. Real energy prices, particularly for liquids, will continue to rise faster than the prices of other components of production costs and will reinforce economic incentives to search for techniques to conserve and use energy in a less costly and more efficient manner. As technologies are being developed they may be adopted as economical as energy prices increase.

A basic problem underlying this situation involves the need for the development of a new approach to evaluate possible investment in new energy savings technologies in a period of uncertainty concerning energy prices. Specifically, for this analysis, the problem centers around the need to develop an approach that can be used to identify the environment of resource prices, production costs, transport costs and investment requirements which must exist for retort pouch processing to be selected as the minimum cost packaging system for replacement of existing can packaging systems.

Overview of Research Objectives

The objective of this research is to evaluate the economic feasibility of retort pouches for processing, packaging and distribution of processed fruit and vegetable products. Specific objectives include the identification of alternative packaging system boundaries for a canning system and retort pouch system and the estimation of the costs associated with the durable equipment and other operating requirements for each system.

The major objectives of the study are to compare the costs associated with:

1. Purchasing processed food packaging containers, specifically cans and flexible retort pouches of retail size for packaging fruit and vegetable commodities.

2. Transportation of these containers from the package producer to the food processor.

3. Processing and packaging of fruits and vegetable products in these alternative packages.

4. Transportation of product to wholesale distribution centers from the processing location.

Additional objectives include:

5. Identification of the amount of energy used in the various stages of the alternative packaging systems which include construction of the containers, transportation of empty containers and processed products, and processing and packaging of the product.

6. Estimation of the economic life of can and retort pouch processing equipment and the costs associated with their

acquisition and operation over that period.

7. A description of the advantages and disadvantages of using retort pouches and cans in the food system for fruit and vegetable products.

8. Identification of the conditions under which retort pouches are a viable and economically feasible package for packaging processed fruit and vegetable commodities.

Production of Package Materials and Shipment

The objectives of the study that pertain to the packaging containers and shipment of them include:

1. The identification of the amount of energy used in construction of cans, retort pouches and protective boxes.

2. Determination of the current purchase price of cans, retort pouches and retort pouch cartons and the possible future price.

3. Selection of the size pouch which would substitute for the 16 oz., 303 x 406, fruit and vegetable can.

4. Calculation of the weights and volumes of the can and retort pouch in transport.

5. Identification of the method of transporting the packages between producer and processor.

6. Estimation of the current and future per unit transport cost of cans, retort pouches and retort pouch cartons.

Fruit and Vegetable Processing and Packaging

In the food processing component of the study, the objectives are to evaluate the advantages, disadvantages and economic feasibility of retort pouches versus cans for fruit and vegetable processing. Cans are extensively used for packaging fruits and vegetables for market. Processed fruits and vegetables in cans are an important commodity in the Michigan agricultural economy as well. Therefore retort pouches have potentially large influences on the processed fruit and vegetable packaging system. Additionally, the packaging systems for fruit and vegetable products are considered because essential data concerning energy use in food processing plants is available for fruit and vegetable processing lines. Although high value items such as gourmet foods and meat based products appear to currently be economically feasible for market in retort pouches, the major potential impact lies in the canned fruit and vegetable market.

An additional objective of this part of the study is the estimation of the economic life of can and retort pouch processing equipment and the costs associated with their acquisition and operation over that period under conditions of rising energy prices.

Further objectives of this section of the study include:

1. Identification of the operations within a canning plant which will have the greatest influence on resource use and production costs when comparing canning operations and retort pouch operations.

2. Identifying the type of machinery and associated resource use and operating costs used in retort pouch and canning operations.

3. Determination of the amount of product which is processed in the retail size pouch.

4. Identifying the amount of energy used in processing the can versus the pouch.

5. Comparing processing costs for a given design which includes the essential machine operations for retort pouch and canning operations.[1.1]

6. Comparing the packaging costs and determining the economic feasibility of investing in retort pouch processing under a variety of resource prices.

[1.1] This comparative analysis is conducted with a computer model that allows for the inclusion of costs associated with can and pouch packaging in the other sectors of the packaging system outlined in figure 1-1.

Transportation of Product

Specific objectives concerning transportation of the product to distribution centers include:

1. Selection of a method of transporting the packages between processor and distribution center.
2. Determination of the weights and volumes of the pouched and canned product in transport.
3. Identification of the amount of energy used in transporting the cans and pouches.
4. Estimation of the per unit transport cost of the finished pouched and canned product.

Marketing and Preparation

Although specific marketing problems, additional distribution costs, and energy use are not examined in detail at the retail or individual household level in this study, there is a general discussion of these issues and an outline of problems in these areas is presented for consideration in future research.

Procedure

A variety of information sources are used to construct the operating and capital costs associated with three alternative packaging systems. These systems are an existing canning system, a new canning system, and a retort pouch packaging system. The results of two energy accounting studies, which document the energy used in fruit and vegetable processing plants, are used to estimate the amount of energy required in the processing stage of the alternative packaging systems. Further, the essential components of the processed fruit and vegetable packaging system that could effect the adoption of the retort pouch are identified and the capital and operating requirements for each system considered are established. This information is then used to construct a generalized model of the packaging system alternatives for processed fruit and vegetables to estimate and evaluate the equipment and operating costs associated with each alternative system under a variety of input price scenarios and operating conditions.

Selection of the fruit and vegetable processing plants from which the processing and packaging component of the model is constructed was conducted in conjunction with the National Food Processors Association, Berkeley, California and the Department of Agricultural Engineering, University of California, located in Davis. For the research to be of general use it is necessary that the model be based on typical fruit and vegetable processing plants and operating conditions. Although the fruit and vegetable processing and packaging industry is very diverse in its operating procedures, the processing plants from which the operating data was collected are not atypical.[1.2] Further, it is believed that the firms selected are of the approximate size of firm that may consider the use of retortable pouches as a packaging alternative sometime in the future. The energy accounting studies which were used in the study had previously been conducted in the plants which were selected.

After the typical fruit and vegetable processing operations were selected the next step was to collect information concerning the rate of production, type of equipment and associated labor, energy and

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[1.2]Personal communication, National Food Processors Association.

maintenance costs for the plants selected. This additional information for the existing plants was collected by surveying the respective plant production managers. Information concerning the retort pouch and new can packaging system alternatives was collected from a variety of equipment manufacturers and distributors. Data concerning construction and the estimation of the cost of retort pouches and cans was collected from package manufacturers and convertors. Current transportation costs were obtained from commodity transport companies and motor freight firms.

Energy price scenarios are developed from a number of sources including responses to an open ended survey soliciting opinions on energy price scenarios. The respondents were generally agricultural engineers and agricultural economists who have been conducting energy related research in the North Central States. Other input price scenarios are developed in conjunction with the analysis and are mainly used to indicate the sensitivity of the results to certain increases in prices.

As the required data was being collected, a computer model was formulated in accordance with the conceptual system outlined in figure 1-1. The model is used to estimate the costs which are associated with acquiring and maintaining a new technologically advanced set of durable equipment for processing retort pouches. These costs are also estimated for a new canning equipment complement. The model then uses this cost data in an economic replacement routine to determine the optimal economic life of the new durable equipment complements which could potentially replace the existing canning equipment.

The model is also used for estimating the cash cost flows for each of the new alternative packaging systems over the optimal economic life of the durable equipment complements which are required for operating the system. Cash flows are also estimated for the costs associated with the operation of the existing packaging system and the maintenance of the existing durable equipment complement.

The investment and operating costs used in this study are not total system costs but partial costs in the sense of partial budgeting costs because only those costs which are expected to be significantly different across the alternative packaging systems were estimated.

In the analysis procedure, the investment and operating costs of each new alternative packaging system are compared with the cost of continuing to operate the existing can packaging system to determine:

1. If a new packaging system which required either new canning equipment or retort pouch equipment should replace the existing canning system.

2. If a replacement system is needed, to determine which system it should be; a retort pouch system or a new canning system.

This procedure of analysis is conducted on two sets of data for two different processing plants. In summary, the costs of each alternative replacement packaging system are estimated and compared with the costs associated for each existing operation under conditions of rising energy prices and a variety of other price and cost variables to determine if a retort pouch system could compete on a cost basis with the other alternative packaging systems.

Organization

This study is organized to describe the essential operations and comparative cost differences in using retort pouches and food cans in packaging food systems. Chapter 2 discusses the current retort pouch technology, practical application to date and the potential benefits and disadvantages of using retort pouches. Chapter 3 outlines the conceptual energy price adjustment issues and reviews the current theory concerning asset replacement analysis. Chapter 4 presents the model, assumptions and basic data used in the study. Chapter 5 presents the analysis concerning the economic feasibility of a retort pouch packaging system. A summary of the results and discussion and needs for future research are presented in chapter 6.

CHAPTER II

THE RETORT POUCH

The retort pouch is a flexible package made from a laminate of three materials; polyester, aluminum foil and polypropylene. This container can withstand thermal processing temperatures that are required in food canning operations (figure 2.1). Combining the advantages of the can and the plastic boil-in-bag, retortable pouches substitute for the metal food can. Taste tests indicate that the quality of foods processed in the retort pouch is superior to that of foods processed in cans and approaches the quality of frozen foods (OTA, 1978). Additionally, the pouch product has a shelf life similar to canned products and requires no refrigeration before opening.

The inner layer of the pouch, polypropylene, acts as a food contact material. It also forms the pouch seal under the application of heat. Aluminum foil is used in the middle of the laminate to serve as a moisture, light and gas barrier while the outer layer, polyester, adds strength to the package. This construction can withstand sterilizing temperatures of 240-270° F which are considerably higher than the temperature exposure of the boil-in-bag associated with frozen food products.

History of Retort Pouch Development

Chughatta (1979), reports that the initial development of the retort pouch in the United States dates back to the 1950's when

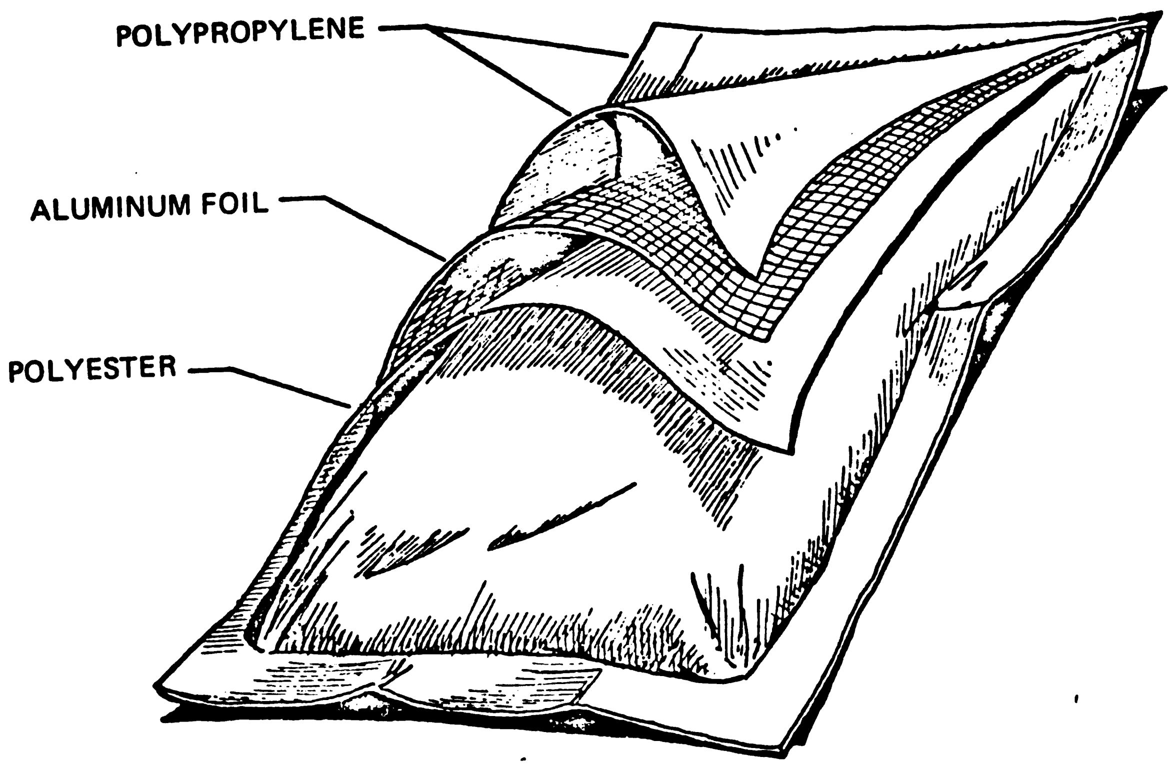

Figure 2-1--The Retort Pouch.

Source: FMC.

laboratory work was first initiated on thermal processable films. Its first practical application occurred in the Apollo Space Program in 1968. The U. S. Army Natick Laboratory first proposed the use of the pouch as an alternative package to the conventional rigid can, in order to alleviate the difficulties encountered by the combat soldier with C-rations which were served in a metal can. The Army desired a pouch which would be light, could be carried by a soldier without interfering with normal movement, could fit into combat uniform pockets conveniently and would not injure the soldier if he fell on it. Additionally, it should be durable yet easy to open and dispose of. The contents of the pouch would be heated before being consumed by boiling for a few minutes. Further the quality should be at least equal to canned foods.

During the course of the pouch development Natick evaluated the durability and storage stability of the pouch, its resistance to bacteria, and thermal processing temperatures and procedures. Additionally, the possible migration of pouch material extractives to the food was examined (Chughatta, 1979). Natick determined whether overwrapping of the pouch by paperboard envelope or carton would be necessary or recommended. Results of a field test in 1965-66 using 50,000 filled pouches indicated that if the pouch was constructed well, it would perform well (Mermelstein, 1978).

Natick conducted a reliability project beginning in 1968 to determine what type of pouch manufacturing and processing methods were suitable. Swift, Pillsbury, Continental Can, Rexham Corporation and FMC joined the effort. A pilot pouch processing line was installed in Swifts research and development center in Oak Brook, Illinois in 1970 and received USDA approval for army usage and testing.

The reliability and a subsequent project culminated in the running of the pilot plant for eight months in 1972, producing more than 400,000 five ounce pouches. A variety of twenty-two different food items were tested. These pouches were tested for seal integrity, sterility, and overall defects. The results showed performance equal to or better than the metal can (Mermelstein, 1976).

Natick Laboratories examined the comparative resistance to damage from rough handling abuse of flexible packages and metal cans. The overall failure rate of the flexible package was slightly lower than that of metal cans (Burke and Schulz, 1972).

After completion of the reliability project, several of the cooperating firms pursued work on the retort pouch and its related processing equipment. Rexham and FMC proceeded in designing and improving the packaging and processing equipment. Continental Can actively pursued commercialization of the retort pouch and purchased the pilot plant from Natick Laboratories (Mermelstein, 1976).

Mermelstein (1978), reports that in 1974, the U. S. Department of Agriculture gave its approval for a number of manufacturers to market meat and poultry products in the retort pouch, provided that the pouch materials met Food and Drug Administration regulations. At that time, there was no data indicating any problem concerning the materials used in construction of the pouch. However, in early 1975, studies indicated that components of the adhesive used to hold the three layers of the pouch material together would migrate through the inner food contact layer at the high sterilization temperatures. As a result, the FDA asked USDA to withdraw its approval and asked the material suppliers to submit data identifying and measuring the components of the adhesives and pouch materials.

In 1976, the FDA reviewed additional safety testing data on the adhesive components. However, the major suppliers of the pouch materials, Continental Flexible Packaging and Reynolds' Metals Flexible Packaging, modified the components of the pouch by using different thermal adhesives and bonding agents, that complied with existing FDA regulations. The following year the modified pouches were approved by the FDA. The USDA subsequently approved the pouches for use with meat and poultry products.

The U. S. Experience

Since 1977, several companies have shown interest in packaging commercially marketable food products in retort pouches. In September, 1977 the Continental Kitchens Division of ITT Continental Baking Company introduced a retort pouch product in the market. The product, Flavor Seal, was introduced in a limited test market of three cities: Fresno, California; Fort Wayne, Indiana; and Syracuse, New York. Seven meat based items were available in 8 oz. retail pouches. The items were Beef Bourguignon, Veal Scaloppini, Chicken Cacciatore, Chinese Pepper Steak, Beef Stroganoff, Chicken à la King and Beef Stew. Each item was marketed in an individual carton which displayed graphics illustrating the product. The items were simply prepared by heating the pouch in boiling water for five minutes. Because market demands in each test city consistently out-stripped supply, Continental halted its test and moved to develop an expanded production facility

(Food Production Management, 1979). The Flavor Seal product was displayed near canned meat items and above freezers where the frozen dinners were located. Accordingly the pouch was advertised as a substitute to the frozen product as well as canned meat products.

In summer 1979 ITT Continental retort pouch line re-entered the retail test markets. The new markets for distribution were Columbus, Ohio and Atlanta, Georgia. Bannar (1979) reports that according to a spokesman for ITT Continental Baking the pouched dinner market test had been successful. However, supermarkets in the Columbus area reported that the products were moving slowly, selling approximately a case of each variety per store per week with some stores selling more and some selling less. Each case of product contained twelve individually cartoned pouches. A majority of retail market managers consider sales of a product at a rate of a case per store per week to be the minimum acceptable rate. Two issues which appeared to effect sales were the price of the product and the positioning of the product in the store. Prices ranged from $1.59 to $2.49 with an average price of $1.89 to $1.99 for an 8 oz. package (Bannar, 1979). It is yet to be determined which location in the supermarket may optimize the sale of the product. The location has varied from canned meats, frozen food, dried soups and boxed dinners sections. At least one store reported that sales appeared to be best when placed in the boxed dinner section. Although the success of ITT's product in the retail market appears to be mixed, the company has applied for seven patents concerning the processing of the product .

George A. Hormel Company also initiated pouch production in the fall of 1977 on a line at its Austin, Minnesota plant. The company's marketing thrust aimed at specialized markets where the retort pouch could command a premium price. The main market which the Hormel pouch is aimed at is the camping market (Food Product Development, 1979).

The Hormel product line had twelve items which included meatballs in sauce, chicken à la king, frankfurters, ham patties, beef stew, ham slices, chicken loaf, beef and onions and beef patties. The serving sizes ranged from three to five ounces. Apparently, the pouches are attractive in the camping market because of their ease of handling and preparation. Further, their quality is superior to freeze dried foods. The Hormel products are also compatible with some of the currently available freeze dried foods. This enhances Hormel's concept of a total camping food line.

Hormel also supplies retort pouch foods to Sky Lab Foods of Elmsford, N. Y. Bannar (1979) reported that this firm serves retort pouch foods to government institutions, public and private agencies, camping and recreational markets and expects to expand distribution into disaster relief programs. An additional market for the pouches through Sky Lab Foods is the Meals on Wheels program (Food Products Development, 1979). Prices for individual four ounce pouches are approximately $1.10.

Specialty Seafoods, Inc., Anacortes, Washington is using the retort pouch for its top-of-the-line Gold Seal brand of oysters and smoked salmon products. The pre-formed pouches measure 7-1/4 by 18 inches and are decorated with a gold seal label. After processing, the retort pouch product is packaged in a gift box for sale in gourmet food shops in the Pacific Northwest.

By far the greatest extent of development of retort pouch products in the near future will be for the military. The last year in which the Army plans to rely on the three-piece can C-ration is 1980. The Department of Defense has contracted with three suppliers for providing 24 million meals in retort pouches. The order involves production of 40 million pouches of meat entrees, fruit and baked products. The U. S. Army is calling its new rations MRE: (Meal, Ready to Eat). Each contractor will take responsibility for the production, assembly and delivery of complete rations. This is different than in the past where the government contracted separately for the manufacture of various food packets that comprise the ration, and then contracted to have them assembled.

The first company awarded a contract was American Pouch Food Company. This firm was founded specifically to apply retort pouch technology to food processing. American Pouch Foods will produce the MRE ration at two Chicago plants. The pouch food processing plant will include four form/fill/seal lines utilizing 4-3/4" x 7-1/4" x 3/4" pouches formed from roll stock. The pouches will contain 4 to 5 oz. of food (Morris, 1979).

The complete MRE program consists of twelve menus incorporating the following foods packaged in retort pouches:

1. 12 meat entrees
2. 1 vegetable
3. 2 fruits
4. 6 cake items
5. 6 freeze-dried items (2 meat, 4 fruit)

6. Miscellaneous items such as cookies, brownies, cheese spread, peanut butter, jelly, crackers and cocoa powder.

The other two contractors which are currently gearing up for retort pouch food production are Southern Packaging Co. Inc. of Baltimore, Maryland and Right Away Foods Co. of Edinburg, Texas.

Kraft Foods announced in March 1980 that they would begin testing five entrees in retort pouches in five test market areas in May, under the name à la carte. The items will include beef stew, creamed chicken, sweet and sour pork, beef stroganoff and beef burgundy. Each pouch will be of the 8 oz. single serving size. Reynolds Metals and Continental Can will be supplying the pouches for Kraft's product line.

The primary marketing objectives in the test markets are to determine sales potential. Kraft's primary competition in marketing its new line will be Stouffer's frozen entrees and a line of retort packaged products marketed by ITT Continental. Market studies will be conducted to determine if there is a significant preference for one brand over another. Retail prices of the items are expected to be approximately equal per ounce of product to Stouffer's frozen entree prices.

During the developmental stages of the à la carte program an independent marketing firm surveyed fifteen major national grocery chains and wholesalers purchasing staffs regarding the potential of Kraft's retort pouch product. According to the study 80% indicated they would purchase the pouch entree line (Supermarket News, March 24, 1980).

To date retort pouch products in the U. S. are viewed as convenience foods and are produced by firms which aim at marketing a distinctly different and readily identifiable food product. These firms generally are able to spend a good deal on product research and development, advertising and promotion of the product. Competition among these firms is related significantly to advertising and promotion. Few commodity processing firms, which tend to compete on efficiency of operation and distribution instead of brand name and differential product characteristics, have attempted to enter the market with retort pouches. This is primarily due to the amount of uncertainty regarding the economic and technical processing and distribution aspects of such products.

The Foreign Experience

In Europe retort pouches are being sold at a rate of about 40-50 million pouches per year, a relatively small market (Ebben, 1979). Lustucru, a French food company appears to be the leader to date. Retort pouch food production started in the fall of 1978. A new factory was built in northern France near a modern canning cooperative which had agreed to supply a variety of vegetables to be packaged. The plant uses pre-form pouches which measure 7-1/2" by 9-1/2" to fill 14 oz. of product. The products consist of a variety of retort pouched vegetables which include potatoes, carrots, brussels sprouts and mushrooms. The line currently operates at fifty-five pouches per minute but is capable of 140 pouches per minute (Package Engineer, May, 1979).

Japan has the most experience with the retort pouch. In 1978, the total sales figure for retort pouched foods amounted to $259 million. This figure compares to $1,764 million for total canned food sales in Japan (Food Engineering, September, 1979). Approximately thirty-three manufacturers are involved in retort pouch packaging. Many of the Japanese pouches are convenience type products which are of high quality and call for relatively higher market price than canned goods.

Canada has also had some experience with retort pouch use. Magic Pantry Foods of Hamilton, Ontario have been making stuffed cabbage rolls in retort pouches since 1978. The cabbage rolls are stuffed with meat and rice, then hand-placed into pre-formed pouches. Before sealing and retorting, a tomato sauce is added. The pouch is approximately 14 oz. and sells for $1.89 to $2.09 (Food Engineering, April, 1979).

Retort Pouched Vegetable Experience

Although there are no current marketings of retail size retort pouch vegetable products in the United States, there does appear to be market potential. Tung, Garland and Maurer (1976) reported that retort pouch vegetable products studied were "highly" acceptable and normal in storage stability. Flexible packaging techniques for shelf stable foods appeared to permit production of very high quality vegetable products. Even after twenty-five weeks of storage at room temperature products received sensory scores of 77 percent for overall acceptability, compared to 50 percent for commercial frozen samples (Food Production Management, June, 1978).

Southwick and Winship (1971) also report that selected vegetables processed in foil pouches have been shown by actual consumer tests to be preferable in quality to similar vegetables processed in cans.

Approximately 75 percent of the respondents indicated that the pouch is a better way to package vegetables. Further, 50 percent of the respondents in the study indicated that vegetables in pouches could cost as much or more than equivalent quantities of frozen vegetables. Approximately 80 percent believe the price should be above the price of canned vegetables. The products tested were peas, whole-kernel corn, cut green beans and mixed vegetables.

Even though vegetables in pouches were found to be more acceptable than the canned product, they were not as acceptable as the frozen product. According to the authors even though the taste of pouched vegetables was recognized to be better than frozen vegetables, the overall acceptability was less due to the fact the frozen products had superior color.

Although the market tests appeared to support the claims of higher quality products and desirability when compared to the can, the issue of acceptability is still open to some question. Initially, retort pouches will be viewed as a unique product rather than as a direct competitor against either canned or frozen goods. It is expected that the pouch product may be sold at a premium price above comparable canned items that will reflect the superior sensory quality of the product. However, if production and distribution cost advantages are significant for the retort pouches, their market price may be quite competitive with canned products.

The Pouch and Regulatory Agencies

Two agencies, the Food and Drug Administration (FDA) and U. S. Department of Agriculture (USDA) have been involved in regulating pouch use. The basic requirements for pouch use have been reported by Chughatta (1979). These include:

1. Identification of all materials used in the pouch.
2. Materials must meet the FDA regulation regarding migration of substances into the food product.
3. The pouch must be able to withstand exposure to 250°F water.
4. The sealed package must be resistant to bacterial penetration.
5. Additionally the pouch must preserve the food product for at least six months at 100°F and two years at 70°F.

All products currently being marketed meet and surpass these requirements.

For distribution of retail size pouches the USDA has dictated that an overwrap must protect the pouch. The pouch is generally marketed in a small carton which guarantees pouch integrity during shipment from processor to supermarket. Some industry people feel this may not be necessary. For example, an official representing American Can Company feels that if the transportation packing is adequate, overwrap cartons are not needed. From the standpoint of package design and display, an overwrap is unnecessary, since the pouch can have multi-color printing and can be displayed without overwrap from racks or even on shelves (Pinto, 1978). Currently there are no overwrap regulations for institutional size containers moving to institutional markets.

Benefits of the Retort Pouch

The retort pouch has many advantages when compared to canned and frozen products throughout the various stages necessary to deliver processed foods to the consumer.

Production and distribution of containers:

1. Currently a retail size pouch which measures 6" x 8" and its protective carton costs less than a comparable size retail can, (303 x 406). The pouch, including carton, would be approximately 10.5¢ while the comparable can would be 12¢. The difference in cost between larger pouches and cans is even greater. An institutional pouch with the capacity of .8 gallons would cost 12¢ while a number 10 can with the same capacity would cost 42¢ (Beverly, 1980).

2. A comparison of the energy requirements for comparable 8 oz. containers shows that retort pouches require less energy to produce, (Table 2.1).

3. Retort pouches require less energy and cost less to transport than cans because they generally weigh less than cans. For example, 1,000 pouches with dimensions of 5-1/2" x 7" weigh 12.5 lbs. and 1,000, 211 x 304 cans of the same capacity, 8 oz., weigh 109 lbs. (Hoddinott, 1975). Additionally, 1,000 6" x 8" pouches would weigh 15.6 lbs. while 1,000, 303 x 406 cans of comparable capacity would weigh 168 pounds.

The cost to transport pouches would be less because empty pouches take up considerably less space than empty cans. The area required for shipping 1000 empty 303 x 406 cans is approximately 25.72 cu. ft. while 1000 empty 6" x 8" x 0.1" pouches need only approximately .28 cu. ft., (appendix A.2). A shipment of one million pouches of this size requires only one 45 foot long trailer truck. However, a shipment of one million cans requires approximately 10 trailer trucks. This disparity is even greater for number 10 cans and institutional size pouches. Approximately 36 truckloads of number 10 cans are equivalent to one truckload of institutional size pouches (Silverman, 1979). Consequently, the amount of storage space for empty containers is much less for the pouch than the can.

Table 2-1--Energy Intensiveness of Food Containers (8 oz. Capacity)

Container	Weight	BTU/LB.	BTU/Container
Pouch			
Mylar .0005"	1.86 lb./1000	21,850	41
Thermoplastic adhesive	.36 lb./1000	21,850	8
Foil 00035"	2.42 lb./1000	124,800	302
Thermoplastic adhesive	.36 lb./1000	21,850	8
Modified Polypropylene .003"	7.45 lb./1000	21,850	163
Inks	.11 lb./1000	21,850	2
(Single Pouch)	12.56 lb./1000	Sub Total	524
Carton	84.26 lb./1000	16,700	1,410
		TOTAL	1,934
Frozen Food Dishes			
Aluminum	14.78 lb./1000	124,480	1,840
Organic Coatings	1 lb./1000	20,927	21
Plug lid:	11 lb./1000		
Foil	.825 lb./1000	124,800	103
Paper	10.175 lb./1000	16,700	170
Carton	41 lb./1000	16,700	685
		TOTAL	2,819
Glass Jars - Wide Mouth			
Jar	4-5/8 oz.	10,440	3,020
Lid (Steel)	10 gms. (est)	32,100	71
Seal Compound	1 gm. (est)	20,927	46
Label & Glue	1 gm.	16,700	37
		TOTAL	3,174
Three-Piece Steel (Tinplate Cans - 211 x 303)			
Steel (1)	109 lb./1000	32,100	3,500
Tin	605 gm./1000		
Organic Coatings	0.5 gm./can	20,927	23
Label & Glue	1 gm./can	16,700	37
		TOTAL	3,560

Source: Hoddinott, 1975.

Processing and packaging:

1. Because the pouch has a thinner profile than cans or jars it takes about 30-50 percent less time to reach sterilizing temperatures at the center of the food in the pouch than in cans or jars. In addition, the product near the surface of the container is not overcooked, as it may be with cans and jars. Most products' quality is generally maintained--the product is truer in color, firmer in texture, fresher in flavor, and there is likely less nutrient loss (Mermelstein, 1978). It is expected that certain products will be more suitable for processing in pouches than others.

2. Some products such as vegetables and fruits can be processed with less brine or syrup than is required with cans. This advantage becomes more significant as the package size becomes larger.

3. Because of the previously mentioned items, the pouch product should require less energy to process than the canned product.

Distribution, marketing and preparation:

1. The pouched product prepared for distribution weighs less and takes up less room than the comparable canned product. A case of twenty-four 303 x 406 cans weighs approximately 31 lbs. while a case of 24 retort pouch products weighs approximately 23 lbs. (Appendix A.1). As a result, distribution costs for the pouch should be less.

2. The pouch product after processing is commercially sterile, and shelf stable. Refrigeration or freezing are not required.

3. Retail size pouched foods can be heated quickly by placing the pouch in boiling water for 3-5 minutes, substantially less preparation time than for frozen foods. Therefore, less energy is used in the home when compared to frozen foods.

4. There is little need for pots and pans and cleanup is relatively simple. Pouches take up less disposal space than cans and should contribute to less costly refuse removal and incineration.

5. Additionally, the pouch can be opened easily by tearing across the top of the pouch before or after preparation. There are no sharp edges for injuries and a can opener is not necessary.

6. Retort pouches could also be used for portion control for people on strict diets and could also be advantageous for elderly persons. Single-serving portions individually packaged could be of use to many groups such as single persons or hospitals.

7. The potential for packaging larger quantities of product with less brine than is necessary in cans is particularly advantageous for institutional markets.

8. Mermelstein (1978) reports that from harvesting to consumption the total energy required is about 60% less for vegetables packaged in retort pouches when compared to frozen vegetables. When compared to canned vegetables the result is approximately 15 percent lower.

9. For retail sizes the label display area on pouches is greater than that of cans.

Disadvantages of Retort Pouches

1. Currently, the biggest difficulty and the main impediment to retort pouch sales growth is the lack of high speed pouch filling and sealing equipment. Most equipment currently available is only capable of handling up to sixty pouches per minute while canning equipment is many times faster.

2. Retort pouches are not as standardized in sizes as cans, mainly because the technical processing relationship of certain size pouches with various products are still somewhat uncertain.

3. The most appropriate way to ship the pouch has still not been determined. It is not totally clear whether cartons are actually beneficial or detrimental to pouch protection. Further recommendations concerning appropriate shipping containers for institutional size pouches are virtually non-existent.

4. At this time retail prices for pouched products are considerably higher than both canned and frozen foods. This is likely due to initial large food product development costs associated with the pouch products.

5. General technical sophistication, knowledge and experience with the pouch is less than alternative packages.

6. Considerable experimentation and testing is usually needed to bring a retort pouch product on-line. Expenses related to product development will be significant.

7. Consumers will need to be educated about the retort pouch concept and its use. Costs associated with marketing the new retort pouch may initially be substantial.

8. Retort pouches, as they are currently constructed, are not suitable for microwave preparation because of the aluminum layer. Some research is being conducted to develop pouch materials which could be substituted for the aluminum foil and allow for microwave cooking. The tradeoff which is made when aluminum foil is removed from the pouch is one of reduced shelf life. However, the amount of energy needed for home preparation may be further reduced.

CHAPTER III

CONCEPTUAL ISSUES

The methods and techniques applied in the analysis of the problem are based on theoretical considerations. Several theoretical and conceptual issues are involved in outlining and conducting an economic feasibility study of a new technology. This chapter reviews the necessary conceptual issues which include several aspects of the theory of the firm. A firm's possible responses or adjustments to rising input prices such as energy prices will also be reviewed. The necessary issues concerning capital investment and replacement theory will be dealt with in detail and a technique for applied replacement analysis will be suggested. The specific assumptions and technique for model construction and analysis will be discussed in chapter 4.

The Firm

In this study the major concern with the firm, a food processing firm, involves its possible adjustments as a response to rising input costs. Specifically, this concern involves the issue of how a firm should evaluate the question of technological adjustment in an environment of rising real energy prices which would make its operating system less energy intensive and less costly than would exist under the current set of technology. A modification where technological change is considered may involve the disinvestment of existing durable equipment and investment in technologically advanced durable equipment.

A procedure is needed to evaluate the question of whether or not the firm should invest in new durable equipment and a more energy efficient operating system. The procedure should be able to determine when and under what conditions durable asset replacement should be made. Secondly it should be able to select which durable assets should be used as replacements from the possible replacement alternatives. Before examining such a procedure and other possible adjustments, a review of some production economics theory is necessary.

A firm is defined as a "going concern" which produces one or several economic goods. A firm must decide on what goods to produce and how much of these goods to produce. To accomplish this, it is necessary for the firm to select the best possible way to technically combine various inputs such as labor, machinery, energy and other raw materials in combination to derive a saleable product.

Firms involved in making such technical decisions are constrained by the existing productive technology. Any productive process and its relationship of rate of input use to rate of output of product can be represented by a production function. In a simple single output productive process the production function can be represented by equation (3.1) where q represents the output per unit of time, while $x_1 \ldots x_n$

$$(3.1) \quad q = f(x_1, x_2, x_3 \ldots x_n | x_{n+1} \ldots x_m)$$

represent variable inputs per unit of time in the production process. The $x_{n+1} \ldots x_m$ represent inputs which are not variable but have been fixed at some predetermined level. The production function represents the maximum output obtainable from the possible input combinations and is determined by existing technology at a given point in time.

Technology is defined as the available productive processes technically feasible for producing an output. In the long run technological change can occur. Therefore the production function of the firm may be altered by adjustments to its technological base.

To determine the best input combination for production of a particular output level, input price information needs to be included in the analysis. Consider, for example, a two variable input production function, equation (3.2), in which all other inputs are held constant.

$$(3.2) \quad q = f(x_1, x_2 | x_{n+1} \ldots x_m)$$

The problem for the firm is to choose x_1 and x_2 levels so as to minimize costs for each level of output. In order to minimize the cost of producing a given level of output a firm should choose that point on the isoquant or isoproduct curve for which the rate of technical substitution of inputs x_1 to x_2 is equal to the ratio of prices x_1 and x_2, (figure 3.1). The isoquant or isoproduct is defined as a curve that illustrates all the possible combinations of inputs, (processes), that can produce an equivalent level of output. The slope of the isocost curve, the ratio of input prices, should be tangent to the isoproduct curve in the production function. The isocost or total cost line illustrates the combination of x_1 and x_2 which have equal cost. By equating equation (3.3) at every level of output that level of output is obtained at minimum cost given the existing technology which is in use in the production process. This occurs where the rate of technical substitution of x_1 and x_2 is equal to the ratio of the input prices and their marginal products.

$$(3.3) \quad \frac{\Delta x_1}{\Delta x_2} = \frac{MPx_2}{MPx_1} = \frac{Px_2}{Px_1}$$

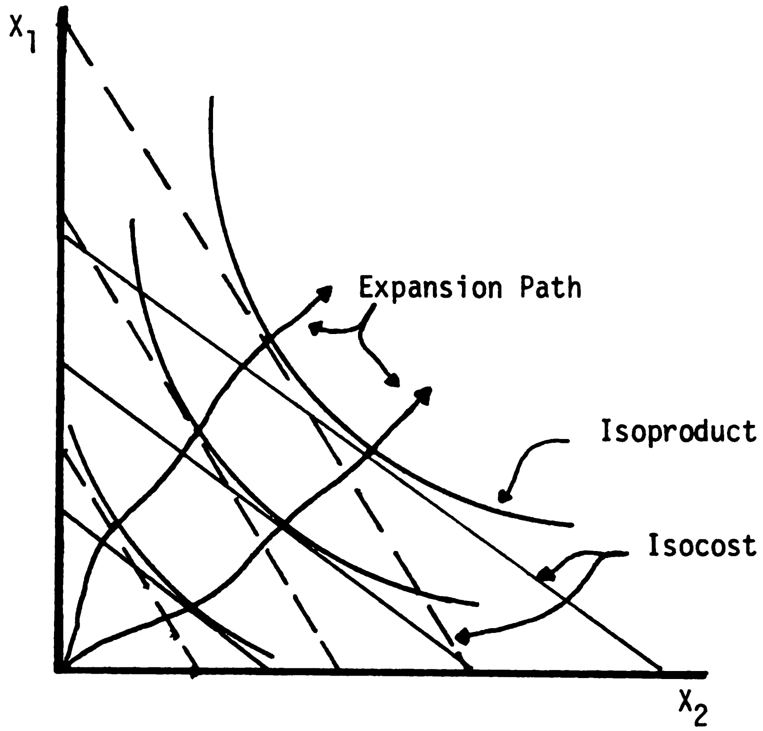

Figure 3-1--Imperfect substitute input combinations and expansion paths under different relative input prices.

The locus of the tangencies is called the firm's expansion path. It traces how input combinations change as output expands given constant input prices. However as prices of inputs change the slope of the isocost line changes and the combination of the inputs used in production is altered if the production function has attributes of substitutability.

The technology currently in use restricts the available combinations in which the inputs can be combined to produce a given level of output because it influences the positioning of the isoquants. As a new technology becomes available additional combinations of inputs to produce the previous level of output are a possibility. Therefore the expansion path can be effected by the technology changing the shape of the isoquant as well as by the changing ratio of input prices. Ferguson (1972), Lancaster (1974) and Herfindahl and Kneese (1974) should provide a further detailed review of the theory of production economics.

Firm Adjustments to Rising Energy Prices

The possible adjustments to rising energy prices a food processing firm can undertake are influenced by the production function or the technical relationships dictated by existing technology. The relationships can range from perfect substitutability to perfect complementarity. The economic structure of the food processing industry also has some influence on the possible adjustments.

In the short run when some inputs are fixed and the technology is given, adjustments are limited. As the period of analysis becomes longer the opportunities for other types of adjustment increase. In the short run it may be possible in some circumstances to substitute one energy input for another energy input. As the price of one of the inputs of energy increases it may be cost effective to substitute the cheaper energy input. For example, a BTU of natural gas may be substitutable for a BTU of fuel oil in the process of producing steam for use in food processing operations. What determines this substitutability relationship is the technology in place. Figure 3-2 illustrates the possible adjustments under changing relative energy input prices for a production function which exhibits the characteristics of perfect substitutability. Natural gas is x_1 and fuel oil is x_2.

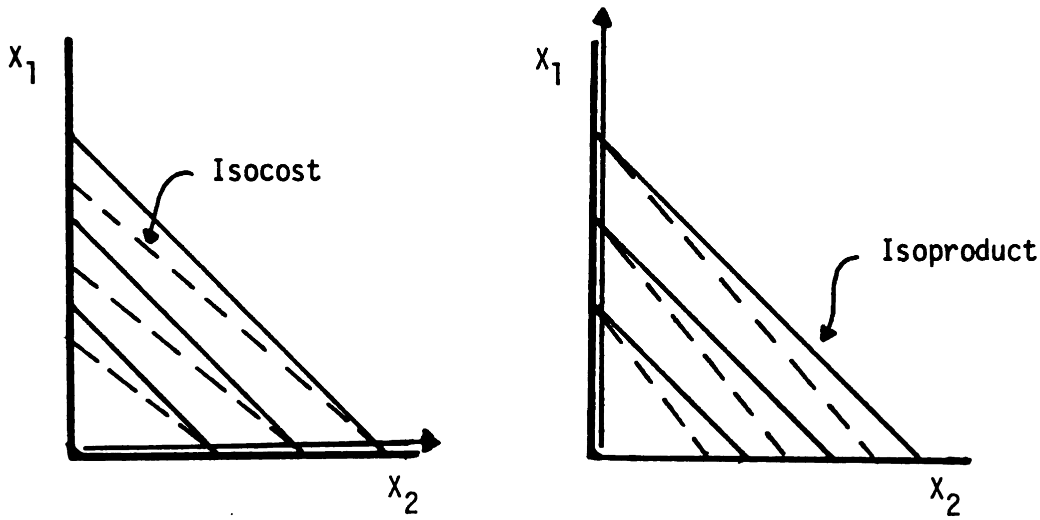

Figure 3-2--Perfect substitute input combinations and expansion paths under different relative input prices.

The diagram on the left in figure 3-2 illustrates the case where a BTU of fuel oil is cheaper than a BTU of natural gas. Thus the tangency of the isocost and isoproduct line occurs on the x_2 axis. The expansion path is the x_2 axis. If fuel oil were to increase in price to be more expensive per BTU than natural gas then the expansion path and isocost curves would be different. The diagram on the right of figure 3-2 shows the result. Natural gas is relatively less expensive than fuel oil and the expansion path is the x_1 axis. Because the ratio of input prices is used in determining the optimal input combination and not the absolute price of the input alone, the expansion path would remain as it was originally if both energy input prices increased equivalently so that the ratio was uneffected.

A production function exhibiting the case of imperfect substitutes is illustrated in figure 3-1. For this case there would be some substitution of inputs occurring as the ratio of the input prices change. This substitution would not be a one to one or all or none switch. In this case let x_2 be energy input and x_1 be labor. As the price of the energy input x_2 increases the slope of the isocost line changes and the point of tangency of the isocost and isoproduct line change. More labor and less energy is being used to produce every level of output than before. There are likely some adjustment alternatives of this type which can be used in a food processing plant. Some labor or a combination of inputs may substitute for a small amount of energy in the food processing operation.

Possibly the most interesting case in light of the study objectives is the case where energy and other inputs are perfect complements in production. Figure 3-3 illustrates that for all ratios of input prices the cost minimizing input combination for a particular level of output is always the same. There is no adjustment which takes place in terms of the input combination to produce a given level of output under changing input prices in the short run.

A good deal of the energy use in the food processing industry exhibits technical relationships like the latter. Energy needs to be combined with other inputs such as machine hours and raw product at very specific levels to arrive at a product given the existing technology in use. In the short run there is little chance of reducing energy use or making input substitutions for energy. Over a longer time period the technology and, therefore, the production function may be changed so that different and more cost effective input combinations can be considered. If this is true, the economic evaluation of investments in technology which reduce energy use in the operating system

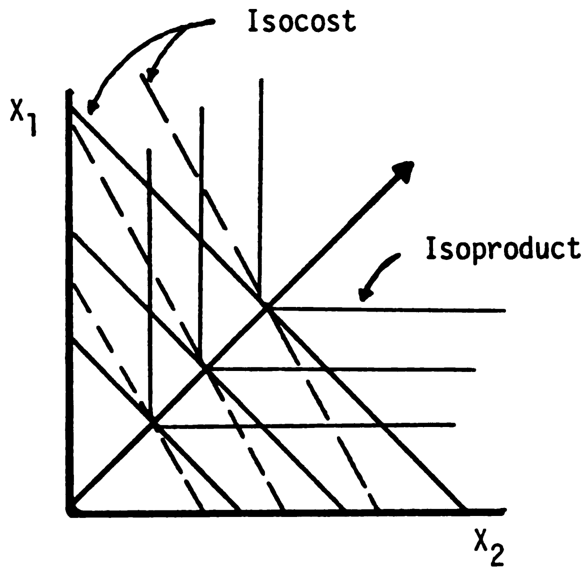

Figure 3-3--Perfect complement input combinations and expansion path under different relative input prices.

is important.

When the price of energy inputs in production increase the level of output can also be affected. The increased input price will affect the marginal cost of production and therefore the level of output that the firm chooses to maximize profits. This is illustrated in figure 3-4. As the price of energy rises the ratio of the input prices becomes larger and the slope of the isocost line becomes steeper. Less units of energy input can be purchased for the same amount of money as previously. Therefore, with the same dollar outlay for inputs, less can be purchased and less output produced. The total cost to produce the previous level of output has been increased. In the short run a firm which exists in a perfectly competitive market with price given would reduce output as the costs associated in production rise. However, the level of output is a function of the price the product

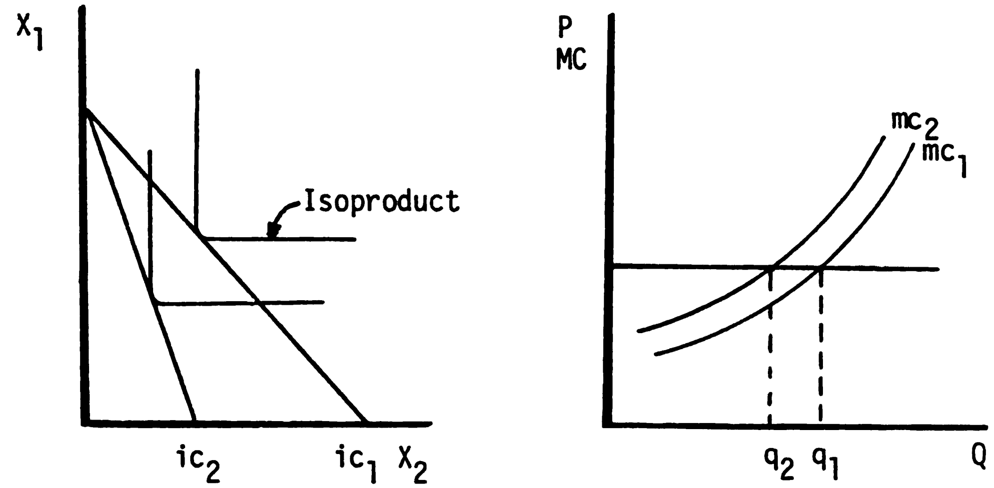

Figure 3-4--Short run marginal cost and output effect from an increase in real energy prices.

receives in the market over the long run, as well as the influence of input prices and marginal costs. As the market determined price of the product changes the level of output can change. The optimizing point is where marginal costs are equated with price or marginal revenue.

Of course the firm could always attempt to pass higher input costs on to consumers in the form of higher product prices. The success of such an adjustment depends upon the structure of the industry that the firm exists in. If there are a large number of firms in the industry and there are many close substitutes and demand for the specific product or brand is elastic it is possible that a higher price for the product would influence consumers to switch to substitutes or other manufacturers' products which are cheaper. However, if all firms in the industry have the same cost structure and are effected by rising energy prices similarly then the aggregate result may be a rise in price along with some reduction in output. The actual level of price in the market will be the result of aggregate supply and demand adjustments. In general the more atomistic the industry and homogeneous the products, the less the individual firm can influence the market price and the more important the level of costs are in influencing the level of output.

Alternatively, if the number of firms in the industry are small, close substitutes are nonexistent and demand for the product is inelastic, then the individual producer may have more influence on the market price and therefore is somewhat more successful in passing increased production costs along to consumers. However, even in this case output would not remain at its original level.

The food processing industry is characterized by a large number of firms of various size operating under different conditions of cost. Greig, (1976) reports that firms involved in commodity processing participate in an industry which is nearly atomistic. Further, this type of processing results in production of fairly standard homogeneous commodities. A substantial part of the canning and freezing industry produce standard commodities. Although brands may exist, in most cases there are few distinguishing characteristics among commodities manufactured by different companies. Typically the cost of entry into this industry is not high. These firms tend to compete on efficiency of operations and efficiency of distribution of relatively low margin products (Greig, 1976). Under such circumstances the possibility to pass increases in energy costs of production on to consumers are limited.

Most producers would control a nonsufficient share of the industry to influence price. As energy prices increase firms with different cost structures will hold somewhat different competitive positions. Some firms will fare better than others. If a firm has little ability to influence the price it receives for its product then other types of adjustments are particularly important.

Reducing the amount of energy used in the production process is another alternative which firms have. The possibilities for doing such are related to the shape of the production function as previously illustrated by super-imposing different combinations of relative input prices on the isoquant surface. Before the firm can attempt to reduce energy inputs it is essential to examine the forms and amounts of energy used in the production process. Singh, (1979) has outlined a procedure for accounting for energy inputs and flows in food processing firms which appears to be receiving wide acceptance. It is also important to identify how the inputs are combined in the process and the potential for substitution in the short run versus the long run.

In the short run the technology is fixed and therefore technology, which generally exhibits input complementarity, has little potential for input substitution. This appears to be the general case for many food processing operations. Initially a food processing firm may be able to substitute some cheaper fuel for a more expensive fuel and make slight improvements in the efficiency of machinery which requires energy in the plant. By improving in-plant housekeeping, energy use can also be reduced. These possible adjustments include:

1. Improve boiler and other processing machinery efficiency with improved maintenance.

2. Eliminate excessive lighting.

3. Minimize idle time of equipment when product is not being processed.

4. Repair leaks in steam lines.

5. Insulate steam lines, boilers, retorting equipment and other process equipment.

6. Consider around the clock operation a few days per week instead of one or two shifts per day to eliminate start up time and further reduce operation of equipment when actual processing is not being conducted.

The firm may also consider shifting to processing other products that require less energy but can still utilize the existing technology of the plant. More specifically, a shift to processing products which are valued higher in relation to their cost of production may be considered in the short run if existing plant equipment can be used.

In the longer run a variety of energy saving technologies associated with similar or different products than were processed previously may be considered. These technologies would change the production function, input combinations and the expansion path of the plant. The conceptual issues and a procedure for evaluating these possibilities will be examined in detail in a subsequent section of this chapter.

Food processing firms also have a few other adjustment alternatives even though they may not be particularly pleasing. One possibility is to absorb the higher operating costs associated with the increased cost of energy inputs without reducing output and live with a reduced profit margin. Another alternative is for the firm to try to get control of its input costs by lobbying regulating agencies for some type of price break or associated tax breaks. This would generally be done as a member of a larger association of firms within the industry. Therefore, except for firms at the margin, the relative competitive advantage of any particular firm may not be substantially changed by this type of activity. Finally, as a last resort, the firm could cease production and salvage its assets.

In summary, there are several options a firm has for adjusting to rising energy input costs. The potential of these options is limited by the type of production function or technical relationship dictated by existing technology and the structure of the industry. The adjustment options are:

1. Substitute a cheaper energy input for a more expensive one where possible.
2. Reduce the amount of energy inputs used by substituting other inputs where possible.
3. Reduce amount of energy inputs by shifting to products which are less energy intensive.
4. Shift to products which have a higher value to energy cost ratio.
5. Reduce energy use and produce at a lower level of output.
6. Continue to produce at the same level of output and absorb increased operating costs and accept a lower profit margin.
7. Conserve energy and reduce waste by establishing improved housekeeping and maintenance practices.
8. Lobby or try to influence regulatory agencies.
9. Discontinue production and salvage assets.
10. Invest in new energy saving technologies which will change the production function and therefore the optimal input combinations.

Technology Replacement

As mentioned previously, investment in a new energy saving technology is one possible adjustment which may be chosen in the long run. Retortable pouches and the associated equipment for processing each individual pouch is a different technology than currently exists in traditional food processing plants. Therefore the issue of the economic feasibility of the retort pouch involves the question of replacement: that of a new technology for an existing technology. Processors who are going to use retortable pouches in the future are required to invest in new durable assets and disinvest existing durable assets. In this case, durable assets are processing machinery such as fillers, sealers, cartoners and retorts. Different amounts and types of variable inputs will also be associated with the new technology for use with the durable assets services.

The new technology will have a different production function and cost structure than the previously existing technology. Although an energy saving technology will have lower costs associated with variable energy inputs, the costs of the other variable inputs in production and the investment required for the purchase of the durable assets may be substantial and needs to be considered.

The evaluation of the question to invest in a new technology or not is difficult because it involves evaluating the costs and benefits attributed to the new technology, not only in the current time period, but in the future as well. Baquet (1980), reports that decisions concerning the acquisition and/or disposal of durable assets are inherently different from decisions regarding the acquisition of nondurable assets. Durable assets which are typically available in large fixed units are capable of being used in a number of production periods. Thus decisions regarding the acquisition and disposal of durable assets require information about future production periods. Nondurable assets are used up in the current production period and decisions regarding their purchase do not require information about future periods. Durable assets effect the firm's ability to respond to changing economic conditions and the decision maker could have to bear the responsibility for his decision for a considerable period of time because the capital expenditure may involve relatively permanent commitments that can influence the profitability of the firm in the long run.

Replacement Theory Reviewed

Asset replacement criteria under the assumptions that the firm is motivated to maximize profits and also exists in an environment of certainty has received considerable attention in economic theory literature in recent years. Vernon Smith, (1961) reports that this body of theory had its origin in two papers by J. S. Taylor, (1923) and Harold Hotelling, (1925). Taylor conceptually identified the costs associated with using a durable asset in production over a period of years. He also determined that the optimal time period to hold the durable asset in production would be where the average unit cost of the output of the durable over time would be minimized. The average unit cost of output was related to the acquisition price of the durable asset, its salvage value at the end of its service life and the costs associated with maintaining the durable asset during each production period. Smith also reveals that Hotelling reworked Taylor's theory to add profit consideration to the analysis. Hotelling proposed that the owner of the durable asset wished to maximize the present value of its output minus its operating costs. The optimal time period to hold the durable asset was the period that maximized present value of net returns to the durable.

Preinreich, (1940) reports that neither of the previous authors defined what the limitation of their methods were. However, he determines that they are only valid under static conditions where the existing durable would be replaced by another of identical type and operated under the same economic conditions. Preinreich goes on to point out that the Taylor method is also invalid when the existing durable is not to be replaced. The value of the product must be considered as well as the cost of producing the output when determining how long to keep the durable in production. The author also reveals in his discussion of the previous works limitations that the economic life of a single durable cannot be determined without consideration of the economic life of all durables in the chain or replacement over the firms planning horizon. Therefore the criteria becomes one of maximizing the present value of net returns to all durables in the replacement chain.

Terbough, (1949) contributes to the development of replacement theory by emphasizing the effect of dynamic external technological change on the decision process as well as internal deterioration of the durable. Terbough states:

> The majority of durable goods require during their service life a flow of maintenance expenditures, which as a rule rises irregularly with age and use. Most of them suffer a deterioration in the quality of their service as time goes on. Moreover, in a dynamic technology such

> as ours, they are subject to the competition of improved substitutes, so that the quality of their service may decline relative to available alternatives even when it does not deteriorate absolutely.

In other words, the existing durable should be evaluated against the performance of the latest technologically advanced durable. The criteria for evaluation should include these technologically advanced durables in the replacement chain.

Faris, (1960) was one of the initial works to appear which dealt with replacements of assets pertaining to agricultural systems. Faris identified the optimal replacement strategy to use when replacing an asset where the only revenue derived is by the sale of the asset. The principal of optimum replacement for a firm with a long production period and returns being realized by the sale of the asset is that replacement should take place when the marginal net revenue from the present enterprise is equal to the highest amortized present value of anticipated net revenues from the enterprise immediately following. This criteria can also be used where revenue is received from the enterprise throughout the economic life of the asset.

Smith, (1961) in addition to reviewing the development of the theory in its early stages, questions the need for developing the theory in terms of profit maximization. He reveals that if neither output or price of the output is influenced by the replacement decision then the decision can only be influenced by the associated costs of using the durables under evaluation. In other words, if a durable is replaced with a durable of equal capacity, there would be no effect on the price of the output and therefore on profit that could be attributed to output price alone. Profit could be affected however by a different cost structure attributed to the replacement but this could be handled under a purely cost minimization criteria. He develops a criteria using cost minimization where obsolescence and deterioration affect only operating cost per unit of output and not the level of output.

Smith's criteria is not entirely correct. In the long run, because a different cost structure attributed to the replacement would effect the profit maximizing criteria and the level of output and therefore market price of the output. However, the criteria should serve for a single firm in an atomistic industry where internal production decisions will not effect market price.

Smith also gives an excellent review of the intertemporal considerations for replacement. If the firm's planning horizon extends beyond the life of a single replacement, a sequence of replacements must be examined. Postponing of replacement will permit the adoption of more technologically advanced equipment at a later date but also burdens the firm with rising operation costs of the existing equipment. Additionally there are three opportunity costs which are attributed to delaying replacement. As a result of holding a durable asset for an additional production period, it suffers a decline in salvage value and the return foregone from the salvage proceeds. Further delaying replacement will likely lead to installation of durable assets with lower operating costs when technological change is occurring. However, the initial purchase price of the new durable may increase from one period to another.

A summary of the functional relationship between operation costs of the replacement durable and several factors which appear to be based on the previous work of Terbough is also given. The operating costs of a replacement durable are a function of the utilization rate of the durable, its age and the time, a proxy for the state of advancement of the durable, at which it is acquired. Operation costs are assumed to increase with the utilization rate of the durable and its age. The state of advancement of the durable asset is assumed to influence the operation costs negatively, in that the more advanced the durable is, the lower the underlying operating cost structure.

Smith's criteria for replacement of the existing durable without accounting for revenue consideration directly is based on cost minimization taking account of the previously mentioned costs. When the cost of holding the existing durable asset for another production period is equal to the uniform equivalent of all future durable expenses the existing durable asset should be replaced.

Perrin, (1972) presents a general model of asset replacement which accounts for opportunity costs. He suggests that to determine the optimal replacement age of durable that will be replaced by an improved durable, one must first determine the present value stream of the earnings associated with the "challenger" or durable asset to be acquired to replace the "defender," the durable asset currently in use. Using Perrin's notation the stream of earnings associated with the first challenger in the string of replacement assets is

$$(3.4)\quad C(b, s, 1) = \int_{b}^{s} R(t)\, e^{-p\,(t-b)}\, dt + M(s)\, e^{-p\,(s-b)} - M(b)$$

and the present value of the entire stream of replacements would be

$$(3.5)\quad C(o, s, \infty) = \frac{1}{1-e^{-ps}}\, C(o, s, 1)$$

where

C(b, s, m) = the present value of the stream of residual earnings from a challenger to be purchased at age b and replaced at age s by a series of m identical challengers.

R(t) = current revenues less costs from the process when the durable asset is age t.

M(s) = salvage of the durable at age s.

M(b) = acquisition cost of the durable at age b.

p = the interest rate.

Equation (3.5) is an expression for the present value of a perpetual annuity of amount C(o, s, 1) received every s years. In other words the present value of all the replacement assets in the stream are based on being identical to the first asset in the stream. Taking the derivative with respect to s and setting it equal to zero to determine the replacement age which maximizes the present value of the returns from the chain of replacement durable assets yields

$$(3.6)\quad R(s) + M'(s) = P[M(s) + C(o, s, \infty)]$$

where the value maximizing replacement age s is the age at which marginal revenue (residual earnings plus changes in the asset value for the first asset in the chain) equals the marginal opportunity costs (defined as the interest which could be earned by salvaging the asset in existence and the interest which could be earned on the returns from the replacement chain of assets which is postponed each period the asset is not replaced). Perrin states that the greater these future earnings are, the sooner the firm will replace the current asset.

In the case where there is a durable asset in existence, a defender, the criteria of optimal replacement is essentially the same. The defender should be held until the net earnings of the defender plus the changes in the defenders salvage value equal the opportunity costs of postponing the replacement. The opportunity cost is the interest which could be earned from the salvage value of the defender plus the interest on the present value of returns from future replacements. The replacement criteria is

$$(3.7) \qquad R(c) + M'(c) = P[M(c) + C(o, s, \infty)]$$

where c is the period in which the defender is salvaged.

In most real world replacement evaluations, net revenues and market values are observed as discrete annual levels rather than as continuous functions of time. Additionally, income tax regulations and investment credits can affect decisions of replacement of durable assets. Tax credits received for the investment in a durable asset can significantly reduce the price of the durable for evaluation. Tax considerations and discrete observations need to be accommodated in an approach for evaluation of real world replacement issues.

Chisholm (1974) and Kay and Rister (1975) present discrete time replacement models with tax considerations and apply them to optimal replacement decisions for farm machinery. Chisholm states that because of the severe problems of measurement of returns attributed to a particular durable, the model is formulated in a cost minimization fashion. The model developed as presented by Kay and Rister is presented in equation (3.8).

$$(3.8)\quad PV_n = \frac{1}{1-(1+r)^{-n}} [(C_o - C_n (1+r)^{-n}) + (1-T) (\sum_{k=1}^{n} R_k(1+r)^{-k}) - T(A_n (1+r)^{-1}) - T(\sum_{k=1}^{n} D_k (1+r)^{-k}) - I_n (1+r)^{-1}]$$

where:

PV_n = the present value of costs of a perpetual replacement policy of N years

r = after tax discount rate

C_o = acquisition cost of the challenging durable

C_n = value of challenging durable at the end of the n^{th} year in constant dollars

T = the marginal income tax rate

R_k = repair cost in k^{th} year in constant dollars

A_n = additional first year depreciation which can be taken with a replacement policy of N years

D_k = regular depreciation in k^{th} year

I_n = investment credit which can be taken with a replacement policy of N years

The model assumes that the resale value is equivalent to the depreciated book value when replacement occurs. If resale value did exceed the depreciated book value, then the difference would need to be added to taxable income in the year replacement occurred.

Operationally the authors suggest that the optimal time period be selected by evaluating the present value from t=1...N until the amortized cost is minimized. This cost is then compared to the cost of operating the defending durable for an additional production period. If it exceeds the amortized cost of the challenger's stream, then replacement should occur.

This particular formulation allows for consideration of income taxes. The after-tax present value of the sum of operation costs which are a function of machine age are included as well as the present value of tax savings from depreciation and investment credit. Income and expenses after tax considerations are equal to (1-T) multiplied by the before tax level of income and expenses, where T is equal to the tax rate. Depreciation and interest credit advantages after taxes are equal to (T) multiplied by the before tax level of depreciation and interest.

Further, by reformulating the amortization factor to allow for the discount rate in the numerator, the formulation allows the replacement criterion to reflect the opportunity cost of postponing the returns which would be realized from the next durable in the stream. This is consistent with Perrin's suggestion.

Robison (1980), identifies five costs associated with durable asset use in a production process which may be considered in replacement analysis. Three of these costs are related to the passage of time and are: control costs, time depreciation costs, and replacement opportunity costs. The fourth and fifth costs are user costs which are a function of both the amount of services extracted from the durable as well as time.

A direct user cost is defined as the value of the durable's capacity or services used up in the production process in a particular period. The user cost depends upon the rate of utilization of the durable. The utilization rate of the durable effects its lifetime capacity and therefore the period of time the durable would be held in service. The greater the utilization rate, the greater the loss in the durable's value in the current period because of its use. There is also a user cost associated with the passage of time which is defined as indirect user cost. This is the value of future durable services foregone because of current use (Robison, 1980).

The control cost is defined as the opportunity cost associated with money used to purchase the durable and maintain it in production over several periods. It is the amount which could be earned from that money in the next best investment alternative. Interest costs associated with financing the purchase of the durable could be used as a proxy for this opportunity cost. The second cost associated with the passage of time is the time depreciation costs. The value of a durable changes over time because of physical deterioration, inferior performance compared to technologically improved durables and imperfect markets for buying and selling durables of various ages. Because of some combination of these factors the durable asset's value depreciates over time. Robison refers to the third cost which is a function of time as the replacement opportunity cost. The opportunity cost is that which is associated with the delay of receiving benefits from a replacement durable. This cost is only relevant when services from a replacement are considered as an alternative to the durable or equipment complement in use.

Although it is recognized that the determination of the optimal rate of extraction of services from the durable and maintenance levels in each production period are important they will not be dealt with in this study because of the extremely difficult and uncertain process of determining them. A constant rate of services from the durable over some fixed production period is assumed. From an operational point of view, food processing equipment can operate over a range of utilization rates. However, in practice this range may be sufficiently small enough to ignore its relevance. Further the amount of operation or service extraction durables may be subject to in a production period may be determined by factors exogenous to the firm. The size of a particular fruit or vegetable crop and the frequency of delivery to the plant can not be totally controlled by the processors. It is likely that the firm's fixed capacity in some years may not be totally used simply because the size of the crop for processing may be small. Although the processor may desire to operate at a higher level, the raw product is unavailable. Other resource supplies may have the same effect if not controlled entirely by the plant manager.

The assumption concerning fixed extraction rates would appear to be suitable for making preliminary comparisons concerning the economic feasibility of different technologies. Where specific operating levels for particular durables in service, under actual operating conditions are trying to be determined for optimizing returns, variable rates of service extraction and particular maintenance levels would become more important to consider but nonetheless difficult.

Study Approach for Replacement Analysis

The approach used in this study is similar to the discrete time replacement models presented by Chisholm (1974) and Kay and Rister (1975). A present value replacement criteria will be calculated using equation (3.9). The computer program for operationalizing the criteria is presented in appendix B.

$$(3.9)\quad APVFD_N = \frac{r}{1-(1+r)^{-N}} [\, C_o - C_N\,(1+r)^{-N} + (1-T)\sum_{k=1}^{n} R_k\,(1+r)^{-k})$$

$$- T(\sum_{k=1}^{n} D_k\,(1+r)^{-k}) - I_N\,(1+r)^{-1} + T(BC_k\,(1+r)^{-k})]$$

where:

$APVFD_N$ = the amortized present value of costs which are a function of the age of the durable with a perpetual replacement policy of N years

r = after tax discount rate

C_o = acquisition cost of the challenging durable

C_N = value of challenging durable at the end of the N^{th} year in constant dollars

T = the marginal income tax rate

R_k = maintenance cost in the k^{th} year in constant dollars

D_k = depreciation in k^{th} years

I_N = investment credit which can be taken in first year with a replacement policy of N years

BC_k = balancing charge which adjusts for the possible difference between resale value and depreciated book value

The optimal time period for holding the durable will be selected by evaluating the present value from $t = 1...N$ until the amortized cost is minimized. Once the optimal t is found the additional costs associated with operating the durable which are not a function of the age of the durable must be calculated.

In this study the costs which are not a direct function of the age of the durable considered are described by equation (3.10).

$$(3.10) \quad APVND_N = \frac{r}{1-(1+r)^{-N}} [(1-T) (\sum_{k=1}^{n} E_k (1+r)^{-k} + \sum_{k=1}^{n} L_k (1+r)^{-k} + \sum_{k=1}^{n} INT_k (1+r)^{-k} + \sum_{k=1}^{n} IN_k (1+r)^{-k} + \sum_{k=1}^{n} O_k (1+r)^{-k})]$$

where:

$APVND_N$ = the amortized value of costs associated with operating the durable which are not a function of the age of the durable.

E_k = costs associated with energy use in k^{th} year in constant dollars

L_k = costs associated with labor use in k^{th} year in constant dollars

INT_k = interest charges in k^{th} year on a loan associated with acquisition of the durable

IN_k = insurance cost in k^{th} year in constant dollars

O_k = all other costs in year k associated with operating the durable which are not a function of its age (in this study such costs as containers and transportation charges are included here).

These costs which are not a function of the age of the durable are amortized over the economic life of the durable which was determined by the previously described process using equation (3.9). The two amortized cost figures are then summed to find the total amortized costs associated with using the durable over its optimal life (equation 3.11). This cost is then compared to the total costs which are associated with purchase and operation of other new alternative processing techniques. If more than one alternative is being considered the amortized values of all the alternatives can be compared. The alternative which has the lowest amortized value should be selected.

$$(3.11) \quad TPV_N = APVFD_N + APVND_N$$

If the objectives include evaluation of the question of whether or not the currently operating processing technique, the defender, should be replaced with a new technique, a challenger, the evaluation criteria for selection of the least cost alternative is somewhat different. Evaluation of the replacement question initially follows the previously described approach. Equation (3.9) would be evaluated for the minimum amortized cost associated with the age of the durable equipment. The optimal economic life of the durable is found where the amortized costs are a minimum. Again, once the optimal time period is estimated and the minimum amortized costs found the additional costs associated with operating the durable and the production process which are not a function of the age of the equipment must be calculated. For evaluation of the replacement issues these costs are estimated using equation (3.12).

$$(3.12)\quad PVND_k = (1-T)\ [E_k\ (1+r)^{-k} + L_k\ (1+r)^{-k} + INT_k\ (1+r)^{-k} + IN_k\ (1+r)^{-k} + O_k\ (1+r)^{-k}]$$

where:

$PVND_k$ = the present value of costs associated with operating the durable which are not a function of the age of the durable in the k^{th} year

E_k = costs associated with energy use in the k^{th} year in constant dollars

L_k = costs associated with labor use in k^{th} year in constant dollars

INT_k = interest charges in k^{th} year on a loan associated with acquisition of the durable

IN_k = insurance cost in k^{th} year in constant dollars

O_k = all other costs in year k associated with operating the durable which are not a function of its age (in this study such costs as containers and transportation charges are included here).

These costs which are not a function of the age of the durable are estimated on an annual basis over the economic life of the durable which was determined by evaluation of equation (3.9). The minimum amortized cost is then summed with present value of costs associated with operation of the production process which are not a function of the age of the durable in the current production period (equation 3.13).

$$(3.13) \quad TPV_k = APVFD_N + PVND_k$$

This cost is then compared to the total costs which are associated with operating the defending durable for an additional production period. If the total costs associated with the challenger are less than that of the defender then replacement with the challenger should be considered. If the total cost for the challenger is less than the total costs for the defender in all k^{th} years from 1...N where N is the optimal life of the challenger, the replacement should be made. However, if the total costs associated with the challenging process are less than that of the total costs of the defending process only in a few production periods and not all of them, an alternative evaluation procedure needs to be considered. If the total cost associated with the challenger in all periods is greater than the total cost associated with the defender in all periods, replacement should not be considered for the current production period. The analysis can then be repeated for each of the following production periods.

Discount Rate Selection

The approach suggested here involves discounting all flows over the economic life to a present cost and annualizing this cost by amortizing the present costs over the expected economic life. Discounting is necessary because a dollar's value at some future date is worth less than a dollar in the present. This is true because of the opportunity of investing money in the present to yield some return in the future. Therefore returns or costs associated with various future periods are not comparable unless converted to a value at a specific point in time. In this case, the present. The present costs associated with a stream of costs through future periods is that stream of costs discounted to the present period. To discount costs an appropriate discount rate must be determined. Several rates may be selected. These rates are based on the cost of borrowed capital, a weighted cost of borrowed capital and equity capital, and a firm's expected or minimum rate of return for investments undertaken. In this study the cost of borrowed capital will be used for the discount rate. This rate was selected because it has been suggested that most fruit and vegetable firms would obtain commercial loan money for purchasing equipment for the type of investment under evaluation in this study.[3.1]

To correctly account for inflation, real cost flows should be discounted by a real discount rate and cost flows which are not in constant dollars should be discounted with a nominal rate. Watts and

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[3.1] Personal communication with Comptroller, Michigan Fruit Canners Division of Curtice-Burns Inc.

Helmers (1979) report that for annual compounding the relationship of the real discount rate rr, the rate of inflation ri and the nominal discount rate mr, are as presented in equation (3.14). In this study the costs are in terms of real dollars, therefore, a real discount rate will be used. This rate will be estimated using equation (3.14).

$$(3.14) \quad rr = \frac{1 + mr}{1 + ri} - 1$$

The nominal rate is determined by the interest rate on long term commercial and industrial loans. The inflation rate is determined from the average annual increase in the gross national product deflator over the last several years.

Because the cost streams are calculated as after tax flows in this analysis the discount rate must be adjusted to an after tax basis. The before tax discount rate must be multiplied by (1-T) to determine the after tax discount rate. T is the marginal income tax rate.

Uncertainty

Decision making concerning investment and disinvestment in durables involves evaluation of uncertain conditions. Estimates of the capital requirements and the cash flows over time which are necessary for evaluating equations (3.9)--(3.12) have some degree of uncertainty associated with them. Each alternative investment and the values assigned to the parameters of a model to estimate cash inflows and outflows are subject to different amounts of uncertainty. It is not generally appropriate to assume that for each future period the cash flows have single value estimates.

Hopkins et al, (1973) states that it may be more realistic to describe an investment in terms of a range of possible outcomes and introduce the dimension of risk by examining the characteristics of that range. These risk characteristics are based on probability theory and statistical techniques. Methods are available for including variance, skewness, and expected values of a distribution of cash flows in an investment analysis. One of these techniques is referred to as Monte Carlo simulation. Monte Carlo simulation involves specification of probability distributions for the parameters that most influence investment feasibility. A series of random values are then generated for these parameters based on the previously specified probability density functions. These values are then used to calculate the cash flows and present value of the investment. With a large number of repetitions of this procedure a probability density function of present values for the investment can be determined. This additional information is useful for the manager to evaluate the risk associated with different alternative investments. A range of present values is available with an associated probability at each specified level within the range. The manager can then evaluate the alternatives with reference to his particular preferences concerning risk and uncertainty.

Hopkins et al, (1973) reviews two other alternatives for incorporating uncertainty into the investment analysis procedure. These two procedures are basically adjustments of the single valued estimates of a present value estimate and are known as the Discount Rate Adjustment and Certainty-Equivalent method. According to the discount rate adjustment method the discount rate being used in the present value analysis can be adjusted upward to reflect investment alternatives which are uncertain or known to have comparatively more risk associated within them. Everything else being constant, a higher discount rate would deliver a lower net present value of an investment than a lower discount rate. Different discount rates will reveal different values for the net return from the investment, however it is difficult to consistently choose an appropriate discount rate which reflects the risk associated with the investment. When the present value analysis is being conducted on cost streams alone, the discount rate would be adjusted downward to reflect the uncertainty associated with the investment. A lower discount rate would deliver a higher present value of costs than a relatively higher discount rate with all other things constant.

Certainty-Equivalent techniques have the discount rate reflect only the time preference of money and not variations in risk. The risk adjustment should occur in the cash flow or the numerator of the present value equation. The adjustment coefficient AC_M in equation (3.15) takes on a value between 1.0 and 0.0 depending upon the degree of risk associated with the investment.

$$(3.15) \qquad PV = \sum_{m=0}^{n} \frac{AC_m(Y_m - C_m)}{(1+r)^m}$$

where:

PV = present value of the investment

Y_m = income in year m from the investment

C_m = costs in year m associated with the investment

r = discount rate

n = economic life of the investment

AC_m = risk adjustment factor in year m

Hopkins et al, (1973) reveal that the adjustment coefficient AC_m can be interpreted as the adjustment factor which would lead the manager to regard the projected cash flows from an investment as equal to a certain cash flow as opposed to an uncertain cash flow. The coefficient AC_m is equal to 1.0 when the cash flow is certain and something less than 1.0 when it is uncertain. A risk adjustment factor which approaches 0.0 would indicate a very high risk. When working only with cost streams an adjustment coefficient range which varied between 1.0 and 2.0 could be used to compare alternative investments. In this case the more risky the investment the greater the value of the adjustment coefficient. In other words, if the gross returns are assumed to be equivalent for the possible investment alternative but there is uncertainty associated with their costs streams the allowance for risk would be operationalized by increasing the level of the costs and thereby decreasing what the net return would actually be if it were calculated.

Both the certainty-equivalent and risk adjusted discount rate approach have the same weaknesses. The present values associated with certainty and varying degrees of risk can be compared, but they represent single-valued estimates of the expected return from alternative investments adjusted for risk using a quantitative measure based on limited subjective judgment.

Another approach exists for attempting to deal with uncertainty in the estimation of cash flows which are essential for evaluating equations (3.9)-- (3.12). This approach, the one which will be used in this study, recognizes that many investments have more than one possible outcome and will utilize a range of possible cash flows.

Different cash flows will be generated by using a range of values for the important variables in the analysis. This will allow for a range of values to be evaluated using the investment or replacement criteria previously outlined in this chapter. This alternative allows for examination of the evaluation under a wide range of conditions and indicates how sensitive the results are to changes in individual values used in the estimation of the cash flows.

CHAPTER IV

MODEL DEVELOPMENT AND PROCEDURE FOR CONSTRUCTING COST ANALYSIS

Systems Approach

According to Manetsch and Park (1979), a "systems approach" is a problem solving methodology which begins with an identified set of needs and has as its result an operating system for satisfying the set of needs which is acceptable in light of the trade-offs among the needs and resource limitations that are accepted as constraints. The systems approach seeks to include those factors which are important in arriving at a solution to the problem and makes use of quantitative models and often computer simulation of those models in a decision making framework. This study uses the systems approach for the economic evaluation of retort pouches as a new replacement packaging technology.

The economic evaluation of a new technology requires the examination of the larger process of which it is a component. Further, it requires the identification of the interrelationship of the technology components inputs, outputs of the process, their values, and how they change over time. The relationship between process components and the inputs and outputs to and from the components constitute a system. More generally, a system is a set of interconnected elements organized toward a goal or set of goals (Manetsch and Park, 1979). A system can be defined to be large, such as the food system, or small, such as a food processing plant. Subsystems, such as a processing plant, contribute to the structure of a larger system--the food system.

A system can be modeled for use in a problem solving or decision making process. A model is an abstract representation of a real world system which represents those aspects of real world behavior which are important in the problem solving or decision making process. This study incorporates the use of a mathematical model of a subsystem of the larger food delivery system. The subsystem under study is outlined in figure 1-1.

Once the general objective is decided upon and the problem defined the next step is selection of the system boundaries. The system boundaries that are selected are a function of the objective of the research and the experience of the researcher in identifying the important components of the system and the system inputs and outputs. The boundaries for this study contain the components outlined in figure 1-1. These boundaries are selected because the issues related to package costs, transportation costs, processing equipment investment requirements and operating costs are the primary components of the larger food delivery system to consider in an initial economic feasibility analysis of the retort pouch. Although it is recognized that the cost of the pouch is influenced by retailing and home preparation considerations, the initial concern centers around the issue of whether pouch packaging costs are at least closely competitive with the can in the commodity processors' realm of operations. Alternatively, a study of the processing plant alone would not be comprehensive enough because the processor does have to deal with package, transportation and distribution cost issues. This is not to say that marketing issues are not important but that the costs associated with using retort pouches for packaging commodities in the parts of the system outlined in figure 1-1 are of significant concern at the present time. Commodity products are generally homogeneous in nature and are processed by a large number of firms that compete on production and distribution efficiency in terms of minimizing cost and not on expensive and far reaching marketing programs. If the major costs associated with using retort pouches in the components of the system in this study, (figure 1-1) are not somewhat competitive with the traditional canning method, then the issues associated with marketing pouches as opposed to cans would appear to currently need little consideration. However, if a retort pouch packaging system described by figure 1-1 appears to be cost competitive with a canning system, the marketing and home preparation issues should definitely receive further consideration.

This study uses the structural approach to systems model building in that it attempts to represent a detailed system structure. The approach divides a system into its component parts and builds a mathematical model that simulates the costs associated with each component and its relationship to other components within the system. The first task after the system boundaries were selected and the technology components identified was the identification of design parameters. The design parameters are such things as capacities and production rates, which are associated with the flow of resources and products through the system. Controllable inputs and their substitutes in the system which are important to the analysis were identified in conjunction with the design parameters. The relationship between the flows of inputs to the system, within the system and outputs from the system are quantified per unit of time. The controllable inputs values such as cost and price are established on a per unit basis over the time period the analysis is to take place. Finally, alternative technology components which could potentially be components of the packaging system were identified. Their design parameters, input and output flows and their values, were also determined in order to evaluate changes in system design.

In this particular study operating costs are of primary concern. Three system models are used to simulate or generate the costs associated with alternative packaging systems as a function of time. These models were developed specifically for simulating the costs of processing, packaging and transporting fruits and vegetables in accordance with a currently existing canning system, a new canning system and a new retort pouch system. By examining different alternatives or scenarios which include changes in the technology components, design parameters, internal resource flows, controllable inputs and values of these inputs, a range of operating costs are determined for evaluation of the systems costs under different operating situations.

Selection of Existing Processes for Modelling

For this type of research to be of general application it is necessary that the processing component of the models constructed for use in the economic evaluation of retort pouches versus cans be based on typical fruit and vegetable processing plants. Initially, Michigan Fruit Canners in Benton Harbor a division of Curtice-Burns Inc. was consulted in an effort to pursue selection of typical plants. It was their opinion that the National Food Processors Association (NFPA) would be most helpful in this regard. Of major concern was that energy consumption and flow information would be available for the processing operations selected. This data was necessary to determine if retort pouch adoption is particularly sensitive to rising energy prices. The National Food Processors Association in Berkeley, California was consulted concerning this matter. They revealed that the Departments of Agricultural Engineering, Food Science and Technology and NFPA had cooperated in several energy accounting studies concerning fruit and vegetable processing plants. The information collected in these studies is presented in Chhinnan and Singh (1978), Carroad and Singh (1980) and Singh and Carroad (1979). These three studies contain an energy accounting for the processing of spinach, peaches and tomato products.

The peach and spinach processing plants were selected from the three studies available for use in constructing the processing component of the models. They were selected because of their different characteristics in relation to type of process, labor intensiveness and rate of production. The spinach processing plant is a relatively labor intensive plant that has non-continuous batch retorting process. It also has a lower output per hour and shorter processing season than the peach plant. The peach plant processing line operates for an average of 40 days a year while the spinach line operates approximately 20 days a year. A continuous rotary retorting operation is used in the peach processing line. Further details concerning the existing processing lines are presented in the following sections of this chapter. The two processing plants selected for use in constructing the processing component of the packaging system models should be suitable and present sufficient contrasts for comparison in this initial study of the economic feasibility of the retort pouch.

Fruit and vegetable commodity items are useful in setting the more restrictive or demanding case for evaluation of the retort pouch packaging system in terms of cost effectiveness. It is felt that fruit and vegetable pouched products would have to receive a price very close to the currently existing canned product price to be market competitive. Fruits and vegetable products are comparatively low valued to other types of items which have received attention for retort pouch packaging. Fruits and vegetables would generally not be expected to derive a significantly higher value in the market place because of the change in processing and packaging technology. Improved product quality and a lighter more convenient package may contribute to the product being valued higher, but a significant change in value for commodity items is unexpected. Therefore, the chance of an increased return from fruit and vegetable pouch products does not complicate the analysis. Meat entrees, gourmet sauces and other specialty items would not present a restrictive case or a good comparison because they may be viewed as new products with little or few competitors. Further, these types of items are likely to receive a higher price than canned items and also compete in markets where more slack exists in terms of cost competitiveness. The competition in these areas would be centered mainly around advertising, promotion and product differentiation, not cost effectiveness.

Data for formulating a retort pouch processing line and a new canning line and the associated costs of packages and transportation were collected from a wide variety of sources which are referenced in the following text. Any reference to a company or product name does not imply approval or recommendation of the product to the exclusion of others that may be suitable and appropriate. Only those components of the packaging system which were considered to be significantly different in terms of costs across alternative systems were considered in the data collection process. The necessary assumption or condition which makes this allowable is that output from the existing canning line and either of the proposed alternatives would be equivalent. This eliminates the need to be concerned with revenue because under the same levels of output there would be no output effect on revenue for the comparative evaluation. Additionally, if output is considered to be equivalent for all of the alternatives, then rates of flow of energy and other resources and amount of equipment needed in some parts of the packaging system can be considered to be equivalent for either of the alternatives and their cost ignored.

The models and results are not necessarily specific for spinach or peach processing. The intent has been to keep the model and the results general enough to make some basic conclusions about the economic feasibility of the retort pouch and is not intended for any specific commodity. In fact, if the results were to be used for designing spinach and peach processing operations they would be inadequate because a greater level of detail in some aspects of the processing design would be needed for actual application. This is not to say that the models or the results would be less useful for consideration in a detailed study concerning possible investment in new retort pouch or can processing lines.

The Packages

The containers under consideration for packaging in this study are the retail size metal can and retort pouch. The metal can measures 3-3/16" in diameter and 4-6/16" in depth and is commonly referred to as the 303 can by the food processing industry. Number 303 cans have a capacity of 16.85 fluid ounces and are commonly used to package fruit and vegetable products. A brief examination of the U. S. pack statistics in Section VIII of The Almanac of the Canning, Freezing and Preserving Industries (1979) reveals that 303 cans are the most widely used for canning vegetables and are used in significant numbers for processing fruit products. Further, this size container was selected because it is widely used in the existing processing operations upon which this study bases its model of fruit and vegetable processing.

A retort pouch which will allow for packaging the same amount of drained weight of edible product as the comparable size metal 303 can was determined to be 6" wide and 8" long with seal widths on each side of the pouch being 3/8".[4.1] The calculation of the size of the pouch includes the assumption that the extra fluid in the typical canned fruit and vegetable product would be reduced for the retort pouch.

[4.1]Pouch size is based on a personal communication with the Project Director of the Flex-Can Program, Flexible Packaging Division, Reynolds Metals Company. Although an American Can Company official estimated the size to be 5" x 7", it was felt that given the lack of a standardized procedure for establishing retort pouch sizes, the larger estimate would present the more restrictive case.

Less fluid is needed in the retort pouch because when air is extracted from the pouch after filling, the pouch conforms to the geometry of the food. This does not happen with cans resulting in a greater amount of fluid needed to fill the can. Air is extracted from the containers in a standard procedure to reduce the chance of bacteria growth and spoilage. It was assumed that the pouch net weight would be 12 oz. although the drained weight would be equivalent to that of the product contained in the 303 can. Berry (1979) reports that 6" x 8" pouches accommodated 12 oz. of corn in brine for determining critical processing parameters in tests which he conducted.

The 6" x 8" retort pouches are approximately .01" thick and require less space in shipping than the 303 x 406 food can.[4.2] Weight is also significantly different when retort pouches are compared to cans. Less weight and a smaller volume will contribute to comparatively smaller freight costs for transporting empty retort pouches versus cans. Table 4-1 contains a comparison of weight and volumes of the alternative containers.

For distribution of retail size pouches the USDA has stated that an overwrap must protect the pouch to guarantee integrity during shipment from processor to consumer. Protective cartons for a 6" x 8" pouch would measure 5-3/4" wide 8" long and 3/4" in depth with each wall of the carton measuring .016" in thickness.[4.3] The weight of each carton would be approximately .79 oz.[4.4] A group of 1000 cartons

[4.2]Information supplied by Reynolds Metals.

[4.3]Personal communication American Container Corporation.

[4.4]Based on Kelsey, (1976). See appendix A.1 for further details.

Table 4-1--Comparison of Weights and Volume for Empty Preformed Retort Pouches

	Retort Pouches 6" x 8" x .01"	Metal Cans 3-3/16" x 4-6/16"
Weight[1]	15.58 lbs./1000	167.95 lbs./1000
w/cartons[2]	65.19 lbs./1000	
Volume[1]	.2778 cu. ft./1000	25.72 cu. ft./1000
w/cartons	1.42 cu. ft./1000	

[1]Based on information supplied by Reynolds Metals. See appendix A.1 for details.

[2]Based on Kelsey, (1976). See appendix A.1 for further details.

would weigh 49.61 lbs. This makes the total weight of cartons and pouches, 65.19 lbs./1000, significantly less than that of cans, (table 4-1). The volume a flat carton would require is approximately 1.976 cu. in. or 1.14 cu. ft./1000 cartons.

Pouch material instead of preformed pouches can also be purchased for use on retort pouch form/fill/seal machines. These machines form the pouch just before filling occurs. Generally a form/fill/seal machine would be more expensive than a fill/seal machine. However, it would require less labor because pouches would not have to be loaded into the machine as preformed pouches generally are. Each roll of material could contain enough material for approximately 15,000 pouches of the 6" x 8" size.[4.5] The roll stock would be 16" wide and be

[4.5]Personal communication, Retort Pouch Market Development Manager, American Can Company.

shipped on a 6" fiber core. The entire roll would be approximately 18" diameter. The weight of 1000 pouches on roll stock would be slightly heavier allowing for added weight of the fiber core.

Less energy is also used in the production of retort pouches and their protective cartons in total than is used in the production of cans, (table 2-1). Table 4-2 illustrates the difference in energy use for producing the size of containers considered in this study.

Table 4-2--Energy Used in Production of Retort Pouches and Cans

Container	Energy Embodied Per 1000 Containers[1]
Pouches 6" x 8"	3,646,499 BTU
Cartons 5-3/4" x 8" x 3/4"	828,487 BTU
Cans 303 x 406	8,905,884 BTU

[1]Based on Hoddinott, (1975).

As mentioned previously, the costs or value associated with the inputs needs to be established. Retort pouches currently cost less than the metal food can. Estimates of the cost of the 6" x 8" pouch ranged from \$50-\$100/1000 units. Reynolds Metals Company estimated the cost of the preformed 6" x 8" pouch at \$50-\$70/1000.[4.6] Alternatively, American Can Company estimated the costs based on square inches of pouch material. Pouch material would cost approximately 85¢-90¢/1000 sq." with an approximate charge of 1¢ to 1.5¢ additional for

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[4.6]Personal communication, Project Director of Flex-Can, Program Flexible Packaging Division, Reynolds Metals.

preformed pouches.[4.7] Under these circumstances a 6" x 8" preformed pouch could cost as much as 10¢ or $100/1000. Cartons costs range from $20-$30/1000 depending upon the quantity ordered.[4.8] A 5 million order or larger would be approximately $20/1000. Prices for empty 303 x 406 cans ranged from $118.16/1000 to $120.56/1000.[4.9] Table 4-3 presents a summary of these costs.

Table 4-3--Empty Container Costs (1980)

Container	Cost $/1000 units
Pouch 6" x 8"	$ 50-$100/1000
Carton 5-3/4" x 8" x 3/4"	$ 20-$30/1000
Can 303 x 406	$118-$120/1000

Transportation Considerations

Retort pouches require less energy in transportation and cost less to ship than cans. This is by virtue of the fact that retort pouches weigh less than cans and also require significantly less space in shipment, (table 4-1). Assuming that trucks are used to deliver retort pouches, cartons, and cans to the fruit and vegetable processors, it is possible to estimate the freight costs associated with the containers. A standard 45 ft. trailer truck has approximately 2669 cu. ft.

[4.7] Personal communication, Retort Pouch Market Development Manager, American Can Company.

[4.8] Personal communication, American Container Corporation.

[4.9] Personal communication, National Can Company.

of space.[4.10] The weight limitation for this size truck ranges from 40,000-43,000 lbs.[4.11] That is, approximately 20 tons can be loaded if enough useable volume is available. A 45 ft. truck with a 40,000 lb. weight limitation could load approximately 2,500,000 retort pouches or 103,770 metal cans.[4.10] One truck could handle 806,289 cartons.[4.10] To deliver 2,500,000 units of containers, one truck would be needed for pouches, four trucks for cartons and 25 trucks for metal cans. This represents a significant difference in the cost of transporting empty pouches and their required cartons when compared to the metal food can. Less energy in the form of diesel fuel would be required for shipping empty cartons and pouches than cans. According to USDA (1980) a truck with a 22.1 ton weight limitation required 2,550 BTU's/ton-mile. Therefore, retort pouches and cartons, because of their comparably smaller weight, require less energy in transport than cans. Table 4-4 illustrates the amount of energy needed for transportation of the alternative containers. The actual current freight costs to ship the alternative containers is illustrated in table 4-5 for various shipping mileages.

Up to this point the discussion has focused on identifying the characteristics and current values and costs associated with empty containers. The transport costs associated with the filled, processed package are also an integral part of this evaluation. Again retort pouches which contain fruit and vegetable products appear to have an advantage related to the weight of the finished package. Reduced

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[4.10] See appendix A.2 for details.

[4.11] Personal communication, Yellow Freight Line.

Table 4-4--Energy Required for Transporting Containers

Container	BTU's/1000 Units/Mile
Retort Pouches 6" x 8"	19.48[1]
Cartons 5-3/4" x 8" x 3/4"	62.01[1]
Cans 303 x 406	189.03[2]

[1]Based on weights of containers in appendix A.1 and 2,500 BTU's/ton-mile.

[2]Based on weights of containers in appendix A.1 and 2,251 BTU's/ton-mile.

Table 4-5--Freight Costs of Empty Containers (1980)

Container	Miles Shipped	Freight Cost/1000 Units
Retort Pouch[1]	250	$ .31
	500	$ .42
	750	$ .54
	1000	$ .88
Cartons[2]	250	$ .78
	500	$ 1.16
	750	$ 1.69
	1000	$ 2.77
Metal Cans[3]	250	$ 4.83
	500	$ 7.14
	750	$ 8.14
	1000	$11.06

[1]Based on one truck of 2,500,000 pouches.

[2]Based on one truck of 806,289 cartons.

[3]Based on one truck of 103,770 cans.

See appendix A.5 for Raw Freight Rate Data Information.

weight will result in comparatively lower freight costs for retort pouch packaged products versus canned products. The Almanac (1979) contains tables which list the approximate case shipping weights for various products in a variety of can sizes. According to these tables the average weight of a case containing 24 303 x 406 cans of fruit and vegetable products weighs 30.7 lbs. Alternatively, a case of 24 comparable 6" x 8" x 3/4" pouches of fruit and vegetable products is estimated to weigh 22.23 lbs.[4.12] This is a 8.47 lbs. difference.

Less energy is also required to ship a case of pouched products than a case of canned products. A 22.23 lb. case of pouched products would require 27.79 BTU's/Mile while 30.70 lb. case of canned products would consume 38.40 BTU's/Mile.[4.13]

The actual current freight costs to ship the processed products packaged in different containers is illustrated in table 4-6. Goldfarb (1971) writes that retort pouched vegetables have been approved for freight rates equivalent to canned vegetables. It is assumed that this rate holds for fruits as well because fruits are currently charged equivalently to canned vegetable products.

The initial value used for transport mileage in the analysis is 750 miles. This assumes that empty containers are shipped 750 miles from manufacturers to processor and finished products are shipped 750 miles from processor to wholesale distribution centers or warehouses. Barton (1980), reports that the average mileage manufactured food products are shipped to the warehouse is 765 miles. Therefore it was

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[4.12]See appendix A.3 for details for this estimate.

[4.13]See appendix A.3 for details of this estimate.

Table 4-6--Freight Costs of Processed Products Packaged in Retort Pouches and Cans (1980)

Container	Miles Shipped	Freight Cost/1000 Units
Retort Pouch[1]	250	$ 9.63
	500	$ 14.45
	750	$ 20.52
	1000	$ 31.20
Metal Can[2]	250	$ 13.31
	500	$ 19.96
	750	$ 28.35
	1000	$ 43.10

[1]Based on 1799 cases in a trailer truck, 40,000 lb. limit.

[2]Based on 1302 cases in a trailer truck, 40,000 lb. limit.

See appendix A.5 for further details concerning estimates.

assumed that 750 miles would be suitable for use as the distance fruit and vegetable products are shipped from processor to warehouse. Due to the lack of information concerning the distance that empty containers are shipped it was initially assumed to be 750 miles. The effect of different transport distances is further analyzed in chapter 5.

The Processing Lines

This section presents the data which was collected from the two existing processing lines. The data for constructing the models of the necessary components for a new retort pouch and can processing line that are replacement alternatives is also presented. Tables 4-7 and 4-8 present the information needed concerning equipment, capital expenditures, labor and energy flows required for modeling of the alternative packaging processes. As mentioned previously, this information is for those components which are considered significantly different from one alternative process to another and have different costs associated with acquisition and operation. Firm A is based on the existing spinach processing plant and Firm B is based on data collected from the existing peach processing plant.

The energy requirements listed in tables 4-7 and 4-8 are based on the information in Chhinnan and Singh (1978) and Carroad and Singh (1980). In these studies energy data was collected for several processing lines which were packing several size cans. This presented a problem because the energy consumption data for processing only 303 cans was what was necessary for this analysis. The procedure undertaken to determine the energy use in processing only 303 cans in each plant is as follows. The plant managers of the spinach and peach processing plants were contacted to determine the average production rate of the processing lines which were packaging 303 cans. Production rates were determined to be 300 cans per minute for spinach processing and 360 cans per minute for peach canning. Once this step was completed the tons of product being processed per 8 hour shift was estimated. This calculation was based upon the average rates of production and the drained weights of each product being processed. Drained weights of processed product used in this estimate were 10.6 oz. for spinach and 10.3 oz. for peaches. The result was that 47.73 tons of raw spinach and 55.62 tons of peaches were processed in 303 cans on the respective canning lines per 8 hour shift. The required

Table 4-7--Equipment, Capital Expenditures, Labor and Energy Requirements for Processing Alternatives For Firm A at 300 Packages per Minute

Operation	Number of Units	Capital Expenditure 1980 $	Labor Required Per Unit	Total Labor Per 8 Hr. Shift	Electrical Energy Use KWH's Per 8 Hr. Shift	Thermal Energy Use BTU's Per 8 Hr. Shift
Existing Equipment						
Fillers	5	N. A.	3	15	11.8	
Hand Filling-Check Weight				20		
Exhaust Box	2	N. A.		0	4.5	61747350
Seamer	2	N. A.	1	2	19.8	
Retorts	3	N. A.		1	.24	19633950
Total				38	36.34	81381300
New Canning Equipment						
Filler	1	$ 40,000	0	0	6.0	
Can Closer (Steam Closure)	1	$ 60,000	1	1	60.0	4457950
Retorts	3	N. A.		1	.24	19633950
Total		$ 100,000		2	66.24	24091900
New Retort Pouch Equipment						
Form/Fill/Seal	5	$1,500,000	1	5	800	4457950
Retort	3	N. A.		1	.1	4932200
Dryer	5	$ 30,000		0	223.5	
Cartoner	2	$ 300,000		0	53.7	
Additional Inspection				2		
Total		$1,830,000		8	1077.3	9390150
With Fill/Seal	5	$ 700,000	2	10	132.0	4457950
Total		$1,030,000		13	409.3	9390150

Table 4-8--Equipment, Capital Expenditures, Labor and Energy Requirements for Processing Alternatives for Firm B at 360 Packages per Minute

Operation	Number of Units	Capital Expenditure 1980 $	Labor Required Per Unit	Total Labor Per 8 Hr. Shift	Electrical Energy Use KWH's Per 8 Hr. Shift	Thermal Energy Use BTU's Per 8 Hr. Shift
Existing Equipment						
Fillers	2	N. A.	1	2	16.17	
Seamer-Syruper	2	N. A.	1	2		
Continuous Retorts	2	N. A.		2	26.95	81286450
Total				6	43.12	81286450
New Canning Equipment						
Filler	1	$ 40,000		0	6.0	
Syruper	2	$ 130,000		0		
Can Closer (Steam Closure)	1	$ 60,000	1	1	60.0	4457950
Continuous Retorts	2	460,000	1	2	26.95	81286450
Total		$ 690,000		3	92.95	85744400
New Retort Pouch Equipment						
Form/Fill/Seal	6	$1,800,000	1	6	960.0	5349540
Retorts	4	$ 420,000		1		81286450
Dryer	6	$ 36,000		0	268.2	
Cartoner	2	$ 300,000		0	53.7	
Additional Inspection				2		
Total		$2,556,000		9	1281.9	86635990
With Fill/Seal	6	$ 840,000	2	12	158.4	5349540
Total		$1,596,000		15	480.3	86635990

energy used per ton of product being processed in the respective processing operation was multiplied by the estimated tonage to arrive at a value of energy consumption for canning 303 cans in an 8 hour shift. The energy used per ton of product being processed in the respective processing operations was derived from the energy accounting data reported in the previously mentioned studies. Electrical and thermal energy use per shift is reported in tables 4-7 and 4-8.

Additional information was also collected from the production managers of the two processing plants from which the energy information was originally collected. This information included the number of units of each type of equipment in the processing line and the amount of labor required to operate it on an 8 hour shift. This information is reported in tables 4-7 and 4-8.

Firm A is a relatively labor intensive plant which requires a significant number of persons in the filling stages of the processing operation. Exhaust boxes are also used to obtain a vacuum in the container just ahead of the sealing machine. This operation consumes a considerable amount of energy. Batch type retorts are used in this thermal-processing system. Firm B is comparatively much less labor intensive. Vacuum for closing the can is produced mechanically in the sealing machine and does not require an exhaust box. Further, this process uses continuous rotary retorts for processing the canned product. Firm B uses approximately 15% less thermal energy per ton of product processed than Firm A. Part of this can be attributed to the fact that peaches processed in Firm B can be processed at a lower temperature than spinach which was processed in Firm A.

Once the information concerning the existing canning plants was collected it was necessary to establish what the requirements for equipment, capital expenditures, labor and energy would be if the existing processing lines were to be replaced with new retort pouch equipment or new canning equipment. The information in tables 4-7 and 4-8 concerning the equipment required and the associated labor required is based upon personal communications with package manufacturers and machinery suppliers. The dollar figures are estimates based on average requirements and should not be considered exact costs because the requirements would vary depending upon the brand of equipment and the product being processed. Further, only those pieces of equipment which would be significantly different in each processing line alternative were considered. The operations concerning raw product cleaning, washing, blanching and sorting were excluded. Therefore a relative comparison or partial budgeting technique is presented in terms of cost and not total costs. An important assumption in this regard is that the equipment to move cans and pouches from one stage to the other in the process would be essentially alike and cost the same to purchase or modify and to operate. What is assumed for replacement considerations is that the equipment to move cans in the existing operation would be suitable or easily modified to move pouches. Additionally, the amount of pouch filling and sealing equipment required is based upon the assumption that each machine can operate at a rate of 60 packages per minute. This rate of production is the machine's top production speed. Alternatively, the canning equipments production rate which is required to produce the indicated output is well within its top production speed. These conditions present the best possible case for operating a retort pouch processing line. Obviously if a retort pouch processing line for fruits and vegetables does not appear to be economically feasible under these conditions, then the state of retort pouch processing technology would have to be considerably improved.

In Firm A the retort pouch processing replacement equipment consists of form/fill/seal or fill/seal machines and retort pouch dryers and cartoners. The new replacement canning equipment consists of fillers and can closers or seamers. Retorts are not considered for replacement in Firm A because the batch retorts are suitable for either cans or pouches. Of course the retort carts for holding the containers for processing would have to be replaced or modified for pouches, but this cost is considered to be negligible for the purposes of this analysis.

Firm B's retort pouch processing replacement equipment also consists of form/fill/seal or fill/seal machines, pouch dryers and cartoners. However, because Firm B's existing retort system uses continuous rotary retorts which are unsuitable for pouch processing, new batch retorts would need to be installed for a retort pouch packaging system. In this case four batch retorts would be required to handle the same production rate that the continuous retorts accommodate. The new replacement canning equipment complement for Firm B consists of fillers, syrupers, can closers or seamers and new continuous rotary retorts. The energy use in the new continuous retorts was assumed to be equivalent to that of the existing continuous retorts in Firm B.

Retort pouch processing characteristics and performance under actual processing conditions are as yet not as well known as for cans and therefore will receive more quality control attention. An additional two units of labor above that amount used for cans has been allowed for inspection and quality control. When fill/seal machines are used with preformed pouches instead of form/fill/seal machines with roll stock the labor requirements increase.

The energy consumption values listed in tables 4-7 and 4-8 for the replacement retort pouch and canning equipment are estimates. The estimates for the filling, sealing, cartoning and drying operations are based on equipment specifications supplied by the various equipment manufacturers. The energy estimates for the retorting operations are based on the energy use in the existing retorts and processing characteristics of retort pouches. In Firm A the same retorts are used for pouch processing as for the existing can processing operation. The thermal energy use for processing pouches was estimated to be 25 percent of that used for processing cans. A 75 percent reduction in the amount of energy used in the retort was considered to be the maximum energy advantage which could possibly be obtained in the retorting operation. It is generally presumed that the thermal energy requirements for retorting pouches is significantly less than that required for comparable cans. This is due to the fact that the pouch has a geometry which is more favorable to heat transfer than the can. The shortest distance from the heating medium to the slowest heating point in a 303 x 406 can is approximately 1.59". This distance is less than .39" for a 6" x 8" pouch. However, there are many other factors which may affect processing time: amount of fill, heating characteristics of the food, heating media, circulation of heating media, container agitation and residual air in the container. Manufacturers vary greatly in their estimates regarding process time reduction for food contained in pouches as opposed to cans, these values may range from 30 percent to 70 percent when an equal mass of food is being cooked. To account for the reduced sensible heat requirements (due to brine reduction) and the potential reduction in process time, it was assumed that a 75 percent reduction in thermal energy could be achieved by cooking food in pouches instead of comparable size cans. The thermal energy requirements for pouch retorting were initially estimated for preliminary analysis by multiplying the values used for the existing can process by .25. Because there is a great deal of uncertainty surrounding the use of this estimate a more restrictive energy consumption estimate for pouch retorting was used for all of the analysis which is reported in this study. The thermal energy consumed in pouch retorting is assumed to be equivalent to that amount used in processing cans. Electrical energy use (for compressed air) was assumed to be equal for retorting in either system. In Firm B there was considered to be no significant energy saving advantage in the retorting process because the replacement involved switching from two continuous rotary retorts to four batch type retorts for processing the same number of containers per minute. Supposedly can agitation in the rotary retorts reduces the process time for retorting cans. Therefore there appears to be little, if any, comparative energy saving advantage when switching from an agitating can retort to a batch retort for processing pouches. Because of this factor and the lack of any documentable data for comparative energy use in continuous versus batch retorts which would be suitable for this study, it was assumed the total thermal energy use in retorting pouches and cans would be the same in alternative systems based on Firm B. Electrical use in the new replacement batch retorts has been ignored because electricity is not needed to turn a rotary retort reel in the batch retorts used for processing pouches. Further detailed research in measuring comparative processing times and energy use for pouches and cans is needed if credible research is to proceed in this area.

Estimates of Values For Replacement Criteria Variables

Evaluation of the replacement criteria discussed in chapter 3 requires estimation of the values of the variables found in equations (3.9) through (3.12). These values are a function of time and many of them represent actual cash expenditures. However, some of these such as depreciation, investment credits and balancing charges are non-cash expenditures. These items must be considered in the analysis for adjusting actual cash expenditures for tax purposes. The cash expenditures which are a function of time are referred to as cash flows. In this study those cash flows associated with costs are only considered because the assumption is that the cash flows associated with gross revenue for each packaging system are equivalent. Therefore, the objective is to select the packaging system which has the lowest after tax costs associated with it.

This section will discuss the estimation of these cash and non-cash flows which are required for the evaluation of the replacement criteria. Reasonable forecasts of the values of the variables which account for the cash and non-cash flows are crucial as well as difficult to determine. Because uncertainties concerning the future make cash flow projection imprecise it is necessary to proceed with good judgment and credible assumptions. The techniques for forecasting these values are based on past trends and subjective judgments about the future. Although there are many possible techniques and estimates which could be used, the ones described here are deemed appropriate and reasonable for the study and objective at hand.

The techniques and estimates for calculating the present value of equation (3.9) will be discussed first and will be followed by a discussion concerning the estimate of equation (3.10). The procedure used for estimating the discount rate and determining the tax rate concludes this section of the study.

Capital Expenditures. The cost of purchasing new equipment in 1980 was based on primary data collected from a variety of equipment manufacturers. The expenditures required in 1980 are indicated in tables 4-7 and 4-8. To evaluate the possibility of replacement of old canning equipment with new canning equipment or retort pouch processing equipment in future years the capital expenditures need to be projected for those years. The cost of this equipment in future years is based on the trend in these costs since 1975. Code #1161 of the Producer Price Index is an index for the costs of Food Products Machinery. This index reveals that the average cost for food processing machinery has been increasing at an average rate of approximately one percent per year, in real dollars, since 1975. Therefore, the costs associated with purchasing the equipment will be increased at a real rate of one percent per year to allow for the evaluation of possible replacement of the old canning processes with new canning processes or retort pouch processes in years beyond 1980.

Salvage Value. Just as there is a cost associated with the purchase of durable equipment, there is also a value which may be received for the used durable in the market. The amount of money which can be received in the market for the used durable in any particular production period is known as the salvage value. A positive salvage value associated with the used durable can be viewed as increasing the positive cash flow or decreasing the negative cash flow for the year in which it is received. The salvage value of the used equipment in this study is assumed to decline with the passing of each production period. Coen (1975) has suggested that the pattern of economic depreciation of equipment used in the Food and Kindred Products Industry, (SIC 20) most closely follows a sum-of-the-years-digits pattern. This pattern implies a more rapid depreciation in the earlier years of the durables life than in the later years. This would appear to be intuitively true because of the specialized nature of food processing equipment and the imperfect market conditions for the used equipment. In practice, the salvage value may decline more rapidly than the sum-of-the-years-digits function given in equation (4.1). The effect of a more rapidly declining function on the replacement decision with all other things constant would result in an extended economic life of the durable which is being evaluated.

$$(4.1) \quad PPV_i = (n+1 - i) / \sum_{i=1}^{n} i$$

where:

PPV_i = percent of original purchase value which is lost in year i

i = year

n = number of years in which the salvage value is greater than 0.0.

Equation (4.1) is used to determine the salvage value of the new canning and retort pouch processing equipment when n is set at fourteen years. This length of time was estimated by Coen (1975) for the Food and Kindred Products Industry. It was determined to describe the economic depreciation function by the sum-of-the-year-digits pattern the best. If the equipment was held in the processing operation for greater than fourteen years the salvage value is assumed to be zero. The salvage value of the existing equipment in the old canning lines is assumed to be zero because in most cases it is substantially older than fourteen years.

Maintenance. Another cost which is assumed to change with the use and the age of the equipment is maintenance cost. Presumably, if the equipment is used at a constant rate in each production period the maintenance costs will rise with the age of the equipment. In practice the amount of maintenance costs allowed for a particular piece of equipment which is being considered for purchase is based on 2-3 percent of the original purchase price.[4.14] In other words, an

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[4.14] Personal communication, Consultant to the Food Industry.

average annual real maintenance cost could be figured by multiplying the original purchase price by .02-.03. Because maintenance costs are assumed to increase with the age and use of the equipment, it was decided to use a function which allowed for increasing maintenance costs as a function of the age of the equipment. The function illustrated in equation (4.2) allows for .5 percent of the original purchase cost in the first year of operation. Maintenance charges in the following years increase by .1786 percent per year of the original purchase price of the equipment. Even though the annual maintenance charges are increasing as a function of age of the equipment the maintenance charges still fall within the suggested range of an average of 2-3 percent. Over a twenty-nine year period the average annual maintenance charge is approximately 3 percent.

$$(4.2) \quad MC_t = OPP_1 \times (.003214 + (.001786 \times t))$$

where:

MC_t = maintenance cost in year t

OPP_1 = original purchase price of equipment in the first year of operation

t = time or specifically year of operation

This technique for estimating the maintenance cost was only used for the new canning equipment and the retort pouch line processing equipment. Maintenance cost estimates in 1980 and future production periods for the existing canning processes were determined in a somewhat different fashion. The plant managers who were in charge of operating the existing processing lines were asked to estimate an annual maintenance cost for the specific pieces of the equipment in the processing lines. These estimates are reported in appendix A.9. The maintenance costs for 1980 are assumed to be equivalent to these estimates. Further, the maintenance costs for the years following 1980 are estimated by multiplying each previous year's maintenance cost by the equivalent percentage increase for that year found by equation (4.2). It is assumed that any existing processing equipment is twenty-five years old and that the maintenance cost will increase at the same percentage rate described by equation (4.2) for equipment that is twenty-five years old in 1980. Therefore the 1980 estimated maintenance costs would be multiplied by the percentage change in maintenance costs, (PMC), where t is equal to twenty-six to estimate the 1981 maintenance cost associated with the previously existing processing equipment. The value of PMC is estimated in equation (4.3).

$$(4.3) \quad PMC = .003214 + (.001786 \times t)/.003214 + (.001786 \times (t-1))$$

Additional years maintenance costs are calculated in a repetitive manner. Additional details concerning these calculations can be found in the maintenance cost routine in the computer programs presented in appendix B.

Depreciation and Balancing Charge. A straight line depreciation technique is used for calculating the non-cash depreciation expense. The book salvage value is assumed to be zero at the end of the depreciation period of ten years. This period is the shortest complete year period which is allowed by tax regulations for the industries in asset guideline class 20.4 (U. S. Master Tax Guide, 1980). This classification is for industries involved in manufacturing of food and kindred products. Although the book salvage value at the end of the depreciation period is assumed to be zero, the actual market salvage value may not be. Therefore if the durable asset is sold in a period where the depreciated book value and the salvage value are not equivalent, a balancing charge adjusts the cash flow estimates for that period. If the salvage value exceeds the depreciated book value the difference between the two is added to the costs for that period. If the salvage is less than the book value the difference between the two values is subtracted from costs for that period. If the depreciated book value which is calculated for tax reasons is always equivalent to the salvage value then no balancing charge is needed. However, it is common practice to depreciate the book value of the asset sooner than what the actual salvage value may be for that asset. The balancing charge adjustment allows for flexibility in that the two functions, that of salvage value and depreciated value, can be different. This also precludes the necessity of assuming the depreciable life and economic life of the durable assets are equivalent and guesstimating the economic life as opposed to empirically solving for it.

Investment Credit. According to Section 1178 of the Master Tax Guide (1980), a credit for investment in depreciable personal property against federal income tax is allowed. This amount may be as much as 10 percent of the purchase price of the asset. The limitations involving this credit require that a firm cannot drive its tax liability to zero by using the credit. If a firm does not have enough tax liability to write off all of the credit in the year when the asset is purchased the remaining amount can be carried over until the 10 percent is used. However, no more than 10 percent can be used and it can only be used once for reducing the firm's tax liability. In addition, if a 10 percent tax credit is taken the asset must be held in production for a minimum of seven years. If it is held for a shorter period than seven years then less than the 10 percent investment tax credit is allowed. If the asset or durable equipment in this circumstance is held for five-six years only 6.6 percent is allowed. A three-four year period allows 3.3 percent and any period less than three years has no allowable investment tax credit. This study assumes that the firms who would be considering this type of investment would be able to take the entire 10 percent in the year in which the durable assets were acquired if they hold the equipment seven years or longer.[4.15] However, the analytical procedure used in estimating the optimal economic life of the replacement durable assets does allow for the alternative amounts of tax credit to be used when the durable asset has been held in the production system for less than seven years.

Energy Expenditures. Energy consumption for the processing alternatives has been previously identified in tables 4-7 and 4-8. Electrical consumption is indicated by KWH's per 8 hour shift. Alternatively, the thermal energy consumption is indicated by BTU's per 8 hour shift. Singh (1979) reveals that 78.5 percent of the fossil fuel based energy used in the canned fruits and vegetable industry is natural gas. This energy is used to generate thermal energy. Additionally, 17.8 percent of the thermal energy used is generated by a variety of petroleum products and 3.4 percent by coal. Therefore the thermal energy used in processing is priced as a BTU of natural gas.

[4.15]This assumption is based on a personal communication with the Comptroller, Michigan Fruit Canners, Division of Curtice-Burns.

Electricity is valued on a KWH basis. Because the amount of energy used in processing is based upon the amount of energy being used by individual pieces of equipment during the processing operation it must be assumed that the efficiency of delivery of energy to each of these pieces in the process for all alternatives is equivalent. This is necessary to allow for a fair comparison of the energy expenditures of the major components of the alternative processing lines considered in the packaging systems.

To calculate the total energy expenditure for the processing alternatives the price of the energy per BTU or KWH is multiplied by the amount of energy used. Electricity is generally priced on a KWH basis but natural gas is priced on a cubic foot basis. The necessary conversion factor used to convert $/cu. ft. of natural gas to $/BTU of natural gas is 1000 BTU/cu. ft.

To calculate the cash expenditures for energy in processing for future years of operation it is necessary to project the price of electricity and natural gas. This experience proved to be an extremely difficult and frustrating process. Initially, the USDA was contacted for information concerning energy price forecasts. At that time USDA had been relying on information generated by the Project Independence Evaluation System model, (PIES) of which the Department of Energy (DOE) was the caretaker. The PIES model is now known as the Midrange Energy Forecasting System (MREFS). In discussions with USDA officials it was determined that the MREFS had proved unreliable for forecasting energy prices in the past. Following such discussions the officials administering MREFS in DOE were contacted for their opinions. DOE was unwilling to commit themselves to making available any forecasts at that time. One DOE official stated that he felt any long term forecasts they might possibly generate from MREFS would be unreliable for the purposes of this study.

The next strategy undertaken to obtain a handle on future energy prices involved surveying a group of agricultural economists and agricultural engineers who were working on energy related research in agriculture throughout the midwest. Each person was asked to outline a low, medium and high energy price scenario for several types of energy sources over a fifteen year period. The majority of those who responded stated that they were quite skeptical about any scenarios they outlined. A summary of the results would show a very wide divergence of opinion concerning how energy prices may rise although all respondents did agree that prices would rise at a rate faster than the general rate of inflation.

As a result of the lack of concensus among experts and the inability of any particular model to forecast energy prices, three increasing price scenarios were selected for use in estimating energy input expenditures over the period of analysis. The lower bound scenario uses a 5 percent real increase in energy prices per year. The upper bound uses a 15 percent real increase per annum. A medium energy price scenario is calculated by using a 10 percent annual increase in real energy prices. The majority of the analysis is conducted with energy prices based on the lower bound scenario.

The lower limit of 5 percent real price increase per annum appears intuitively correct if the own price elasticity of aggregate energy demand is considered in relation to the necessary reductions in energy use over the period of 1980-1990. According to Sawhill (1979) some studies such as Pindyck (1979) have estimated the own price elasticity of aggregate energy demand in the residential sector to be as great as -1.0. Therefore, a one percent increase in the real price of energy would result in a one percent decline in consumption. Inversely, a one percent decline in the supply available for consumption would result in a one percent increase in the real energy price. A recent study by Exxon (1980) reports that domestic production of oil will decline from about 10.0 million barrels per day in 1980 to 6.0 million barrels per day by 1990. Imports are also expected to decline. The current administration strategy calls for imports to fall from the current level of approximately 8.0 million barrels per day to 4.5 million barrels per day by 1990. These figures point to a 40 percent reduction in the liquid energy supply over the period from 1980-1990. Therefore an average annual 4 percent reduction of supply from 1980-1990 may cause the real energy price of liquid fuel to rise approximately 4 percent per year.

The elasticity estimate reported above is considered to be the upper bound for the own price elasticity of aggregate energy demand. Therefore if the elasticity of demand is actually smaller the actual real rate of adjustment would be greater. Increasing levels of income may also force a greater increase in real price in order to reduce demand to meet the available supply. In light of these considerations a 5 percent annual real rate of increase for energy prices appears to be appropriate for the majority of the analyses conducted in this study.

The energy prices used in the analysis are national annual averages. Annual average prices estimated for 1980, the base year, are illustrated in table 4-9. Diesel fuel price is included because it is used in calculating the transportation costs which were discussed previously .

Table 4-9--Base Period Energy Prices (1980)

Energy Type	Price/Unit[1]	$/Unit
Electricity	$3.87¢/KWH	$0.0387/KWH
Natural Gas	$2.60/1000 cu ft.	$0.0026/1000 BTU[2]
Diesel Fuel	$1.20/gallon	$ .00857/100 BTU[3]

[1]See Energy Price Estimates appendix A.7.

[2]Based upon 1,000 BTU/cu. ft.

[3]Based upon 140,000 BTU/gallon

Labor Expenditures. Labor costs are simply multiplying the labor charge per hour by the amount of hours of labor employed on the food processing line. The 1980 annual average labor charge for the food and kindred products industry is estimated to be $7.02/hr. This reflects a 12 percent increase over the 1979 annual average of $6.27/hr.[4.16] Costs associated with labor use in years beyond 1980 are expected to remain at the 1980 level in real dollars. There is no

[4.16]1979 labor rate obtained from the Monthly Labor Review, March 1980. The 12 percent increase in labor rates is based on outlook information in Agricultural Outlook, April 1980.

assumed increase or decrease in real labor costs for the calculation of cash flows.

Interest. Interest charges on a commercial loan for acquiring new retort pouch processing and canning equipment are included as cash flows. An interest rate for calculating the interest charges is based on long-term commercial and industrial loan rates. In this study the interest rate is assumed to be 13 percent per year.[4.17] The loan period allowed for payback is assumed to be five years.[4.18]

Insurance Costs. Cash outlays for casualty insurance based on replacement value for processing equipment are included in the analysis. These annual cash outlays are calculated as one percent of the actual acquisition costs of the processing equipment in each subsequent year. Acquisition costs for new equipment have been previously discussed. Estimation of insurance charges for previously existing equipment are somewhat different. These costs are based on one percent of the acquisition cost of new processing equipment which would serve as replacements. Details concerning the replacement equipment acquisition costs used for calculating the insurance charges for new canning and retort pouch processing equipment as well as new and previously existing equipment are presented in appendix A.12.

Expenditures for Containers. Prices for the containers which are under study in this evaluation have been previously listed in table 4.3 for 1980. However it is also necessary to project their costs for several years into the future because they are an important component

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[4.17] Thirteen percent is the 1979 average, Federal Reserve Bulletin, 1979 issues.

[4.18] Based on Personal communication, Commercial Loan Officer, Old Kent Bank, Grand Rapids, Michigan.

of the cash flows in the packaging systems under evaluation. Historical trend data collected since 1973 is used to project the annual real rate of increase in the cost of the respective containers.[4.19] Metal can prices have been increasing at an average annual real rate of 3.28 percent. Retort pouch materials are estimated to increase at an average annual real rate of 0.94 percent. Carton costs on the other hand have been declining at an average annual real rate of 1.6 percent. For purposes of this analysis the real cost of the cartons were not allowed to decline over time. Carton costs were assumed to remain constant in real terms to present a restrictive case for comparison.

Transportation Costs. Tables 4-5 and 4-6 contain the data on freight rates for shipping 1000 units of empty containers and finished products for various distances in 1980. These figures are re-estimated for each of the years that the cash flows are needed for the analysis. The assumption for estimating transportation costs is one that seems reasonable but yet somewhat rather simplified. It is assumed that all other costs except for the energy cost component of the freight charges will remain constant in real dollars. Therefore the only factor which will cause a real cost increase in transportation rates is the price of diesel fuel. Future years transportation rates are estimated by increasing the 1980 dollar value of transportation costs associated with energy consumption by the forecasted annual real increase in diesel fuel prices. The raw freight rate data and the costs associated with energy consumption in transportation are located in appendix A.

[4.19] Details concerning these calculations are presented in appendix A.8.

Discount Rate. An after tax discount rate is determined by multiplying (1-T) by the result of equation (3.14) where T is the marginal tax rate. The nominal rate in equation (3.14) is determined by the interest rate on long term commercial and industrial loans and the inflation rate deflator is determined from the fourth quarter to fourth quarter increase in the gross national product deflator. The after tax discount rate used in this study is 1.07%.[4.20]

Tax Rate. The marginal income tax rate which was considered to be appropriate for this analysis is 46 percent. This tax rate is based on corporations that have a taxable income which exceeds $100,000 per year.[4.21]

[4.20] See appendix A.10 for details concerning the calculation of this estimate.

[4.21] 1980 United States Master Tax Guide.

CHAPTER V

ANALYSIS

The conceptual and analytical approach used to evaluate the economic feasibility of the retort pouch for processing fruits and vegetables is described in detail in chapters 3 and 4. This chapter presents an economic comparison of fruit and vegetable processing using a new retort pouch processing system, a new canning system and an old existing canning system. A variety of energy scenarios and production parameters are examined in an effort to present a range of economically viable processing conditions. Each scenario presents a different set of purchase and operating conditions under which the issue of economic replacement is evaluated. The minimum cost alternative is selected for each set of conditions. Further, sensitivity analysis is conducted on: 1) the cost estimates which are used to determine the optimal economic life of the durable equipment complements of the new packaging systems; and 2) the overall cost of operating either of the three packaging system alternatives under consideration.

Procedure for Selection of Minimum Cost Packaging System

The initial step in the analysis involves the determination of the optimal economic life of the durable assets which are required in the new packaging system alternative. The optimal economic life is determined by solving for the period of time which minimizes the annual amortized costs of holding the durable assets in production, (equation (3.9)). Once the optimal time period for holding the new retort pouch and new canning durable assets in production is found it is necessary to estimate the operating costs, which are not a direct function of the age and utilization of the durables, for the alternative systems. Equation (3.12) is used for estimating these costs. The minimum amortized cost, which is the present value of the average annual cost of holding the durable assets in production over their economic life, is summed with the present value of the operation costs of the packaging system for each subsequent production period. This aggregate cost estimate for a new packaging system, which is calculated by using equation (3.13), is then compared to the total cost of operating the existing or defending packing system for an additional production period. If the total costs associated with the challenging systems, new canning and retort pouch systems, are less than that of the defending packaging system, in this case, the existing canning system, replacement with the challenging system is considered. If the total cost of the challenging system is less than the total cost for the defending system in all k^{th} years from 1...N where N is the optimal life of the challenger, replacement with the challenger is selected. If this is not true the defender is held for continued production in the next period. If replacement does not occur in the first period the analysis is then repeated for the next production period to determine if the defender will be replaced by a challenging system.

If it is determined that both of the challenger systems are less costly than the defending system then the issue becomes one of selecting the minimum cost challenger. This is done by comparing the result of equation (3.11) for each alternative challenging system.

The results of the analysis conducted on the packaging system alternatives for Firm A are presented first with the results of the evaluation of the minimum cost packaging system for Firm B following.

Firm A

Determination of the Optimal Replacement Period

The optimal economic life of the new durable equipment complements for a retort pouch packaging system and a new canning system were determined for Firm A. The optimal period to hold the durable equipment in production in a retort pouch system was determined to be thirty-four years. The optimal period for operating the durable equipment associated with a new canning system was estimated to be thirty-three years. Figure 5-1 illustrates the amortized present value of costs for holding the respective durable equipment complements in production as a function of time. Actual estimates of these costs are presented in appendix C.3 and C.4. Each of the cost curves have similar shapes and are quite flat after the twenty-second year of operation. The minimum point on these cost functions indicates the optimal economic life of the durable equipment complement. The shape of the functions indicates that an extremely accurate decision concerning selection of the replacement period for the durable machinery complement, under the conditions of constant technology, is not particularly critical. The optimal period for replacement would only minimize costs by a few dollars as compared to any particular period a few years either side

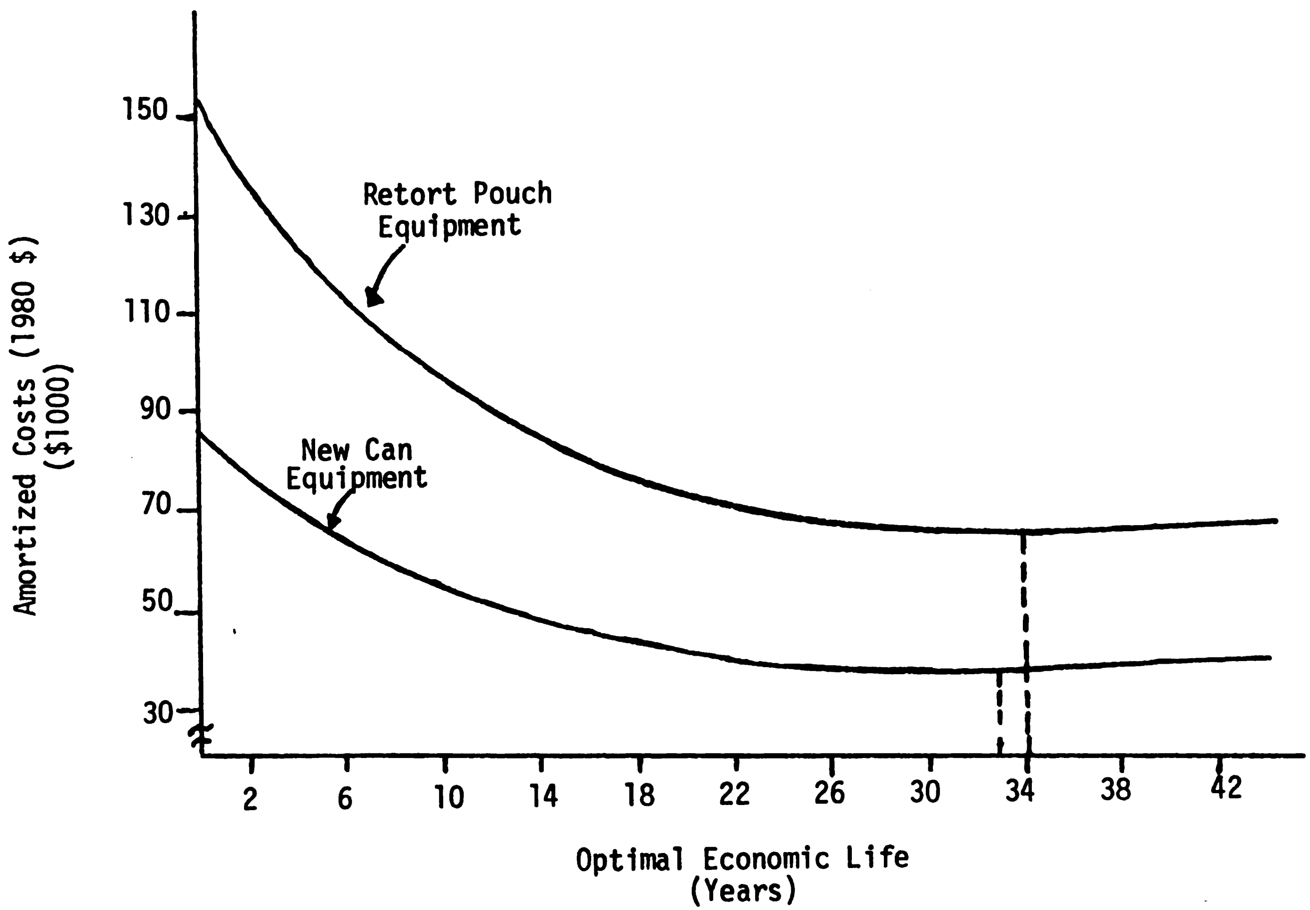

Figure 5-1--Amortized present value (1980 $) of durable equipment costs for Firm A as a function of the age of equipment.

of the optimal.

Sensitivity analysis which consisted of varying the after tax discount rate, maintenance function, depreciation period, salvage function, tax rate and investment credit allowance was performed on the replacement analysis concerned with using retort pouch processing in Firm A. In this case, the machinery complement contained form/fill/seal units for using roll stock pouch material, as opposed to preformed pouches for the operation. The objective was to determine how alternative scenarios would effect the optimal period of time the replacement retort pouch equipment would be held in production before being replaced with a similar equipment complement. After tax discount rates and the rate at which maintenance costs increased over time influenced length of the optimal replacement period. The direction in which combinations of discount rates and maintenance cost functions influence the number of years the durable equipment should be held in service is reported in table 5-1. A discussion of how the base rate maintenance function and discount rate were selected is presented in chapter 4.

Table 5-1--Sensitivity of Optimal Replacement Period, (Years), for Retort Pouch Equipment in Firm A

After Tax Discount Rate	Maintenance Function		
	1/2 Base Rate	Base Rate	Double Base Rate
.0007	44	31	22
.0107 (Base Rate)	50	34	24
.0207	56	37	25

An increase in the after tax discount rate increased the optimal length of time the durable equipment would be held in service. A one percent increase in the after tax discount rate resulted in an increase in the optimal replacement period of one to six years. However the greatest effect was for the situation where the increase in the maintenance cost function was one-half the base rate, (equation (4.2)). Alternatively an increase in the rate at which the maintenance costs increased over time caused a decrease in the period of time the durable equipment should be held in service. Therefore the combination of lowering the discount rate and increasing the rate at which maintenance costs increased over time results in a shorter replacement period.

Changes in other variable values had little effect on the optimal replacement period. A change in the number of years for which depreciation and salvage values were calculated over did not effect the replacement age. Depreciation calculated over depreciation periods of five, ten and fifteen years and salvage values based on functions declining to 0.0 by the tenth, fourteenth and twentieth years of operation had no effect on the optimal period. All salvage functions did however follow a function equivalent to a sum-of-the-years-digits scheme. This result is specific to the conditions under which the replacement analysis was conducted and should not be interpreted as a general result for all types of durable equipment. The optimal time period for holding the durables in service for the base case scenario was thirty-four years which is significantly outside of the range of production periods in which the depreciation and salvage values were varied for sentitivity analysis.

A change in the corporate income tax rate to 30 percent and 40 percent had no effect on the optimal replacement period net of the effect on the discount rate. Of course, as the tax rate changes the discount rate changes and results in a different optimal replacement period. As the tax rate declines, the after tax discount rate increases and the optimal replacement period increases. Just the opposite would be true as the corporate tax rate increases. The optimal replacement age was also evaluated with and without the allowance for the 10% investment credit. The investment credit allowance resulted in an optimal replacement period which was one year shorter than it was when it was excluded from the calculation.

Energy Price Scenario Effect on Selection. Initially, the analysis was conducted under conditions of constant energy prices and three scenarios where energy prices increased at an annual real rate of 5 percent, 10 percent and 15 percent. The initial values of the other relevant parameters and variables used in the analysis are described in detail in chapter 4. The results of the analysis, where only the percentage annual increase in real energy prices were varied, is illustrated in table 5-2. Retort pouches appear to be the most cost effective packaging system available for Firm A under the operating conditions outlined in chapter 4. Retort pouch packaging could replace the existing canning system under any of the energy scenarios selected including constant energy prices. Because retort pouch processing and packaging systems are less energy intensive than either a new canning or existing canning system, the cost advantage of retort pouch packaging is increased under scenarios where energy prices increase.

Table 5-2--Ranking of Packaging Systems for Firm A by Lowest Cost Under Alternative Energy Price Scenarios

	Annual Percent Real Energy Price Increase			
Rank	0.0%	5.0%	10.0%	15.0%
1.	RP	RP	RP	RP
2.	NC	NC	NC	NC
3.	OC	OC	OC	OC
	(1980)	(1980)	(1980)	(1980)

RP - Retort pouch process

NC - New can process

OC - Old can process

Number in parenthesis is the first year in which replacement of old canning process could be made.

Additional analysis concerning other selected variables was conducted under the energy price scenario which increased at an annual real rate of 5 percent. This rate of price increase is appropriate because it is thought to be the lower bound on the rate energy prices may increase in future years. Additionally, it presents a more restrictive case for a cost comparison of the retort pouch packaging system with the other packaging alternatives than do scenarios which have a 10 percent or 15 percent annual increase in real energy prices. The results of the analysis under a 5% annual real increase in energy prices are presented in detail in appendix C. The costs associated with the existing canning system, new canning system and new retort pouch packaging system are presented in C.2, C.3 and C.4 respectively. Figure 5-2 presents the total costs associated with the alternative

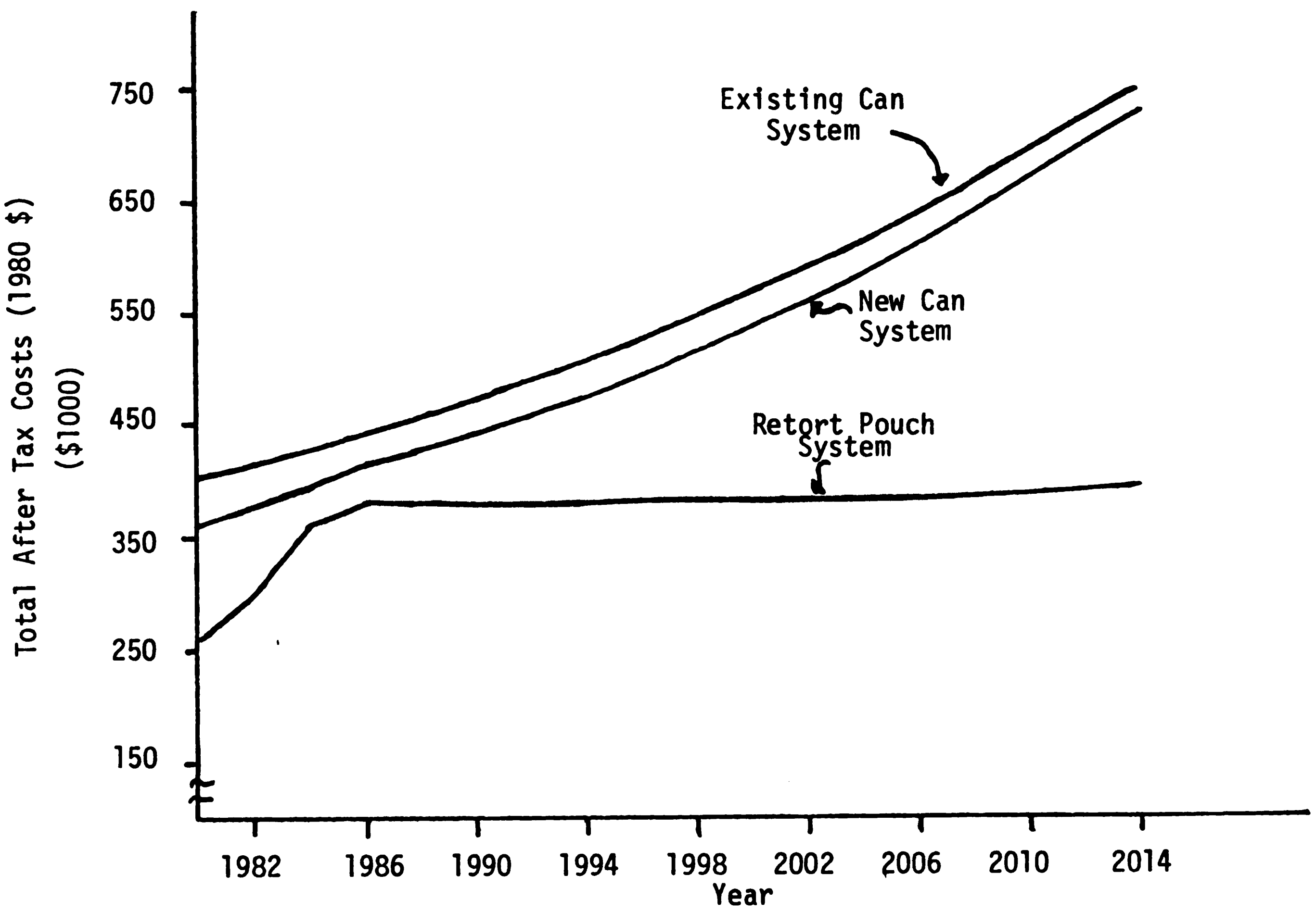

Figure 5-2--Total comparative after tax costs of alternative packaging systems for Firm A.

processes in graphical form. The values for the new canning process and retort pouch processing system are estimated by equation (3.13). Estimates of the total cost for the existing canning system include maintenance costs, which are the only relevant costs associated with the age of the existing canning equipment, plus all other costs associated with the existing can packaging system which are not a function of the age of the equipment. Clearly retort pouches have an advantage over the other packaging systems for Firm A.

The actual variable operating costs for the three alternative packaging systems which are not a function of equipment complements age are displayed in figure 5-3. The actual estimates are also presented in appendix C.2, C.3 and C.4. Table 5-3 illustrates the different percentages of total operating costs that the individual cost categories account for in each alternative packaging system in 1980 and 1985.

Package costs are the largest component of the costs for operating either of the packaging system alternatives which are described in table 5-3. Freight costs associated with transportation of the processed commodities accounts for the second largest expenditure. Energy used in the processing line actually accounts for a very small percentage of the operating costs of each packaging system.

Effect of Energy Requirements of Processing on Analysis Results

Initially, the value used for the actual BTU's of natural gas consumed in the retorting operation for retort pouch processing was estimated to be 25 percent of that used in the existing canning line operation. Manufacturers vary greatly in their estimates regarding

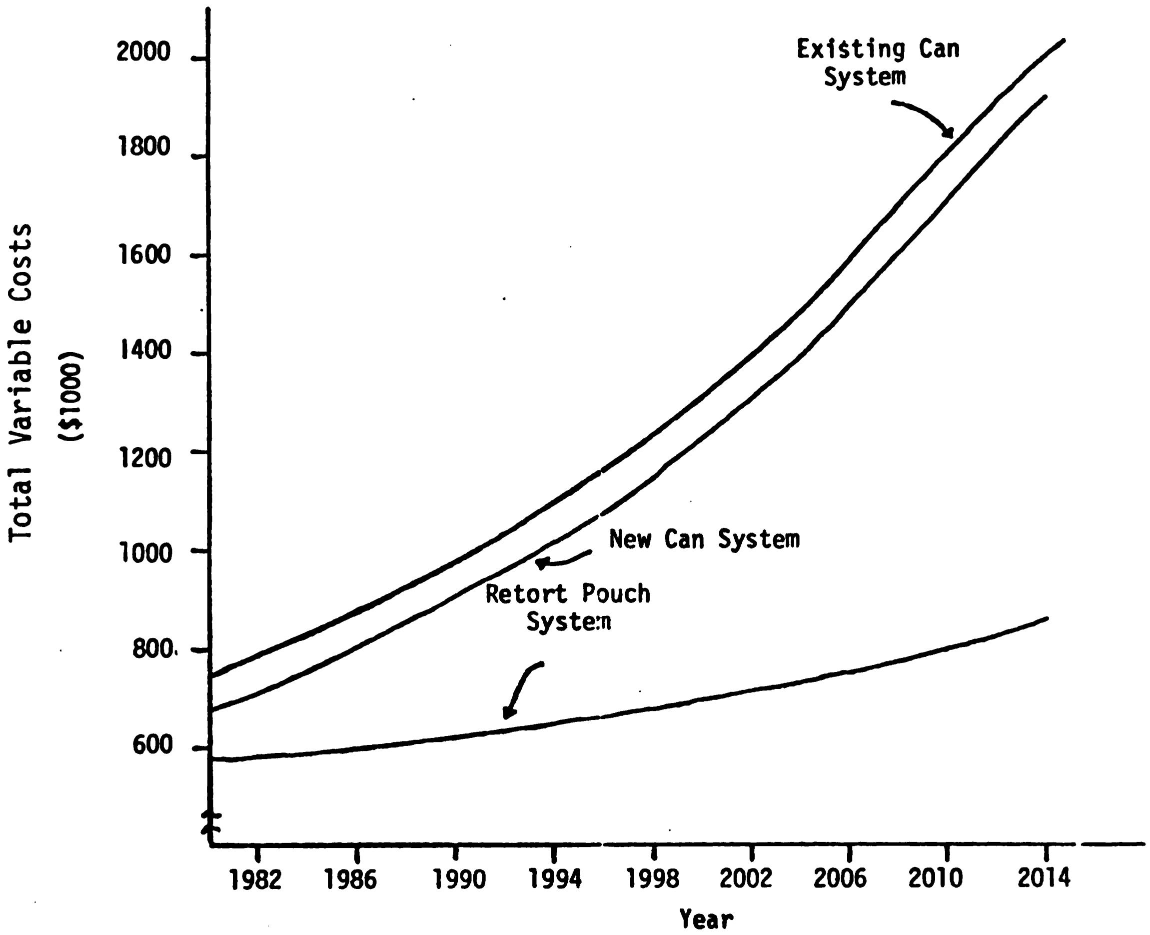

Figure 5-3--Total comparative variable operating costs not associated with equipment age of alternative packaging systems for Firm A.

Table 5-3--Total Variable Operating Costs Accounted for by Cost Category--Firm A

Cost Category	Year	Existing Canning System		New Canning System		Retort Pouch System	
		Actual	Percent	Actual	Percent	Actual	Percent
Labor	(1980)	$ 64,022	8.6	$ 3,369	.5	$ 13,478	2.4
	(1985)	64,022	7.5	3,369	.4	13,478	2.4
Packages							
Cans	(1980)	515,635	69.3	515,635	76.0	N. A.	
	(1985)	605,931	71.3	605,931	77.4		
Pouches	(1980)	N. A.		N. A.		345,600	60.8
	(1985)					362,151	60.8
Cartons	(1980)	N. A.		N. A.		108,000	19.0
	(1985)					108,000	18.0
Freight							
Before Processing	(1980)	35,164	4.7	35,164	5.2	9,676	1.7
	(1985)	36,608	4.3	36,608	4.7	10,309	1.7
After Processing	(1980)	122,515	16.5	122,515	18.0	88,603	16.0
	(1985)	134,796	15.9	134,796	17.0	97,483	16.0
Processing Energy							
Natural Gas	(1980)	6,347	.9	1,879	.3	1,879	.3
	(1985)	8,101	1.0	2,398	.3	2,398	.4
Electricity	(1980)	42	L.T. .1	76	L.T. .1	1,250	.2
	(1985)	53	L.T. .1	98	L.T. .1	1,596	.3

N. A. - Not Applicable

process time reductions for food contained in pouches as opposed to cans. These values may range from 30 to 70 percent when an equal mass of food is being cooked. To account for the reduced sensible heat requirements (due to brine reduction) and the potential reduction in process time, it was initially assumed that a 75 percent reduction in thermal energy could be achieved by cooking food in pouches instead of the comparable cans.

The preliminary results of the analysis, however, were quite insensitive to the level of energy used in the retorting operations. Thus, because of the uncertainty in estimating the thermal energy requirement of pouch retorting, a more restrictive case was used for all of the analysis which is reported in this study. The thermal energy used for pouch retorting was assumed to be equivalent to that amount used in processing cans. The estimates in table 5-3 reflect this assumption. Further analysis, under the assumption that the pouch uses 25 percent more thermal energy in the retorting operation indicated that the pouch processing system would remain the minimum cost processing system. Under this assumption natural gas costs for the additional thermal energy accounted for an additional $469 and $600 in 1980 and 1985 respectively. This alternative only added $251 in 1980 and $304 in 1985 to the after tax present value of the total costs used in comparison of the alternative processing systems.

<u>Effects of Retort Pouch Cost on Analysis</u>. Table 5-3 indicates that the cost associated with purchasing the empty packages is a significant part of the variable operating costs of the alternative systems. The effect of a higher price for purchasing empty retort pouches was evaluated. When the price of retort pouches was raised to $90/1000

from the $80/1000 used in the base case the cost of the retort pouch processing system increased significantly. However, the retort pouch processing system was still selected as the minimum cost packaging system. Additionally, the retort pouch packaging system was the minimum cost system under conditions where pouches were $100/1000 and cartons were $30/1000. These prices are currently what could be considered the upper bound for costs of purchase of the containers. However, if conditions were such that the pouches were $100/1000 units and cartons were $25/1000 units and the cost of the pouches was expected to increase at the same rate as cans the new canning system would be the minimum cost system for replacement in 1980. Table 5-4 summarizes the results of the variable pouch price analysis. The amortized costs reported were calculated using equation (3.11).

Table 5-4--Comparison of Total Amortized Costs Under Different Base Period Pouch Prices (1980 $)

Pouch Price $/1000		Retort Pouch System	New Can System
80.00	w/$25/1000 cartons	$433,721	$614,593
90.00	w/$25/1000 cartons	460,916	614,593
100.00	w/$25/1000 cartons	488,111	614,593
100.00	w/$30/1000 cartons	499,775	614,593
80.00[1]	w/$25/1000 cartons	545,054	614,593
90.00[1]	w/$25/1000 cartons	586,166	614,593
100.00[1]	w/$25/1000 cartons	627,277	614,593
100.00[1]	w/$30/1000 cartons	638,941	614,593

[1]Pouch prices increasing at same annual real rate as can prices.

Effect of Transport Distance. Although the analysis to this point has been based upon transport mileage of 750 miles each, for before and after processing, it is important to consider the effects of alternative transport distances upon the selection of a replacement packaging system. Distances of 250,500, and 1000 miles have been evaluated in addition to the 750 mile distance which is used in the base case analysis. Please refer to chapter 4 for details concerning the selection of the 750 mile distance. At all distances the new canning system and retort pouch system are less costly than the existing canning system at the equivalent transportation distances. Further, the retort pouch system is the minimum cost system at each level of transport distance considered. Table 5-5 summarizes the results of this evaluation. The costs displayed in table 5-5 were calculated using equation (3.11).

Table 5-5--Comparison Total Amortized System Costs Under Alternative Transport Distances (1980 $)

Before Processing	After Processing	Retort Pouch System	New Canning System
250	250	$387,641	$547,032
500	500	409,013	580,301
750	750	433,721	614,593
1000	1000	470,957	668,153

According to the results presented in table 5-5 a retort pouch system for Firm A that had transportation distances of 1000 miles would prove to be less costly than a new canning system with transport distances of only 250 miles. Table 5-6 presents the actual 1980 freight costs per 1000 units shipped for each packaging system. Retort pouches hold a distinct advantage over cans in the transportation components of the system considered in this study.

Table 5-6--Freight Costs of Alternative Packaging Systems per 1000 Units Shipped at Selected Transport Distances (1980 $)

	Distance Shipped - Miles			
	250	500	750	1000
Empty Containers				
Retort Pouch & Cartons	$ 1.09	$ 1.58	$ 2.23	$ 3.65
Cans	4.83	7.14	8.14	11.06
Advantage of Retort Pouch System	(3.74)	(5.56)	(5.91)	(7.41)
Processed Products				
Retort Pouch Product	9.63	14.45	20.52	31.20
Canned Product	13.31	19.96	28.35	43.10
Advantage of Retort Pouch System	(3.68)	(5.51)	(7.83)	(11.90)

Evaluation of the Preformed Pouch Alternative. Retort pouches can also be purchased preformed with the sides and bottom already sealed. This is an alternative to purchasing retort pouch material on rolls for forming into pouches. Retort pouch system evaluation in the analysis preceding this section has been based on purchasing pouch material and forming the pouch just previous to the filling and sealing stages in the processing operation in the food plant. The equipment complement included form/fill/seal machines for accomplishing this task. However, when preformed pouches are used a different equipment complement is needed which requires a lower amount of electrical energy and a greater amount of labor. Table 4-7 presents the alternative requirements of the fill/seal machines for Firm A. Fill/seal machines are cheaper to purchase than form/fill/seal machines but require preformed pouches which are generally \$10-\$15 more expensive per 1000 units than roll stock material. As a result of the comparatively lower acquisition cost for fill/seal machines the insurance cost is lower than that of form/fill/seal machines. Transportation costs for preformed pouches and roll stock are considered to be equivalent.

Comparison of the retort pouch system using preformed pouches and fill/seal machines with the retort pouch system using roll stock material revealed that the retort pouch system which uses form/fill/seal machines and roll stock material is less costly. However, the preformed pouch system remains less costly than the new canning system alternative. The costs associated with this alternative are presented in appendix C.5. Although the costs associated with machinery purchase are less when preformed pouches are used the labor requirements and pouch costs are substantially greater. Preformed retort pouch costs for this comparison were considered to be \$95/1000. The after tax amortized total costs of the preformed pouch system were \$449,534. This compares to \$433,721 for the roll stock system.

Effect of Production Rate. Under conditions in which the form/fill/seal and fill/seal machines are not operated at their rated capacity of sixty packages per minute it is necessary to repeat the evaluation of the retort pouch packaging system with the other alternatives. In this study a lower production rate for each filling machine was evaluated. The alternative rate considered in the analysis was forty packages per minute or 66 percent of the rated production limit. Therefore, if a required 300 packages per minute are to be produced, additional pieces of equipment and units of labor and energy are needed in the production process. Both preformed pouch processing equipment and form/fill/seal machines for roll stock material were considered under these production conditions. Although the evaluation showed that the costs of the retort pouch systems with lower filling machine production rates were greater than the systems with the higher sixty package per minute production rates, they were less costly than the new canning system alternative and the existing canning system. Table 5-7 presents a summary of the results of this comparative analysis. The costs reported are obtained from equation (3.11). Actual cost estimates for these operating conditions can be found in appendix C.6 and C.7.

Investment Credit Deduction Effect. The analysis in this study allows for an investment credit of 10% which can be deducted from the firm's tax liability. Further details concerning the investment credit allowance are located in chapter 4. The investment tax credit effectively lowers the costs associated with purchasing the new durable equipment complement required for fruit and vegetable processing and packaging. Because there is no investment credit allowed in the calculation of the previously existing canning equipment complement costs,

Table 5-7--Total Amortized System Costs for Alternative Production Rates of Retort Pouch Systems (1980 $)

System	Amortized Costs (1980)
New Canning System	$615,539
Retort Pouch System	
Roll Stock 60 ppm	433,721
40 ppm	458,943
Preformed Pouches 60 ppm	449,534
40 ppm	470,130

the investment credit allowance presents a particular cost advantage for the alternative processing systems. Replacement equipment associated with the retort pouch system requires the largest investment. Therefore, the largest investment credit write-off is associated with the retort pouch processing alternative.

When the base case, as described in chapter 4, was analyzed without an allowance for investment tax credit in the new can and retort pouch packaging systems, the ordering of replacement alternatives remained the same. Although the cost advantage of each replacement system was reduced, they remained less costly than the alternative of continuing to process under the existing canning system. Retort pouch packaging remained the lowest cost system. The actual estimates for this evaluation are reported in appendix C.8 and C.9.

Effect of Interest Deduction. The irregular shape of the cost function of the retort pouch processing system, presented in figure 5-2 in the first five years of operation is due to the deduction of interest payments from the cost stream. There is also an interest deduction effect on the cost function of the new canning system, however, it is not nearly as significant because the outlay required for acquisition of the new canning equipment complement is significantly less than that which is required for retort pouch processing equipment. Therefore the commercial loan balance and interest payments would be substantially less for the canning equipment complement. Because of the large amount of deductions which can be taken for interest payments associated with the retort pouch packaging system in the first several years the effect of not including these deductions was evaluated. Figure 5-4 illustrates the effect on the total cost function of not including the allowable interest deductions. Both alternative replacement systems are less costly than the existing can packaging system. If the amortized total costs of the new canning and retort pouch packaging system, (equation (3.11)), are compared, the retort pouch system proves to be less costly. However, the absence of the interest deduction in the first five years of operation of the retort pouches system influences the cost substantially. Estimates for this analysis are presented in appendix C.10 and C.11.

The assumption allowing interest deductions and investment tax credit allowances are both included in the basic analysis. This appears to be a reasonable assumption, particularly if there are different divisions of a food processing firm that have enough tax liability in total to allow for these deductions from an individual division to be used. Initially it is believed that any firms involved in considering such operations would be large and profitable enough to be able to take

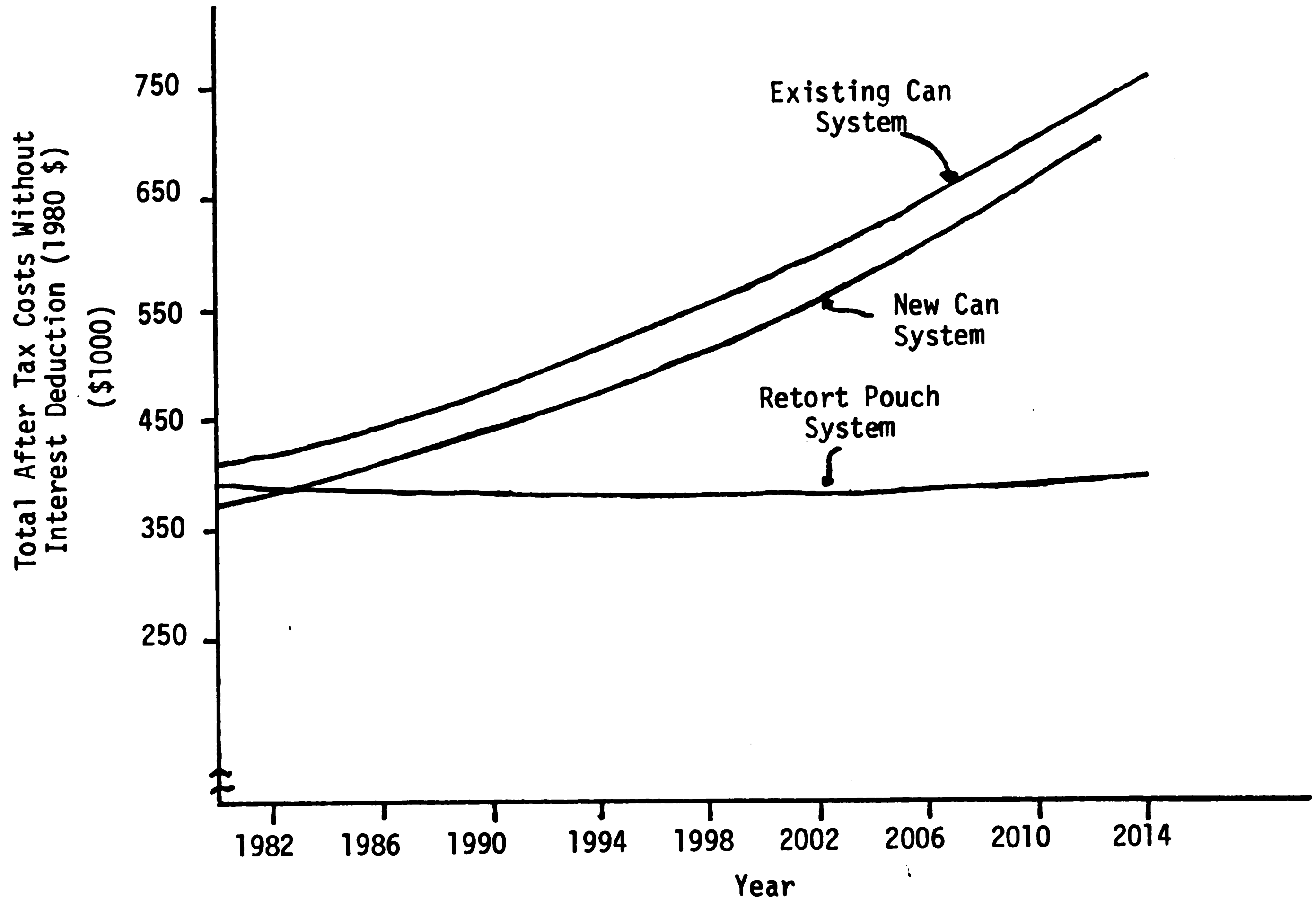

Figure 5-4--Total comparative after tax costs without interest deduction of alternative packaging systems for Firm A.

advantage of these credits and deductions.

Effect of Higher Discount Rate. A real, as compared to nominal, after tax discount rate was used in the preceding analysis. The effect of using a higher discount rate was evaluated. Under a 3.07 percent discount rate the ranking of the processing alternatives in terms of cost effectiveness was unchanged from the base case. Retort pouch packaging was the minimum cost alternative. The optimal economic life of the retort pouch equipment complement increased to forty-one years whereas the optimal economic replacement period for the new canning line changed to thirty-nine years. The difference between the respective total amortized system costs, (equation (3.11)), for retort pouches and the new canning alternative were essentially the same. Table 5-8 demonstrates this result.

Table 5-8--Comparison of Total Amortized System Costs Under Alternative Discount Rates

	.0107	.0307
Retort Pouch System	$ 433,721	$ 447,310
New Can System	614,593	627,909
Difference	(180,872)	(180,599)

Firm B

Determination of the Optimal Replacement Period

The optimal economic life of the new durable equipment complements for a retort pouch packaging system and a new canning system were also determined for Firm B. The optimal period to hold the durable equipment in production in a retort pouch system and a new can packaging system was estimated at thirty-four years. Figure 5-5 illustrates the amortized present value of costs associated with the age of the durable equipment which is used in the challenging packaging systems. Estimates of these costs are presented in appendix C.13 and C.14. The minimum location of the cost curve indicates the optimal economic life of the durable equipment complements. Both cost functions have similar shapes and are quite flat after the twenty-fourth year of operation. This would appear to indicate, as did the results from the analysis concerning Firm A, that an extremely accurate decision concerning selection of the replacement period for the durable machinery complement, under the conditions of constant technology, is not particularly critical.

Sensitivity analysis, which consisted of varying the after tax discount rate, maintenance function and the investment credit allowance, was performed on the replacement analysis concerned with evaluating retort pouch processing for Firm B. As with Firm A, the analysis was based on a system which used form/fill/seal units for using roll stock pouch material for forming the pouch in the packaging operation. Table 5-9 illustrates the results of varying the after tax discount rate and the maintenance cost function in the analysis. The base rate at which maintenance costs increase as a function of time is described in chapter 4.

The results of the sensitivity analysis are very similar to the results obtained for Firm A. In fact, the results should be similar

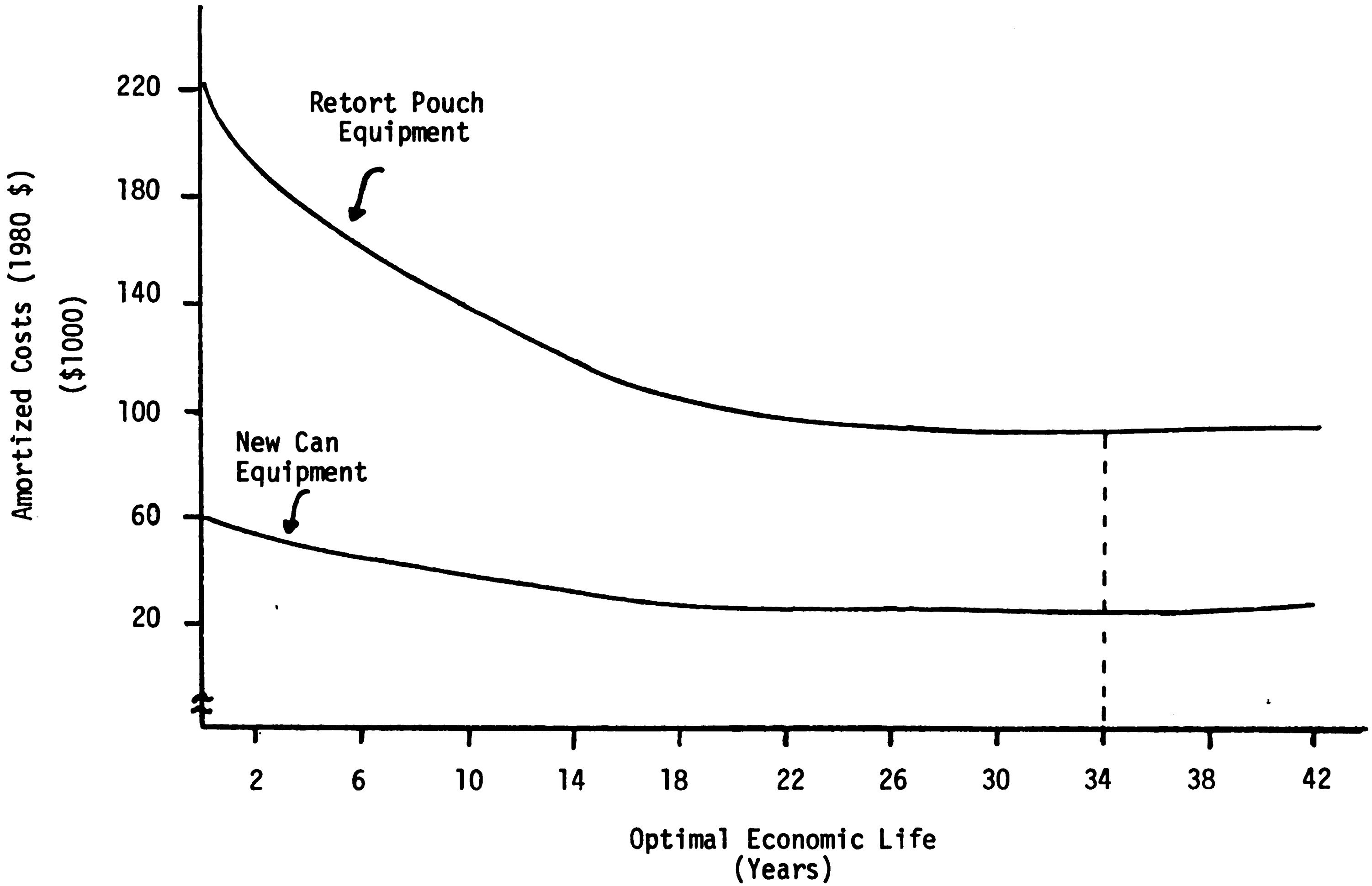

Figure 5-5--Amortized present value (1980 $) of durable equipment costs for Firm B as a function of the age of equipment.

Table 5-9--Sensitivity of Optimal Replacement Period, (Years) for Retort Pouch Equipment in Firm B

After Tax Discount Rate	Maintenance Function		
	1/2 Base Rate	Base Rate	Double Base Rate
.0007	45	31	22
.0107 (Base Rate)	50	34	23
.0207	56	37	25

because all of the equipment costs which are a function of the durable equipments' age were calculated in the same manner for each firm. The actual levels of costs are different but the pattern of the changes in costs over time is equivalent.

An increase in the after tax discount rate increased the optimal length of time the durable equipment would be held in service. A one percent increase in the after tax discount rate resulted in an increase in the optimal replacement period of one to six years. An increase in the rate at which the maintenance costs increased over time caused a decrease in the period of time the durable equipment should be held in service. Therefore the combination of lowering the discount rate and increasing the rate at which maintenance costs increased over time resulted in a shorter replacement period.

The optimal replacement age was also evaluated under conditions where the 10 percent investment credit was not allowed. Under these circumstances the optimal replacement period was two years longer than it was in the situation where the base case allowed the deduction. The base case is that set of conditions which are described in chapter 4.

Energy Price Scenario Effect on Selection. Evaluation of the alternative processing and packaging systems for Firm B was initially conducted under four energy price projection scenarios. The analysis was conducted under the situation where energy prices remained constant at the 1980 level and under three scenarios where the annual real rate of energy prices increased at 5 percent, 10 percent and 15 percent respectively. The results of the analysis where only the percent annual increase in real energy prices was varied is reported in table 5-10. Retort pouch processing could replace the existing canning

Table 5-10--Ranking of Packaging Systems for Firm B by Lowest Cost Under Alternative Energy Price Scenarios

	Annual Percent Real Energy Price Increase			
Rank	0.0%	5.0%	10.0%	15.0%
1.	RP	RP	RP	RP
2.	OC	OC	OC	OC
3.	NC (1980)	NC (1980)	NC (1980)	NC (1980)

RP - Retort pouch process

NC - New can process

OC - Old can process

Number in parenthesis is the first year in which replacement of old canning process could be made.

system under any of the scenarios selected including the scenario of constant energy prices. The second best alternative system for Firm B was not a new canning system. A new canning system for Firm B did not present enough of a reduction in operating costs to offset the increased expense of obtaining and maintaining a new durable equipment complement. This held true for the analysis when the replacement years considered varied from 1980 - 1985. Although the costs associated with obtaining and maintaining the equipment complement for retort pouch processing are substantially higher than that of the new canning system (figure 5-5) the operating costs associated with the retort pouch system are much lower than the other alternative packaging systems (figure 5-6). Therefore the total costs associated with the retort pouch system are less than the other canning alternatives (figure 5-7).

There are two major factors which contribute to increasing the advantage of retort pouch packaging over time. Each category of operating costs, which is not a function of the age of equipment, increases at a slower rate than the rate at which these costs increase for the canning system alternatives. Chapter 4 contains further details concerning the estimation of these costs. Secondly, retort pouch processing and packaging systems are less energy intensive than either a new can packaging or an existing can packaging system. Therefore, as energy prices increase, the difference between the total costs associated with the can processing and packaging systems and the retort pouch packaging systems gets larger. Further, the advantage of retort pouch processing becomes greater the faster energy prices increase.

As with the previous analysis, conducted for Firm A, evaluation of changes in other selected variables was conducted under the energy price scenario where prices increased at an annual real rate of 5 percent. The results of the analysis under a 5 percent annual real

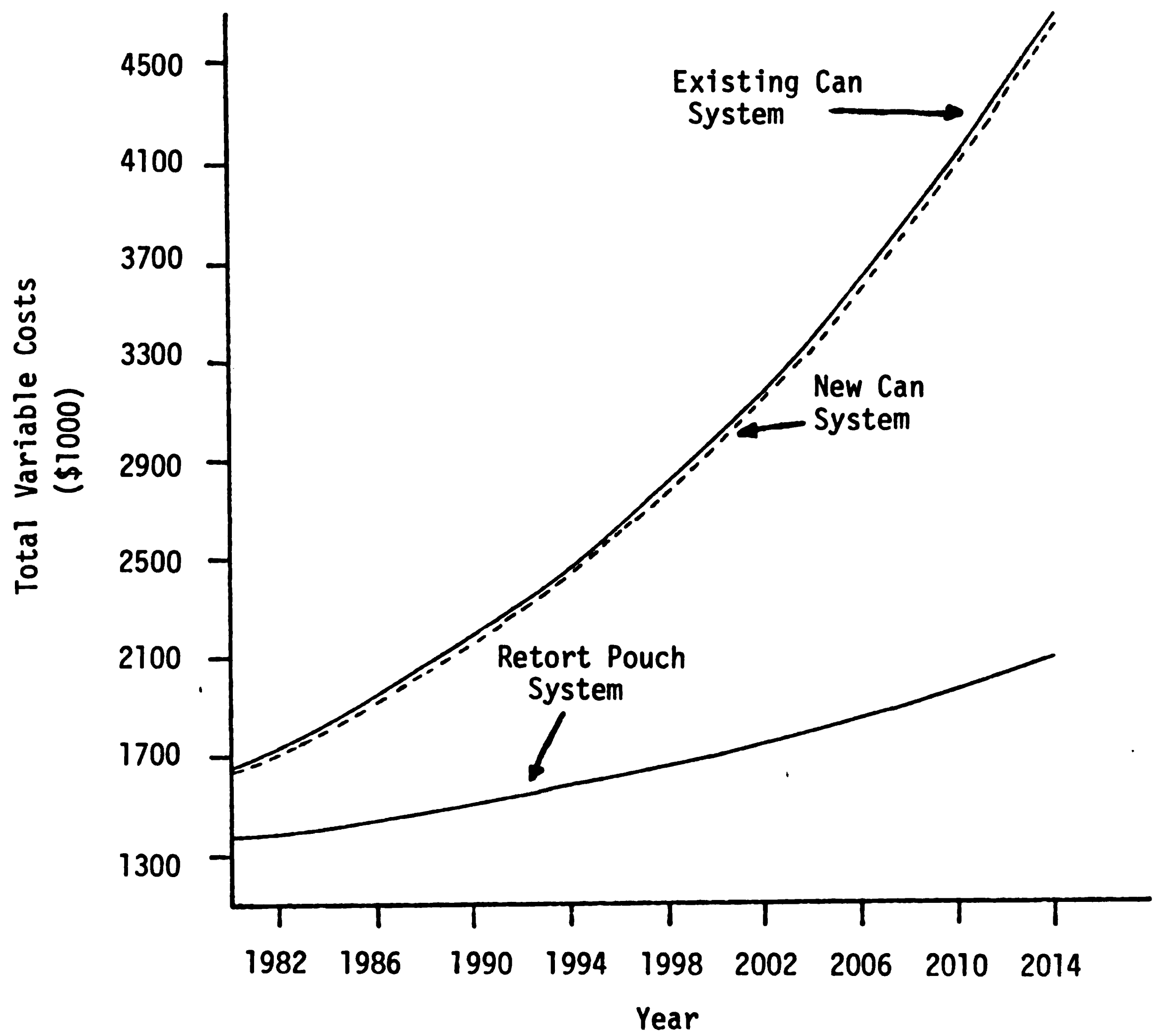

Figure 5-6--Total comparative variable operating costs not associated with equipment age of alternative packaging systems for Firm B.

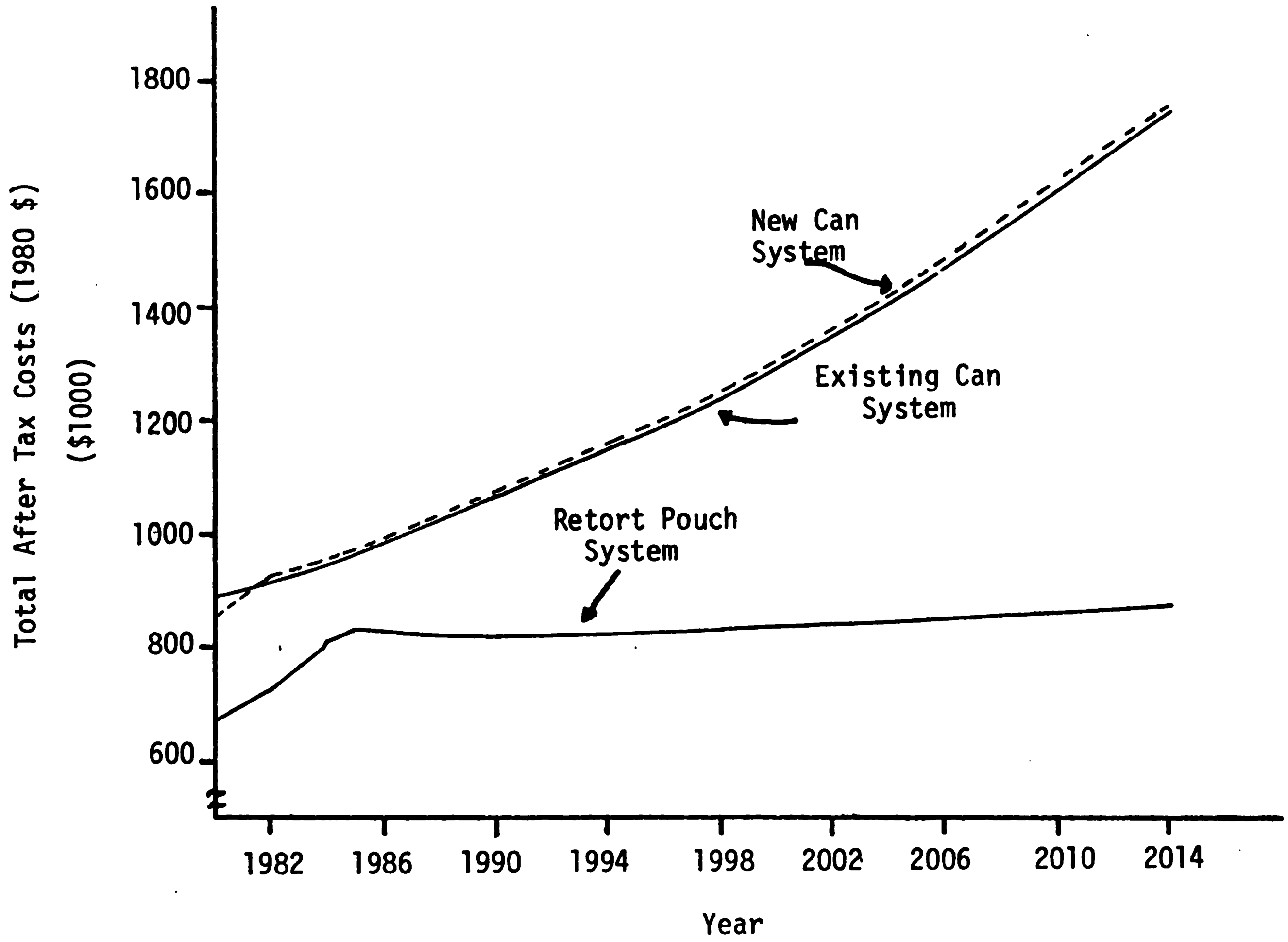

Figure 5-7--Total after tax costs of alternative packaging systems for Firm B.

increase in energy prices are presented in detail in appendix C. The costs associated with the existing canning system, new canning system and new retort pouch packaging system are present in appendix C.12, C.13 and C.14 respectively. Figure 5-7 presents the total costs associated with the alternative processes in graphical form. The values of the new canning process and retort pouch processing system were estimated using equation (3.13). Estimates of the total cost for the existing canning system include maintenance costs, which are the only relevant costs associated with the age of the existing canning equipment, plus all other costs associated with the existing can packaging system which are not a function of the age of the equipment. Clearly retort pouches have an advantage over the other packaging systems considered for Firm B given the conditions presented in this study.

The actual variable production costs for the three alternative processing systems which are not a function of equipment age are displayed in figure 5-6. Table 5-11 illustrates the different percentages of total operating costs that the individual cost categories account for in each alternative processing system in 1980 and 1985.

Operating Costs

Table 5-11 indicates that package costs are the largest component of the costs for operating the packaging systems. Although pouches and cartons account for a larger percentage of the total variable costs of the retort pouch packaging system than cans account for in the canning system alternatives, the actual expense for the containers is significantly less. Freight costs associated with transportation of the processed commodities accounted for the second largest amount in all

Table 5-11--Total Variable Operating Costs Accounted for by Cost Category--Firm B

Cost Category	Year	Existing Canning System		New Canning System		Retort Pouch System	
		Actual	Percent	Actual	Percent	Actual	Percent
Labor	(1980)	$ 20,217	1.2	$ 10,108	.6	$ 30,326	2.2
	(1985)	20,217	1.1	10,108	.5	30,326	2.1
Packages							
Cans	(1980)	1,237,524	75.0	1,237,524	75.5	N. A.	
	(1985)	1,454,236	76.5	1,454,236	76.8		
Pouches	(1980)	N. A.		N. A.		829,440	60.5
	(1985)					869,163	60.4
Cartons	(1980)	N. A.		N. A.		259,200	18.9
	(1985)					259,200	18.0
Freight							
Before Processing	(1980)	84,395	5.1	84,395	5.1	23,224	1.7
	(1985)	87,861	4.6	87,861	4.6	24,742	1.7
After Processing	(1980)	294,036	17.8	294,036	18.0	212,647	16.0
	(1985)	323,512	17.0	323,512	17.0	233,959	16.0
Processing Energy							
Natural Gas	(1980)	12,680	.8	13,376	.8	13,515	1.0
	(1985)	16,184	.9	17,071	.9	17,249	1.2
Electricity	(1980)	100	L.T. .1	215	L.T. .1	2,976	.2
	(1985)	127	L.T. .1	275	L.T. .1	3,798	.3

N. A. - Not Applicable

of the systems. Again, the freight costs of the retort pouch system were significantly less. Energy used in processing accounted for a very small amount of the total variable costs, therefore, the results of the comparative analysis are quite insensitive to the level of energy used in the processing of the retortable pouches. Further, the thermal energy used for pouch retorting was assumed to be equivalent to that amount used in processing cans even though manufacturers of processing equipment estimate that process time for an equal mass of food contained in pouches may range from 30 to 70 percent of the time required for processing of cans. Because of the uncertainty which surrounds the estimating of the thermal energy requirement for pouch retorting this more restrictive case of assuming the requirements were equivalent was used in the analysis. The estimates in table 5-11 include this assumption.

Effects of Retort Pouch Cost on Analysis. Table 5-11 illustrates that the cost associated with purchasing the empty packages is a significant part of the variable operating costs of the alternative systems. Therefore, the effect that a range of purchase prices for retort have on the analysis was evaluated for Firm B. The effect of a higher price for purchasing empty retort pouches and cartons is summarized in table 5-12. When the total after tax system costs for the retort pouch packaging system under various pouch and carton prices are compared with the other alternative packaging systems it is revealed that the retort pouch system is the minimum cost system. A retort pouch processing system was the minimum cost system under conditions where pouches were $100/1000 and cartons were $30/1000. These are the

Table 5-12--Comparison of Present Values of Total After Tax System Costs and 1980 Amortized Costs Under Various Pouch Prices

Pouch Price $/1000	Year	Retort Pouch System 1980 Present Value After Tax Costs	Retort Pouch System Amortized Costs	Old Can System 1980 Present Value After Tax Costs	Old Can System Amortized Costs[2]	New Can System 1980 Present Value After Tax Costs	New Can System Amortized Costs
80.00 w/$25/1000 cartons							
	(1980)	$ 672,778	$ 982,168	$ 893,083	$1,520,841	$ 859,870	$1,523,184
	(1985)	833,820		976,616		987,392	
90.00 w/$25/1000 cartons							
	(1980)	728,172	1,047,435	893,083	1,520,841	859,870	1,523,184
	(1985)	888,859		976,616		987,392	
100.00 w/$25/1000 cartons							
	(1980)	783,567	1,112,703	893,083	1,520,841	859,870	1,523,184
	(1985)	943,898		976,616		987,392	
100.00 w/$30/1000 cartons							
	(1980)	811,264	1,140,696	893,083	1,520,841	859,870	1,523,184
	(1985)	970,160		976,616		987,392	
80.00[1] w/$25/1000 cartons							
	(1980)	672,778	1,249,367	893,083	1,520,841	859,870	1,523,184
	(1985)	887,279		976,616		987,392	
90.00[1] w/$25/1000 cartons							
	(1980)	728,172	1,348,034	893,083	1,520,841	859,870	1,523,184
	(1985)	949,000		976,616		987,392	
100.00[1] w/$25/1000 cartons							
	(1980)	783,567	1,446,701	893,083	1,520,841	859,870	1,523,184
	(1985)	1,010,722		976,616		987,392	
100,00[1] w/$30/1000 cartons							
	(1980)	811,264	1,474,695	893,083	1,520,841	859,870	1,523,184
	(1985)	1,036,983		976,616		987,392	

[1]Pouch prices increasing at same annual real rate as can prices.

[2]Amortized costs are based on the result of equation (3.10) plus the amortized maintenance costs which are the only costs which are considered to be a function of the age of the old canning equipment complement in this study. The period of amortization is equivalent to the optimal economic life of the retort pouch and new canning equipment complements.

current prices which are considered the upper bound for the price of the containers.

Some additional explanation of the calculations which pertain to the costs of the old canning system shown in table 5-12 are necessary. Previous analysis has shown that if retort pouch processing or a new canning equipment complement was acquired in 1980 they should be held in production for thirty-four years. The optimal replacement period of thirty-four years was found where the amortized costs of challengers were minimized (equation (3.9)). No such analysis was performed on the existing canning equipment complement due to the impossibility of tracing its history. However, replacement theory states that it is not necessary to consider such cost history. Simply, if the marginal costs or the cost of operating the equipment one additional production period are greater than the average costs or amortized costs of the challenger the challenger should replace the existing equipment complement. This theory ignores the additional costs which are not a function of equipment age that become important when challengers are being compared that are technologically different. The procedure outlined in chapter 3 appears to be adequate at handling these comparisons although it is somewhat cumbersome when comparing many different alternatives. Further, the technique used in this study is only useful when the ordering of the alternatives by their costs is consistent. In other words, where the total costs of operating one system remain consistently below that of another system in each production period. This is where the problem enters the retort pouch price analysis. Under the conditions at which pouch prices are $100 in 1980 and increase over time at a rate equivalent to that of cans, the ordering of the alternatives does not remain consistent. Therefore another evaluation procedure for analysis must be considered. The total amortized system costs calculated over a period of thirty-four years for the existing canning systems were compared with the amortized costs of the other systems. If the existing canning plant could be operated for thirty-four more years it would be more costly than the retort pouch packaging system.

Effect of Transport Distance. As with the previous analysis concerning Firm A, the effect that the transport distance has on the analysis was evaluated for the alternative systems considered for Firm B. Distances of 250, 500 and 1,000 miles have been evaluated in addition to the 750 mile distance which is used in the base case. Table 5-13 summarizes the results of this evaluation. The costs presented in table 5-13 for the retort pouch system were calculated using equation (3.11). The costs presented for the existing canning system were calculated using equation (3.10) plus the amortized maintenance costs which are the only costs which are considered to be a function of the age of the old canning equipment complement in this study. The total amortized cost was calculated over a period of thirty-four years as it was in the previous section for the existing canning system and retort pouch packaging systems. Costs for the new canning system were not included because they were higher than those associated with the existing canning system except in the first two years of operation.

The main point to consider in this evaluation is that the retort pouch system is the minimum cost system at each level of transport distance considered. Further, according to the results presented in

Table 5-13--Comparison of After Tax and Amortized System Costs Under Alternative Transport Distances

Transport Distance Before and After Processing	Year	Retort Pouch System 1980 Present Value After Tax Costs[1]	Retort Pouch System Amortized Costs	Existing Can System 1980 Present Value After Tax Costs	Existing Can System Amortized Costs[2]
250					
	(1980)	$606,138	$871,575	$791,407	$1,355,775
	(1985)	762,914		869,085	
500					
	(1980)	635,497	922,868	841,012	1,437,083
	(1985)	794,612		921,685	
750					
	(1980)	672,778	982,168	893,083	1,520,841
	(1985)	833,820		976,616	
1000					
	(1980)	739,805	1,071,533	990,910	1,650,844
	(1985)	901,234		1,074,930	

[1]The actual examination of the cost streams show that if the costs of the retort pouch system are lower in 1985 they are also lower in all of the following years considered.

[2]Amortized costs are based on the result of equation (3.10) plus the amortized maintenance costs over the optimal replacement period for the retort pouch system.

table 5-13 a retort pouch system that had transportation distances of 750 miles would prove to be less costly than the existing canning system with transport distances of only 250 miles. Clearly retort pouch systems have a distinct advantage over the alternative system considered in this study in terms of the transport costs.

Evaluation of the Use of Preformed Pouches. As pointed out in the analysis for Firm A, retortable pouches can also be obtained preformed. Retort pouch system evaluation in the analysis preceding this section has been based on purchasing pouch material and forming the pouch just previous to the filling and sealing stages on the processing line. Table 4-8 presents the requirements of the alternative system which uses preformed pouches and fill/seal machines in Firm B.

A comparison of the retort pouch system using preformed pouches and fill/seal machines, with the retort pouch system using roll stock material, for Firm B revealed that the retort pouch system which uses form/fill/seal machines and roll stock material is less costly. The preformed pouch system, however, is less costly than the existing canning system alternative, (table 5-14). The estimated costs associated with this alternative are presented in appendix C.15. Although the costs associated with machinery purchase are less when preformed pouches are used, the labor requirements and pouch costs are substantially greater. Retort pouch costs used in this comparison were $95/1000.

Effect of Production Rate. Under conditions in which the form/fill/seal and fill/seal machines are not operated at their rated production rate of sixty packages per minute it is necessary to

Table 5-14--After Tax System Costs and Total Amortized System Costs for Alternative Production Rates of Retort Pouch Systems

System	Year	Total After Tax Costs	Amortized Costs (1980 $)
New Canning System			
	(1980)	$859,870	$1,523,184
	(1985)	987,392	
Existing Canning System			
	(1980)	893,083	1,520,841
	(1985)	976,616	
Retort Pouch System			
Roll Stock Pouches			
60 ppm	(1980)	672,778	982,168
	(1985)	833,820	
40 ppm	(1980)	657,906	1,021,240
	(1985)	876,944	
Preformed Pouches			
60 ppm	(1980)	788,175	1,054,832
	(1985)	885,937	
40 ppm	(1980)	789,455	1,081,285
	(1985)	913,841	

re-evaluate the retort pouch packaging system with the other alternatives. In this study a lower production rate for each filling machine of forty packages per minute or 66 percent of the rated production limit was considered. If the total plant production rate of 360 pouches per minute is to be maintained additional pieces of equipment and units of labor and energy are required. Both preformed pouch processing equipment and form/fill/seal machines for roll stock material were considered under these production conditions. Although the evaluation showed that the costs of the retort pouch systems with lower filling machine production rates were greater than the systems with the higher, sixty package per minute, production rates, they were less costly than the new canning system alternative and the existing canning system. Table 5-14 presents a summary of the results of this comparative analysis. Actual cost estimates for these operating conditions can be found in appendix C.16 and C.17.

Investment Credit Deduction Effect. The analysis in this study allows for an investment credit of 10 percent which can be deducted from the firm's tax liability. Further details concerning the investment credit allowance are discussed in chapter 4. The investment tax credit effectively lowers the costs associated with purchasing the new durable equipment complement required for the packaging systems. Because there is no investment credit allowed in the calculation of the previously existing canning equipment complement costs, the investment credit allowance presents a particular cost advantage for the alternative processing systems. Replacement equipment associated with the retort pouch system requires the largest investment. The largest investment credit write-off, therefore, is associated with the retort pouch processing alternative.

When the base case for Firm B was analyzed without an allowance for investment tax credit in the new can and retort pouch packaging systems, the ordering of replacement alternatives remained the same. The retort pouch packaging system remained the lowest cost packaging system. The actual estimates are reported in appendix C.18 and C.19.

Effect of Interest Deduction. The irregular shape of the cost function of the retort pouch processing system, presented in figure 5-7, in the first five years of operation is due to the deduction of interest payments from the cost stream. There is also an interest deduction effect on the cost function of the new canning system, however, it is not nearly as significant because the outlay required for acquisition of the new canning equipment complement is significantly less than that required for retort pouch processing equipment. The effect of not including interest deductions in the evaluation was tested. Figure 5-8 illustrates the effect on the total cost function of not including the allowable interest deductions. Although the cost advantage of the retort pouch processing system was reduced, the pouch system did remain consistently less costly than the existing canning system and the new canning system alternative. Further, under these conditions the new canning system alternative would be the highest cost system in all production periods. The actual estimates are reported in appendix C.20 and C.21.

Conclusions

The retort pouch packaging system is the minimum cost system among the alternatives considered under the assumptions and conditions described in chapter 4. Although the costs associated with acquiring and maintaining the durable machinery complement for retort pouches is greater than that of either a new canning equipment complement or the existing canning equipment, the other operating expenditures for the system are less. If the projections used in this study for the costs of cans, cartons, retort pouches, labor, freight and energy are

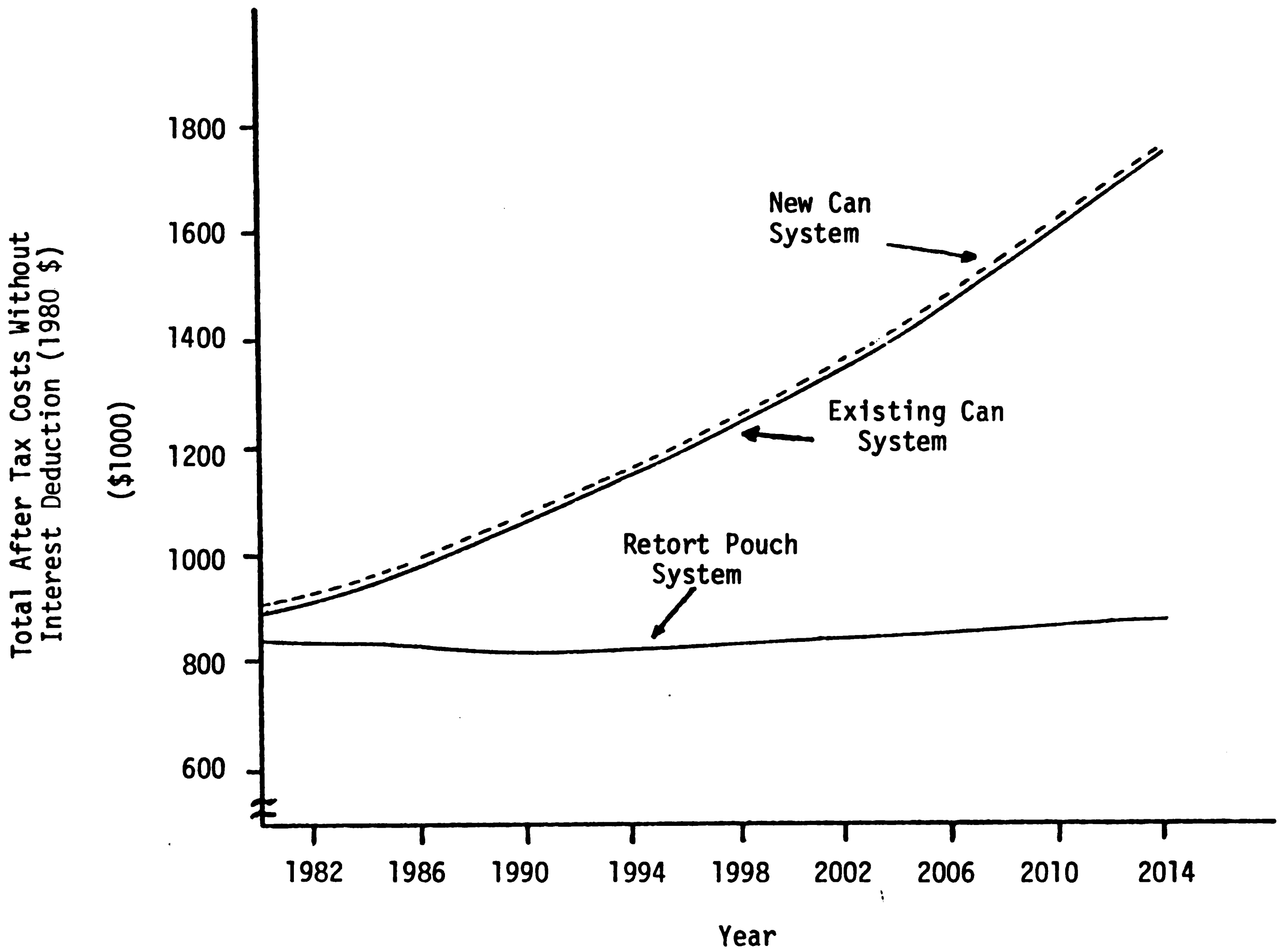

Figure 5-8--Total comparative after tax costs without interest deduction of alternative packaging systems for Firm B.

approximately correct, the difference between the operating costs of the retort pouch system and the alternative canning system will increase over the next several years.

Package costs influence the analysis to the greatest extent. A savings advantage of $15/1000 units for retort pouches and cartons versus cans in the base year (1980) is significant. This factor will become even more significant over a period of years if the cost of cans continues to increase faster than the cost of the empty retort pouch. It is expected that this difference in the trend in the prices of cans and pouches will continue because cans are significantly more energy intensive to construct than retort pouches.

Retort pouches also have a particular advantage in the transportation component of the system, particularly in the delivery of empty containers from manufacturer to processor. Because the processed retort pouch product is lighter than the canned product it also has a freight cost advantage in distribution from processor to wholesale market.

Lighter weight, smaller volumes, low freight costs and a purchase price that is significantly less than that of the empty can are the major contributors to the cost effectiveness of the retort pouch packaging system. The level of energy used in processing the pouch versus the can appears to be of much less significance and has little effect on the selection of the minimum cost system in this study. Labor use is generally more intensive in the retort pouch packaging system. However, labor use contributes only a small percentage to the operating costs which were considered in this study. Labor costs do not influence the results to a great extent.

Comparisons of the differences in the after tax amortized costs for the proposed retort pouch system and new canning system reveal the cost advantage of the retort pouch system. For conditions presented for Firm A the cost advantage to the retort pouch system is $41/1000 units produced. The cost advantage under the circumstances described for Firm B is $52/1000 units.

A further summary, conclusions and issues for further research are presented in chapter 6.

CHAPTER VI

SUMMARY

This research evaluated the economic feasibility of the retort pouch for processing, packaging, and distributing processed fruit and vegetable products. Specifically, the study identified alternative packaging systems which are currently technically feasible and compared the costs associated with the durable equipment and operating requirements for each of the systems. The packaging systems studied were an existing canning system, a new canning system, and a new retort pouch packaging system. Further, the economic feasibility of replacing an existing canning system with a new canning system or a new retort pouch packaging system was examined.

The major objectives of the study were to compare the costs associated with:

1. Purchasing processed food packaging containers, specifically cans and flexible retort pouches of retail size for packaging fruit and vegetable commodities.

2. Transportation of these containers from the package producer to the food processor.

3. Processing and packaging of fruit and vegetable products in these alternative packages.

4. Transportation of products to wholesale distribution centers from the processing location.

Additional objectives included:

5. Identification of the amount of energy used in the various stages of the alternative packaging systems which include

construction of the containers, transportation of empty containers and processed products, and processing and packaging of the product.

6. Estimation of the economic life of can and retort pouch processing equipment and the costs associated with their acquisition and operation over that period.

7. Identification of the conditions under which retort pouches are a viable and economically feasible package for fruit and vegetable commodities.

8. A description of the advantages and disadvantages of using retort pouches and cans for fruit and vegetable products in the food system.

Procedure

A variety of information sources has been used to construct the operating and capital costs associated with three alternative packaging systems. The systems studied were an existing canning system, a new canning system, and a retort pouch packaging system. The results of two energy accounting studies, which document the energy used in fruit and vegetable processing plants, were used to estimate the amount of energy required in the processing stage of the alternative packaging systems. Further, the essential components of the processed fruit and vegetable packaging system that could effect the adoption of the retort pouch were identified and the capital and operating requirements for each system considered were established. This information was then used to construct a generalized model of the packaging system alternatives for processed fruits and vegetables to estimate and evaluate the equipment and operating costs associated with each alternative system under a variety of input price scenarios and operating conditions.

Selection of the fruit and vegetable processing plants from which the processing and packaging component of the model was constructed was conducted in conjunction with the National Food Processors Association, Berkeley, California and the Department of Agricultural Engineering, University of California, located at Davis. For the research to be of general use, it was necessary that the model be based on typical fruit and vegetable processing plants and operating conditions. Although the fruit and vegetable processing and packaging industry is very diverse in its operating procedures, the processing plants from which the operating data was collected are not atypical.[6.1] Further, the firms selected are of the approximate size of firms that may consider the use of retort pouches as a packaging alternative sometime in the future. The energy accounting studies which were used in the study had previously been conducted in the plants which were selected.

After the typical fruit and vegetable processing operations were selected, information concerning the rate of production, type of equipment and associated labor, energy, and maintenance costs for the plants selected was collected. Data from the existing plants was collected by surveying the plant production managers. Information concerning the retort pouch and new can packaging system alternatives was collected from a variety of equipment manufacturers and distributors. Data concerning the construction of cans and pouches and the estimation of their market price was collected from package manufacturers and convertors. Current transportation costs were obtained from commodity transport companies and motor freight firms.

Energy price scenarios were developed from a number of sources including responses to an open ended survey soliciting opinions on energy

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[6.1]Personal communication, National Food Processors Association.

price scenarios. The respondents were generally agricultural engineers and agricultural economists who have been conducting energy related research in the North Central States. Other input price scenarios were developed in conjunction with the analysis and were mainly used to indicate the sensitivity of the results to alternative rates of price increases of selected inputs.

As the required data was being collected, a computer model was formulated in accordance with the conceptual system outlined in figure 1-1. The model was used to estimate the costs which are associated with acquiring and maintaining a new technologically advanced set of durable equipment for processing retort pouches. These costs were also estimated for a new canning equipment complement. The model used this cost data in an economic replacement routine to determine the optimal economic life of the new durable equipment complements which could potentially replace the existing canning equipment.

The model was also used for estimating the cash flows for each of the new alternative packaging systems over the optimal economic life of the durable equipment complements which are required for operating each system. Cash flows were also estimated for the costs associated with the operation of the existing packaging system and the maintenance of the existing durable equipment complement.

In the analysis procedure, the investment and operating costs of each new alternative packaging system were compared with the cost of continuing to operate the existing can packaging system to determine if:

1. A new packaging system which required either new canning equipment or retort pouch equipment should replace the existing canning system.

2. A replacement system is needed, which system it should be; a retort pouch system or a new canning system.

This procedure of analysis is conducted on two sets of data for two different processing plants. In summary, the costs of each alternative replacement packaging system were estimated and compared with the costs associated for each existing operation under conditions of rising energy prices and a variety of other price and cost variables to determine if a retort pouch system could compete on a cost basis with other alternative packaging systems.

Conclusion

The retort pouch packaging system is the minimum cost system among the alternatives considered given the acquisition and operating requirements described in this study. Although the costs associated with acquiring and maintaining the durable machinery complement for retort pouches is significantly greater than that of either a new canning equipment complement or the existing canning system alternative, the other operating expenditures considered in the packaging system alternatives are considerably smaller for the retort pouch system. As energy prices continue to rise at a positive real rate and if the costs of cans, cartons, retort pouches, labor and freight increase at similar rates of those used in this study to simulate future production period costs, the difference between the operating costs of the retort pouch system and the alternative canning systems will become larger over the next several years.

The expenditure category which influences the analysis to the largest extent, and will be the major factor in explaining the difference in costs between retort pouch packaging systems and canning systems, is the cost of empty containers. If carton manufacturers and film and foil convertors are continually able to hold price increases of their products to a relatively lower rate than those of can manufacturers, the retort pouch system will have substantial cost advantages in this segment of the packaging system. The total cost of retort pouches and cartons used in this analysis is $15 less per 1000 units than the cost of 1000 retail size cans. This is a significant factor in the base year (1980) and should prove to be even more significant over a period of years as real energy prices increase. Because the construction of the can is more energy intensive than that of the retort pouch and carton, rising energy prices will have a greater effect on the cost of production of cans than of retort pouches and cartons. Although energy requirements will not be the only item to effect the purchase price of the respective containers, it will have an important effect. Further consideration of the supply-demand characteristics of retort pouch markets is necessary.

Retort pouches also have a particular advantage in the transportation sectors of the packaging system. In 1980, freight costs attributed to transporting empty retort pouches and cartons of retail size are 66 percent to 77 percent less than the freight costs associated with transportation of empty 303 cans for an equivalent distance. Freight costs associated with shipment of the processed product in the retort pouch system are approximately 27 percent less than those costs attributed to transporting the processed product in cans. This freight savings is attributed to the lighter weight of processed pouch products which is a result of the reduced brine requirements considered in this study. As freight costs and energy prices increase, the cost advantage which retort pouches hold in this area should increase because a smaller number of shipments and less energy are required for shipping the equivalent amount of product.

Lower freight costs, attributed to lighter weight, and smaller volumes and the fact that the purchase price of retort pouches are significantly less than that of empty cans are the major contributors to the cost effectiveness of the retort pouch packaging system. Although the amount of energy used in transportation and container manufacture may play an important role in the cost effectiveness of the retort pouch, the amount of energy used directly in processing the pouch versus the can appears to be of much less significance. The amount of energy used in processing and the potential energy savings attributed to processing retort pouches does not influence the results of the comparative cost analysis to a great extent.

A comparison of the difference in the after tax amortized costs for the proposed retort pouch system and new canning system over their optimum economic lives indicates there is cost advantage for the retort pouch system. Given the base case conditions presented for Firm A, the cost advantage to the retort pouch system is $41/1000 units. The cost advantage of the retail pouch system estimated for Firm B is $52/1000 units. The retort pouch system evaluated in this study was also found to hold a cost advantage over the new canning system when lower production rates of 40 packages per minute were considered for each individual filling and sealing machine. The advantage of a retort pouch system for Firm A and Firm B under these set of conditions is $38 and $48 per 1000 units, respectively. Consideration of using preformed pouches under these lower production rates lowers the cost advantage of the pouch systems to $35 and $42 per 1000 units produced.

Issues of Concern for Managerial Implications

Although the results reveal that the retort pouch has particular cost advantages in the subsectors of the food system considered in this study (figure 1-1), they must be interpreted carefully. As with any general system simulation study, assumptions were made which simplify the real world conditions so they could be handled in an evaluation. There are many technical, locational, financial, managerial and institutional considerations which need to be addressed when evaluating the retort pouch packaging system for individual processing plants. The following discussion presents the issues which could effect the results of the analysis. A manager should consider these issues and the implications they may have on any evaluation that is conducted which concerns alternative packaging systems.

The results presented do not include comparative costs associated with cans and pouches for other subsectors of the food system such as marketing at the retail level and home preparation and storage. Pouches would appear to have particular advantages in storage because of their lighter weight and cubic design. There may, however, be unforseen handling problems and additional marketing costs attributed to product promotion and consumer education which may need to be considered. Costs associated with development of the food product and technical processing characteristics may reduce the comparative cost advantage of the pouch. Initial research and development for pouch use and production start up costs would also contribute to increased costs associated with pouch processing systems. This would certainly be true if the pouch processing system was being considered as a replacement alternative to an existing canning system. Alternatively, this difference in costs may be insignificant if the decision has already been made to replace an old canning line with a new processing and packaging system. Initial planning and start up costs may be similar for a new canning system and a retort pouch packaging system, therefore, the advantage of the retort pouch system may be maintained in such a comparison.

This study has considered replacement of an existing process in an existing food processing plant. It has not considered the alternative of constructing an entirely new fruit and vegetable processing plant with either a new canning equipment complement or a retort pouch packaging equipment complement.

Consideration of the price of the product is an additional issue which is important. If retort pouch packaged fruit and vegetable products are of considerably higher quality than their canned counterparts and approach the quality of frozen fruits and vegetables, they may draw a relatively higher price in the market. A higher price than the can product price would increase the attractiveness of the retort pouch packaging system for the processor, wholesaler and retailer.

A major issue which effects the results of the study is related to the replacement equipment complements that were considered. It was assumed that if retort pouch processing equipment were to replace existing canning equipment, the machinery which moved the canned product from operation to operation in the processing line could also move retort pouches with a minimum of modification. The possibility of this assumption being correct would vary a great deal and is a function of which processing plants are considered. This assumption was used because there is a substantial amount of uncertainty surrounding the particular design and types of equipment available for use in these operations in any particular processing line. If this assumption is not valid, the cost advantage attributed to the retort pouch system would be smaller. A somewhat more valid assumption is that the cost of acquiring and operating equipment which moves pouches or cans from one processing stage to another in a new processing line would be essentially equivalent although the actual equipment design may be quite different. If this is true, there is a greater level of confidence that the retort pouch processing system holds a cost advantage over a new canning system.

Quality control problems with canning and retort pouch packaging systems have been assumed to be equivalent in terms of costs. The lack of technical experience in processing pouches on a day to day basis may make this assumption somewhat questionable, although, it is hoped that these problems have been previously considered in the design of processing equipment.

A majority of the price projections are based on 1970s price series data and the results are dependent upon the historical relationships holding true for the forseeable future. Importantly, the historical price series may be suitable for projections because they are from a period when real energy prices were rising. However, a different rate of increase in real energy prices would also have an effect on the other prices and costs considered in the alternative packaging systems. Unless there are substantial changes in the pattern of price increases, the retort pouch system will become more attractive.

The results of the study are only valid for fruit and vegetable products which are currently packaged with brine. A reduction in the amount of brine needed in the package was used in estimating the size of the pouch for the retort pouch packaging system. Less brine reduces process times and energy consumption costs in the retorting operation and weight of the processed product for consideration in the calculation of freight costs.

Energy use in processing was estimated from two energy accounting studies. A problem with these estimates is related to the potential improvement which may exist in new canning and pouch processing equipment. New processing equipment would be more energy efficient than similar older processing equipment. Even without reduced process times, a retorting system would likely use less energy than an older system because of the fact that newer retorts would be more efficient. This change in efficiency was not considered.

The investment and operating costs estimated in this study are not total system costs, but partial costs in the sense of partial budgeting costs because only those components of the packaging system that were not considered to be common and equivalent in terms of costs were considered. The results, therefore, should not be interpreted as a comparison of actual total operating costs, but only a comparison of those costs associated with those parts of the packaging systems which were considered to be different.

The calculations which are used to estimate the optimal economic life of the replacement equipment are based on the aggregate costs of the equipment complement. This assumes that all pieces of the equipment complement are used at equivalent rates in each production period and are effected by the salvage function and maintenance function in a similar fashion. Their patterns of depreciation and maintenance and useful physical lives are equivalent for equipment within alternatives and across alternatives. However, under actual operating conditions, one piece of machinery in the equipment complement may wear out before the other pieces. This could effect the results of the study to some degree.

The comparative costs of the alternative systems may be effected by the total amount of fruits and vegetables being processed. The costs may vary with the level of output. This study assumes fixed levels of output in each production season and for each alternative process and does not consider the effects of a variable length processing season and the total tonage processed.

In summation, it is the position of this study that retort pouch packaging is not the only viable processing and packaging alternative for fruit and vegetable products. In fact, a retort pouch system may not be the minimum cost system under some production conditions. The study, however, does suggest that retort pouches clearly have some specific economic advantages in certain components of the packaging system under study and that they should be considered in any evaluation of replacement of an existing processing system or investment in a new processing plant for fruit and vegetable products. Importantly, the results of this study should be considered with reference to the conditions under which the study was conducted. Managerial groups should consider any implications the preceeding issues have on the evaluation of a retort pouch packaging system.

Suggestions for Future Research

Further questions surrounding the use of retort pouches for packaging fruits and vegetables need to be investigated. Other types of research which are required as an input into further analysis of these questions is also needed. Several are pointed out below.

1. Additional research concerning the economics of the retort pouch is needed in the retail and home preparation sectors of the food system. Questions concerning marketing issues, retailing costs and benefits and costs for home use should receive further attention. Disposal problems and the potential for recycling may also need to be studied.

2. Although the retort pouch appears to have a great deal of potential for institutional markets, further research is needed on the problems of processing and handling large pouches in the distribution stages. Even less is known about the economic feasibility of the institutional size pouch as a replacement for large institutional size cans.

3. Other cartoning and shipping container alternatives and their costs may prove feasible and provide additional cost advantages for the retort pouch packaging alternative. Further research in this area could prove beneficial.

4. Improved data on processing times and energy consumption of the equipment complements for the alternative processing systems would prove valuable. Establishment of a relationship between the size of the package and the required amount of energy needed for processing would prove useful.

5. A better understanding of the relationship of total production costs and retort pouch product package size is also of interest.

6. From an engineering and food processing perspective, the processing characteristics of a wider variety of products need to be developed and standardized as they have been to a large extent with cans.

7. Improvements are necessary in the techniques for determining or estimating freight costs for a variety of transportation modes at various transport distances. This research would be of benefit to a wide variety of studies in which transport costs need to be considered, particularly under the conditions of rising real fuel prices.

8. Projections of energy prices under selected scenario conditions would be extremely useful for use in the evaluation of new energy saving technologies related to energy policy.

9. Improvements in operationalizing economic replacement theory under conditions of technological change and rising costs should be made. This is particularly important as energy prices continue to increase at a significant rate and efforts are reinforced to evaluate technologically improved ways of handling energy and using it productively throughout the food system.

In addition to the more technical research needs and narrowly defined research needs identified, further identification is needed on how fundamental institutional and market characteristics will effect retort pouch adoption. The impact that retort pouches will have on market structure and performance and institutions is an important area for future research.

APPENDIX A

PRIMARY DATA FOR ESTIMATES USED IN MODEL DEVELOPMENT

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A.1--Pouch Can and Carton Weights

1000 5-1/2" x 7" pouches weigh 12-1/2 lbs.

1000 211 x 304 cans weigh 109 lbs.

Source: Hodinott (1975).

5-1/2" x 7" pouch = .00032468 lbs./sq."

2-11/16" x 3-1/4" cans = .00281035 lbs./sq."

Circumference = $2\pi R$ or πD

Circumference of 211 x 304 can = 8.44305"

Height of 211 x 304 can = 3.25"

Area of Can Walls = 27.439913 sq."

Area of Lids each = πR^2 = 5.6726742 sq."

Total Surface Area = 38.785261 sq."

Weight per Area = .00281035 lbs./sq."

6" x 8" pouch = 48 sq."

303 x 406 can = 59.770167 sq."

Therefore:

1000 6" x 8" pouches weigh 15.58464 lbs.

100 303 x 406 cans weigh 167.95509 lbs.

Weight of Cartons = .0065471 oz./sq."

Source: Kelsey (1976).

For a 5-3/4" x 8" x 3/4" carton

Sides = 3/4" x 8" x 2	= 12 sq."
Faces = 5-3/4" x 8" x 2	= 92 sq."
Ends = 1-1/2" x 5-3/4" x 2	= 17.25 sq."
Total Surface Area	=121.25 sq."

1000 5-3/4" x 8" x 3/4 cartons weigh 49.61 lbs.

A.2--Transportation Calculation for Pouches, Cans and Cartons

Truck dimensions

45' L x 90" W x 110" H

With pallet dimensions of 5" x 44" x 56"

The approximate useable space is:

42' L x 88" W x 104" H or 2669 cu. ft.

Source: Based on information in Lopez (1975) pages 120-121.

One truck potential for loading containers:

1000 303 x 406 cans	= 25.72 cu. ft.
1000 6" x 8" x .01" pouch	= .2778 cu. ft.
1000 5-3/4" x 8" x 3/4" cartons	= 1.14 cu. ft.

Source: Calculations based on information supplied by Reynolds Metals and American Container Corporation.

Cans:

With 2669 cu. ft. useable truck space 103,770 cans can be loaded with a weight of 17,429 lbs. Space is the restriction and not weight.

Pouches:

With a 40,000 lb. weight limitation approximately 2,566,629 pouches can be loaded with a volume of 713 cu. ft. Weight is the restriction and not space.

Cartons:

With a 40,000 lb. weight limitation approximately 806,289 cartons could be loaded with a volume of 919 cu. ft. Weight is the restriction and not space.

A.3--Estimated Weight of Retort Pouch Products

The shipping weight of a case of 24 6" x 3/4" pouches containing fruits and vegetables is estimated as follows:

Product	24 x 12.0 oz. net weight	= 18.0	lbs.
Pouch	24 x .01558464 lbs./pouch	= .347	lbs.
Carton	24 x .04961 lbs./carton	= 1.19	lbs.
Shipping Case		= 2.67	lbs.
Total		22.23	lbs.

The product weight is based upon the assumption that the liquid component of the product can be reduced when packaged in retort pouches. This is due to the pouches ability to reduce void air space when vacuumized. Assuming that the comparable pouch will have the same drained weight of product but less fluid the figure of 12 oz. of net weight is used. A 6" x 8" x 3/4" pouch is deemed suitable for 12 oz. of fruit and vegetable product.[1]

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[1]Size is based on personal communication with the Project Director of the Flex-Can Program, Flexible Packaging Division, Reynolds Metals Company.

The shipping case weight is estimated to be the same for pouches as it is for cans. In reality the weight of the shipping container would likely be less for retort pouches than cans because the case would be smaller. The possibility does exist that heavier materials or other packaging materials may make the case for shipping retort pouches heavier. Little information was available for making estimates concerning the weight and size of the packing case. In this study it is estimated by subtracting the weight of 24 303 x 406 cans and the net weight of the packaged product from the total average case weight of 30.7 lbs.[2] for a case of 24 303 cans. The net weight of the product in cans as reported in Sacharow & Griffen (1970) was assumed to be 16 oz.

A.4--Transportation Calculations for Processed Pouched Products and Canned Products

Dimensions:

One case of 24 303 x 406 cans has the following dimensions:

12-3/4" L x 9-9/16" W x 8-3/4" H.

Source: Lopez (1975), page 122.

One case of 24 5-3/4" x 8" x 3/4" cartoned pouches are estimated to have the following dimensions:

11.5" L x 8" W x 9" H.

One case of pouches requires 828 cu." or .479 cu. ft.

One case of cans requires 1066.8 cu." or .617 cu. ft.

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[2]Source: <u>The Almanac of The Canning, Freezing, Preserving Industries</u>, 1979.

Processed Cans:

With a 40,000 lb. weight restriction for trucks approximately 1302 cases could be loaded with a volume of approximately 803.33 cu. ft. Weight is the restriction and not space.

Processed Pouches:

With a 40,000 lb. weight restriction for trucks approximately 1799 cases could be loaded with a volume of approximately 861.72 cu. ft. Weight is the restriction and not space.

A.5--Freight Rate Information for 1980

The freight rate estimates are based on information collected from freight haulers and commodity transport companies. The rates are adjusted for the weight of the load assumed in the study and are reported in Table A-1.

A.6--Transportation Energy Requirements

Energy Requirements for Capacity Loads:

Loaded truck	- 0.01089 gallons/ton-mile
Unloaded truck	- 0.00733 gallons/ton-mile
Total	- 0.01822 gallons/ton-mile

Total assumed no backhaul--truck departs full and returns empty.

Energy coefficients are based on a 22.1 ton unrefrigerated truck.

Source: Barton (1980).

Table A-1--Freight Rate Estimates (1980)

Container	Miles	Rate/cwt	Fuel Surcharge	Total	Energy Cost Associated With Total	$/1000 Units	All Other Costs Associated With Total	$/1000 Units
Food Cans Class 50 ITEM 52755								
	250	$2.22/cwt	+13%	$ 501.72	$ 42.03	.405	459.69	4.43
	500	$3.28/cwt	+13%	$ 741.28	$ 84.07	.81	657.21	6.33
	750	$3.74/cwt	+13%	$ 845.24	$126.10	1.21	719.14	6.93
	1,000	$5.08/cwt	+13%	$1,148.08	$168.14	1.62	979.94	9.44
Information and Totals Based on a 20,000 Minimum Load Requirement								
Paper Board Cartons								
	250	$1.40/cwt	+13%	$ 632.80	$107.14	.13	525.66	.65
	500	$2.07/cwt	+13%	$ 935.64	$214.28	.27	721.36	.89
	750	$3.03/cwt	+13%	$1,369.56	$321.42	.40	1,048.14	1.30
	1,000	$4.95/cwt	+13%	$2,237.40	$428.56	.53	1,808.84	2.24
Information Based on Loads Weighing 36,000-43,000 lbs. -- Totals Based on 40,000 lbs. Load								
Pouches Class 60 ITEM 20480								
	250	$1.77/cwt	+13%	$ 800.04	$107.13	.04	692.91	.27
	500	$2.41/cwt	+13%	$1,089.32	$214.28	.08	875.04	.34
	750	$3.04/cwt	+13%	$1,374.08	$321.42	.13	1,052.66	.41
	1,000	$4.97/cwt	+13%	$2,246.44	$428.56	.17	1,817.88	.71
Information Based on Loads Weighing 24,000-43,000 lbs. -- Totals Based on 40,000 lbs. Load								
Source: Personal Communications with Yellow Freight Lines								
Packed Fruit & Vegetable Commodities in Cans								
	250	$ .92/cwt	+13%	$ 415.84	$107.14	3.43	308.70	9.88
	500	$1.38/cwt	+13%	$ 623.76	$214.28	6.86	409.48	13.10
	750	$1.96/cwt	+13%	$ 885.92	$321.42	10.29	564.50	18.07
	1,000	$2.98/cwt	+13%	$1,346.96	$428.56	13.71	918.40	29.39
Packed Fruit & Vegetable Commodities in Pouches								
	250	$ .92/cwt	+13%	$ 415.84	$107.14	2.48	308.70	7.15
	500	$1.38/cwt	+13%	$ 623.76	$214.28	4.96	409.48	9.48
	750	$1.96/cwt	+13%	$ 885.92	$321.42	7.44	564.50	13.07
	1,000	$2.98/cwt	+13%	$1,346.96	$428.56	9.93	918.40	21.27
Information and Totals Based on 40,000 lbs. Loads								
Source: Personal Communication with Michigan-Nebraska Transit Company, Food Commodity Carriers								

All mileages are based on shipments from Lansing to Joliet, Illinois, St. Louis, Missouri, Memphis, Tennessee, Oklahoma City, Oklahoma respectively.

Rates from different locations to different destinations of the same mileage would vary somewhat.

Energy Required for Less Than Capacity Loads:

40,000 lb. shipments of cartons, pouches and packaged products--

[2(.00733) + .9(.01089 - .00733)] x 140,000 BTU/gal. = 2500 BTU/ton-mile

17,429 lb. shipments of empty cans--

[2(.00733) + .4(.01089 - .00733)] x 140,000 BTU/gal. = 2251 BTU/ton-mile

Energy requirements are based on BTU's of diesel fuel.

A.7--Energy Price Estimates for 1980

The energy prices listed in table 4-9 of the text are based on the historical trend in real energy prices. Historical data on energy prices in recent years is presented below in table A-2.

Table A-2--Historical Energy Price Data

Year	Industrial Electricity		Industrial Natural Gas		Diesel Fuel	
	¢/KWH		$/100 cu. ft.		$/Gallon	
	Actual[1]	Real[2]	Actual[1]	Real[2]	Actual[1]	Real[2]
1979	3.03	1.39	2.03	.94	.79	.36
1978	2.77	1.42	1.54	.79	.53	.27
1977	2.50	1.37	1.32	.73	.51	.28
1976	2.21	1.29	.97	.57	.45	.26
1975	2.07	1.28	.73	.45	N.A.	
1974	1.69	1.14	.53	.36	N.A.	
1973	1.25	.94	N.A.		N.A.	

[1]Actual price data was collected from the DOE Monthly Energy Review, various issues.

[2]Real prices are estimated by deflating the actual price by the CPI.

N.A.--Not Available.

The 1980 national average electricity price was estimated from the trend in prices from 1973-1979 using the following equation which describes the trend in real prices. The inflation rate in the CPI was assumed to be 15% above the 1979 average level.

$$\text{Real Electric Price} = \underset{(-3.67)}{-4.17447} + \underset{(4.79)}{.0715672} * \text{Year}$$

$$R^2 = .82$$

A 1980 national average industrial natural gas price was estimated from the trend in prices from 1974-1979 using the following equation which describes the trend in real prices. The inflation rate in the CPI was again assumed to be 15%.

$$\text{Real Natural Gas Price} = \underset{(-20.81)}{-8.20521} + \underset{(22.44)}{.115611} * \text{Year}$$

$$R^2 = .99$$

An annual average price of diesel fuel for 1980 was estimated from the 1978-1979 trend in prices again assuming a 15% rate of inflation in the CPI. It was felt that the 1979-1980 period would be very similar to the 1978-1979 period in terms of diesel fuel price increases. To date this appears to be the case.

A.8--Projected Cost of Containers

The cost projections for the various containers considered in the analysis are based on the historical trends of price indexes which apply to metal cans, cartons and retort pouch materials. These indexes are listed in table A-3. A real price index was calculated by deflating the actual price index by the aggregate PPI.

Table A-3--Historical Container Costs

Year	Cans			Retort Pouches			Cartons		
	Actual[1]	Real	% Change From Previous Year	Actual[2]	Real	% Change From Previous Year	Actual[3]	Real	% Change From Previous Year
1979	2.92	1.242	-1.2%	N.A.			1.97	.837	+0.4
1978	2.63	1.256	+5.6%	1.21	.578	- 8.8	1.75	.834	-3.3
1977	2.31	1.190	+2.7%	1.23	.633	- 7.3	1.68	.863	-4.1
1976	2.12	1.158	+1.3%	1.25	.683	+19.5	1.65	.900	-0.4
1975	2.00	1.144	+7.7%	1.00	.572	+ 1.7	1.58	.903	-0.9
1974	1.70	1.062	+3.6%	.90	.562	- 0.4	1.46	.912	-1.3
1973	1.38	1.025		.76	.564		1.25	.924	
			AVE = +3.28%			AVE = + .94%			AVE = -1.6%

[1]303 x 406 cans index in PPI, code 1031.0101.

[2]Index data supplied by FMC.

[3]Paper boxes and containers index in PPI, code 091503.

A.9--Maintenance Costs for Existing Processing Equipment in 1980

The maintenance costs for the existing processing equipment was collected by surveying the existing plants' production managers.

Table A-4--Maintenance Costs for Existing Processing Equipment (1980)

Operation	Number of Units		Total Maintenance Estimate
Plant A			
Fillers	5		$ 1,240
Exhaust Box	2		900
Seamer	2		6,000
Batch Retort	3		375
		TOTAL	$ 8,515
Plant B			
Fillers	2		$ 1,400
Seamer-Syruper	2		9,800
Continuous Retorts	2		4,500
		TOTAL	$15,700

A.10--Discount Rate Estimation

The real discount rate is calculated using the following equation:

$$rr = \frac{1+mr}{1+ri} - 1$$

where:

rr = real discount rate

mr = nominal discount rate--interest rate on long term commercial and industrial loans

ri = inflation rate--percent annual increase in GNP deflator

Table A-5--Interest Rates on Long Term Commercial and Industrial Loans

Year	Q_1	Q_2	Q_3	Q_4	Annual Average
1979	12.01	12.23	12.52	15.15	13.08
1978	9.19	9.67	10.20	11.38	10.11
1977	N.A.	8.24	8.09	8.71	8.34
1976	8.02	8.02	8.45	7.48	7.99
1975	10.26	8.22	8.89	8.88	9.06
1974	10.16	11.41	13.08	12.16	11.70
1973	7.11	7.66	9.82	10.68	8.82

Source: Federal Reserve Bulletin, various issues.

Table A-6--Gross National Product Deflator Trend

Year	Q_4	% Increase From Previous Year
1979	170.74	8.97
1978	156.68	8.20
1977	144.82	6.21
1976	136.35	4.75
1975	130.17	7.53
1974	121.06	11.01
1973	109.05	7.50
1972	101.44	

Source: Survey of Current Business, various issues.

Table A-7--Estimated Real Discount Rate Trend

Year	Rate	
1979	3.77	
1978	1.77	Average Real Rate 1973-1979
1977	2.01	1.99
1976	3.09	After Tax Real Rate
1975	1.42	1.07
1974	0.62	
1973	1.22	

A.11--Estimation of the Annual Increase in Real Costs of Processing Equipment

The capital equipment cost projections for the years following 1980 are based on historical trends of the producer price index which applies to food processing equipment. This is code group 1161 and the index for years 1973-1979 appears below. A real index was calculated by deflating the actual price index by the aggregate PPI.

Table A-8--Food Products Machinery Producers Price Index

Year	PPI Food Products Machinery		
	Actual	Real	% Change From Previous Year
1979	2.325	.988	-.018
1978	2.106	1.006	+.005
1977	1.943	1.001	+.018
1976	1.798	.983	+.036
1975	1.659	.949	+.036
1974	1.471	.919	-.055
1973	1.309	.972	
			AVE = +.004

A.12--Replacement Values of Equipment in 1980 for Insurance Calculations

The replacement values of equipment in 1980 are the acquisition costs of the durable equipment used in the processing lines. Replacement values for the equipment in the existing processing plants is based upon the cost of new canning equipment which would replace the existing equipment. The values for the new canning equipment and the retort pouch equipment are their current acquisition costs.

Table A-9--Insurance Replacement Values (1980)

	Plant A	Plant B
Operation		
Existing Equipment		
Filling	40,000	40,000
Syruping	N.A.	130,000
Closing	60,000	60,000
Retorting	315,000	460,000
TOTAL	415,000	690,000
New Canning Equipment		
Filling	40,000	40,000
Syruping	N.A.	130,000
Closing	60,000	60,000
Retorting	315,000	460,000
TOTAL	415,000	690,000
New Retort Pouch Equipment		
Form/Fill Sealing	1,500,000	1,800,000
Retorting	315,000	420,000
Dryering	30,000	36,000
Cartoning	300,000	300,000
TOTAL	2,145,000	2,556,000
With Fill/Seal	700,000	840,000
TOTAL	1,345,000	1,596,000

A.13--Miscellaneous Information and Conversions

The indexes and conversions listed in table A-10 are used in various calculations and are listed here for reference.

Table A-10--Selected Indexes and Conversions

	Indexes		
Year	PPI	CIP	GNP
1979	2.352	2.174	1.655
1978	2.093	1.954	1.520
1977	1.942	1.815	1.417
1976	1.830	1.705	1.337
1975	1.749	1.612	1.271
1974	1.601	1.477	1.160
1973	1.347	1.331	1.058
1972	1.191	1.253	1.000

Conversions

Natural gas - 1000 BTU/cu. ft.

Diesel fuel - 140,000 BTU/gal.

Electricity - 3,413 BTU/KWH

GJ - 9.485×10^5 BTU

APPENDIX B

COMPUTER PROGRAMS USED FOR ESTIMATING THE COSTS OF THE ALTERNATIVE PACKAGING SYSTEMS

APPENDIX B

COMPUTER PROGRAMS USED FOR ESTIMATING THE COSTS OF THE ALTERNATIVE PACKAGING SYSTEMS

B.1--Computer Program Used for Estimating the Costs of the Retort Pouch Packaging Systems

```
      PROGRAM PPACK(INPUT,OUTPUT,TAPE60=INPUT,TAPE61=OUTPUT)
C             PROGRAM TO CALCULATE PRESENT VALUE
C              OF RETORT POUCH PROCESSING OPERATION
C
C         REAL STATEMENTS
C
      REAL IR,LCH,LRI,MHD,LOL,NDP,MHY,MUNGH,MUFOH,KWHH
      REAL INT,INV
      INTEGER DATE1,DATE2,DATE3,DATE4,DATE5,DATE6,DATE7,DATE8,DATE9,
     XDATE10,DATE11,DATE12,DATE14,DATE15,DATE16,DATE17,DATE18,DATE19
      INTEGER TN
C         DIMENSION STATEMENTS
C
      DIMENSION PAC(10),PDC(10,80),PEMAT(10,80),PIC(10,80),A(10)
      DIMENSION INT(150),BB(150),PRIN(150),EB(150),TINT(10,80)
      DIMENSION DSI(80),DS(10,80),PSAL(10,80),LCH(80),PLE(80)
      DIMENSION RTPC(80),ERTP(80),CRC(80),ECR(80),BEFC(80),BPFR(80)
      DIMENSION EBPF(80),PMUNG(80),PMUFO(80),PKWH(80),ENG(80),EFO(80)
      DIMENSION EEL(80),AEFC(80),APFR(80),EAPF(80)
      DIMENSION TOC(10,80), TDEP(10,80)
      DIMENSION AC(80),PV(10,80)
      DIMENSION TIT(10,80),PVBC(10,80),BC(10,80)
      DIMENSION PVC(80),AC1(80),PVTOCE(10,80),PVTDEP(10,80),PVTIT(10,80)
      DIMENSION TDBC(10,80),PVEC1(10,80),PVEC(10,80),PVTOO(10,80)
      DIMENSION PVOC1(10,80),PVOC(10,80),TPVAC(10,80),PVPLE(10,80)
      DIMENSION PVERTP(80),PVECR(80),PVEBPF(80),PVENG(80),PVEFO(80)
      DIMENSION PVEEL(80),PVEAPF(80),TPVPLE(80),TPVERTP(80)
      DIMENSION TPVECR(80),TPVEBPF(80),TPVENG(80),TPVEFO(80),TPVEEL(80)
      DIMENSION TPVEAPF(80),PVTENGY(80),PVTTRAN(80),PVTPACK(80)
      DIMENSION PVEC3(10,80),PVEC2(10,80),PVOC2(10,80),PVOC3(10,80)
      DIMENSION TPVAC2(10,80)
      DIMENSION TENERGY(80),TTRAN(80),TPACK(80),TOTAL(80),PPLE(80)
      DIMENSION PENERGY(80),PTRAN(80),PPPACK(80),PERTP(80),PECR(80)
      DIMENSION PEBPF(80),PEAPF(80),PENG(80),PEEL(80),PEFO(80)
      DIMENSION PAETRAN(80),TOTEFR(80),PTOTEFR(80),TTENERG(80)
      DIMENSION PTTENER(80),BETRAN(80),AETRAN(80)
      DIMENSION PBETRAN(80),INV(10,80),PVINV(10,80)
      DIMENSION TEC(10,80),PTINT(10,80),PPIC(10,80),PPEMAT(10,80)
      DIMENSION PEMATN(10,80),PEMATO(80),PIMC(80),RMC(80)
      DIMENSION RVI(10,80),TOT(10,80),RMIN(10),TTOL(10,80)
      WRITE(61,999)
999   FORMAT(*1*)
C*****************************************************
C         INITIALIZE VARIABLES STATEMENTS           *
C*****************************************************
      PAC(1)=1830000.00
C     PAC=RETORT POUCH PROCESSING EQUIPMENT ACQUISITION COST IN 1980
      RVI(1,1)=2145000.00
C     RVI(1)= REPLACEMENT INSURANCE VALUE OF EQUIPMENT IN 1980
      LCH(1)=7.02
C     LCH(1)=LABOR RATE IN 1980 $/HR
      LRI=1.00
C     LRI= LABOR RATE INDEX PERCENT INCREASE PER YEAR
      RTPC(1)= 80.00
C     RTPC(1)= RETORT POUCH COST $/1000 IN 1980
      RTPCI=1.0094
C     RTPCI= RETORT POUCH COST INDEX
      PPM= 300.
C     PPM= PACKAGES USED PER MINIUTE
      LOL=8
C     LOL=LABOR ON LINE
      NDP=  15
C     NDP = NUMBER OF DAYS PROCESSING
      CRC(1)= 25.00
C     CRC(1) = CARTON COST IN 1980 $/1000
      CRCI=1.00
C     CRCI = CARTON COST INDEX
      BFM=750
C     BFM = FREIGHT MILES BEFORE PROCESSING
      AFM=750
C     AFM = FREIGHT MILES AFTER  PROCESSING
      DFI =  1.05
C     DFI = DIESEL FUEL INDEX
      PMUDF=8.57
C     PMUDF=PRICE OF DEISEL FUEL IN 1980 $/MILLION BTU
      PMUNG(1)=2.60
C     PMUNG(1)= PRICE OF NATURAL GAS IN 1980 $/1MILLION BTU
```

```
      PMUFO(1)=0.00
C     PMUFO(1)= PRICE OF FUEL OIL IN 1980 $/1MILLION BTU
      PKWH(1)=0.0387
C     PKWH(1)=  PRICE OF ELECTRICITY IN 1980  $/KWH
      MUNGH=3.0114875
C     MUNGH= MILLION BTU NATURAL  GAS PER HOUR
      MUFOH  =0.0
C     MUFOH= MILLION BTU FUEL OIL PER HOUR
      KWHH=134.6625
C     KWHH = KWH PER HOUR
      PNGI=1.05
C     PNGI= PRICE OF NATURAL GAS INDEX
      PFOI=1.05
C     PFOI= PRICE OF FUEL OIL INDEX
      PELI=    1.05
C     PELI= PRICE OF ELECTRICITY INDEX
      R=.0107
C     R=REAL DISCOUNT RATE
      PEMATO(1)=375.00
C      PEMATO(1)=MAINTENANCE COST EXISTING EQUIPMENT IN 1980
      AGE=25.00
C     AGE=AVERAGE AGE OF OLD PROCESSING EQUIPMENT
      J=1
C     J=NUMBER OF YEARS WHICH TO CALCULATE ACQUISITION COST OVER
      PACI=  1.004
C     PACI=INDEX TO INCREASE PROCESSING MACHINERY ACQUISTION COST
      ND= 10
C     ND=NUMBER OF YEARS TO CALCULATE DEPRECIATION OVER FOR TAXES
      N=50
C     N=NUMBER OF YEARS FOR CONSIDERATION OF OPERATION  AFTER PURCHASE


      PI=.01
C     PI=PERCENT OF ORIGINAL PURCHASE COST ALLOWED FOR INSURANCE
      TN=60
C     TN=TOTAL NUMBER OF MONTHS FOR CALCULATON OF ANNUA INTERST CHARGE
C     TN=NUMBER OF YEARS IN LOAN * 12
      IR=.13/12
C     IR=INTERST RATE ON LOAN PER MONTH
      NS=14
C     NS=NUMBER OF YEARS SALVAGE GREATER THAN 0
C     INITIALIZATION OF TINT(IX,*)
C     TINT(IX,*)= TOTAL INTEREST CHARGE IN YEAR * WHEN LOAN STARTED IN
C     YEAR IX
C     INITIALIZATION OF INTEREST CHARGE ANC INVESTMENT TAX CREDIT
      DO 6 IX=1,J
      DO 5 IZ=1,N
      TINT(IX,IZ)=0.0
      INV(IX,IZ)=0.0
    5 CONTINUE
    6 CONTINUE
C     SNS= SUM OF NS
      SNS=0.0
      DO 8 IW=1,NS
      SNS=SNS+IW
    8 CONTINUE
      DO 9 I1=1,J
      RMIN(I1)=0.0
9     CONTINUE
C
C
C     HRSPD= HOURS PER DAY
      HRSPD=    16
C     BALOFC1 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 250 M
C     BALOFC2 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 500 M
C     BALOFC3 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 750 M
C     BALOFC4 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 1000 M
      BALOFC1= .92
      BALOFC2=    1.23
      BALOFC3= 1.71
      BALOFC4=2.95
C     BEFC1=FREIGHT COST ATTRIBUTEC TO ENERGY AT 250 MILES   $/1000 PACK
C     BEFC2=                                     500 MILES   $/1000 PACK
C     BEFC3=                                     750 MILES   $/1000 PACK
C     BEFC4=                                     1000 MILES  $/1000 PACK
      BEFC1= .17
      BEFC2= .35
      BEFC3= .53
      BEFC4=.70
C     AALOFC1= FREIGHT COST ALL BUT ENERGY AFTER PROCESSING AT 250 MILES
      AALOFC1= 7.15
      AALOFC2= 9.48
      AALOFC3= 13.07
      AALOFC4=21.27
C     AEFC1= FREIGHT CCST ATTRIBUTED TO ENERGY AT 250 MILES $/1000 PACK
C     AEFC2=                                      500 MILES $/1000 PACK
C     AEFC3=                                      750 MILES $/1000 PACK
C     AEFC4=                                     1000 MILES $/1000 PACK
      AEFC1=  2.48
      AEFC2=  4.96
      AEFC3=  7.44
      AEFC4=9.93
```

```
C      T=MARGINAL TAX  RATE
       T=.46
C
C
C***********************************************************************
C          CALCULATION OF ACQUISITION COST OF RETORT POUCH PROCESSING *
C                            EQUIPMENT                                *
C***********************************************************************
C
       DO 10 IA=2,J
       PAC(IA)=PAC(IA-1)*PACI
 10    CONTINUE
C
C          PAC(IA)= RETORT POUCH PROCESSING EQUIPMENT COST IN YEAR IA
C          PACI   = INDEX TO INCREASE AQUISITION COST
C*****************************************************************
C          CALCULATION OF INVESTMENT TAX CREDIT          *   .
C*****************************************************************
       DO 12 LA=1,J
       DO 11 LX=1,N
       IF(LX.GE.7)ACIVCC=0.10
       IF(LX.LT.7)ACIVCC=0.066666667
       IF(LX.LT.5)ACIVCC=0.033333333
       IF(LX.LT.3)ACIVCC=0.0
       INV(LA,LX)=PAC(LA)*ACIVCC
11     CONTINUE
12     CONTINUE
C          INV=INVESTMENT TAX CREDIT ALLOW
C          ACIVCC=AQUISITION COST INVESTMENT CREDIT CONVERSION
C          WHICH IS A FUNCTION OF LENGHT OF TIME THE EQUIPMENT
C          IS HELD IN PRODUCTION
C*******************************************************************
C           CALCULATION OF DEPRECIATION CHARGE             *
C*******************************************************************
       DO 20 IB=1,J
       DO 15 IC=1,N
       PDC(IB,IC)=PAC(IB)/FLOAT(ND)
       IF(IC.GT.ND) PDC(IB,IC)=0.0
 15    CONTINUE
 20    CONTINUE
C
C          PDC(IB,IC)=RETORT POUCH DEPRCIATION CHARGE WHERE IB = YEAR
C          PURCHASED AND IC=YEAR OF OPERATION. FUNCTION OFAR OFPURCHASE
C*******************************************************************
C             CALCULATION OF ANNUAL INTERST CHARGES             *
C*******************************************************************
       DO 80 IJ=1,J
       BB(1)=PAC(IJ)
       DO 70 IK=1,TN
       A(IJ)=PAC(IJ)*((IR*((1+IR)**TN))/(((1+IR)**TN)-1))
       INT(IK)=BB(IK)*IR
       PRIN(IK)=A(IJ)-INT(IK)
       EB(IK)=BB(IK)-PRIN(IK)
       BB(IK+1)=EB(IK)
       IF(IK.LE.12) TINT(IJ,1)=TINT(IJ,1)+INT(IK)
       IF((IK.GT.12).AND.(IK.LE.24)) TINT(IJ,2)=TINT(IJ,2)+INT(IK)
       IF((IK.GT.24).AND.(IK.LE.36)) TINT(IJ,3)=TINT(IJ,3)+INT(IK)
       IF((IK.GT.36).AND.(IK.LE.48)) TINT(IJ,4)=TINT(IJ,4)+INT(IK)
       IF((IK.GT.48).AND.(IK.LE.60)) TINT(IJ,5)=TINT(IJ,5)+INT(IK)
       IF((IK.GT.60).AND.(IK.LE.72)) TINT(IJ,6)=TINT(IJ,6)+INT(IK)
       IF((IK.GT.72).AND.(IK.LE.84)) TINT(IJ,7)=TINT(IJ,7)+INT(IK)
       IF((IK.GT.84).AND.(IK.LE.96)) TINT(IJ,8)=TINT(IJ,8)+INT(IK)
       IF((IK.GT.96).AND.(IK.LE.108)) TINT(IJ,9)=TINT(IJ,9)+INT(IK)
       IF(IK.GT.108) TINT(IJ,10)=TINT(IJ,10)+INT(IK)
70     CONTINUE
80     CONTINUE
C     A(IJ)=AMORTIZED MONTHLY PAYMENT FOR EQUIPMENT PURCHASED IN
C     YEAR IJ
C      PAC(IJ)=ACQUSITION COST OF EQUIPMENT IN YEAR IJ
C     IR=INTEREST RATE
C     TN=TOTAL MONTHS PAYMENT OF LOAN TAKES PLACE OVER
C     BB(IK)=AMOUNT LEFT TO PAY ON LOAN AT BEGINNING OF MONTH
C     EB(IK)=AMOUNT AT END OF MOMTH = BB OF FOLLOWING MONTH
C     PRIN(IK)= AMOUNT OF PRINCIPAL PAID ON LOAN IN THE MONTH
C     INT(IK)= AMOUNT OF INTEREST PAID ON THE LOAN IN MONTH IK
C     TINT(IJ,**)= TOTAL INTERST PAID ON LOAN IN YEAR ** WHEN
C     PURCHASED IN YEAR IJ
C*******************************************************************
C              CALCULATION OF MAINTENANCE COSTS                 *
C*******************************************************************
       DO 40 ID=1,J
       DO 30 IE=1,N
       PEMAIN(ID,IE)=(PAC(ID)* (.003214+(.001786*IE)))
 30    CONTINUE
 40    CONTINUE
       RMC(1)=.003214+(.001786*AGE)
       NL=N+J
       DO 45 I=2,NL
       RMC(I)=.003214+(.001786*(I+AGE-1))
       PIMC(I)=RMC(I)/RMC(I-1)
       PEMATO(I)=PEMATO(I-1)*PIMC(I)
45     CONTINUE
```

```
      DO 48 LB=1,J
      DO 49 LC=1,N
      KK=LB-1
      PEMAT(LB,LC)=PEMATN(LB,LC)+PEMATO(LC+KK)
49    CONTINUE
48    CONTINUE
C
C          PEMATN(ID,IE)= EXPENDITURE FOR MAINTENANCE ON NEW EQUIPMENT
C          IN YEAR IE WHEN PURCHASED IN YEAR ID
C          PEMATO(I)= EXPENDITURE FOR MAINTENANCE ON OLD PROCESSING
C          EQUIPMENT IN THE PROCESSING LINE IN YEAR I.
C          RMC= REAL MAINTANCE COST CONVERSION FACTOR FOR CALCULATING
C          PERCENTAGE CHANGE FROM YEAR TO YEAR
C          PIMC(I)=PERCENT INCREASE IN MAINTENANCE COST FOR OLD
C          PROCESSING EQUIPMENT FROM PREVIOUS YEAR I-1
C          PAC(ID) =ACQUISITION COST IN YEAR ID
C          AGE=AVERAGE AGE OF OLD PROCESSING EQUIPMENT IN 1980
C
C***********************************************************
C          CALCULATION OF SALVAGE VALUE OF EQUIPMENT        *
C***********************************************************
      DO 100 IL=1,J
      DSI(1)=((NS+1)-1)/SNS
      PSAL(IL,1)=PAC(IL)-(PAC(IL)*DSI(1))
      DO 90 IM=2,N
      DSI(IM)=((NS+1)-IM)/SNS
      IF(IM.GE.NS) DSI(IM)=0.0
      DS(IL,IM)=PAC(IL)*DSI(IM)
      PSAL(IL,IM)=ABS(PSAL(IL,IM-1)-DS(IL,IM))
      IF(IM.GE.NS) PSAL(IL,IM)=0.0
 90   CONTINUE
 100  CONTINUE
C          DSI(IM)= PERCENT OF ORIGINAL VALUE IN YEAR IM
C          DS(IL,IM)= ACTUAL DECLINE IN SALVAGE VALUE IN YEAR IM WHEN
C          PURCHASED IN YEAR IL
C          PSAL(IL,IM)= ACTUAL SALVAGE VALUE OF EQUIPMENT IN YEAR IM WHEN
C          PURCHASED IN YEAR IL
C***********************************************************
C          CALCULATION OF LABOR EXPENDITURE                 *
C***********************************************************
      DO 120 IN=2,N
      LCH(IN)=LCH(IN-1)*LRI
 120  CONTINUE
      MHD=LOL*HRSPD
      MHY=NDP*MHD
      DO 130 IO=1,N
      PLE(IO)=LCH(IO)*MHY
 130  CONTINUE
C     LCH(IN)=LABOR CHARGE PER HOUR IN YEAR IN
C     LRI=LABOR RATE INDEX
C     LOL=LABOR ON LINE
C     HRSPD=HOURS PER DAY
C     MHD= MAN HOURS PER DAY
C     NDP= NUMBER OF DAYS PROCESSING
C     MHY= MAN HOURS PER YEAR
C     PLE(IO)= EXPENDITURE FOR LABOR IN RETORT POUCH PROCESS IN YEAR IO
C***********************************************************
C        CALCULATION OF INSURANCE CHARGES                   *
C***********************************************************
      JJ=J+1
      DO 55 LD=2,JJ
      RVI(LD,1)=RVI(LD-1,1)*PACI
55    CONTINUE
      DO 57 LE=1,J
      DO 56 LF=2,N
      RVI(LE,LF)=RVI(LE,LF-1)*PACI
56    CONTINUE
57    CONTINUE
      DO 60 IG=1,J
      DO 50 IH=1,N
      PIC(IG,IH)=(RVI(IG,IH)*PI)
 50   CONTINUE
 60   CONTINUE
C
C          PIC(IG,IH)= ANNUAL INSURANCE CHARGE ON EQUIPMENT WHEN IG= YEAR
C           PURCHASED AND IH= YEAR OF OPERATION
C          RVI(LE,LF)=REPLACEMENT INSURANCE VALUE IN YEAR LF WHEN
C          PURCHASED IN THE LE YEAR
C          PI= PERCENT OF ACQUISITION COST   ALLOWED FOR INSURANCE
C***********************************************************
C        CALCULATION OF RETORT POUCH PURCHASE EXPENDITURE    *
C***********************************************************
      DO 150 IP=2,N
      RTPC(IP)=RTPC(IP-1)*RTPCI
 150  CONTINUE
      PPH=PPM*60.0
      TOTPAKD=PPH*HRSPD
      TOTPAK= TOTPAKD*NDP
      TOTPAKT=TOTPAK/1000
      DO 160 IQ=1,N
      ERTP(IQ)= TOTPAKT*RTPC(IQ)
 160  CONTINUE
```

```
C
C         RTPC(IP)= RETORT POUCH COST IN YEAR IP $/1000
C         RETORT POUCH COST INDEX
C         PPM= PACKAGES PROCESSED PER MINUTE
C         PPH= PACKAGES PROCESSED PER HOUR
C         TOTPAKD = PACKAGES PROCESSED PER DAY
C         TOTPAK = TOTAL PACKAGES PROCESSED PER SEASON
C         TOTPAKT= 1000  PACKAGES PROCESSED PER SEASON
C         NDP = NUMBER OF DAYS PROCESSING IN SEASON
C         ERTP(IQ)= TOTAL EXPENDITURE FOR PURCHASING RETORT POUCHES IN
C         YEAR IQ
C*********************************************************
C         CALCULATION OF CARTON PURCHASE EXPENDITURE        *
C*********************************************************
      DO 180 IZ=2,N
      CRC(IZ)=CRC(IZ-1)*CRCI
  180 CONTINUE
      DO 190 IS=1,N
      ECR(IS)= TOTPAKT * CRC(IS)
  190 CONTINUE
C
C     CRC(IR)= CARTON COST IN YEAR IR
C     CRCI = CARTON COST INDEX
C     ECR(IS) = EXPENDITURE FOR CARTONS IN YEAR IS
C     TOTPAKT = 7000 OF TOTAL PACKAGES USED
C******************************************************************
C        CALCULATION OF PACKAGE FREIGHT COST BEFORE PROCESSING       *
C******************************************************************
      IF(BFM.EQ.250) GO TO 300
      IF(BFM.EQ.500) GO TO 310
      IF(BFM.EG.750) GO TO 320
      IF(BFM.EQ.1000) GO TO 330
  300 CONTINUE
      BALOFC = BALOFC1
      BEFC(1)= BEFC1
      BPFR(1)= BALOFC1+BEFC1
      GO TO 350
  310 BALOFC=BALOFC2
      BEFC(1)=BEFC2
      BPFR(1)= BALOFC2+BEFC2
      GO TO 350
 320  BALOFC=BALOFC3
      BEFC(1)=BEFC3
      BPFR(1)=BALOFC3+BEFC3
      GO TO 350
  330 BALOFC=BALOFC4
      BEFC(1)=BEFC4
      BPFR(1)=BALOFC4+BEFC4
  350 CONTINUE
      DO 360 IT=2,N
      BEFC(IT)=BEFC(IT-1)*DFI
      BPFR(IT)=BALOFC+BEFC(IT)
  360 CONTINUE
      DO 370 IU=1,N
      EBPF(IU)= TOTPAKT * BPFR(IU)
      BETRAN(IU)=TOTPAKT*BEFC(IU)
  370 CONTINUE
C
C         BFM= FREIGHT MILES BEFORE PROCESSING
C         BALOFC= FREIGHT CHARGE ATTRIBUTED TO ALL  BUT ENERGY  BEFORE
C         PROCESSING $/1000 PACKAGES
C         BEFC= FREIGHT CHARGE ATTRIBUTED TO ENERGY  BEFORE PROCESSING
C         $/1000 PACKAGES
C         1=250 MILES   2= 500 MILES  3= 750 MILES   4= 1000 MILES
C         BPFR(IT)= FREIGHT RATE BEFORE PROCESSING $/1000 PACKAGES IN
C         YEAR IT
C         DFI= DIESEL FUEL INDEX
C         EBPF= EXPENDITURE ON FREIGHT BEFORE PROCESSING IN YEAR IU
C******************************************************************
C         CALCULATION OF EXPENDITURES FOR ENERGY IN PROCESSING     *
C******************************************************************
      TUNG=MUNGH*HRSPD*NDP
      TUFO=MUFOH*HRSPD*NDP
      TKWH=KWHH*HRSPD*NDP
      DO 400 JA=2,N
      PMUNG(JA)=PMUNG(JA-1)*PNGI
      PMUFO(JA)=PMUFO(JA-1)*PFOI
      PKWH(JA)=PKWH(JA-1)*PELI
 400  CONTINUE
      DO 410 JB=1,N
      ENG(JB)= TUNG*PMUNG(JB)
      EFO(JB)= TUFO*PMUFO(JB)
      EEL(JB)= TKWH*PKWH(JB)
  410 CONTINUE
C         TUNG=TOTAL NATURAL GAS USED  MILLION BTU      TUNGH= PER HOUR
C         TUFO=TOTAL FUEL OIL USED  MILLION BTU         TUFOH= PER HOUR
C         TKWH=TOTAL ELECTRICITY USED  KWH              KWHH = PER HOUR
C         PMUNG(JA)= PRICE OF NATURAL GAS IN YEAR JA    $/MILLION BTU
C         PNGI= PRICE OF NATURAL GAS INDEX
C         PMUFO(JA)= PRICE OF FUEL OIL IN JA            $/MILLION BTU
C         PFOI= PRICE OF FUEL OIL INDEX
C         PKWH(JA)= PRICE OF ELECTRICITY IN YEAR JA     $/KWH
C         PELI= PRICE OF ELECTRICITY INDEX
```

```
C********************************************************************
C         CALCULATION OF PACKAGE FREIGHT COST AFTER PROCESSING      *
C********************************************************************
      IF(AFM.EQ.250) GO TO 450
      IF(AFM.EQ.500) GO TO 460
      IF(AFM.EQ.750) GO TO 470
      IF(AFM.EQ.1000) GO TO 480
 450  CONTINUE
      AALOFC= AALOFC1
      AEFC(1)= AEFC1
      APFR(1)= AALOFC1+AEFC1
      GO TO 490
460   CONTINUE
      AALOFC = AALOFC2
      AEFC(1)=AEFC2
      APFR(1)=AALOFC2+AEFC2
      GO TO 490
470   AALOFC=AALOFC3
      AEFC(1)=AEFC3
      APFR(1)=AALOFC3+AEFC3
      GO TO 490
480    AALOFC=AALOFC4
      AEFC(1)=AEFC4
      APFR(1)=AALOFC4+AEFC4
 490  CONTINUE
      DO 500 JC=2,N
      AEFC(JC)=AEFC(JC-1) * DFI
      APFR(JC)=AALOFC+AEFC(JC)
 500  CONTINUE
      DO 510 JD=1,N
      EAPF(JD)=TOTPAKT * APFR(JD)
      AETRAN(JD)=TOTPAKT*AEFC(JD)
 510  CONTINUE
C
C          AFM= FREIGHT MILES AFTER PROCESSING
C          AALOFC= FREIGHT CHARGE ATTRIBUTED TO ALL BUT ENERGY AFTER
C          PROCESSING $/1000 PACKAGES
C          AEFC= FREIGHT CHARGE ATTRIBUTED TO ENERGY AFTER PROCESSING
C          $/1000 PACKAGES
C          APFR(JC)= FREIGHT RATE   AFTER PROCESSING IN YEAR JC $/1000
C          PACKAGES
C          DFI= DIESEL FUEL INDEX
C          EAPF(JD)= EXPENDITURE ON FREIGHT AFTER  PROCESSING IN YEAR JD
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C*******************************************************************
C                                                                  *
C          CALCULATION OF PRSENT VALUE                             *
C               REPLACEMENT CRITERIA                               *
C                                                                  *
C*******************************************************************
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
      DO 550 M=1,J
      TD=0.0
      TOE=0.0
      TI=0.0
      DBC=0.0
      TOO=0.0
      NN=N-5
      DO 540 L=1,NN
      K=M-1
      LL=-L
      PVC(L)=((1+R)**LL)
      AC(L)=1/(1-((1+R)**LL))
      AC1(L)=R/(1-((1+R)**LL))
      TOE=TOE+(PEMAT(M,L)*PVC(L))
      PVTOCE(M,L)=TOE
      TD=TD+(PDC(M,L)*PVC(L))
      PVTDEP(M,L)=TD
      DBC=DBC+PDC(M,L)
      TDBC(M,L)=DBC
      BC(M,L)=TDBC(M,L)-PAC(M)+PSAL(M,L)
      PVINV(M,L)=INV(M,L)*PVC(1)
      PVBC(M,L)=BC(M,L)*PVC(L)
      PVEC1(M,L)=AC1(L)*(PAC(M)-(PSAL(M,L)*PVC(L))+((1-T)*PVTOCE(M,L))
     +  -(T*PVTDEP(M,L))+(T*PVBC(M,L))-(T*PVINV(M,L)))
      LM=1-M
      PVEC(M,L)=PVEC1(M,L)*((1+R)**LM)
      PVEC3(M,L)=AC1(L)*(PAC(M)-(PSAL(M,L)*PVC(L))+((1-T)*PVTOCE(M,L))
     +  -(T*PVTDEP(M,L))+(T*PVINV(M,L)))
      PVEC2(M,L)=PVEC3(M,L)*((1+R)**LM)
      TOO=TOO+(((PLE(L+K)+ERTP(L+K)+ECR(L+K)+EBPF(L+K)+ENG(L+K)+EFO(L+K)
     +  +EEL(L+K)+EAPF(L+K)-TINT(M,L)+PIC(M,L))*PVC(L))*(1-T))
      TOT(M,L)=(((PLE(L+K)+ERTP(L+K)+ECR(L+K)+EBPF(L+K)+ENG(L+K)
     + +EFO(L+K)+EEL(L+K)+EAPF(L+K)-TINT(M,L)+PIC(M,L))*PVC(L))*(1-T))
      PVTOO(M,L)=TOO
      PVOC1(M,L)=AC1(L)*PVTOO(M,L)
      PVOC(M,L)=PVOC1(M,L)*((1+R)**LM)
      TPVAC(M,L)=PVEC(M,L)+PVOC(M,L)
540   CONTINUE
550   CONTINUE
      DO 570 M1=1,J
      NN=N-5
      N1=NN-1
```

```
      DO 560 L1=2,N1
      IF((PVEC2(M1,L1).LT.PVEC2(M1,L1-1)).AND.(PVEC2(M1,L1).LT.
     + PVEC2(M1,L1+1))) RMIN(M1)=PVEC2(M1,L1)
560   CONTINUE
570   CONTINUE
      DO 572 M2=1,J
      NN=N-5
      DO 571 L2=1,NN
      TTOL(M2,L2)=TOT(M2,L2)+RMIN(M2)
571   CONTINUE
572   CONTINUE
C PVC(L)=PRESENT VALUE CONVERSION IN YEAR L
C AC(L)=ANNUITY CONVERSION IN YEAR L FOR AN INFINITE STREAM
C AC1(L)=ANNUITY CONVERSION IN YEAR L
C PVTOCE(M,L)=PRESENT VALUE OF TOTAL OPERATING COSTS WHICH ARE
C A FUNCTION OF EQUIPMENT AGE UP TO YEAR L WHEN PURCHASED IN
C YEAR M
C PVTDEP(M,L)=PRESENT VALUE OF TOTAL DEPRECIATION UP TO YEAR L
C WHEN PURCHASED IN YEAR M
C TINT(M,L)= TOTAL INTERST CHARGE UP TO YEAR L WHEN PURCHASED IN YEAR M
C PVBC(M,L)=PRESENT VALUE OF BALANCING CHARGE UP TO YEAR L WHEN
C PURCHASED IN YEAR M
C BC(M,L)=BALANCING CHARGE IN YEAR L WHEN PURCHASED IN YEAR M
C PVEC(M,L)=PRESENT VALUE OF AMORTIZED COST OF EQUIPMENT WHEN
C OPERATING TO YEAR L WHEN PURCHASED IN YEAR M ADJUSTED TO 1980
C PVTOO(M,L)=PRESENT VALUE OF ALL OTHER OPERATING COSTS NOT
C ASSOCIATED WITH THE AGE OF THE EQUIPMENT
C PVOC(M,L)=PRESENT VALUE OF AMORTIZED COST OF ALL OTHER
C OPERATING COSTS NOT ASSOCIATED WITH THE AGE OF THE EQUIPMENT
C WHEN OPERATING TO YEAR L WHEN PURCHASED IN YEAR M ADJUSTED
C TO 1980
C TPVAC(M,L)=PRESENT VALUE OF AMORTIZED COST OF ALL OPERATING
C WHEN OPERATING TO YEAR L WHEN PURCHASED IN YEAR M
C ADJUSTED TO 1980
C RMIN(M1)= MINIMUM AMORTIZED COST WHICH IS A FUNCTION OF AGE OF EQUIP.
C TOT(M2,L2)= PRESENT VALUE OF TOTAL ANNUAL OPERATING COST WHICH
C IS NOT A FUNCTION OF THE AGE OF THE EQUIPMENT.
C TTOL(M2,L2)= TOTAL COST OF OPERATION
      DO 580 II=1,N
      TENERGY(II)=ENG(II)+EFO(II)+EEL(II)
      TTRAN(II)=EBPF(II)+EAPF(II)
      TPACK(II)=ERTP(II)+ECR(II)
      TOTAL(II)=TENERGY(II)+TTRAN(II)+TPACK(II)+PLE(II)
      PPLE(II)=PLE(II)/TOTAL(II)
      PENERGY(II)=TENERGY(II)/TOTAL(II)
      PTRAN(II)=TTRAN(II)/TOTAL(II)
      PPPACK(II)=TPACK(II)/TOTAL(II)
      PERTP(II)=ERTP(II)/TOTAL(II)
      PECR(II)=ECR(II)/TOTAL(II)
      PEBPF(II)=EBPF(II)/TOTAL(II)
      PEAPF(II)=EAPF(II)/TOTAL(II)
      PENG(II)=ENG(II)/TOTAL(II)
      PEEL(II)=EEL(II)/TOTAL(II)
      PEFO(II)=EFO(II)/TOTAL(II)
      PBETRAN(II)=BETRAN(II)/TOTAL(II)
      PAETRAN(II)=AETRAN(II)/TOTAL(II)
      TOTEFR(II)=BETRAN(II)+AETRAN(II)
      PTOTEFR(II)=TOTEFR(II)/TOTAL(II)
      TTENERG(II)=TENERGY(II)+TOTEFR(II)
      PTTENER(II)=TTENERG(II)/TOTAL(II)
580   CONTINUE
C TENERGY=TOTAL PROCESSING ENERGY EXPENDITURES
C TTRAN= TOTAL FREIGHT EXPENDITURES
C TPACK= TOTAL PACKAGE EXPENDITURES
C TOTAL= TOTAL COSTS NOT ASSOCIATED DIRECTLY WITH MACHINE AGE
C PPLE= PERCENT  LABOR COSTS OF TOTAL
C PENERGY= PERCENT  PROCESSING ENERGY OF TOTAL
C PTRAN= PERCENT  FREIGHT COST OF TOTAL
C PPPACK= PERCENT PACKAGE COST OF TOTAL
C PERTP= PERCENT RETORT POUCH COST OF TOTAL
C PERC= PERCENT CARTON COST OF TOTAL
C PEBPF= PERCENT BEFORE PROCESSING FREIGHT COST OF TOTAL
C PEAPF= PERCENT AFTER PROCESSING FREIGHT COST OF TOTAL
C PENG= PERCENT NATURAL GAS COSTS OF TOTAL
C PEEL= PERCENT ELECTRICITY COSTS OF TOTAL
C PEFO= PERCENT RESIDUAL FUEL OIL COSTS OF TOTAL
C BETRAN= BEFORE PROCESSING ENERGY FREIGHT COSTS
C AETRAN= AFTER PROCESSING ENERGY FREIGHT COSTS
C PBETRAN= PERCENT BEFORE PROCESSING ENERGY FREIGHT COST OF TOTAL
C PAETRAN= PERCNET AFTER PROCESSING ENERGY FREIGHT COST OF TOTAL
C TOTEFR= TOTAL ENERGY FREIGHT COSTS
C PTOTEFR= PERCENT TOTAL ENERGY FREIGHT COSTS OF TOTAL
C TTENERG= TOTAL ENERGY COSTS INCLUDING ENERGY FREIGHT COSTS
C PTTENER= PERCENT ENERGY COSTS OF TOTAL COSTS
      DO 595 NC=1,J
      DO 590 NE=1,NN
      TEC(NC,NE)=TINT(NC,NE)+PEMAT(NC,NE)
      PTINT(NC,NE)=TINT(NC,NE)/TEC(NC,NE)
      PPEMAT(NC,NE)=PEMAT(NC,NE)/TEC(NC,NE)
590   CONTINUE
595   CONTINUE
```

```
C TEC=TOTAL COSTS ASSOCIATED WITH THE AGE OF EQUIPMENT
C PTINT= PERCENT TOTAL INTERST COST OF TEC
C PPIC= PERCENT TOTAL INSURANCE COST OF TEC
C PPEMAT= PERCENT TOTAL MAINTENANCE COST OF TEC
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C                     OUTPUT SECTION                          $
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
      WRITE(61,750)
750   FORMAT(*1*,30X,*ASSUMPTIONS CONCERNING PARAMETERS*)
      WRITE(61,751)PNGI
751   FORMAT(*-*,10X,*NATURAL GAS INDEX*,14X,*=*,F4.2)
      WRITE(61,752)PMUNG(1)
752   FORMAT(* *,10X,*$ PER MILLION BTU NATURAL GAS  =*,F5.3)
      WRITE(61,753)PELI
753   FORMAT(* *,10X,*ELECTRICITY INDEX*,14X,*=*,F4.2)
      WRITE(61,754)PKWH(1)
754   FORMAT(* *,10X,*$ PER KWH ELECTRICITY*,10X,*=*,F6.4)
      WRITE(61,755)PFOI
755   FORMAT(* *,10X,*FUEL OIL INDEX*,17X,*=*,F4.2)
      WRITE(61,756)PMUFO(1)
756   FORMAT(* *,10X,*$ PER MILLION BTU FUEL OIL*,5X,*=*,F4.2)
      WRITE(61,757)DFI
757   FORMAT(* *,10X,*DIESEL FUEL INDEX*,14X,*=*,F4.2)
      WRITE(61,758)PMUDF
758   FORMAT(* *,10X,*$ PER MILLION BTU DIESEL FUEL  =*,F5.3)
      WRITE(61,759)MUNGH
759   FORMAT(*-*,10X,*MILLION BTU NATURAL GAS PER HOUR  =*,F10.7)
      WRITE(61,760)MUFOH
760   FORMAT(* *,10X,*MILLION BTU FUEL OIL PER HOUR*,5X,*=*,F5.2)
      WRITE(61,761)KWHH
761   FORMAT(* *,10X,*KWH PER HOUR*,22X,*=*,F9.4)
      WRITE(61,762)BFM
762   FORMAT(*-*,10X,*FREIGHT MILES BEFORE PROCESSING  =*,F5.0)
      WRITE(61,763)AFM
763   FORMAT(* *,10X,*FREIGHT MILES AFTER PROCESSING   =*,F5.0)
      WRITE(61,764)RTPC(1)
764   FORMAT(*-*,10X,*RETORT POUCH COST PER 1000   =*,F7.2)
      WRITE(61,765)CRC(1)
765   FORMAT(* *,10X,*CARTON COST PER 1000*,9X,*=*,F5.2)
      WRITE(61,766)RTPCI
766   FORMAT(* *,10X,*POUCH COST INDEX*,13X,*=*,F7.4)
      WRITE(61,767)CRCI
767   FORMAT(* *,10X,*CARTON COST INDEX*,12X,*=*,F4.2)
      WRITE(61,768)PPM
768   FORMAT(* *,10X,*PACKAGES PER MINIUTE*,9X,*=*,F4.0)
      WRITE(61,769)LOL
769   FORMAT(*-*,10X,*LABOR ON LINE    =*,F3.0)
      WRITE(61,770)LRI
770   FORMAT(* *,10X,*LABOR RATE INDEX =*,F4.2)
      WRITE(61,771)R
771   FORMAT(*-*,10X,*REAL DISCCUNT RATE*,15X,*=*,F6.4)
      WRITE(61,772)T
772   FORMAT(* *,10X,*MARGINAL TAX RATE*,16X,*=*,F3.2)
      WRITE(61,773)TN
773   FORMAT(* *,10X,*MONTHS FOR INTERST CALCULATION   =*,I3)
      WRITE(61,774)IR
774   FORMAT(* *,10X,*INTEREST RATE*,20X,*=*,F4.3)
      WRITE(61,775)ND
775   FORMAT(* *,10X,*YEARS FOR DEPRECIATION*,11X,*=*,I3)
      DO 820 JW=1,J
      DATE19=1979+JW
      WRITE(61,800)DATE19
800   FORMAT(*1*,45X,*ACQUISITION YEAR IS*,1X,I4)
      WRITE(61,801)PAC(JW)
801   FORMAT(*0*,42X,*ACQUISITION COST IS*,1X,F12.2)
      WRITE(61,802)
802   FORMAT(*-*,5X,*YEAR*,9X,*AMORTIZED*,5X,*AMORTIZED*,5X,
     + *AMORTIZED*,5X,*AMORTIZED*)
      WRITE(61,803)
803   FORMAT(* *,17X,*REPLACEMENT*,3X,*PRODUCTION*,7X,*TOTAL*,6X,
     +  *REPLACEMENT*,3X,*PRODUCTION*,7X,*TOTAL*)
      WRITE(61,804)
804   FORMAT(* *,20X,*COSTS*,9X,*COSTS*,9X,*COSTS*,8X,*COSTS*,
     +  1X,*1*,7X,*COSTS*,1X,*1*,8X,*COSTS 1*)
      WRITE(61,805)
805   FORMAT(*-*)
      DO 810 IZ=1,NN
      DATE18=1979+IZ+(JW-1)
      WRITE(61,806)DATE18,PVEC(JW,IZ),PVOC(JW,IZ),TPVAC(JW,IZ)
     + ,PVEC2(JW,IZ),TOT(JW,IZ),TTOL(JW,IZ)
806   FORMAT(*0*,5X,I4,4X,6F14.2)
810   CONTINUE
820   CONTINUE
      WRITE(61,830)
830   FORMAT(*1*,35X,*OPERATING EXPENDITURES*)
      WRITE(61,831)
831   FORMAT(*-*,5X,*YEAR*,10X,*LABOR*,5X,*P*,7X,*POUCH*,6X,
     + *P*,7X,*CARTON*,5X,*P*,7X,*BEFORE*,5X,*P*,7X,*AFTER*,6X,*P*)
      WRITE(61,832)
832   FORMAT(* *,19X,*COSTS*,5X,*OF*,6X,*COSTS*,6X,*OF*,7X,*COSTS*,
     +5X,*OF*,6X,*FREIGHT*,4X,*OF*,5X,*FREIGHT*,5X,*OF*)
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      WRITE(61,833)
833   FORMAT(* *,28X,*TOT*,16X,*TOT*,16X,*TOT*,7X,*COSTS*,4X,*TOT*,6X,
     + *COSTS*,5X,*TOT*)
      WRITE(61,834)
834   FORMAT(*-*)
      DO 840 JO=1,N
      DATE17=1979+JO
      WRITE(61,835)DATE17,PLE(JC),PPLE(JO),ERTP(JO),PERTP(JO),ECR(JO),
     + PECR(JO),EBPF(JO),PEBPF(JO),EAPF(JO),PEAPF(JO)
835   FORMAT(*0*,5X,I4,4X,F12.2,2X,4(F4.3,2X,F11.2,2X),F3.2)
840   CONTINUE
      WRITE(61,845)
845   FORMAT(*1*,35X,*OPERATING EXPENDITURES*)
      WRITE(61,846)
846   FORMAT(*-*,5X,*YEAR*,9X,*NATURAL*,4X,*P*,3X,*ELECTRICITY*,
     + 4X,*P*,6X,*FUEL OIL*,4X,*P*,7X,*BEFORE*,5X,*P*,7X,*AFTER*,6X,*P*)
      WRITE(61,847)
847   FORMAT(* *,20X,*GAS*,6X,*OF*,5X,*COSTS*,7X,*OF*,7X,*COSTS*,
     +5X,*OF*,6X,*ENERGY*,5X,*OF*,5X,*ENERGY*,6X,*OF*)
      WRITE(61,848)
848   FORMAT(* *,19X,*COSTS*,4X,*TOT*,16X,*TOT*,16X,*TOT*,6X,
     + *FREIGHT*,3X,*TOT*,5X,*FREIGHT*,4X,*TOT*)
      WRITE(61,849)
849   FORMAT(* *,76X,*COSTS*,13X,*COSTS*)
      WRITE(61,850)
850   FORMAT(*-*)
      DO 870 JK=1,N
      DATE16=1979+JK
      WRITE(61,860)DATE16,ENG(JK),PENG(JK),EEL(JK),PEEL(JK),EFO(JK),
     + PEFO(JK),BETRAN(JK),PBETRAN(JK),AETRAN(JK),PAETRAN(JK)
860   FORMAT(*0*,5X,I4,4X,F12.2,2X,4(F4.3,2X,F11.2,2X),F4.3)
870   CONTINUE
      WRITE(61,880)
880   FORMAT(*1*,35X,*OPERATING EXPENDITURES*)
      WRITE(61,881)
881   FORMAT(*-*,5X,*YEAR*,11X,*TOTAL*,6X,*P*,8X,*TOTAL*,7X,*P*,
     + 8X,*TOTAL*,7X,*P*,9X,*TOTAL*,6X,*P*,9X,*TOTAL*,6X,*P*,9X,*TOTAL*)
      WRITE(61,882)
882   FORMAT(* *,19X,*FREIGHT*,5X,*OF*,6X,*PACKAGES*,5X,*OF*,7X,*ENERGY*
     + ,6X,*OF*,8X,*ENERGY*,5X,*OF*,8X,*ENERGY*,5X,*OF*,8X,*COSTS*)
      WRITE(61,883)
883   FORMAT(* *,20X,*COSTS*,5X,*TOT*,7X,*COSTS*,6X,*TOT*,5X,
     + *PROCESSING*,3X,*TOT*,7X,*FREIGHT*,4X,*TOT*,8X,*COSTS*,5X,*TOT*,8
     +X,*N EQUIP*)
      WRITE(61,884)
884   FORMAT(* *,61X,*COSTS*,17X,*COSTS*)
      WRITE(61,885)
885   FORMAT(*-*)
      DO 900 JI=1,N
      DATE15=1979+JI
      WRITE(61,890)DATE15,TTRAN(JI),PTRAN(JI),TPACK(JI),PPPACK(JI),
     + TENERGY(JI),PENERGY(JI),TOTEFR(JI),PTOTEFR(JI),TTENERG(JI),
     + PTTENER(JI),TOTAL(JI)
890   FORMAT(*0*,5X,I4,4X,F14.2,2X,4(F4.3,2X,F13.2,2X),F4.3,2X,F13.2)
900   CONTINUE
      DO 920 NA=1,J
      DATE14=1979+NA
      WRITE(61,905)DATE14
905   FORMAT(*1*,45X,*ACQUISITION YEAR IS*,1X,I4)
      WRITE(61,906)PAC(NA)
906   FORMAT(*0*,42X,*ACQUISITION COST IS*,1X,F12.2)
       WRITE(61,907)
907   FORMAT(*-*,5X,*YEAR*,4X,*SALVAGE*,3X,*DEPRECIATION*,2X,
     + *INSURANCE*,9X,*INTEREST*,4X,*P*,3X,*MAINTENANCE*,
     + 3X,*P*,9X,*TOTAL*)
      WRITE(61,908)
908   FORMAT(* *,14X,*VALUE*,48X,*OF*,16X,*OF*,5X,
     +*COSTS F  OF*)
      WRITE(61,909)
909   FORMAT(* *,66X,*TOT*,15X,*TOT*,5X,*EQUIPMENT*)
      WRITE(61,910)
910   FORMAT(*-*)
      DO 915 NB=1,NN
      DATE12=1979+NB+(NA-1)
      WRITE(61,911)DATE12,PSAL(NA,NB),PDC(NA,NB),PIC(NA,NB)
     +, TINT(NA,NB),PTINT(NA,NB),PEMAT(NA,NB),PPEMAT(NA,NB)
     +, TEC(NA,NB)
911   FORMAT(*0*,5X,I4,3F12.2,6X,F12.2,1X,F5.2,F12.2,1X,F5.2,
     +F14.2)
915   CONTINUE
920   CONTINUE
      STOP
      END
```

B.2--Computer Program Used for Estimating the Costs of the New Canning Systems

```
      PROGRAM CPACK(INPUT,OUTPUT,TAPE60=INPUT,TAPE61=OUTPUT)
C              PROGRAM TO CALCULATE PRESENT VALUE
C               OF NEW CAN PROCESSING OPERATION
C
C          REAL STATEMENTS
C
      REAL IR,LCH,LRI,MHD,LOL,NDP,MHY,MUNGH,MUFOH,KWHH
      REAL INT,INV
      INTEGER DATE1,DATE2,DATE3,DATE4,DATE5,DATE6,DATE7,DATE8,DATE9,
     XDATE10,DATE11,DATE12,DATE14,DATE15,DATE16,DATE17,DATE18,DATE19
      INTEGER TN
C          DIMENSION STATEMENTS
C
      DIMENSION PAC(10),PDC(10,80),PEMAT(10,80),PIC(10,80), A(10)
      DIMENSION INT(150),BB(150),PRIN(150),EB(150),TINT(10,50)
      DIMENSION DSI(80),DS(10,80),PSAL(10,80),LCH(80),PLE(80)
      DIMENSION RTPC(80),ERTP(80),BEFC(80),BPFR(80)
      DIMENSION EBPF(80),PMUNG(80),PMUFO(80),PKWH(80),ENG(80),EFO(80)
      DIMENSION EEL(80),AEFC(80),APFR(80),EAPF(80)
      DIMENSION TOC(10,80), TDEP(10,80)
      DIMENSION AC(80),PV(10,80)
      DIMENSION TIT(10,80),PVBC(10,80),BC(10,80)
      DIMENSION PVC(80),AC1(80),PVTOCE(10,80),PVTDEP(10,80),PVTIT(10,80)
      DIMENSION TDBC(10,80),PVEC1(10,80),PVEC(10,80),PVTOO(10,80)
      DIMENSION PVOC1(10,80),PVOC(10,80),TPVAC(10,80),PVPLE(10,80)
      DIMENSION PVERTP(80),PVECR(80),PVEBPF(80),PVENG(80),PVEFO(80)
      DIMENSION PVEEL(80),PVEAPF(80),TPVPLE(80),TPVERTP(80)
      DIMENSION TPVECR(80),TPVEBPF(80),TPVENG(80),TPVEFO(80),TPVEEL(80)
      DIMENSION TPVEAPF(80),PVTENGY(80),PVTTRAN(80),PVTPACK(80)
      DIMENSION PVEC3(10,80),PVEC2(10,80),PVOC2(10,80),PVOC3(10,80)
      DIMENSION TPVAC2(10,80)
      DIMENSION TENERGY(80),TTRAN(80),TPACK(80),TOTAL(80),PPLE(80)
      DIMENSION PENERGY(80),PTRAN(80),PPACK(80),PERTP(80),PECR(80)
      DIMENSION PEBPF(80),PEAPF(80),PENG(80),PEEL(80),PEFO(80)
      DIMENSION PAETRAN(80),TOTEFR(80),PTOTEFR(80),TTENERG(80)
      DIMENSION PTTENER(80),BETRAN(80),AETRAN(80)
      DIMENSION PBETRAN(80),INV(10,80),PVINV(10,80)
      DIMENSION TEC(10,80),PTINT(10,80),PPIC(10,80),PPEMAT(10,80)
      DIMENSION PEMATN(10,80),PEMATO(80),PIMC(80),RMC(80)
      DIMENSION RVI(10,80),TOT(10,80),RMIN(10),TTOL(10,80)
      WRITE(61,999)
999   FORMAT(*1*)
C***********************************************
C          INITIALIZE VARIABLES STATEMENTS        *
C***********************************************
      FAC(1)=100000.
C     PAC=CAN PROCESSING EQUIPMENT ACQUISITION COST IN 1980
      RVI(1,1)=415000.00
C     RVI(1)=REPLACEMENT INSURANCE VALUE OF EQUIPMENT IN 1980
      LCH(1)=7.02
C     LCH(1)=LABOR RATE IN 1980 $/HR
      LRI=1.00
C     LRI= LABOR RATE INDEX PERCENT INCREASE PER YEAR
      RTPC(1)= 119.36
C     RTPC(1)= CAN COST $/1000 IN 1980
      RTPCI=1.0328
C     RTPCI= CAN COST INDEX
      PPM= 300.
C     PPM= PACKAGES USED PER MINIUTE
      LOL=2
C     LOL=LABOR ON LINE
      NDP=  15
C     NDP = NUMBER OF DAYS PROCESSING
      BFM=750
C     BFM = FREIGHT MILES BEFORE PROCESSING
      AFM=750
C     AFM = FREIGHT MILES AFTER  PROCESSING
      DFI =  1.05
C     DFI = DIESEL FUEL INDEX
      PMUDF=8.57
C     PMUDF=PRICE OF DEISEL FUEL IN 1980 $/MILLION BTU
      PMUNG(1)=2.60
C     PMUNG(1)= PRICE OF NATURAL GAS IN 1980 $/1MILLION BTU
      PMUFO(1)=0.00
C     PMUFO(1)= PRICE OF FUEL OIL IN 1980 $/1MILLION BTU
      PKWH(1)=0.0387
C     PKWH(1)=  PRICE OF ELECTRICITY IN 1980  $/KWH
```

```
      MUNGH=3.0114875
C     MUNGH= MILLION BTU NATURAL  GAS PER HOUR
      MUFOH  =0.0
C     MUFOH= MILLION BTU FUEL OIL PER HOUR
      KWHH=8.28
C     KWHH = KWH PER HOUR
      PNGI=1.05
C     PNGI= PRICE OF NATURAL GAS INDEX
      PFOI=1.05
C     PFOI= PRICE OF FUEL OIL INDEX
      PELI=    1.05
C     PELI= PRICE OF ELECTRICITY INDEX
      R=.0107
C     R=REAL DISCOUNT RATE
      PEMATO(1)=375.00
C     PEMATO(1)=MAINTENANCE COST EXISTING EQUIPMENT IN 1980
      AGE=25.00
C     AGE= AVERAGE AGE OF OLD PROCESSING EQUIPMENT
      J=1
C     J=NUMBER OF YEARS WHICH TO CALCULATE ACQUISITION COST OVER
      PACI=  1.004
C     PACI=INDEX TO INCREASE PROCESSING MACHINERY ACQUISTION COST
      ND= 10
C     ND=NUMBER OF YEARS TO CALCULATE DEPRECIATION OVER FOR TAXES
      N=50
C     N=NUMBER OF YEARS FOR CONSIDERATION OF OPERATION  AFTER PURCHASE


      PI=.01
C     PI=PERCENT OF ORIGINAL PURCHASE COST ALLOWED FOR INSURANCE
      TN=60
C     TN=TOTAL NUMBER OF MONTHS FOR CALCULATON OF ANNUA INTERST CHARGE
C     TN=NUMBER OF YEARS IN LOAN * 12
      IR=.13/12
C     IR=INTERST RATE ON LOAN PER MONTH
      NS=14
C     NS=NUMBER OF YEARS SALVAGE GREATER THAN 0
C     INITIALIZATION OF TINT(IX,*)
C     TINT(IX,*)= TOTAL INTEREST CHARGE IN YEAR * WHEN LOAN STARTED IN
C     YEAR IX
C     INITIALIZATION OF INTEREST CHARGE AND INVESTMENT TAX CREDIT
      DO 6 IX=1,J
      DO 5 IZ=1,N
      TINT(IX,IZ)=0.0
      INV(IX,IZ)=0.0
 5    CONTINUE
 6    CONTINUE
C     SNS= SUM OF NS
      SNS=0.0
      DO 8 IW=1,NS
      SNS=SNS+IW
 8    CONTINUE
      DO 9 I1=1,J
      RMIN(I1)=0.0
9     CONTINUE
C
C
C     HRSPD= HOURS PER DAY
      HRSPD=    16
C     BALOFC1 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 250 M
C     BALOFC2 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 500 M
C     BALOFC3 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 750 M
C     BALOFC4 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 1000 M
      BALOFC1= 4.43
      BALOFC2=    6.33
      BALOFC3= 6.93
      BALOFC4=9.44
C     BEFC1=FREIGHT COST ATTRIBUTED TO ENERGY AT 250 MILES   $/1000 PACK
C     BEFC2=                                     500 MILES   $/1000 PACK
C     BEFC3=                                     750 MILES   $/1000 PACK
C     BEFC4=                                     1000 MILES  $/1000 PACK
      BEFC1= .405
      BEFC2= .81
      BEFC3= 1.21
      BEFC4=1.62
C     AALOFC1= FREIGHT COST ALL BUT ENERGY AFTER PROCESSING AT 250 MILES
      AALOFC1= 9.88
      AALOFC2= 13.10
      AALOFC3= 18.07
      AALOFC4=29.39
C     AEFC1= FREIGHT COST ATTRIBUTED TO ENERGY AT 250 MILES $/1000 PACK
C     AEFC2=                                      500 MILES $/1000 PACK
C     AEFC3=                                      750 MILES $/1000 PACK
C     AEFC4=                                     1000 MILES $/1000 PACK
      AEFC1=   3.43
      AEFC2=   6.86
      AEFC3=   10.29
      AEFC4=13.71
C     T=MARGINAL TAX  RATE
      T=.46
C
```

```
C
C******************************************************************
C         CALCULATION OF ACQUISITION COST OF CAN PROCESSING *
C                            EQUIPMENT                     *
C******************************************************************
C
      DO 10 IA=2,J
      PAC(IA)=PAC(IA-1)*PACI
 10   CONTINUE
C
C         PAC(IA)= CAN PROCESSING EQUIPMENT COST IN YEAR IA
C         PACI   = INDEX TO INCREASE AQUISITION COST
C*****************************************************
C         CALCULATION OF INVESTMENT TAX CREDIT       *
C*****************************************************
      DO 12 LA=1,J
      DO 11 LX=1,N
      IF(LX.GE.7)ACIVCC=0.10
      IF(LX.LT.7)ACIVCC=0.066666667
      IF(LX.LT.5)ACIVCC=0.033333333
      IF(LX.LT.3)ACIVCC=0.0
      INV(LA,LX)=PAC(LA)*ACIVCC
11    CONTINUE
12    CONTINUE
C         INV=INVESTMENT TAX CREDIT ALLOWED
C         ACIVCC=AQUISITION COST INVESTMENT CREDIT CONVERSION
C         WHICH IS A FUNCTION OF LENGHT OF TIME THE EQUIPMENT
C         IS HELD IN PRODUCTION
C*********************************************************
C          CALCULATION OF DEPRECIATION CHARGE            *
C*********************************************************
      DO 20 IB=1,J
      DO 15 IC=1,N
      PDC(IB,IC)=PAC(IB)/FLOAT(ND)
      IF(IC.GT.ND) PDC(IB,IC)=0.0
 15   CONTINUE
 20   CONTINUE
C
C         PDC(IB,IC)=CAN DEPRCIATION CHARGE WHERE IB = YEAR
C         PURCHASED AND IC=YEAR OF OPERATION. FUNCTION OFAR OFPURCHASE
C**********************************************************
C            CALCULATION OF ANNUAL INTERST CHARGES        *
C**********************************************************
      DO 80 IJ=1,J
      BB(1)=PAC(IJ)
      DO 70 IK=1,TN
      A(IJ)=PAC(IJ)*((IR*((1+IR)**TN))/(((1+IR)**TN)-1))
      INT(IK)=BB(IK)*IR
      PRIN(IK)=A(IJ)-INT(IK)
      EB(IK)=BB(IK)-PRIN(IK)
      BB(IK+1)=EB(IK)
      IF(IK.LE.12) TINT(IJ,1)=TINT(IJ,1)+INT(IK)
      IF((IK.GT.12).AND.(IK.LE.24)) TINT(IJ,2)=TINT(IJ,2)+INT(IK)
      IF((IK.GT.24).AND.(IK.LE.36)) TINT(IJ,3)=TINT(IJ,3)+INT(IK)
      IF((IK.GT.36).AND.(IK.LE.48)) TINT(IJ,4)=TINT(IJ,4)+INT(IK)
      IF((IK.GT.48).AND.(IK.LE.60)) TINT(IJ,5)=TINT(IJ,5)+INT(IK)
      IF((IK.GT.60).AND.(IK.LE.72)) TINT(IJ,6)=TINT(IJ,6)+INT(IK)
      IF((IK.GT.72).AND.(IK.LE.84)) TINT(IJ,7)=TINT(IJ,7)+INT(IK)
      IF((IK.GT.84).AND.(IK.LE.96)) TINT(IJ,8)=TINT(IJ,8)+INT(IK)
      IF((IK.GT.96).AND.(IK.LE.108)) TINT(IJ,9)=TINT(IJ,9)+INT(IK)
      IF(IK.GT.108) TINT(IJ,10)=TINT(IJ,10)+INT(IK)
70    CONTINUE
80    CONTINUE
C     A(IJ)=AMORTIZED MONTHLY PAYMENT FOR EQUIPMENT PURCHASED IN
C     YEAR IJ
C      PAC(IJ)=ACQUSITION COST OF EQUIPMENT IN YEAR IJ
C     IR=INTEREST RATE
C     TN=TOTAL MONTHS PAYMENT OF LOAN TAKES PLACE OVER
C     BB(IK)=AMOUNT LEFT TO PAY ON LOAN AT BEGINNING OF MONTH
C     EB(IK)=AMOUNT AT END OF MOMTH = BB OF FOLLOWING MONTH
C     PRIN(IK)= AMOUNT OF PRINCIPAL PAID ON LOAN IN THE MONTH
C     INT(IK)= AMOUNT OF INTEREST PAID ON THE LOAN IN MONTH IK
C     TINT(IJ,**)= TOTAL INTERST PAID ON LOAN IN YEAR ** WHEN
C     PURCHASED IN YEAR IJ
C**********************************************************
C              CALCULATION OF MAINTENANCE COSTS           *
C**********************************************************
      DO 40 ID=1,J
      DO 30 IE=1,N
      PEMATN(ID,IE)=(PAC(ID)* (.003214+(.001786*IE)))
 30   CONTINUE
 40   CONTINUE
      RMC(1)=.003214+(.001786*AGE)
      NL=N+J
      DO 45 I=2,NL
      RMC(I)=.003214+(.001786*(I+AGE-1))
      PIMC(I)=RMC(I)/RMC(I-1)
      PEMATO(I)=PEMATO(I-1)*PIMC(I)
45    CONTINUE
      DO 48 LB=1,J
      DO 49 LC=1,N
      KK=LB-1
      PEMAT(LB,LC)=PEMATN(LB,LC)+PEMATO(LC+KK)
```

```
49    CONTINUE
48    CONTINUE
C
C         PEMAT(ID,IE)= EXPENDITURE FOR MAINTENANCE WHERE ID= YEAR
C         PURCHASED AND IE= YEAR OF OPERATION
C         PAC(ID) =ACQUISITION COST IN YEAR ID
C         PM= PERCENT OF ORIGINAL PURCHASE COST ALLOWED FOR MAINTENANCE
C
C*********************************************************
C         CALCULATION OF SALVAGE VALUE OF EQUIPMENT      *
C*********************************************************
      DO 100 IL=1,J
      DSI(1)=((NS+1)-1)/SNS
      PSAL(IL,1)=PAC(IL)-(PAC(IL)*DSI(1))
      DO 90 IM=2,N
      DSI(IM)=((NS+1)-IM)/SNS
      IF(IM.GE.NS) DSI(IM)=0.0
      DS(IL,IM)=PAC(IL)*DSI(IM)
      PSAL(IL,IM)=ABS(PSAL(IL,IM-1)-DS(IL,IM))
      IF(IM.GE.NS) PSAL(IL,IM)=0.0
 90   CONTINUE
 100  CONTINUE
C         DSI(IM)= PERCENT OF ORIGINAL VALUE IN YEAR IM
C         DS(IL,IM)= ACTUAL DECLINE IN SALVAGE VALUE IN YEAR IM WHEN
C         PURCHASED IN YEAR IL
C         PSAL(IL,IM)= ACTUAL SALVAGE VALUE OF EQUIPMENT IN YEAR IM WHEN
C         PURCHASED IN YEAR IL
C**********************************************************
C         CALCULATION OF LABOR EXPENDITURE                *
C**********************************************************
      DO 120 IN=2,N
      LCH(IN)=LCH(IN-1)*LRI
 120  CONTINUE
      MHD=LOL*HRSPD
      MHY=NDP*MHD
      DO 130 IO=1,N
      PLE(IO)=LCH(IO)*MHY
 130  CONTINUE
C     LCH(IN)=LABOR CHARGE PER HOUR IN YEAR IN
C     LRI=LABOR RATE INDEX
C     LOL=LABOR ON LINE
C     HRSPD=HOURS PER DAY
C     MHD= MAN HOURS PER DAY
C     NDP= NUMBER OF DAYS PROCESSING
C     MHY= MAN HOURS PER YEAR
C     PLE(IO)= EXPENDITURE FOR LABOR IN CAN PROCESS IN YEAR IO
C*********************************************************
C        CALCULATION OF INSURANCE CHARGES                 *
C**********************************************************
      JJ=J+1
      DO 55 LD=2,JJ
      RVI(LD,1)=RVI(LD-1,1)*PACI
55    CONTINUE
      DO 57 LE=1,J
      DO 56 LF=2,N
      RVI(LE,LF)=RVI(LE,LF-1)*PACI
56    CONTINUE
57    CONTINUE
      DO 60 IG=1,J
      DO 50 IH=1,N
      PIC(IG,IH)=(RVI(IG,IH)*PI)
 50   CONTINUE
 60   CONTINUE
C
C         PIC(IG,IH)= ANNUAL INSURANCE CHARGE ON EQUIPMENT WHEN IG= YEAR
C          PURCHASED AND IH= YEAR OF OPERATION
C         RVI(LE,LF)=REPLACEMENT INSURANCE VALUE IN YEAR LF WHEN
C         PURCHASED IN THE LE YEAR
C         PI= PERCENT OF ACQUISITION COST   ALLOWED FOR INSURANCE
C***********************************************************
C       CALCULATION OF CAN PURCHASE EXPENDITURE   *
C***********************************************************
      DO 150 IP=2,N
      RTPC(IP)=RTPC(IP-1)*RTPCI
 150  CONTINUE
      PPH=PPM*60.0
      TOTPAKD=PPH*HRSPD
      TOTPAK= TOTPAKD*NDP
      TOTPAKT=TOTPAK/1000
      DO 160 IQ=1,N
      ERTP(IQ)= TOTPAKT*RTPC(IQ)
 160  CONTINUE
C
C         RTPC(IP)= CAN COST IN YEAR IP $/1000
C         CAN COST INDEX
C         PPM= PACKAGES PROCESSED PER MINUTE
C         PPH= PACKAGES PROCESSED PER HOUR
C         TOTPAKD = PACKAGES PROCESSED PER DAY
C         TOTPAK = TOTAL PACKAGES PROCESSED PER SEASON
C         TOTPAKT= 1000  PACKAGES PROCESSED PER SEASON
C         NDP = NUMBER OF DAYS PROCESSING IN SEASON
C         ERTP(IQ)= TOTAL EXPENDITURE FOR PURCHASING CANS IN
C         YEAR IQ
```

```
C*********************************************************************
C         CALCULATION OF PACKAGE FREIGHT COST BEFORE PROCESSING      *
C*********************************************************************
      IF(BFM.EQ.250) GO TO 300
      IF(BFM.EQ.500) GO TO 310
      IF(BFM.EQ.750) GO TO 320
      IF(BFM.EQ.1000) GO TO 330
 300  CONTINUE
      BALOFC = BALOFC1
      BEFC(1)= BEFC1
      BPFR(1)= BALOFC1+BEFC1
      GO TO 350
 310  BALOFC=BALOFC2
      BEFC(1)=BEFC2
      BPFR(1)= BALOFC2+BEFC2
      GO TO 350
 320  BALOFC=BALOFC3
      BEFC(1)=BEFC3
      BPFR(1)=BALOFC3+BEFC3
      GO TO 350
 330  BALOFC=BALOFC4
      BEFC(1)=BEFC4
      BPFR(1)=BALOFC4+BEFC4
 350  CONTINUE
      DO 360 IT=2,N
      BEFC(IT)=BEFC(IT-1)*DFI
      BPFR(IT)=BALOFC+BEFC(IT)
 360  CONTINUE
      DO 370 IU=1,N
      EBPF(IU)= TOTPAKT * BPFR(IU)
      BETRAN(IU)=TOTPAKT*BEFC(IU)
 370  CONTINUE
C
C          BFM= FREIGHT MILES BEFORE PROCESSING
C          BALOFC= FREIGHT CHARGE ATTRIBUTED TO ALL  BUT ENERGY  BEFORE
C          PROCESSING $/1000 PACKAGES
C          BEFC= FREIGHT CHARGE ATTRIBUTED TO ENERGY  BEFORE PROCESSING
C          $/1000 PACKAGES
C          1=250 MILES  2= 500 MILES  3= 750 MILES  4= 1000 MILES
C          BPFR(IT)= FREIGHT RATE BEFORE PROCESSING $/1000 PACKAGES IN
C          YEAR IT
C          DFI= DIESEL FUEL INDEX
C          EBPF= EXPENDITURE ON FREIGHT BEFORE PROCESSING IN YEAR IU
C*********************************************************************
C          CALCULATION OF EXPENDITURES FOR ENERGY IN PROCESSING      *
C*********************************************************************
      TUNG=MUNGH*HRSPD*NDP
      TUFO=MUFOH*HRSPD*NDP
      TKWH=KWHH*HRSPD*NDP
      DO 400 JA=2,N
      PMUNG(JA)=PMUNG(JA-1)*PNGI
      PMUFO(JA)=PMUFO(JA-1)*PFOI
      PKWH(JA)=PKWH(JA-1)*PELI
 400  CONTINUE
      DO 410 JB=1,N
      ENG(JB)= TUNG*PMUNG(JB)
      EFO(JB)= TUFO*PMUFO(JB)
      EEL(JB)= TKWH*PKWH(JB)
 410  CONTINUE
C          TUNG=TOTAL NATURAL GAS USED  MILLION BTU      TUNGH= PER HOUR
C          TUFO=TOTAL FUEL OIL USED  MILLION BTU         TUFOH= PER HOUR
C          TKWH=TOTAL ELECTRICITY USED  KWH              KWHH = PER HOUR
C          PMUNG(JA)= PRICE OF NATURAL GAS IN YEAR JA   $/MILLION BTU
C          PNGI= PRICE OF NATURAL GAS INDEX
C          PMUFO(JA)= PRICE OF FUEL OIL IN JA           $/MILLION BTU
C          PFOI= PRICE OF FUEL OIL INDEX
C          PKWH(JA)= PRICE OF ELECTRICITY IN YEAR JA    $/KWH
C          PELI= PRICE OF ELECTRICITY INDEX
C*********************************************************************
C         CALCULATION OF PACKAGE FREIGHT COST AFTER PROCESSING      *
C*********************************************************************
      IF(AFM.EQ.250) GO TO 450
      IF(AFM.EQ.500) GO TO 460
      IF(AFM.EQ.750) GO TO 470
      IF(AFM.EQ.1000) GO TO 480
 450  CONTINUE
      AALOFC= AALOFC1
      AEFC(1)= AEFC1
      APFR(1)= AALOFC1+AEFC1
      GO TO 490
 460  CONTINUE
      AALOFC = AALOFC2
      AEFC(1)=AEFC2
      APFR(1)=AALOFC2+AEFC2
      GO TO 490
 470  AALOFC=AALOFC3
      AEFC(1)=AEFC3
      APFR(1)=AALOFC3+AEFC3
      GO TO 490
 480   AALOFC=AALOFC4
      AEFC(1)=AEFC4
      APFR(1)=AALOFC4+AEFC4
 490  CONTINUE
```

```
      DO 500 JC=2,N
      AEFC(JC)=AEFC(JC-1) * DFI
      APFR(JC)=AALOFC+AEFC(JC)
 500  CONTINUE
      DO 510 JD=1,N
      EAPF(JD)=TOTPAKT * APFR(JD)
      AETRAN(JD)=TOTPAKT*AEFC(JD)
 510  CONTINUE
C
C          AFM= FREIGHT MILES AFTER PROCESSING
C          AALOFC= FREIGHT CHARGE ATTRIBUTED TO ALL BUT ENERGY AFTER
C          PROCESSING $/1000 PACKAGES
C          AEFC= FREIGHT CHARGE ATTRIBUTED TO ENERGY AFTER PROCESSING
C          $/1000 PACKAGES
C          APFR(JC)= FREIGHT RATE   AFTER PROCESSING IN YEAR JC $/1000
C          PACKAGES
C          DFI= DIESEL FUEL INDEX
C          EAPF(JD)= EXPENDITURE ON FREIGHT AFTER  PROCESSING IN YEAR JD
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C*********************************************************************
C                                                                    *
C          CALCULATION OF PRSENT VALUE                               *
C               REPLACEMENT CRITERIA                                 *
C                                                                    *
C*********************************************************************
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
      DO 550 M=1,J
      TD=0.0
      TOE=0.0
      TI=0.0
      DBC=0.0
      TOO=0.0
      NN=N-5
      DO 540 L=1,NN
      K=M-1
      LL=-L
      PVC(L)=((1+R)**LL)
      AC(L)=1/(1-((1+R)**LL))
      AC1(L)=R/(1-((1+R)**LL))
      TOE=TOE+(PEMAT(M,L)*PVC(L))
      PVTOCE(M,L)=TOE
      TD=TD+(PDC(M,L)*PVC(L))
      PVTDEP(M,L)=TD
      DBC=DBC+PDC(M,L)
      TDBC(M,L)=DBC
      BC(M,L)=TDBC(M,L)-PAC(M)+PSAL(M,L)
      PVINV(M,L)=INV(M,L)*PVC(1)
      PVBC(M,L)=BC(M,L)*PVC(L)
      PVEC1(M,L)=AC1(L)*(PAC(M)-(PSAL(M,L)*PVC(L))+((1-T)*PVTOCE(M,L))
     +  -(T*PVTDEP(M,L))+(T*PVBC(M,L))-(T*PVINV(M,L)))
      LM=1-M
      PVEC(M,L)=PVEC1(M,L)*((1+R)**LM)
      PVEC3(M,L)=AC1(L)*(PAC(M)-(PSAL(M,L)*PVC(L))+((1-T)*PVTOCE(M,L))
     +  -(T*PVTDEP(M,L))+(T*PVBC(M,L))-(T*PVINV(M,L)))
      PVEC2(M,L)=PVEC3(M,L)*((1+R)**LM)
      TOO=TOO+(((PLE(L+K)+ERTP(L+K)+EBPF(L+K)+ENG(L+K)+EFO(L+K)
     +  +EEL(L+K)+EAPF(L+K)-TINT(M,L)+PIC(M,L))*PVC(L))*(1-T))
      TOT(M,L)=(((PLE(L+K)+ERTP(L+K)+EBPF(L+K)+ENG(L+K)+EFO(L+K)
     + +EEL(L+K)+EAPF(L+K)-TINT(M,L)+PIC(M,L))*PVC(L))*(1-T))
      PVTOO(M,L)=TOO
      PVOC1(M,L)=AC1(L)*PVTOO(M,L)
      PVOC(M,L)=PVOC1(M,L)*((1+R)**LM)
      TPVAC(M,L)=PVEC(M,L)+PVOC(M,L)
540   CONTINUE
550   CONTINUE
      DO 570 M1=1,J
      NN=N-5
      N1=NN-1
      DO 560 L1=2,N1
      IF((PVEC2(M1,L1).LT.PVEC2(M1,L1-1)).AND.(PVEC2(M1,L1).LT.
     + PVEC2(M1,L1+1))) RMIN(M1)=PVEC2(M1,L1)
560   CONTINUE
570   CONTINUE
      DO 572 M2=1,J
      NN=N-5
      DO 571 L2=1,NN
      TTOL(M2,L2)=TOT(M2,L2)+RMIN(M2)
571   CONTINUE
572   CONTINUE
C PVC(L)=PRESENT VALUE CONVERSION IN YEAR L
C AC(L)=ANNUITY CONVERSION IN YEAR L FOR AN INFINITE STREAM
C AC1(L)=ANNUITY CONVERSION IN YEAR L
C PVTOCE(M,L)=PRESENT VALUE OF TOTAL OPERATING COSTS WHICH ARE
C A FUNCTION OF EQUIPMENT AGE UP TO YEAR L WHEN PURCHASED IN
C YEAR M
C PVTDEP(M,L)=PRESENT VALUE OF TOTAL DEPRECIATION UP TO YEAR L
C WHEN PURCHASED IN YEAR M
C TINT(M,L)= TOTAL INTERST CHARGE UP TO YEAR L WHEN PURCHASED IN YEAR M
C PVBC(M,L)=PRESENT VALUE OF BALANCING CHARGE UP TO YEAR L WHEN
C PURCHASED IN YEAR M
C BC(M,L)=BALANCING CHARGE IN YEAR L WHEN PURCHASED IN YEAR M
C PVEC(M,L)=PRESENT VALUE OF AMORTIZED COST OF EQUIPMENT WHEN
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C OPERATING TO YEAR L WHEN PURCHASED IN YEAR M ADJUSTED TO 1980
C PVTOO(M,L)=PRESENT VALUE OF ALL OTHER OPERATING COSTS NOT
C ASSOCIATED WITH THE AGE OF THE EQUIPMENT
C PVOC(M,L)=PRESENT VALUE OF AMORTIZED COST OF ALL OTHER
C OPERATING COSTS NOT ASSOCIATED WITH THE AGE OF THE EQUIPMENT
C WHEN OPERATING TO YEAR L WHEN PURCHASED IN YEAR M ADJUSTED
C TO 1980
C TPVAC(M,L)=PRESENT VALUE OF AMORTIZED COST OF ALL OPERATING
C WHEN OPERATING TO YEAR L WHEN PURCHASED IN YEAR M
C ADJUSTED TO 1980
C RMIN(M1)= MINIMUM AMORTIZED COST WHICH IS A FUNCTION OF AGE OF EQUIP.
C TOT(M2,L2)= PRESENT VALUE OF TOTAL ANNUAL OPERATING COST WHICH
C IS NOT A FUNCTION  OF THE AGE OF THE EQUIPMENT.
C TTOL(M2,L2)= TOTAL COST OF OPERATION
      DO 580 II=1,N
      TENERGY(II)=ENG(II)+EFO(II)+EEL(II)
      TTRAN(II)=EBPF(II)+EAPF(II)
      TPACK(II)=ERTP(II)
      TOTAL(II)=TENERGY(II)+TTRAN(II)+TPACK(II)+PLE(II)
      PPLE(II)=PLE(II)/TOTAL(II)
      PENERGY(II)=TENERGY(II)/TOTAL(II)
      PTRAN(II)=TTRAN(II)/TOTAL(II)
      PPACK(II)=TPACK(II)/TOTAL(II)
      PERTP(II)=ERTP(II)/TOTAL(II)
      PEBPF(II)=EBPF(II)/TOTAL(II)
      PEAPF(II)=EAPF(II)/TOTAL(II)
      PENG(II)=ENG(II)/TOTAL(II)
      PEEL(II)=EEL(II)/TOTAL(II)
      PEFO(II)=EFO(II)/TOTAL(II)
      PBETRAN(II)=BETRAN(II)/TOTAL(II)
      PAETRAN(II)=AETRAN(II)/TOTAL(II)
      TOTEFR(II)=BETRAN(II)+AETRAN(II)
      PTOTEFR(II)=TOTEFR(II)/TOTAL(II)
      TTENERG(II)=TENERGY(II)+TOTEFR(II)
      PTTENER(II)=TTENERG(II)/TOTAL(II)
580   CONTINUE
C TENERGY=TOTAL PROCESSING ENERGY EXPENDITURES
C TTRAN= TOTAL FREIGHT EXPENDITURES
C TPACK= TOTAL PACKAGE EXPENDITURES
C TOTAL= TOTAL COSTS NOT ASSOCIATED DIRECTLY WITH MACHINE AGE
C PPLE= PERCENT  LABOR COSTS OF TOTAL
C PENERGY= PERCENT  PROCESSING ENERGY OF TOTAL
C PTRAN= PERCENT  FREIGHT COST OF TOTAL
C PPACK= PERCENT PACKAGE COST OF TOTAL
C PERTP= PERCENT CAN COST OF TOTAL
C PERC= PERCENT CARTON COST OF TOTAL
C PEBPF= PERCENT BEFORE PROCESSING FREIGHT COST OF TOTAL
C PEAPF= PERCENT AFTER PROCESSING FREIGHT COST OF TOTAL
C PENG= PERCENT NATURAL GAS COSTS OF TOTAL
C PEEL= PERCENT ELECTRICITY COSTS OF TOTAL
C PEFO= PERCENT RESIDUAL FUEL OIL COSTS OF TOTAL
C BETRAN= BEFORE PROCESSING ENERGY FREIGHT COSTS
C AETRAN= AFTER PROCESSING ENERGY FREIGHT COSTS
C PBETRAN= PERCENT BEFORE PROCESSING ENERGY FREIGHT COST OF TOTAL
C PAETRAN= PERCNET AFTER PROCESSING ENERGY FREIGHT COST OF TOTAL
C TOTEFR= TOTAL ENERGY FREIGHT COSTS
C PTOTEFR= PERCENT TOTAL ENERGY FREIGHT COSTS OF TOTAL
C TTENERG= TOTAL ENERGY COSTS INCLUDING ENERGY FREIGHT COSTS
C PTTENER= PERCENT ENERGY COSTS OF TOTAL COSTS
      DO 595 NC=1,J
      DO 590 NE=1,NN
      TEC(NC,NE)=TINT(NC,NE)+PEMAT(NC,NE)
      PTINT(NC,NE)=TINT(NC,NE)/TEC(NC,NE)
      PPEMAT(NC,NE)=PEMAT(NC,NE)/TEC(NC,NE)
590   CONTINUE
595   CONTINUE
C TEC=TOTAL COSTS ASSOCIATED WITH THE AGE OF EQUIPMENT
C PTINT= PERCENT TOTAL INTERST COST OF TEC
C PPIC= PERCENT TOTAL INSURANCE COST OF TEC -
C PPEMAT= PERCENT TOTAL MAINTENANCE COST OF TEC
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C                    OUTPUT SECTION                                  $
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
      WRITE(61,750)
750   FORMAT(*1*,30X,*ASSUMPTIONS CONCERNING PARAMETERS*)
      WRITE(61,751)PNGI
751   FORMAT(*-*,10X,*NATURAL GAS INDEX*,14X,*=*,F4.2)
      WRITE(61,752)PMUNG(1)
752   FORMAT(* *,10X,*$ PER MILLION BTU NATURAL GAS  =*,F5.3)
      WRITE(61,753)PELI
753   FORMAT(* *,10X,*ELECTRICITY INDEX*,14X,*=*,F4.2)
      WRITE(61,754)PKWH(1)
754   FORMAT(* *,10X,*$ PER KWH ELECTRICITY*,10X,*=*,F6.4)
      WRITE(61,755)PFOI
755   FORMAT(* *,10X,*FUEL OIL INDEX*,17X,*=*,F4.2)
      WRITE(61,756)PMUFO(1)
756   FORMAT(* *,10X,*$ PER MILLION BTU FUEL OIL*,5X,*=*,F4.2)
      WRITE(61,757)DFI
757   FORMAT(* *,10X,*DIESEL FUEL INDEX*,14X,*=*,F4.2)
      WRITE(61,758)PMUDF
758   FORMAT(* *,10X,*$ PER MILLION BTU DIESEL FUEL  =*,F5.3)
      WRITE(61,759)MUNGH
759   FORMAT(*-*,10X,*MILLION BTU NATURAL GAS PER HOUR  =*,F10.7)
```

```
      WRITE(61,760)MUFOH
760   FORMAT(* *,10X,*MILLION BTU FUEL OIL PER HOUR*,5X,*=*,F5.2)
      WRITE(61,761)KWHH
761   FORMAT(* *,10X,*KWH PER HOUR*,22X,*=*,F6.4)
      WRITE(61,762)BFM
762   FORMAT(*-*,10X,*FREIGHT MILES BEFORE PROCESSING  =*,F5.0)
      WRITE(61,763)AFM
763   FORMAT(* *,10X,*FREIGHT MILES AFTER PROCESSING   =*,F5.0)
      WRITE(61,764)RTPC(1)
764   FORMAT(*-*,10X,*CAN COST PER 1000*,11X,*=*,F7.2)
      WRITE(61,766)RTPCI
766   FORMAT(* *,10X,*CAN COST INDEX*,15X,*=*,F7.4)
      WRITE(61,768)PPM
768   FORMAT(* *,10X,*PACKAGES PER MINIUTE*,9X,*=*,F4.0)
      WRITE(61,769)LOL
769   FORMAT(*-*,10X,*LABOR ON LINE    =*,F3.0)
      WRITE(61,770)LRI
770   FORMAT(* *,10X,*LABOR RATE INDEX =*,F4.2)
      WRITE(61,771)R
771   FORMAT(*-*,10X,*REAL DISCOUNT RATE*,15X,*=*,F6.4)
      WRITE(61,772)T
772   FORMAT(* *,10X,*MARGINAL TAX RATE*,16X,*=*,F3.2)
      WRITE(61,773)TN
773   FORMAT(* *,10X,*MONTHS FOR INTERST CALCULATION   =*,I3)
      WRITE(61,774)IR
774   FORMAT(* *,10X,*INTEREST RATE*,20X,*=*,F4.3)
      WRITE(61,775)ND
775   FORMAT(* *,10X,*YEARS FOR DEPRECIATION*,11X,*=*,I3)
      DO 820 JW=1,J
      DATE19=1979+JW
      WRITE(61,800)DATE19
800   FORMAT(*1*,45X,*ACQUISITION YEAR IS*,1X,I4)
      WRITE(61,801)PAC(JW)
801   FORMAT(*0*,42X,*ACQUISITION COST IS*,1X,F12.2)
      WRITE(61,802)
802   FORMAT(*-*,5X,*YEAR*,9X,*AMORTIZED*,5X,*AMORTIZED*,5X,
     + *AMORTIZED*,5X,*AMORTIZED*)
      WRITE(61,803)
803   FORMAT(* *,17X,*REPLACEMENT*,3X,*PRODUCTION*,7X,*TOTAL*,6X,
     +  *REPLACEMENT*,3X,*PRODUCTION*,7X,*TOTAL*)
      WRITE(61,804)
804   FORMAT(* *,20X,*COSTS*,9X,*COSTS*,9X,*COSTS*,8X,*COSTS*,
     +  1X,*1*,7X,*COSTS*,1X,*1*,8X,*COSTS 1*)
      WRITE(61,805)
805   FORMAT(*-*)
      DO 810 IZ=1,NN
      DATE18=1979+IZ+(JW-1)
      WRITE(61,806)DATE18,PVEC(JW,IZ),PVOC(JW,IZ),TPVAC(JW,IZ)
     + ,PVEC2(JW,IZ),TOT(JW,IZ),TTOL(JW,IZ)
806   FORMAT(*0*,5X,I4,4X,6F14.2)
810   CONTINUE
820   CONTINUE
      WRITE(61,830)
830   FORMAT(*1*,35X,*OPERATING EXPENDITURES*)
      WRITE(61,831)
831   FORMAT(*-*,5X,*YEAR*,10X,*LABOR*,5X,*P*,8X,*CAN*,7X,
     + *P*,7X,*BEFORE*,5X,*P*,7X,*AFTER*,6X,*P*)
      WRITE(61,832)
832   FORMAT(* *,19X,*COSTS*,5X,*OF*,6X,*COSTS*,6X,*OF*,
     +6X,*FREIGHT*,4X,*OF*,5X,*FREIGHT*,5X,*OF*)
      WRITE(61,833)
833   FORMAT(* *,28X,*TOT*,16X,*TOT*,7X,*COSTS*,4X,*TOT*,6X,
     + *COSTS*,5X,*TOT*)
      WRITE(61,834)
834   FORMAT(*-*)
      CO 840 JO=1,N
      DATE17=1979+JO
      WRITE(61,835)DATE17,PLE(JO),PPLE(JO),ERTP(JO),PERTP(JO)
     + ,EBPF(JO),PEBPF(JO),EAPF(JO),PEAPF(JO)
835   FORMAT(*0*,5X,I4,4X,F12.2,2X,3(F4.3,2X,F11.2,2X),F3.2)
840   CONTINUE
      WRITE(61,845)
845   FORMAT(*1*,35X,*OPERATING EXPENDITURES*)
      WRITE(61,846)
846   FORMAT(*-*,5X,*YEAR*,9X,*NATURAL*,4X,*P*,3X,*ELECTRICITY*,
     + 4X,*P*,6X,*FUEL OIL*,4X,*P*,7X,*BEFORE*,5X,*P*,7X,*AFTER*,6X,*P*)
      WRITE(61,847)
847   FORMAT(* *,20X,*GAS*,6X,*OF*,5X,*COSTS*,7X,*OF*,7X,*COSTS*,
     +5X,*OF*,6X,*ENERGY*,5X,*OF*,5X,*ENERGY*,6X,*OF*)
      WRITE(61,848)
848   FORMAT(* *,19X,*COSTS*,4X,*TOT*,16X,*TOT*,16X,*TOT*,6X,
     + *FREIGHT*,3X,*TOT*,5X,*FREIGHT*,4X,*TOT*)
      WRITE(61,849)
849   FORMAT(* *,76X,*COSTS*,13X,*COSTS*)
      WRITE(61,850)
850   FORMAT(*-*)
      DO 870 JK=1,N
      DATE16=1979+JK
      WRITE(61,860)DATE16,ENG(JK),PENG(JK),EEL(JK),PEEL(JK),EFO(JK),
     + PEFO(JK),BETRAN(JK),PBETRAN(JK),AETRAN(JK),PAETRAN(JK)
860   FORMAT(*0*,5X,I4,4X,F12.2,2X,4(F4.3,2X,F11.2,2X),F4.3)
870   CONTINUE
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      WRITE(61,880)
880   FORMAT(*1*,35X,*OPERATING EXPENDITURES*)
      WRITE(61,881)
881   FORMAT(*-*,5X,*YEAR*,11X,*TOTAL*,6X,*P*,8X,*TOTAL*,7X,*P*,
     + 8X,*TOTAL*,7X,*P*,9X,*TOTAL*,6X,*P*,9X,*TOTAL*,6X,*P*,9X,*TOTAL*)
      WRITE(61,882)
882   FORMAT(* *,19X,*FREIGHT*,5X,*OF*,6X,*PACKAGES*,5X,*OF*,7X,*ENERGY*
     + ,6X,*OF*,8X,*ENERGY*,5X,*OF*,8X,*ENERGY*,5X,*OF*,8X,*COSTS*)
      WRITE(61,883)
883   FORMAT(* *,20X,*COSTS*,5X,*TCT*,7X,*COSTS*,6X,*TOT*,5X,
     + *PROCESSING*,3X,*TOT*,7X,*FREIGHT*,4X,*TOT*,8X,*COSTS*,5X,*TOT*,8
     +X,*N EQUIP*)
      WRITE(61,884)
884   FORMAT(* *,61X,*COSTS*,17X,*COSTS*)
      WRITE(61,885)
885   FORMAT(*-*)
      DO 900 JI=1,N
      DATE15=1979+JI
      WRITE(61,890)DATE15,TTRAN(JI),PTRAN(JI),TPACK(JI),PPACK(JI),
     + TENERGY(JI),PENERGY(JI),TOTEFR(JI),PTOTEFR(JI),TTENERG(JI),
     + PTTENER(JI),TOTAL(JI)
890   FORMAT(*0*,5X,I4,4X,F14.2,2X,4(F4.3,2X,F13.2,2X),F4.3,2X,F13.2)
900   CONTINUE
      DO 920 NA=1,J
      DATE14=1979+NA
      WRITE(61,905)DATE14
905   FORMAT(*1*,45X,*ACQUISITION YEAR IS*,1X,I4)
      WRITE(61,906)PAC(NA)
906   FORMAT(*0*,42X,*ACQUISITION COST IS*,1X,F12.2)
       WRITE(61,907)
907   FORMAT(*-*,5X,*YEAR*,4X,*SALVAGE*,3X,*DEPRECIATION*,2X,
     + *INSURANCE*,9X,*INTEREST*,4X,*P*,3X,*MAINTENANCE*,
     + 3X,*P*,9X,*TOTAL*)
      WRITE(61,908)
908   FORMAT(* *,14X,*VALUE*,48X,*OF*,16X,*OF*,5X,
     +*COSTS F OF*)
      WRITE(61,909)
909   FORMAT(* *,66X,*TOT*,15X,*TOT*,5X,*EQUIPMENT*)
      WRITE(61,910)
910   FORMAT(*-*)
      DO 915 NB=1,NN
      DATE12=1979+NB+(NA-1)
      WRITE(61,911)DATE12,PSAL(NA,NB),PDC(NA,NB),PIC(NA,NB)
     +, TINT(NA,NB),PTINT(NA,NB), PEMAT(NA,NB),PPEMAT(NA,NB)
     +, TEC(NA,NB)
911   FORMAT(*0*,5X,I4,3F12.2,6X,F12.2,1X,F5.2,F12.2,1X,F5.2,
     +F14.2)
915   CONTINUE
920   CONTINUE
      STOP
      END
```

B.3--Computer Program Used for Estimating the Costs of the Existing Canning Systems

```
      PROGRAM OPACK(INPUT,OUTPUT,TAPE60=INPUT,TAPE61=OUTPUT)
C              PROGRAM TO CALCULATE PRESENT VALUE
C               OF OLD CAN PROCESSING OPERATION
C
C
C         REAL STATEMENTS
C
      REAL IR,LCH,LRI,MHD,LOL,NDP,MHY,MUNGH,MUFOH,KWHH
      REAL INT,INV
      INTEGER DATE1,DATE2,DATE3,DATE4,DATE5,DATE6,DATE7,DATE8,DATE9,
     XDATE10,DATE11,DATE12,DATE14,DATE15,DATE16,DATE17,DATE18,DATE19
      INTEGER TN
C         DIMENSION STATEMENTS
C
      DIMENSION PAC(10),PDC(80),PEMAT(80),PIC(80),A(10)
      DIMENSION INT(150),BB(150),PRIN(150),EB(150),TINT(50)
      DIMENSION DSI(80),DS(80),PSAL(80),LCH(80),PLE(80)
      DIMENSION RTPC(80),ERTP(80),EEFC(80),BPFR(80)
      DIMENSION EBPF(80),PMUNG(80),PMUFO(80),PKWH(80),ENG(80),EFO(80)
      DIMENSION EEL(80),AEFC(80),APFR(80),EAPF(80)
      DIMENSION TOC(80), TDEP(80),TOT(80)
      DIMENSION AC(80),PV(80),TOT1(80)
      DIMENSION TIT(80),PVBC(80),BC(80)
      DIMENSION PVC(80),AC1(80),PVTOCE(80),PVTDEP(80),PVTIT(80)
      DIMENSION TDBC(80),PVEC1(80),PVEC(80),PVTOO(80)
      DIMENSION PVOC1(80),PVOC(80),TPVAC(80),PVPLE(80)
      DIMENSION PVERTP(80),PVECR(80),PVEBPF(80),PVENG(80),PVEFO(80)
      DIMENSION PVEEL(80),PVEAPF(80),TPVPLE(80),TPVERTP(80)
      DIMENSION TPVECR(80),TPVEBPF(80),TPVENG(80),TPVEFO(80),TPVEEL(80)
      DIMENSION TPVEAPF(80),PVTENGY(80),PVTTRAN(80),PVTPACK(80)
      DIMENSION PVEC3(80),PVEC2(80),PVOC2(80),PVOC3(80)
      DIMENSION TPVAC2(80)
      DIMENSION TENERGY(80),TTRAN(80),TPACK(80),TOTAL(80),PPLE(80)
      DIMENSION PENERGY(80),PTRAN(80),PPACK(80),PERTP(80),PECR(80)
      DIMENSION PEBPF(80),PEAPF(80),PENG(80),PEEL(80),PEFO(80)
      DIMENSION PAETRAN(80),TOTEFR(80),PTOTEFR(80),TTENERG(80)
      DIMENSION PTTENER(80),BETRAN(80),AETRAN(80)
      DIMENSION PBETRAN(80),INV(80),PVINV(80)
      DIMENSION TEC(80),PTINT(80),PPIC(80),PPEMAT(80)
      DIMENSION PEMATO(80),PIMC(80),RMC(80),RVI(10,80)
      WRITE(61,999)
999   FORMAT(*1*)
C*************************************************
C         INITIALIZE VARIABLES STATEMENTS        *
C*************************************************
      RVI(1)=415000.00
C     RVI(1)=REPLACEMENT INSURANCE VALUE OF EQUIPMENT IN 1980
      PACI=1.004
C     PACI=INDEX TO INCREASE THE AQUISITION COST OR REPLACEMENT
C     INSURANCE VALUE FOR INSURANCE CALCULATION
      PI=.01
C     PI=PERCENT OF REPLACEMENT VALUE ALLOWED FOR INSURANCE
      LCH(1)=7.02
C     LCH(1)=LABOR RATE IN 1980 $/HR
      LRI=1.00
C     LRI= LABOR RATE INDEX PERCENT INCREASE PER YEAR
      RTPC(1)= 119.36
C     RTPC(1)= CAN COST $/1000 IN 1980
      RTPCI=1.0328
C     RTPCI= CAN COST INDEX
      PPM= 300.
C     PPM= PACKAGES USED PER MINIUTE
      LOL=38
C     LOL=LABOR ON LINE
      NDP= 15
C     NDP = NUMBER OF DAYS PROCESSING
      BFM=750
C     BFM = FREIGHT MILES BEFORE PROCESSING
      AFM=750
C     AFM = FREIGHT MILES AFTER  PROCESSING
      DFI =  1.05
C     DFI = DIESEL FUEL INDEX
      PMUDF=8.57
C     PMUDF=PRICE OF DEISEL FUEL IN 1980 $/MILLION BTU
      PMUNG(1)=2.60
C     PMUNG(1)= PRICE OF NATURAL GAS IN 1980 $/1MILLION BTU
      PMUFO(1)=0.00
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C       PMUFO(1)= PRICE OF FUEL OIL IN 1980 $/1MILLION BTU
        PKWH(1)=0.0387
C       PKWH(1)=  PRICE OF ELECTRICITY IN 1980  $/KWH
        MUNGH=10.1726625
C       MUNGH= MILLION BTU NATURAL  GAS PER HOUR
        MUFOH  =0.0
C       MUFOH= MILLION BTU FUEL OIL PER HOUR
        KWHH=4.5425
C       KWHH = KWH PER HOUR
        PNGI=1.05
C       PNGI= PRICE OF NATURAL GAS INDEX
        PFOI=1.05
C       PFOI= PRICE OF FUEL OIL INDEX
        PELI=    1.05
C       PELI= PRICE OF ELECTRICITY INDEX
        R=.0107
C       R=REAL AFTER TAX DISCOUNT RATE
        PEMATO(1)=8515.00
C       PEMATO(1)=MAINTENANCE COST EXISTING EQUIPMENT IN 1980
        AGE=25.00
C       AGE=AVERAGE AGE OF OLD PROCESSING EQUIPMENT
        N=50
C       N=NUMBER OF YEARS FOR CONSIDERATION OF OPERATION  AFTER PURCHASE


C
C
C       HRSPD= HOURS PER DAY
        HRSPD=    16
C       BALOFC1 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 250 M
C       BALOFC2 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 500 M
C       BALOFC3 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 750 M
C       BALOFC4 = FREIGHT COST ALL BUT ENERGY BEFORE PROCESSING AT 1000 M
        BALOFC1= 4.43
        BALOFC2=   6.33
        BALOFC3= 6.93
        BALOFC4=9.44
C       BEFC1=FREIGHT COST ATTRIBUTED TO ENERGY AT 250 MILES   $/1000 PACK
C       BEFC2=                                     500 MILES   $/1000 PACK
C       BEFC3=                                     750 MILES   $/1000 PACK
C       BEFC4=                                     1000 MILES  $/1000 PACK
        BEFC1= .405
        BEFC2= .81
        BEFC3= 1.21
        BEFC4=1.62
C       AALOFC1= FREIGHT COST ALL BUT ENERGY AFTER PROCESSING AT 250 MILES
        AALOFC1= 9.88
        AALOFC2= 13.10
        AALOFC3= 18.07
        AALOFC4=29.39
C       AEFC1= FREIGHT COST ATTRIBUTED TO ENERGY AT 250 MILES $/1000 PACK
C       AEFC2=                                      500 MILES $/1000 PACK
C       AEFC3=                                      750 MILES $/1000 PACK
C       AEFC4=                                     1000 MILES $/1000 PACK
        AEFC1=   3.43
        AEFC2=   6.86
        AEFC3=   10.29
        AEFC4=13.71
C       T=MARGINAL TAX  RATE
        T=.46
C*****************************************************************
C          CALCULATION OF MAINTENANCE EXPENDITURE          *
C*****************************************************************
        RMC(1)=.003214+(.001786*AGE)
        PEMAT(1)=PEMATO(1)
        DO 45 I=2,N
        RMC(I)=.003214+(.001786*(I+AGE-1))
        PIMC(I)=RMC(I)/RMC(I-1)
        PEMATO(I)=PEMATO(I-1)*PIMC(I)
        PEMAT(I)=PEMATO(I)
45      CONTINUE
C           PEMATO(I)= EXPENDITURE FOR MAINTENANCE ON OLD PROCESSING
C           EQUIPMENT IN THE PROCESSING LINE IN YEAR I.
C           RMC= REAL MAINTANCE COST CONVERSION FACTOR FOR CALCULATING
C           PERCENTAGE CHANGE FROM YEAR TO YEAR
C           PIMC(I)=PERCENT INCREASE IN MAINTENANCE COST FOR OLD
C           PROCESSING EQUIPMENT FROM PREVIOUS YEAR I-1
C           PAC(ID) =ACQUISITION COST IN YEAR ID
C           AGE=AVERAGE AGE OF OLD PROCESSING EQUIPMENT IN 1980
C
C*******************************************************************
C           CALCULATION OF LABOR EXPENDITURE                     *
C*******************************************************************
        DO 120 IN=2,N
        LCH(IN)=LCH(IN-1)*LRI
 120    CONTINUE
        MHD=LOL*HRSPD
        MHY=NDP*MHD
        DO 130 IO=1,N
        PLE(IO)=LCH(IO)*MHY
 130    CONTINUE
C       LCH(IN)=LABOR CHARGE PER HOUR IN YEAR IN
C       LRI=LABOR RATE INDEX
```

```
C      LOL=LABOR ON LINE
C      HRSPD=HOURS PER DAY
C      MHD= MAN HOURS PER DAY
C      NDP= NUMBER OF DAYS PROCESSING
C      MHY= MAN HOURS PER YEAR
C      PLE(IO)= EXPENDITURE FOR LABOR IN CAN PROCESS IN YEAR IO
C*************************************************************
C                 CALCULATION OF INSURANCE COSTS        *
C*************************************************************
       DO 55 LD=2,N
       RVI(LD)=RVI(LD-1)*PACI
55     CONTINUE
       DO 56 LF=1,N
       PIC(LF)=RVI(LF)*PI
56     CONTINUE
C           PIC(LF)=ANNUAL INSURANCE CHARGE ON EQUIPMENT
C           RVI(LD)=REPLACEMENT INSURANCE VALUE IN YEAR LF
C           PI=PERCENT OF REPLACEMENT VALUE ALLOWED FOR ESTIMATING
C           INSURANCE CHARGES
C**********************************************************************
C          CALCULATION OF CAN PURCHASE EXPENDITURE                    *
C**********************************************************************
       DO 150 IP=2,N
       RTPC(IP)=RTPC(IP-1)*RTPCI
 150   CONTINUE
       PPH=PPM*60.0
       TOTPAKD=PPH*HRSPD
       TOTPAK= TOTPAKD*NDP
       TOTPAKT=TOTPAK/1000
       DO 160 IQ=1,N
       ERTP(IQ)= TOTPAKT*RTPC(IQ)
 160   CONTINUE
C
C           RTPC(IP)= CAN COST IN YEAR IP $/1000
C           CAN COST INDEX
C           PPM= PACKAGES PROCESSED PER MINUTE
C           PPH= PACKAGES PROCESSED PER HOUR
C           TOTPAKD = PACKAGES PROCESSED PER DAY
C           TOTPAK = TOTAL PACKAGES PROCESSED PER SEASON
C           TOTPAKT= 1000  PACKAGES PROCESSED PER SEASON
C           NDP = NUMBER OF DAYS PROCESSING IN SEASON
C           ERTP(IQ)= TOTAL EXPENDITURE FOR PURCHASING CANS IN
C           YEAR IQ
C*********************************************************************************
C          CALCULATION OF PACKAGE FREIGHT COST BEFORE PROCESSING          *
C*********************************************************************************
       IF(BFM.EQ.250) GO TO 300
       IF(BFM.EQ.500) GO TO 310
       IF(BFM.EQ.750) GO TO 320
       IF(BFM.EQ.1000) GO TO 330
 300   CONTINUE
       BALOFC = BALOFC1
       BEFC(1)= BEFC1
       BPFR(1)= BALOFC1+BEFC1
       GO TO 350
 310   BALOFC=BALOFC2
       BEFC(1)=BEFC2
       BPFR(1)= BALOFC2+BEFC2
       GO TO 350
320    BALOFC=BALOFC3
       BEFC(1)=BEFC3
       BPFR(1)=BALOFC3+BEFC3
       GO TO 350
 330   BALOFC=BALOFC4
       BEFC(1)=BEFC4
       BPFR(1)=BALOFC4+BEFC4
 350   CONTINUE
       DO 360 IT=2,N
       BEFC(IT)=BEFC(IT-1)*DFI
       BPFR(IT)=BALOFC+BEFC(IT)
 360   CONTINUE
       DO 370 IU=1,N
       EBPF(IU)= TOTPAKT * BPFR(IU)
       BETRAN(IU)=TOTPAKT*BEFC(IU)
 370   CONTINUE
C
C           BFM= FREIGHT MILES BEFORE PROCESSING
C           BALOFC= FREIGHT CHARGE ATTRIBUTED TO ALL  BUT ENERGY  BEFORE
C           PROCESSING $/1000 PACKAGES
C           BEFC= FREIGHT CHARGE ATTRIBUTED TO ENERGY  BEFORE PROCESSING
C           $/1000 PACKAGES
C           1=250 MILES  2= 500 MILES  3= 750 MILES  4= 1000 MILES
C           BPFR(IT)= FREIGHT RATE BEFORE PROCESSING $/1000 PACKAGES IN
C           YEAR IT
C           DFI= DIESEL FUEL INDEX
C           EBPF= EXPENDITURE ON FREIGHT BEFORE PROCESSING IN YEAR IU
C*********************************************************************************
C           CALCULATION OF EXPENDITURES FOR ENERGY IN PROCESSING        *
C*********************************************************************************
       TUNG=MUNGH*HRSPD*NDP
       TUFO=MUFOH*HRSPD*NDP
       TKWH=KWHH*HRSPD*NDP
```

```
      DO 400 JA=2,N
      PMUNG(JA)=PMUNG(JA-1)*PNGI
      PMUFO(JA)=PMUFO(JA-1)*PFOI
      PKWH(JA)=PKWH(JA-1)*PELI
400   CONTINUE
      DO 410 JB=1,N
      ENG(JB)= TUNG*PMUNG(JB)
      EFO(JB)= TUFO*PMUFO(JB)
      EEL(JB)= TKWH*PKWH(JB)
 410  CONTINUE
C          TUNG=TOTAL NATURAL GAS USED  MILLION BTU      TUNGH= PER HOUR
C          TUFO=TOTAL FUEL OIL USED  MILLION BTU         TUFOH= PER HOUR
C          TKWH=TOTAL ELECTRICITY USED  KWH              KWHH = PER HOUR
C        . PMUNG(JA)= PRICE OF NATURAL GAS IN YEAR JA    $/MILLION BTU
C          PNGI= PRICE OF NATURAL GAS INDEX
C          PMUFO(JA)= PRICE OF FUEL OIL IN JA            $/MILLION BTU
C          PFOI= PRICE OF FUEL OIL INDEX
C          PKWH(JA)= PRICE OF ELECTRICITY IN YEAR JA     $/KWH
C          PELI= PRICE OF ELECTRICITY INDEX
C*****************************************************************
C        CALCULATION OF PACKAGE FREIGHT COST AFTER PROCESSING     *
C*****************************************************************
      IF(AFM.EQ.250) GO TO 450
      IF(AFM.EQ.500) GO TO 460
      IF(AFM.EQ.750) GO TO 470
      IF(AFM.EQ.1000) GO TO 480
 450  CONTINUE
      AALOFC= AALOFC1
      AEFC(1)= AEFC1
      APFR(1)= AALOFC1+AEFC1
      GO TO 490
460   CONTINUE
      AALOFC = AALOFC2
      AEFC(1)=AEFC2
      APFR(1)=AALOFC2+AEFC2
      GO TO 490
470   AALOFC=AALOFC3
      AEFC(1)=AEFC3
      APFR(1)=AALOFC3+AEFC3
      GO TO 490
480    AALOFC=AALOFC4
      AEFC(1)=AEFC4
      APFR(1)=AALOFC4+AEFC4
 490  CONTINUE
      DO 500 JC=2,N
      AEFC(JC)=AEFC(JC-1) * DFI
      APFR(JC)=AALOFC+AEFC(JC)
 500  CONTINUE
      DO 510 JD=1,N
      EAPF(JD)=TOTPAKT * APFR(JD)
      AETRAN(JD)=TOTPAKT*AEFC(JD)
 510  CONTINUE
C
C          AFM= FREIGHT MILES AFTER PROCESSING
C          AALOFC= FREIGHT CHARGE ATTRIBUTED TO ALL BUT ENERGY AFTER
C          PROCESSING $/1000 PACKAGES
C          AEFC= FREIGHT CHARGE ATTRIBUTED TO ENERGY AFTER PROCESSING
C          $/1000 PACKAGES
C          APFR(JC)= FREIGHT RATE   AFTER PROCESSING IN YEAR JC $/1000
C          PACKAGES
C          DFI= DIESEL FUEL INDEX
C          EAPF(JD)= EXPENDITURE ON FREIGHT AFTER  PROCESSING IN YEAR JD
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C*******************************************************************
C                                                                  *
C          CALCULATION OF PRSENT VALUE                             *
C               REPLACEMENT CRITERIA                               *
C                                                                  *
C*******************************************************************
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
      TOO=0.0
      NN=N-5
      DO 540 L=1,NN
      LL=-L
      PVC(L)=((1+R)**LL)
      AC1(L)=R/(1-((1+R)**LL))
      TOO=TOO+(((PLE(L)+ERTP(L)+EBPF(L)+ENG(L)+EFO(L)
     +  +EEL(L)+EAPF(L)+PEMAT(L)+PIC(L))*PVC(L))*(1-T))
      PVTOO(L)=TOO
      PVOC3(L)=AC1(L)*PVTOO(L)
      TOT(L)=(((PLE(L)+ERTP(L)+EBPF(L)+ENG(L)+EFO(L)
     + +EEL(L)+EAPF(L)+PEMAT(L)+PIC(L))*PVC(L))*(1-T))
540   CONTINUE
C PVC(L)=PRESENT VALUE CONVERSION IN YEAR L
C AC(L)=ANNUITY CONVERSION IN YEAR L FOR AN INFINITE STREAM
C AC1(L)=ANNUITY CONVERSION IN YEAR L FOR THE FIRST REPLACEMENT
C TOT(L) =PRESENT VALUE OF OPERATING OLD EQUIPMENT IN YEAR L
C PVTOO(L)=PRESENT VALUE OF ALL OTHER OPERATING COSTS NOT
C ASSOCIATED WITH THE AGE OF THE EQUIPMENT
C PVOC3(L)=PRESENT VALUE OF AMORTIZED COST OF ALL OTHER
C OPERATING COSTS NOT ASSOCIATED WITH THE AGE OF THE EQUIPMENT
C WHEN OPERATING TO YEAR L
```

```
      DO 580 II=1,N
      TENERGY(II)=ENG(II)+EFO(II)+EEL(II)
      TTRAN(II)=EBPF(II)+EAPF(II)
      TPACK(II)=ERTP(II)
      TOTAL(II)=TENERGY(II)+TTRAN(II)+TPACK(II)+PLE(II)
      PPEMAT(II)=PEMAT(II)/TOTAL(II)
      PPLE(II)=PLE(II)/TOTAL(II)
      PENERGY(II)=TENERGY(II)/TOTAL(II)
      PTRAN(II)=TTRAN(II)/TOTAL(II)
      PPACK(II)=TPACK(II)/TOTAL(II)
      PERTP(II)=ERTP(II)/TOTAL(II)
      PEBPF(II)=EBPF(II)/TOTAL(II)
      PEAPF(II)=EAPF(II)/TOTAL(II)
      PENG(II)=ENG(II)/TOTAL(II)
      PEEL(II)=EEL(II)/TOTAL(II)
      PEFO(II)=EFO(II)/TOTAL(II)
      PBETRAN(II)=BETRAN(II)/TOTAL(II)
      PAETRAN(II)=AETRAN(II)/TOTAL(II)
      TOTEFR(II)=BETRAN(II)+AETRAN(II)
      PTOTEFR(II)=TOTEFR(II)/TOTAL(II)
      TTENERG(II)=TENERGY(II)+TOTEFR(II)
      PTTENER(II)=TTENERG(II)/TOTAL(II)
580   CONTINUE
C TENERGY=TOTAL PROCESSING ENERGY EXPENDITURES
C TTRAN= TOTAL FREIGHT EXPENDITURES
C TPACK= TOTAL PACKAGE EXPENDITURES
C TOTAL= TOTAL COSTS NOT ASSOCIATED DIRECTLY WITH MACHINE AGE
C PPLE= PERCENT  LABOR COSTS OF TOTAL
C PENERGY= PERCENT  PROCESSING ENERGY OF TOTAL
C PTRAN= PERCENT  FREIGHT COST OF TOTAL
C PPACK= PERCENT PACKAGE COST OF TOTAL
C PERTP= PERCENT CAN COST OF TOTAL
C PERC= PERCENT CARTON COST OF TOTAL
C PEBPF= PERCENT BEFORE PROCESSING FREIGHT COST OF TOTAL
C PEAPF= PERCENT AFTER PROCESSING FREIGHT COST OF TOTAL
C PENG= PERCENT NATURAL GAS COSTS OF TOTAL
C PEEL= PERCENT ELECTRICITY COSTS OF TOTAL
C PEFO= PERCENT RESIDUAL FUEL OIL COSTS OF TOTAL
C BETRAN= BEFORE PROCESSING ENERGY FREIGHT COSTS
C AETRAN= AFTER PROCESSING ENERGY FREIGHT COSTS
C PBETRAN= PERCENT BEFORE PROCESSING ENERGY FREIGHT COST OF TOTAL
C PAETRAN= PERCNET AFTER PROCESSING ENERGY FREIGHT COST OF TOTAL
C TOTEFR= TOTAL ENERGY FREIGHT COSTS
C PTOTEFR= PERCENT TOTAL ENERGY FREIGHT COSTS OF TOTAL
C TTENERG= TOTAL ENERGY COSTS INCLUDING ENERGY FREIGHT COSTS
C PTTENER= PERCENT ENERGY COSTS OF TOTAL COSTS
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C                     OUTPUT SECTION                                  $
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
      WRITE(61,750)
750   FORMAT(*1*,30X,*ASSUMPTIONS CONCERNING PARAMETERS*)
      WRITE(61,751)PNGI
751   FORMAT(*-*,10X,*NATURAL GAS INDEX*,14X,*=*,F4.2)
      WRITE(61,752)PMUNG(1)
752   FORMAT(* *,10X,*$ PER MILLION BTU NATURAL GAS  =*,F5.3)
      WRITE(61,753)PELI
753   FORMAT(* *,10X,*ELECTRICITY INDEX*,14X,*=*,F4.2)
      WRITE(61,754)PKWH(1)
754   FORMAT(* *,10X,*$ PER KWH ELECTRICITY*,10X,*=*,F6.4)
      WRITE(61,755)PFOI
755   FORMAT(* *,10X,*FUEL OIL INDEX*,17X,*=*,F4.2)
      WRITE(61,756)PMUFO(1)
756   FORMAT(* *,10X,*$ PER MILLION BTU FUEL OIL*,5X,*=*,F4.2)
      WRITE(61,757)DFI
757   FORMAT(* *,10X,*DIESEL FUEL INDEX*,14X,*=*,F4.2)
      WRITE(61,758)PMUDF
758   FORMAT(* *,10X,*$ PER MILLION BTU DIESEL FUEL  =*,F5.3)
      WRITE(61,759)MUNGH
759   FORMAT(*-*,10X,*MILLION BTU NATURAL GAS PER HOUR  =*,F10.7)
      WRITE(61,760)MUFOH
760   FORMAT(* *,10X,*MILLION BTU FUEL OIL PER HOUR*,5X,*=*,F5.2)
      WRITE(61,761)KWHH
761   FORMAT(* *,10X,*KWH PER HOUR*,22X,*=*,F6.4)
      WRITE(61,762)BFM
762   FORMAT(*-*,10X,*FREIGHT MILES BEFORE PROCESSING  =*,F5.0)
      WRITE(61,763)AFM
763   FORMAT(* *,10X,*FREIGHT MILES AFTER PROCESSING   =*,F5.0)
      WRITE(61,764)RTPC(1)
764   FORMAT(*-*,10X,*CAN COST PER 1000*,11X,*=*,F7.2)
      WRITE(61,766)RTPCI
766   FORMAT(* *,10X,*CAN COST INDEX*,15X,*=*,F7.4)
      WRITE(61,768)PPM
768   FORMAT(* *,10X,*PACKAGES PER MINIUTE*,9X,*=*,F4.0)
      WRITE(61,769)LOL
769   FORMAT(*-*,10X,*LABOR ON LINE    =*,F3.0)
      WRITE(61,770)LRI
770   FORMAT(* *,10X,*LABOR RATE INDEX =*,F4.2)
      WRITE(61,771)R
771   FORMAT(*-*,10X,*REAL DISCOUNT RATE*,15X,*=*,F6.4)
      WRITE(61,772)T
772   FORMAT(* *,10X,*MARGINAL TAX RATE*,16X,*=*,F3.2)
```

```
      WRITE(61,801)
801   FORMAT(*1*)
      WRITE(61,802)
802   FORMAT(*-*,5X,*YEAR*,9X,*AMORTIZED*,12X,*PV*)
      WRITE(61,803)
803   FORMAT(* *,17X,*PRODUCTION*,8X,*PRODUCTION*)
      WRITE(61,804)
804   FORMAT(* *,20X,*COSTS 1*,11X,*COSTS*)
      WRITE(61,805)
805   FORMAT(*-*)
      DO 810 IZ=1,NN
      DATE18=1979+IZ
      WRITE(61,806)DATE18,PVOC3(IZ),TOT(IZ)
806   FORMAT(*0*,5X,I4,4X,F14.2,4X,F14.2)
810   CONTINUE
820   CONTINUE
      WRITE(61,830)
830   FORMAT(*1*,35X,*OPERATING EXPENDITURES*)
      WRITE(61,831)
831   FORMAT(*-*,5X,*YEAR*,10X,*LABOR*,5X,*P*,8X,*CAN*,7X,
     + *P*,7X,*BEFORE*,5X,*P*,7X,*AFTER*,6X,*P*,3X,*MAINTENANCE*,3X,*P*)
      WRITE(61,832)
832   FORMAT(* *,19X,*COSTS*,5X,*OF*,6X,*COSTS*,6X,*OF*,
     +6X,*FREIGHT*,4X,*OF*,5X,*FREIGHT*,5X,*OF*,16X,*OF*)
      WRITE(61,833)
833   FORMAT(* *,28X,*TOT*,16X,*TOT*,7X,*COSTS*,4X,*TCT*,6X,
     + *COSTS*,5X,*TOT*,15X,*TOT*)
      WRITE(61,834)
834   FORMAT(*-*)
      DO 840 JO=1,N
      DATE17=1979+JO
      WRITE(61,835)DATE17,PLE(JO),PPLE(JO),ERTP(JO),PERTP(JO)
     + ,EBPF(JO),PEBPF(JO),EAPF(JO),PEAPF(JO),PEMAT(JO),PPEMAT(JO)
835   FORMAT(*0*,5X,I4,4X,F12.2,2X,4(F4.3,2X,F11.2,2X),F3.2)
840   CONTINUE
      WRITE(61,845)
845   FORMAT(*1*,35X,*OPERATING EXPENDITURES*)
      WRITE(61,846)
846   FORMAT(*-*,5X,*YEAR*,9X,*NATURAL*,4X,*P*,3X,*ELECTRICITY*,
     + 4X,*P*,6X,*FUEL OIL*,4X,*P*,7X,*BEFORE*,5X,*P*,7X,*AFTER*,6X,*P*
     + ,6X,*INSURANCE*)
      WRITE(61,847)
847   FORMAT(* *,20X,*GAS*,6X,*OF*,5X,*COSTS*,7X,*OF*,7X,*COSTS*,
     +5X,*OF*,6X,*ENERGY*,5X,*OF*,5X,*ENERGY*,6X,*OF*)
      WRITE(61,848)
848   FORMAT(* *,19X,*COSTS*,4X,*TOT*,16X,*TOT*,16X,*TOT*,6X,
     + *FREIGHT*,3X,*TOT*,5X,*FREIGHT*,4X,*TOT*)
      WRITE(61,849)
849   FORMAT(* *,76X,*COSTS*,13X,*COSTS*)
      WRITE(61,850)
850   FORMAT(*-*)
      DO 870 JK=1,N
      DATE16=1979+JK
      WRITE(61,860)DATE16,ENG(JK),PENG(JK),EEL(JK),PEEL(JK),EFO(JK),
     + PEFO(JK),BETRAN(JK),PBETRAN(JK),AETRAN(JK),PAETRAN(JK),PIC(JK)
860   FORMAT(*0*,5X,I4,4X,F12.2,2X,4(F4.3,2X,F11.2,2X),F4.3,3X,F11.2)
870   CONTINUE
      WRITE(61,880)
880   FORMAT(*1*,35X,*OPERATING EXPENDITURES*)
      WRITE(61,881)
881   FORMAT(*-*,5X,*YEAR*,11X,*TOTAL*,6X,*P*,8X,*TOTAL*,7X,*P*,
     + 8X,*TOTAL*,7X,*P*,9X,*TOTAL*,6X,*P*,9X,*TOTAL*,6X,*P*,9X,*TOTAL*)
      WRITE(61,882)
882   FORMAT(* *,19X,*FREIGHT*,5X,*OF*,6X,*PACKAGES*,5X,*OF*,7X,*ENERGY*
     + ,6X,*OF*,8X,*ENERGY*,5X,*OF*,8X,*ENERGY*,5X,*OF*,8X,*COSTS*)
      WRITE(61,883)
883   FORMAT(* *,20X,*COSTS*,5X,*TOT*,7X,*COSTS*,6X,*TOT*,5X,
     + *PROCESSING*,3X,*TOT*,7X,*FREIGHT*,4X,*TOT*,8X,*COSTS*,5X,*TOT*,8
     +X,*N EQUIP*)
      WRITE(61,884)
884   FORMAT(* *,61X,*COSTS*,17X,*COSTS*)
      WRITE(61,885)
885   FORMAT(*-*)
      DO 900 JI=1,N
      DATE15=1979+JI
      WRITE(61,890)DATE15,TTRAN(JI),PTRAN(JI),TPACK(JI),PPACK(JI),
     + TENERGY(JI),PENERGY(JI),TOTEFR(JI),PTOTEFR(JI),TTENERG(JI),
     + PTTENER(JI),TOTAL(JI)
890   FORMAT(*0*,5X,I4,4X,F14.2,2X,4(F4.3,2X,F13.2,2X),F4.3,2X,F13.2)
900   CONTINUE
      STOP
      END
```

APPENDIX C

ESTIMATED COSTS OF ALTERNATIVE PACKAGING SYSTEMS

APPENDIX C

ESTIMATED COSTS OF ALTERNATIVE PACKAGING SYSTEMS

C.1--A Guide to Interpreting Appendix C

The following list indicates the equations which were used for estimating the costs reported in this appendix.

Amortized Replacement Costs	Equation (3.9)
Amortized Production Costs	Equation (3.10)
Amortized Total Costs	Equation (3.11)
Production Costs	Equation (3.12)
Total Costs	Equation (3.13)

Operating Expenditures - All costs listed under the heading of operating expenditures are annual estimates based on the variety of assumptions outlined in chapter 4.

C.2--Estimated Costs for the Existing Canning System - Firm A

YEAR	PV TOTAL COSTS	MAINTENANCE
1980	404127.80	8515.00
1981	410448.73	8832.73
1982	416954.02	9150.46
1983	423648.27	9468.19
1984	430536.18	9785.92
1985	437622.61	10103.65
1986	444912.54	10421.38
1987	452411.11	10739.10
1988	460123.60	11056.83
1989	468055.46	11374.56
1990	476212.28	11692.29
1991	484599.81	12010.02
1992	493223.99	12327.75
1993	502090.90	12645.48
1994	511206.85	12963.21
1995	520578.28	13280.94
1996	530211.85	13598.67
1997	540114.41	13916.4C
1998	550293.01	14234.13
1999	560754.92	14551.85
2000	571507.61	14869.58
2001	582558.78	15187.31
2002	593916.37	15505.04
2003	605588.53	15822.77
2004	617583.67	16140.50
2005	629910.47	16458.23
2006	642577.83	16775.96
2007	655594.96	17093.69
2008	668971.31	17411.42
2009	682716.65	17729.15
2010	696841.02	18046.88
2011	711354.78	18364.60
2012	726268.60	18682.33
2013	741593.47	19000.06
2014	757340.73	19317.79
2015	773522.05	19635.52

OPERATING EXPENDITURES

YEAR	LABOR COSTS	P OF TOT	GAS COSTS	P OF TOT	BEFORE FREIGHT COSTS	P OF TOT	AFTER FREIGHT COSTS	P OF TOT	INSURANCE
1980	64022.40	.086	519635.20	.693	35164.80	.047	122515.20	.165	4150.00
1981	64022.40	.084	532540.83	.698	35426.16	.046	124737.04	.163	4166.60
1982	64022.40	.082	550815.61	.702	35700.59	.046	127071.61	.162	4183.27
1983	64022.40	.080	568056.12	.706	35988.74	.045	129522.07	.161	4200.00
1984	64022.40	.077	586680.36	.710	36291.29	.044	132095.06	.160	4216.80
1985	64022.40	.075	605931.74	.713	36608.90	.043	134796.69	.159	4233.67
1986	64022.40	.073	625806.30	.717	36942.55	.042	137633.40	.158	4250.60
1987	64022.40	.071	646332.75	.720	37292.80	.042	140611.95	.157	4267.60
1988	64022.40	.069	667532.46	.724	37660.56	.041	143739.43	.156	4284.67
1989	64022.40	.068	689427.53	.727	38046.70	.040	147023.20	.155	4301.81
1990	64022.40	.066	712040.75	.730	38452.16	.039	150471.33	.154	4319.02
1991	64022.40	.064	735395.69	.733	38877.09	.039	154091.77	.154	4336.30
1992	64022.40	.062	759516.67	.736	39324.98	.038	157893.24	.153	4353.64
1993	64022.40	.060	784420.01	.739	39794.27	.037	161884.78	.152	4371.06
1994	64022.40	.059	810150.08	.741	40287.10	.037	166075.90	.152	4388.54
1995	64022.40	.057	836731.26	.744	40804.57	.036	170476.58	.151	4406.09
1996	64022.40	.055	864176.05	.746	41347.92	.036	175097.29	.151	4423.72
1997	64022.40	.054	892521.02	.748	41918.44	.035	179949.03	.151	4441.41
1998	64022.40	.052	921795.71	.750	42517.48	.035	185043.36	.151	4459.18
1999	64022.40	.051	952030.61	.752	43146.47	.034	190392.41	.150	4477.02
2000	64022.40	.049	983257.22	.754	43806.92	.034	196008.91	.150	4494.92
2001	64022.40	.048	1015508.05	.756	44500.38	.033	201906.24	.150	4512.90
2002	64022.40	.046	1048816.72	.757	45228.52	.033	208098.43	.150	4530.96
2003	64022.40	.045	1083217.90	.759	45993.07	.032	214600.23	.150	4549.08
2004	64022.40	.044	1118747.45	.760	46795.84	.032	221427.12	.150	4567.28
2005	64022.40	.042	1155442.37	.761	47638.75	.031	228595.36	.151	4585.54
2006	64022.40	.041	1193340.80	.763	48523.81	.031	236122.01	.151	4603.89
2007	64022.40	.040	1232482.46	.764	49453.12	.031	244024.99	.151	4622.30
2008	64022.40	.038	1272907.80	.765	50428.90	.030	252323.12	.152	4640.79
2009	64022.40	.037	1314659.26	.765	51453.46	.030	261036.15	.152	4659.35
2010	64022.40	.036	1357780.09	.766	52529.26	.030	270184.04	.152	4677.99
2011	64022.40	.035	1402315.27	.767	53658.84	.029	279790.96	.153	4696.70
2012	64022.40	.034	1448311.21	.767	54844.90	.029	289877.39	.154	4715.49
2013	64022.40	.033	1495815.82	.768	56098.27	.029	300468.14	.154	4734.35
2014	64022.40	.032	1544878.50	.768	57397.98	.029	311588.43	.155	4753.29
2015	64022.40	.031	1595550.60	.768	58770.92	.028	323264.73	.156	4772.30

OPERATING EXPENDITURES

YEAR	NATURAL GAS COSTS	P OF TOT	ELECTRICITY COSTS	P OF TOT	FUEL OIL COSTS	P OF TOT	BEFORE ENERGY FREIGHT COSTS	P OF TOT	AFTER ENERGY FREIGHT COSTS	P OF TOT
1980	6347.74	.009	42.19	.000	0.00	.000	5227.20	.007	44452.80	.060
1981	6665.13	.009	44.30	.000	0.00	.000	5488.56	.007	46675.44	.061
1982	6990.30	.009	46.52	.000	0.00	.000	5762.99	.007	49009.21	.063
1983	7340.30	.009	48.84	.000	0.00	.000	6051.14	.008	51459.67	.064
1984	7715.72	.009	51.28	.000	0.00	.000	6353.69	.008	54032.66	.065
1985	8101.51	.010	53.85	.000	0.00	.000	6671.38	.008	56734.29	.067
1986	8506.58	.010	56.54	.000	0.00	.000	7004.95	.008	59571.00	.068
1987	8931.91	.010	59.37	.000	0.00	.000	7355.20	.008	62549.55	.070
1988	9378.51	.010	62.33	.000	0.00	.000	7722.96	.008	65677.03	.071
1989	9847.43	.010	65.45	.000	0.00	.000	8109.10	.009	68960.80	.073
1990	10339.80	.011	68.72	.000	0.00	.000	8514.56	.009	72408.93	.074
1991	10856.79	.011	72.16	.000	0.00	.000	8940.29	.009	76029.37	.076
1992	11399.63	.011	75.77	.000	0.00	.000	9387.30	.009	79830.84	.077
1993	11969.61	.011	79.56	.000	0.00	.000	9856.67	.009	83822.38	.079
1994	12568.09	.011	83.53	.000	0.00	.000	10349.50	.009	88013.50	.081
1995	13196.50	.012	87.71	.000	0.00	.000	10866.97	.010	92414.18	.082
1996	13856.32	.012	92.10	.000	0.00	.000	11410.32	.010	97034.89	.084
1997	14549.14	.012	96.70	.000	0.00	.000	11980.84	.010	101886.63	.085
1998	15276.60	.012	101.54	.000	0.00	.000	12579.88	.010	106980.96	.087
1999	16040.43	.013	106.61	.000	0.00	.000	13208.87	.010	112330.01	.089
2000	16842.45	.013	111.94	.000	0.00	.000	13869.32	.011	117946.51	.090
2001	17684.57	.013	117.54	.000	0.00	.000	14562.78	.011	123843.84	.092
2002	18568.80	.013	123.42	.000	0.00	.000	15290.92	.011	130036.03	.094
2003	19497.24	.014	129.59	.000	0.00	.000	16055.47	.011	136537.83	.096
2004	20472.10	.014	136.07	.000	0.00	.000	16858.24	.011	143364.72	.097
2005	21495.71	.014	142.87	.000	0.00	.000	17701.15	.012	150532.96	.099
2006	22570.49	.014	150.02	.000	0.00	.000	18586.21	.012	158059.61	.101
2007	23699.02	.015	157.52	.000	0.00	.000	19515.52	.012	165962.59	.103
2008	24883.97	.015	165.39	.000	0.00	.000	20491.30	.012	174260.72	.105
2009	26128.16	.015	173.66	.000	0.00	.000	21515.86	.013	182973.75	.107
2010	27434.57	.015	182.35	.000	0.00	.000	22591.66	.013	192122.44	.108
2011	28806.30	.016	191.46	.000	0.00	.000	23721.24	.013	201728.56	.110
2012	30246.62	.016	201.04	.000	0.00	.000	24907.30	.013	211814.99	.112
2013	31758.95	.016	211.09	.000	0.00	.000	26152.67	.013	222405.74	.114
2014	33346.89	.017	221.64	.000	0.00	.000	27460.30	.014	233526.03	.116

OPERATING EXPENDITURES

YEAR	TOTAL FREIGHT COSTS	P OF TOT	TOTAL PACKAGES COSTS	P OF TOT	TOTAL ENERGY PROCESSING COSTS	P OF TOT	TOTAL ENERGY FREIGHT COSTS	P OF TOT	TOTAL ENERGY COSTS	P OF TOT	TOTAL COSTS N EQUIP
1980	157680.00	.212	515635.20	.693	6389.93	.009	49680.00	.067	56069.93	.075	743727.53
1981	160164.00	.210	532940.01	.698	6709.43	.009	52164.00	.068	58873.43	.077	763443.86
1982	162772.20	.208	550015.61	.702	7044.90	.009	54772.20	.070	61817.10	.079	783855.11
1983	165510.81	.206	568056.12	.706	7397.15	.009	57510.81	.071	64907.96	.081	804986.40
1984	168386.35	.204	586680.36	.710	7767.00	.009	60386.35	.073	68153.35	.082	826864.12
1985	171405.67	.202	605931.74	.713	8155.35	.010	63405.67	.075	71561.02	.084	849515.16
1986	174575.95	.200	625806.38	.717	8563.12	.010	66575.95	.076	75139.07	.086	872967.77
1987	177904.75	.198	646332.75	.720	8991.28	.010	69904.75	.078	78896.03	.088	897251.17
1988	181399.99	.197	667532.46	.724	9440.84	.010	73399.99	.080	82840.83	.090	922395.69
1989	185069.99	.195	689427.53	.727	9912.88	.010	77069.99	.081	86982.87	.092	948432.60
1990	188923.49	.194	712040.75	.730	10408.53	.011	80923.49	.083	91332.01	.094	975395.16
1991	192969.66	.192	735395.69	.733	10928.95	.011	84969.66	.085	95898.61	.096	1003316.70
1992	197218.14	.191	759516.67	.736	11475.40	.011	89218.14	.086	100693.54	.098	1032232.61
1993	201679.05	.190	784420.01	.739	12049.17	.011	93679.05	.088	105728.22	.100	1062179.43
1994	206363.00	.189	810150.08	.741	12651.63	.012	98363.00	.090	111014.63	.102	1093195.11
1995	211281.15	.188	836731.26	.744	13284.21	.012	103281.15	.092	116565.36	.104	1125319.02
1996	216445.21	.187	864176.05	.746	13948.42	.012	108445.21	.094	122393.63	.106	1158592.08
1997	221867.47	.186	892521.02	.748	14645.84	.012	113867.47	.095	128513.31	.108	1193056.73
1998	227560.84	.185	921795.71	.750	15378.13	.013	119560.84	.097	134938.98	.110	1228757.09
1999	233538.89	.185	952030.61	.752	16147.04	.013	125538.89	.099	141685.93	.112	1265738.94
2000	239815.83	.184	983257.22	.754	16954.39	.013	131815.83	.101	148770.22	.114	1304049.84
2001	246406.62	.183	1015508.05	.756	17802.11	.013	138406.62	.103	156208.73	.116	1343739.19
2002	253326.95	.183	1048816.72	.757	18692.22	.013	145326.95	.105	164019.17	.118	1384858.29
2003	260593.30	.183	1083217.90	.759	19626.83	.014	152593.30	.107	172220.13	.121	1427460.43
2004	268222.97	.182	1118747.45	.760	20608.17	.014	160222.97	.109	180831.13	.123	1471600.99
2005	276234.11	.182	1155442.37	.761	21638.58	.014	168234.11	.111	189872.69	.125	1517337.46
2006	284645.82	.182	1193340.88	.763	22720.51	.015	176645.82	.113	199366.33	.127	1564729.60
2007	293478.11	.182	1232482.46	.764	23856.53	.015	185478.11	.115	209334.64	.130	1613839.50
2008	302752.02	.182	1272907.88	.765	25049.36	.015	194752.02	.117	219801.37	.132	1664731.66
2009	312489.62	.182	1314659.26	.765	26301.83	.015	204489.62	.119	230791.44	.134	1717473.11
2010	322714.10	.182	1357780.09	.766	27616.92	.016	214714.10	.121	242331.02	.137	1772133.58
2011	333449.80	.182	1402315.27	.767	28997.76	.016	225449.80	.123	254447.57	.139	1828785.24
2012	344722.29	.183	1448311.21	.767	30447.65	.016	236722.29	.125	267169.94	.142	1887503.56
2013	356558.41	.183	1495815.82	.768	31970.04	.016	248558.41	.128	280528.44	.144	1948366.66
2014	368986.33	.183	1544878.53	.768	33568.54	.017	260986.33	.130	294554.86	.146	2011455.04

C.3--Estimated Costs for the New Canning System - Firm A

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 100000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS 1	PRODUCTION COSTS 1	TOTAL COSTS 1
1980	8742.50	362164.32	370906.82	8742.50	358330.19	362246.45
1981	8475.65	367967.33	376442.99	8475.65	365959.01	369875.27
1982	7695.02	373922.97	381617.98	7695.02	373095.18	377011.45
1983	7560.77	380038.42	387599.20	7560.77	382159.39	386075.65
1984	7065.20	386321.46	393386.66	7065.20	390774.47	394690.74
1985	6910.99	392632.64	399543.63	6910.99	398911.06	402827.32
1986	6504.32	398872.20	405376.52	6504.32	406309.75	410226.01
1987	6335.52	405111.76	411447.29	6335.52	413912.09	417828.35
1988	6151.24	411392.32	417543.56	6151.24	421723.20	425639.46
1989	5956.92	417739.57	423696.49	5956.92	429748.33	433664.59
1990	5756.00	424170.89	429926.89	5756.00	437992.87	441909.14
1991	5554.64	430698.87	436253.51	5554.64	446462.40	450378.66
1992	5353.53	437333.12	442686.65	5353.53	455162.63	459078.89
1993	5153.14	444081.43	449234.57	5153.14	464099.44	468015.70
1994	4953.81	450950.36	455904.16	4953.81	473278.90	477195.17
1995	4785.44	457945.65	462731.08	4785.44	482787.24	486623.51
1996	4642.53	465072.51	469715.04	4642.53	492390.88	496307.14
1997	4520.81	472335.79	476856.60	4520.81	502336.42	506252.68
1998	4416.91	479740.05	484156.96	4416.91	512550.66	516466.92
1999	4328.12	487289.73	491617.85	4328.12	523040.59	526956.85
2000	4252.26	494989.14	499241.40	4252.26	533813.42	537729.68
2001	4187.54	502842.55	507030.09	4187.54	544876.57	548792.63
2002	4132.49	510854.20	514986.69	4132.49	556237.66	560153.92
2003	4085.87	519028.33	523114.20	4085.87	567904.56	571820.83
2004	4046.65	527369.22	531415.87	4046.65	579885.37	583801.63
2005	4013.95	535881.19	539895.14	4013.95	592188.41	596104.67
2006	3987.04	544568.60	548555.64	3987.04	604822.26	608738.52
2007	3965.26	553435.90	557401.16	3965.26	617795.76	621712.03
2008	3948.08	562487.61	566435.69	3948.08	631116.02	635034.29
2009	3935.00	571728.33	575663.33	3935.00	644798.41	648714.67
2010	3925.63	581162.76	585088.39	3925.63	658846.58	662762.84
2011	3919.59	590745.71	594715.30	3919.59	673272.47	677198.73
2012	3916.56	600632.86	604548.64	3916.56	688086.33	692002.59
2013	3916.26	610176.90	614593.16	3916.26	703298.71	707214.97
2014	3914.45	[illegible]	624853.76	3914.45	718920.49	722836.75

OPERATING EXPENDITURES

YEAR	LABOR COSTS	P OF TOT	CAN COSTS	P OF TOT	BEFORE FREIGHT COSTS	P OF TOT	AFTER FREIGHT COSTS	P OF TOT	NATURAL GAS COSTS	P OF TOT	ELECTRICITY COSTS	P OF TOT	FUEL OIL COSTS	P OF TOT	BEFORE ENERGY FREIGHT COSTS	P OF TOT	AFTER ENERGY FREIGHT COSTS	P OF TOT
1980	3369.60	.005	515635.20	.740	35164.80	.052	122515.20	.18	1879.17	.003	76.90	.000	0.00	.000	5227.20	.008	44452.80	.066
1981	3369.60	.005	532548.03	.763	35426.16	.051	124737.84	.18	1973.13	.003	80.75	.000	0.00	.000	5488.56	.008	46675.44	.067
1982	3369.60	.005	550015.61	.766	35700.59	.050	127071.61	.18	2071.78	.003	84.79	.000	0.00	.000	5762.99	.008	49009.21	.068
1983	3369.60	.005	568056.12	.768	35988.74	.049	129522.07	.18	2175.37	.003	89.03	.000	0.00	.000	6051.14	.008	51459.67	.070
1984	3369.60	.004	586688.36	.771	36291.29	.048	132095.06	.17	2284.14	.003	93.48	.000	0.00	.000	6353.69	.008	54032.66	.071
1985	3369.60	.004	605931.74	.774	36608.98	.047	134796.69	.17	2398.35	.003	98.15	.000	0.00	.000	6671.38	.009	56734.29	.072
1986	3369.60	.004	625806.30	.776	36942.55	.046	137633.40	.17	2518.27	.003	103.06	.000	0.00	.000	7004.95	.009	59571.00	.074
1987	3369.60	.004	646332.75	.778	37292.80	.045	140611.95	.17	2644.18	.003	108.21	.000	0.00	.000	7355.20	.009	62549.55	.075
1988	3369.60	.004	667532.46	.781	37660.56	.044	143739.43	.17	2776.39	.003	113.62	.000	0.00	.000	7722.96	.009	65677.03	.077
1989	3369.60	.004	689427.53	.783	38046.70	.043	147023.28	.17	2915.21	.003	119.30	.000	0.00	.000	8109.10	.009	68960.88	.078
1990	3369.60	.004	712040.75	.785	38452.16	.042	150471.33	.17	3060.97	.003	125.27	.000	0.00	.000	8514.56	.009	72408.93	.080
1991	3369.60	.004	735395.69	.786	38877.89	.042	154091.77	.16	3214.02	.003	131.53	.000	0.00	.000	8940.29	.010	76029.37	.081
1992	3369.60	.003	759516.67	.788	39324.90	.041	157893.24	.16	3374.72	.004	138.11	.000	0.00	.000	9387.30	.010	79830.84	.083
1993	3369.60	.003	784428.81	.790	39794.27	.040	161884.78	.16	3543.45	.004	145.02	.000	0.00	.000	9856.67	.010	83822.38	.084
1994	3369.60	.003	810158.08	.791	40287.10	.039	166075.90	.16	3720.62	.004	152.27	.000	0.00	.000	10349.50	.010	88013.50	.086
1995	3369.60	.003	836731.26	.793	40804.57	.039	170476.58	.16	3906.66	.004	159.88	.000	0.00	.000	10866.97	.010	92414.18	.088
1996	3369.60	.003	864176.05	.794	41347.92	.038	175097.29	.16	4101.09	.004	167.87	.000	0.00	.000	11410.32	.010	97034.89	.089
1997	3369.60	.003	892521.02	.795	41918.44	.037	179949.03	.16	4307.09	.004	176.27	.000	0.00	.000	11980.84	.011	101886.63	.091
1998	3369.60	.003	921795.71	.796	42517.48	.037	185043.36	.16	4522.44	.004	185.08	.000	0.00	.000	12579.88	.011	106980.96	.092
1999	3369.60	.003	952030.61	.797	43146.47	.036	190392.41	.16	4748.54	.004	194.33	.000	0.00	.000	13208.87	.011	112330.01	.094
2000	3369.60	.003	983257.22	.798	43806.92	.036	196008.91	.16	4985.99	.004	204.05	.000	0.00	.000	13869.32	.011	117946.51	.096
2001	3369.60	.003	1015508.05	.799	44500.38	.035	201986.24	.16	5235.29	.004	214.25	.000	0.00	.000	14562.78	.011	123843.84	.097
2002	3369.60	.003	1048816.72	.800	45228.52	.034	208098.43	.16	5497.06	.004	224.97	.000	0.00	.000	15290.92	.012	130036.03	.099
2003	3369.60	.002	1083217.90	.800	45993.07	.034	214600.23	.16	5771.91	.004	236.21	.000	0.00	.000	16055.47	.012	136537.83	.101
2004	3369.60	.002	1118747.45	.801	46795.84	.034	221427.12	.16	6060.51	.004	248.03	.000	0.00	.000	16858.24	.012	143364.72	.103
2005	3369.60	.002	1155442.37	.801	47638.75	.033	228595.36	.16	6363.53	.004	260.43	.000	0.00	.000	17701.15	.012	150532.96	.104
2006	3369.60	.002	1193340.88	.802	48523.81	.033	236122.01	.16	6681.71	.004	273.45	.000	0.00	.000	18586.21	.012	158059.61	.106
2007	3369.60	.002	1232482.46	.802	49453.12	.032	244024.99	.16	7015.79	.005	287.12	.000	0.00	.000	19515.52	.013	165962.59	.108
2008	3369.60	.002	1272907.88	.802	50428.90	.032	252323.12	.16	7366.58	.005	301.48	.000	0.00	.000	20491.30	.013	174260.72	.110
2009	3369.60	.002	1314659.26	.802	51453.46	.031	261036.15	.16	7734.91	.005	316.55	.000	0.00	.000	21515.86	.013	182973.75	.112
2010	3369.60	.002	1357780.09	.802	52529.26	.031	270184.84	.16	8121.66	.005	332.38	.000	0.00	.000	22591.66	.013	192122.44	.114
2011	3369.60	.002	1402315.27	.802	53658.84	.031	279790.96	.16	8527.74	.005	349.00	.000	0.00	.000	23721.24	.014	201728.56	.115
2012	3369.60	.002	1448311.21	.802	54844.90	.030	289877.39	.16	8954.13	.005	366.45	.000	0.00	.000	24907.30	.014	211814.99	.117
2013	3369.60	.002	1495815.82	.802	56090.27	.030	300468.14	.16	9401.83	.005	384.77	.000	0.00	.000	26152.67	.014	222405.74	.119
2014	3369.60	.002	1544878.58	.801	57397.90	.030	311588.43	.16	9871.92	.005	404.01	.000	0.00	.000	27460.30	.014	233526.03	.121

OPERATING EXPENDITURES

YEAR	TOTAL FREIGHT COSTS	P OF TOT	TOTAL PACKAGES COSTS	P OF TOT	TOTAL ENERGY PROCESSING COSTS	P OF TOT	TOTAL ENERGY FREIGHT COSTS	P OF TOT	TOTAL ENERGY COSTS	P OF TOT	TOTAL COSTS
1980	157680.00	.232	515635.20	.760	1956.07	.003	49680.00	.073	51636.07	.076	678640.87
1981	160164.00	.229	532548.03	.763	2053.88	.003	52164.00	.075	54217.88	.078	698135.51
1982	162772.20	.227	550015.61	.766	2156.57	.003	54772.20	.076	56928.77	.079	718313.98
1983	165510.81	.224	568056.12	.768	2264.40	.003	57510.81	.078	59775.21	.081	739200.93
1984	168386.35	.221	586688.36	.771	2377.62	.003	60386.35	.079	62763.97	.082	760821.93
1985	171405.67	.219	605931.74	.774	2496.50	.003	63405.67	.081	65902.17	.084	783203.51
1986	174575.95	.216	625806.30	.776	2621.32	.003	66575.95	.083	69197.28	.086	806373.18
1987	177904.75	.214	646332.75	.778	2752.39	.003	69904.75	.084	72657.14	.088	830359.49
1988	181399.99	.212	667532.46	.781	2899.01	.003	73399.99	.086	76299.00	.089	855192.06
1989	185069.99	.210	689427.53	.783	3034.51	.003	77069.99	.087	80104.50	.091	880901.62
1990	188923.49	.208	712040.75	.785	3186.24	.004	80923.49	.089	84109.72	.093	907520.07
1991	192969.66	.206	735395.69	.786	3345.55	.004	84969.66	.091	88315.21	.094	935080.50
1992	197218.14	.205	759516.67	.788	3512.83	.004	89218.14	.093	92730.97	.096	963617.23
1993	201679.05	.203	784428.81	.790	3688.47	.004	93679.05	.094	97367.52	.098	993165.93
1994	206363.00	.202	810158.08	.791	3872.89	.004	98363.00	.096	102235.89	.100	1023763.57
1995	211281.15	.200	836731.26	.793	4066.53	.004	103281.15	.098	107347.69	.102	1055448.55
1996	216445.21	.199	864176.05	.794	4269.86	.004	108445.21	.100	112715.07	.104	1088260.72
1997	221867.47	.198	892521.02	.795	4483.35	.004	113867.47	.101	118350.82	.105	1122241.45
1998	227560.84	.197	921795.71	.796	4707.52	.004	119560.84	.103	124268.37	.107	1157433.68
1999	233538.89	.196	952030.61	.797	4942.90	.004	125538.89	.105	130481.78	.109	1193882.00
2000	239815.83	.195	983257.22	.798	5190.04	.004	131815.83	.107	137005.87	.111	1231632.69
2001	246406.62	.194	1015508.05	.799	5449.55	.004	138406.62	.109	143856.17	.113	1270733.82
2002	253326.95	.193	1048816.72	.800	5722.02	.004	145326.95	.111	151048.98	.115	1311235.29
2003	260593.30	.193	1083217.90	.800	6008.12	.004	152593.30	.113	158601.42	.117	1353188.93
2004	268222.97	.192	1118747.45	.801	6308.53	.005	160222.97	.115	166531.50	.119	1396648.55
2005	276234.11	.192	1155442.37	.801	6623.96	.005	168234.11	.117	174858.07	.121	1441670.04
2006	284645.82	.191	1193340.88	.802	6955.15	.005	176645.82	.119	183600.97	.123	1488311.45
2007	293478.11	.191	1232482.46	.802	7302.91	.005	185478.11	.121	192781.02	.125	1536633.08
2008	302752.02	.191	1272907.88	.802	7668.06	.005	194752.02	.123	202420.07	.128	1586697.56
2009	312489.62	.191	1314659.26	.802	8051.46	.005	204489.62	.125	212541.08	.130	1638569.94
2010	322714.10	.191	1357780.09	.802	8454.03	.005	214714.10	.127	223168.13	.132	1692317.82
2011	333449.80	.191	1402315.27	.802	8876.74	.005	225449.80	.129	234326.54	.134	1748011.41
2012	344722.29	.191	1448311.21	.802	9320.57	.005	236722.29	.131	246042.86	.136	1805723.68
2013	356558.41	.191	1495815.82	.802	9786.60	.005	248558.41	.133	258345.01	.138	1865530.43
2014	368986.33	.191	1544878.58	.801	10275.93	.005	260986.33	.135	271262.26	.141	1927510.44

ACQUISITION YEAR IS 1980
ACQUISITION COST IS 100000.00

YEAR	SALVAGE VALUE	DEPRECIATION	INSURANCE	INTEREST	MAINTENANCE
1980	86666.67	10000.00	4150.00	12116.20	875.00
1981	74285.71	10000.00	4166.60	10019.83	1067.59
1982	62857.14	10000.00	4183.27	7634.10	1260.19
1983	52380.95	10000.00	4200.00	4919.06	1452.78
1984	42857.14	10000.00	4216.80	1829.25	1645.37
1985	34285.71	10000.00	4233.67	0.00	1837.96
1986	26666.67	10000.00	4250.60	0.00	2030.56
1987	20000.00	10000.00	4267.60	0.00	2223.15
1988	14285.71	10000.00	4284.67	0.00	2415.74
1989	9523.81	10000.00	4301.81	0.00	2608.33
1990	5714.29	0.00	4319.02	0.00	2800.93
1991	2857.14	0.00	4336.30	0.00	2993.52
1992	952.38	0.00	4353.64	0.00	3186.11
1993	0.00	0.00	4371.06	0.00	3378.71
1994	0.00	0.00	4388.54	0.00	3571.30
1995	0.00	0.00	4406.09	0.00	3763.89
1996	0.00	0.00	4423.72	0.00	3956.48
1997	0.00	0.00	4441.41	0.00	4149.08
1998	0.00	0.00	4459.18	0.00	4341.67
1999	0.00	0.00	4477.02	0.00	4534.26
2000	0.00	0.00	4494.92	0.00	4726.86
2001	0.00	0.00	4512.90	0.00	4919.45
2002	0.00	0.00	4530.96	0.00	5112.04
2003	0.00	0.00	4549.08	0.00	5304.63
2004	0.00	0.00	4567.28	0.00	5497.23
2005	0.00	0.00	4585.54	0.00	5689.82
2006	0.00	0.00	4603.89	0.00	5882.41
2007	0.00	0.00	4622.30	0.00	6075.00
2008	0.00	0.00	4640.79	0.00	6267.60
2009	0.00	0.00	4659.35	0.00	6460.19
2010	0.00	0.00	4677.99	0.00	6652.78
2011	0.00	0.00	4696.70	0.00	6845.38
2012	0.00	0.00	4715.49	0.00	7037.97
2013	0.00	0.00	4734.35	0.00	7230.56
2014	0.00	0.00	4753.29	0.00	7423.15

C.4--Estimated Costs for the Retort Pouch Packaging System - Firm A

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 1830000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	156484.50	198834.41	355318.91	156484.50	196729.40	262853.11
1981	151536.22	210537.31	362073.53	151536.22	217602.11	283805.81
1982	137185.74	223163.74	360349.40	137185.74	241004.05	307127.75
1983	134664.58	236803.71	371468.30	134664.58	266993.54	333117.24
1984	125531.28	251556.69	377087.97	125531.28	295986.33	362110.03
1985	122645.05	264827.42	387472.48	122645.05	312720.28	378043.98
1986	115139.28	274745.34	389884.62	115139.28	312361.16	378484.06
1987	111986.59	282575.52	394562.11	111986.59	312050.07	378173.77
1988	108550.87	289021.06	397571.93	108550.87	311708.33	377912.03
1989	104931.54	294504.08	399435.62	104931.54	311577.30	377781.00
1990	101191.77	299293.40	400485.18	101191.77	311418.41	377542.11
1991	97444.33	303568.51	401012.84	97444.33	311313.19	377436.85
1992	93701.53	307453.86	401155.39	93701.53	311263.08	377386.70
1993	89972.08	311038.56	401010.65	89972.08	311269.80	377393.51
1994	86262.33	314388.17	400650.50	86262.33	311335.02	377458.72
1995	83119.37	317552.06	400671.43	83119.37	311460.49	377584.19
1996	80442.63	320568.18	401010.81	80442.63	311648.03	377771.73
1997	78153.89	323466.24	401620.13	78153.89	311899.56	378023.26
1998	76191.38	326269.89	402461.28	76191.38	312217.06	378340.76
1999	74505.71	328998.26	403503.97	74505.71	312602.61	378726.31
2000	73056.08	331666.99	404723.07	73056.08	313058.35	379182.05
2001	71812.17	334289.10	406101.27	71812.17	313586.54	379710.24
2002	70744.55	336875.51	407620.06	70744.55	314189.51	380313.21
2003	69831.48	339435.54	409267.02	69831.48	314869.68	380993.38
2004	69054.06	341977.17	411031.23	69054.06	315629.60	381753.30
2005	68396.27	344507.38	412903.64	68396.27	316471.90	382595.60
2006	67844.47	347032.28	414876.74	67844.47	317399.31	383523.01
2007	67386.97	349557.31	416944.28	67386.97	318414.70	384538.40
2008	67013.70	352087.36	419101.06	67013.70	319521.02	385644.72
2009	66715.93	354626.85	421342.78	66715.93	320721.37	386845.07
2010	66486.04	357179.85	423665.89	66486.04	322018.97	388142.67
2011	66317.39	359750.09	426067.48	66317.39	323417.15	389540.85
2012	66204.12	362341.07	428545.19	66204.12	324919.39	391043.09
2013	66141.08	364956.09	431097.17	66141.08	326529.31	392653.01
2014	66123.70	367598.25	433721.95	66123.70	328250.67	394374.37

OPERATING EXPENDITURES

YEAR	LABOR COSTS	P OF TOT	POUCH COSTS	P OF TOT	CARTON COSTS	P OF TOT	BEFORE FREIGHT COSTS	P OF TOT	AFTER FREIGHT COSTS	P OF TOT
1980	13478.40	.024	345600.00	.608	108000.00	.190	9676.80	.017	88603.20	.16
1981	13478.40	.023	348848.64	.608	108000.00	.188	9791.28	.017	90210.24	.16
1982	13478.40	.023	352127.82	.608	108000.00	.187	9911.48	.017	91897.63	.16
1983	13478.40	.023	355437.82	.608	108000.00	.185	10037.70	.017	93669.39	.16
1984	13478.40	.023	358778.93	.608	108000.00	.183	10170.22	.017	95529.74	.16
1985	13478.40	.023	362151.46	.608	108000.00	.181	10309.37	.017	97483.11	.16
1986	13478.40	.022	365555.68	.608	108000.00	.180	10455.48	.017	99534.15	.17
1987	13478.40	.022	368991.90	.608	108000.00	.178	10608.90	.017	101687.73	.17
1988	13478.40	.022	372460.43	.607	108000.00	.176	10769.98	.018	103949.00	.17
1989	13478.40	.022	375961.56	.607	108000.00	.174	10939.12	.018	106323.33	.17
1990	13478.40	.022	379495.59	.606	108000.00	.173	11116.72	.018	108816.36	.17
1991	13478.40	.021	383062.85	.606	108000.00	.171	11303.19	.018	111434.08	.18
1992	13478.40	.021	386663.64	.605	108000.00	.169	11498.99	.018	114182.66	.18
1993	13478.40	.021	390298.28	.604	108000.00	.167	11704.58	.018	117068.67	.18
1994	13478.40	.021	393967.09	.603	108000.00	.165	11920.45	.018	120098.99	.18
1995	13478.40	.020	397670.38	.602	108000.00	.163	12147.11	.018	123280.81	.19
1996	13478.40	.020	401408.48	.600	108000.00	.162	12385.11	.019	126621.74	.19
1997	13478.40	.020	405181.72	.599	108000.00	.160	12635.01	.019	130129.70	.19
1998	13478.40	.020	408990.43	.597	108000.00	.158	12897.40	.019	133813.07	.20
1999	13478.40	.019	412834.94	.596	108000.00	.156	13172.91	.019	137680.60	.20
2000	13478.40	.019	416715.58	.594	108000.00	.154	13462.19	.019	141741.51	.20
2001	13478.40	.019	420632.71	.592	108000.00	.152	13765.94	.019	146005.47	.21
2002	13478.40	.019	424586.66	.590	108000.00	.150	14084.88	.020	150482.62	.21
2003	13478.40	.018	428577.77	.588	108000.00	.148	14419.76	.020	155183.63	.21
2004	13478.40	.018	432606.40	.585	108000.00	.146	14771.39	.020	160119.69	.22
2005	13478.40	.018	436672.98	.583	108000.00	.144	15140.60	.020	165302.56	.22
2006	13478.40	.018	440777.63	.580	108000.00	.142	15528.27	.020	170744.56	.22
2007	13478.40	.017	444920.94	.577	108000.00	.140	15935.32	.021	176458.67	.23
2008	13478.40	.017	449103.20	.575	108000.00	.138	16362.73	.021	182458.49	.23
2009	13478.40	.017	453324.77	.571	108000.00	.136	16811.50	.021	188756.29	.24
2010	13478.40	.017	457586.02	.568	108000.00	.134	17282.72	.021	195373.09	.24
2011	13478.40	.016	461887.33	.565	108000.00	.132	17777.50	.022	202316.62	.25
2012	13478.40	.016	466229.07	.561	108000.00	.130	18297.01	.022	209611.43	.25
2013	13478.40	.016	470611.62	.558	108000.00	.128	18842.50	.022	217268.88	.26
2014	13478.40	.016	475035.37	.554	108000.00	.126	19415.27	.023	225309.21	.26

OPERATING EXPENDITURES

YEAR	NATURAL GAS COSTS	P OF TOT	ELECTRICITY COSTS	P OF TOT	FUEL OIL COSTS	P OF TOT	BEFORE ENERGY FREIGHT COSTS	P OF TOT	AFTER ENERGY FREIGHT COSTS	P OF TOT
1980	1879.17	.003	1250.75	.002	0.00	.000	2289.60	.004	32148.80	.057
1981	1973.13	.003	1313.28	.002	0.00	.000	2404.08	.004	33747.84	.059
1982	2071.78	.004	1376.95	.002	0.00	.000	2524.28	.004	35435.23	.061
1983	2175.37	.004	1447.89	.002	0.00	.000	2650.50	.005	37206.99	.064
1984	2284.14	.004	1520.29	.003	0.00	.000	2783.02	.005	39067.34	.066
1985	2398.35	.004	1596.30	.003	0.00	.000	2922.17	.005	41020.71	.069
1986	2518.27	.004	1676.12	.003	0.00	.000	3068.28	.005	43071.75	.072
1987	2644.18	.004	1759.92	.003	0.00	.000	3221.70	.005	45225.33	.074
1988	2776.39	.005	1847.92	.003	0.00	.000	3382.78	.006	47486.60	.077
1989	2915.21	.005	1940.32	.003	0.00	.000	3551.92	.006	49860.93	.080
1990	3060.97	.005	2037.33	.003	0.00	.000	3729.52	.006	52353.98	.084
1991	3214.02	.005	2139.20	.003	0.00	.000	3915.99	.006	54971.68	.087
1992	3374.72	.005	2246.16	.004	0.00	.000	4111.79	.006	57720.26	.090
1993	3543.45	.005	2358.47	.004	0.00	.000	4317.38	.007	60606.27	.094
1994	3720.62	.006	2476.39	.004	0.00	.000	4533.25	.007	63636.59	.097
1995	3906.66	.006	2600.21	.004	0.00	.000	4759.91	.007	66818.41	.101
1996	4101.99	.006	2730.22	.004	0.00	.000	4997.91	.007	70159.34	.105
1997	4307.09	.006	2866.73	.004	0.00	.000	5247.81	.008	73667.30	.109
1998	4522.44	.007	3010.07	.004	0.00	.000	5510.20	.008	77350.67	.113
1999	4748.56	.007	3160.57	.005	0.00	.000	5785.71	.008	81218.20	.117
2000	4985.99	.007	3318.60	.005	0.00	.000	6074.99	.009	85279.11	.122
2001	5235.29	.007	3484.53	.005	0.00	.000	6378.74	.009	89543.07	.126
2002	5497.06	.008	3658.76	.005	0.00	.000	6697.68	.009	94020.22	.131
2003	5771.91	.008	3841.69	.005	0.00	.000	7032.56	.010	98721.23	.135
2004	6060.51	.008	4033.78	.005	0.00	.000	7384.19	.010	103657.29	.140
2005	6363.53	.008	4235.47	.006	0.00	.000	7753.40	.010	108840.16	.145
2006	6681.71	.009	4447.24	.006	0.00	.000	8141.07	.011	114282.16	.150
2007	7015.79	.009	4669.60	.006	0.00	.000	8548.12	.011	119996.27	.156
2008	7366.58	.009	4903.08	.006	0.00	.000	8975.53	.011	125996.09	.161
2009	7734.91	.010	5148.24	.006	0.00	.000	9424.30	.012	132295.89	.167
2010	8121.66	.010	5405.65	.007	0.00	.000	9895.52	.012	138910.69	.173
2011	8527.74	.010	5675.93	.007	0.00	.000	10390.30	.013	145856.22	.178
2012	8954.13	.011	5959.73	.007	0.00	.000	10909.81	.013	153149.03	.184
2013	9401.83	.011	6257.71	.007	0.00	.000	11455.30	.014	160806.48	.191
2014	9871.92	.012	6570.60	.008	0.00	.000	12028.07	.014	168846.81	.197

OPERATING EXPENDITURES

YEAR	TOTAL FREIGHT COSTS	P OF TOT	TOTAL PACKAGES COSTS	P OF TOT	TOTAL ENERGY PROCESSING COSTS	P OF TOT	TOTAL ENERGY FREIGHT COSTS	P OF TOT	TOTAL ENERGY COSTS	P OF TOT	TOTAL COSTS
1980	98280.00	.173	453680.00	.798	3129.91	.006	34430.40	.061	37560.31	.066	568486.31
1981	100001.52	.174	456040.64	.796	3286.41	.006	36151.92	.063	39438.33	.069	573614.97
1982	101809.12	.176	460127.02	.795	3450.73	.006	37959.52	.066	41410.25	.072	578866.06
1983	103707.09	.178	463437.82	.793	3623.27	.006	39857.49	.068	43480.76	.074	584246.50
1984	105699.97	.179	466778.93	.791	3804.43	.006	41850.37	.071	45654.80	.077	589761.73
1985	107792.40	.181	470151.46	.790	3994.65	.007	43942.88	.074	47937.54	.081	595416.99
1986	109989.63	.183	473555.68	.788	4194.38	.007	46140.03	.077	50334.41	.084	601218.09
1987	112296.63	.185	476991.90	.786	4404.10	.007	48447.03	.080	52851.13	.087	607171.04
1988	114710.98	.187	480460.43	.783	4624.31	.008	50869.38	.083	55493.69	.090	613282.12
1989	117262.45	.189	483961.56	.781	4855.52	.008	53412.85	.086	58268.37	.094	619557.93
1990	119933.09	.192	487495.59	.779	5098.30	.008	56083.49	.090	61181.79	.098	626005.39
1991	122737.27	.194	491062.85	.776	5353.21	.008	58887.67	.093	64240.88	.102	632631.73
1992	125681.65	.197	494663.64	.774	5620.87	.009	61832.05	.097	67452.93	.105	639444.57
1993	128773.25	.199	498298.28	.771	5901.92	.009	64923.65	.100	70825.57	.110	646481.85
1994	132019.44	.202	501967.89	.768	6197.01	.009	68169.84	.104	74366.85	.114	653661.94
1995	135427.93	.205	505670.38	.765	6506.07	.010	71578.33	.108	78085.19	.118	661083.57
1996	139006.85	.208	509408.48	.762	6832.21	.010	75157.25	.112	81989.45	.123	668725.93
1997	142764.71	.211	513181.72	.758	7173.82	.011	78915.11	.117	86088.93	.127	676598.64
1998	146710.46	.214	516990.43	.755	7532.51	.011	82860.86	.121	90393.37	.132	684711.80
1999	150853.51	.218	520834.94	.751	7989.14	.011	87603.91	.126	94913.04	.137	693075.98
2000	155203.70	.221	524715.58	.748	8304.59	.012	91354.10	.130	99658.69	.142	701782.28
2001	159771.41	.225	528632.71	.744	8719.82	.012	95921.81	.135	104641.63	.147	710682.34
2002	164567.50	.229	532586.66	.740	9155.81	.013	100717.90	.140	109873.71	.153	719788.37
2003	169603.39	.233	536577.77	.736	9613.60	.013	105753.79	.145	115367.40	.158	729273.17
2004	174891.08	.237	540606.40	.731	10094.28	.014	111041.48	.150	121135.76	.164	739070.17
2005	180443.16	.241	544672.90	.727	10599.00	.014	116593.56	.156	127192.55	.170	749193.46
2006	186272.63	.245	548777.63	.722	11128.95	.015	122423.23	.161	133552.18	.176	759657.81
2007	192393.99	.250	552920.94	.718	11685.40	.015	128544.39	.167	140229.79	.182	770478.73
2008	198821.21	.254	557103.20	.713	12269.67	.016	134971.61	.173	147241.28	.188	781672.47
2009	205569.80	.259	561324.77	.708	12883.15	.016	141720.20	.179	154603.34	.195	793256.11
2010	212655.80	.264	565586.02	.702	13527.31	.017	148606.20	.185	162333.51	.202	805247.53
2011	220096.11	.269	569887.33	.697	14203.67	.017	156246.51	.191	170450.19	.208	817665.51
2012	227908.44	.274	574229.07	.691	14913.85	.018	164058.84	.199	178972.70	.215	830529.76
2013	236111.38	.281	578611.62	.686	15659.55	.019	172261.78	.204	187921.33	.223	843860.95
2014	244724.47	.285	583035.37	.680	16442.52	.019	180874.87	.211	197317.40	.230	857680.77

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 1830000.00

YEAR	SALVAGE VALUE	DEPRECIATION	INSURANCE	INTEREST	MAINTENANCE
1980	1586000.00	183000.00	21450.00	221726.44	9525.00
1981	1359428.57	183000.00	21535.80	183362.93	12807.37
1982	1150285.71	183000.00	21621.94	139704.01	16089.75
1983	958571.43	183000.00	21708.43	90018.74	19372.12
1984	784285.71	183000.00	21795.26	33475.29	22654.49
1985	627428.57	183000.00	21882.45	0.00	25936.86
1986	488000.00	183000.00	21969.98	0.00	29219.24
1987	366000.00	183000.00	22057.86	0.00	32501.61
1988	261428.57	183000.00	22146.09	0.00	35783.98
1989	174285.71	183000.00	22234.67	0.00	39066.35
1990	104571.43	0.00	22323.61	0.00	42348.73
1991	52285.71	0.00	22412.90	0.00	45631.10
1992	17428.57	0.00	22502.56	0.00	48913.47
1993	0.00	0.00	22592.57	0.00	52195.85
1994	0.00	0.00	22682.94	0.00	55478.22
1995	0.00	0.00	22773.67	0.00	58760.59
1996	0.00	0.00	22864.76	0.00	62042.96
1997	0.00	0.00	22956.22	0.00	65325.34
1998	0.00	0.00	23048.05	0.00	68607.71
1999	0.00	0.00	23140.24	0.00	71890.08
2000	0.00	0.00	23232.80	0.00	75172.46
2001	0.00	0.00	23325.73	0.00	78454.83
2002	0.00	0.00	23419.03	0.00	81737.20
2003	0.00	0.00	23512.71	0.00	85019.57
2004	0.00	0.00	23606.76	0.00	88301.95
2005	0.00	0.00	23701.19	0.00	91584.32
2006	0.00	0.00	23795.99	0.00	94866.69
2007	0.00	0.00	23891.18	0.00	98149.06
2008	0.00	0.00	23986.74	0.00	101431.44
2009	0.00	0.00	24082.69	0.00	104713.81
2010	0.00	0.00	24179.02	0.00	107996.18
2011	0.00	0.00	24275.74	0.00	111278.56
2012	0.00	0.00	24372.84	0.00	114560.93
2013	0.00	0.00	24470.33	0.00	117843.30
2014	0.00	0.00	24568.21	0.00	121125.67

C.5--Estimated Costs for the Retort Pouch Packaging System Using Preformed Pouches - Firm A

ACQUISITION YEAR IS 1980
ACQUISITION COST IS 1030000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	88164.50	285804.70	373969.20	88164.50	282778.97	320137.23
1981	85381.05	293143.80	378524.85	85381.05	294231.20	331589.47
1982	77305.64	301010.25	378315.88	77305.64	307034.89	344393.16
1983	75888.26	309454.89	385343.14	75888.26	321358.37	358716.63
1984	70749.28	318533.91	389283.19	70749.28	337391.05	374749.32
1985	69126.41	326786.82	395913.23	69126.41	346543.24	383901.51
1986	64903.46	333160.99	398064.45	64903.46	346094.51	383452.78
1987	63130.60	338368.69	401499.29	63130.60	345693.10	383051.36
1988	61198.44	342805.89	404004.33	61198.44	345340.26	382698.53
1989	59162.93	346710.39	405873.32	59162.93	345037.32	382395.59
1990	57059.62	350233.79	407293.41	57059.62	344785.67	382143.93
1991	54951.99	353477.33	408429.32	54951.99	344586.73	381945.00
1992	52846.96	356511.35	409358.31	52846.96	344442.01	381800.28
1993	50749.45	359386.27	410135.72	50749.45	344353.08	381711.35
1994	48663.01	362139.29	410802.30	48663.01	344321.56	381679.83
1995	46895.58	364798.48	411694.07	46895.58	344349.16	381707.42
1996	45390.56	367385.52	412776.08	45390.56	344437.64	381795.91
1997	44103.91	369917.45	414021.36	44103.91	344588.85	381947.12
1998	43000.87	372407.90	415408.78	63000.87	344804.72	382162.99
1999	42053.65	374867.99	416921.64	42053.65	345087.25	382445.51
2000	41239.72	377306.88	418546.60	41239.72	345438.52	382796.78
2001	40540.67	379732.27	420272.93	40540.67	345860.70	383218.96
2002	39941.28	382150.67	422091.95	39941.28	346356.06	383714.32
2003	39428.89	384567.73	423996.62	39428.89	346926.95	384285.21
2004	38992.83	386988.35	425981.18	38992.83	347575.82	384934.09
2005	38624.10	389416.88	428040.98	38624.10	348305.23	385663.49
2006	38315.02	391857.20	430172.22	38315.02	349117.82	386476.09
2007	38059.01	394312.83	432371.84	38059.01	350016.37	387374.64
2008	37850.41	396786.98	434637.39	37850.41	351003.75	388362.02
2009	37684.29	399282.64	436966.92	37684.29	352082.96	389441.22
2010	37556.37	401802.58	439358.95	37556.37	353257.09	390615.36
2011	37462.91	404349.46	441812.37	37462.91	354529.41	391887.67
2012	37400.62	406925.76	444326.38	37400.62	355903.26	393261.53
2013	37366.60	409533.91	446900.51	37366.60	357382.17	394740.44
2014	37358.27	412176.24	449534.51	37358.27	358969.78	396328.05

C.6--Estimated Costs for the Retort Pouch Packaging System Using Roll Stock Material at a Filling Machine Rate of 40 PPM - Firm A

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 2400000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	205162.50	169369.87	374532.37	205162.50	167576.79	254195.87
1981	198671.78	184297.54	382969.32	198671.78	195185.61	281804.69
1982	179850.32	200431.19	380281.51	179850.32	225089.34	312500.41
1983	176542.72	217888.75	394431.46	176542.72	260078.88	346697.98
1984	164563.46	236800.47	401363.93	164563.46	298194.23	384813.31
1985	160777.09	253762.63	414539.72	160777.09	320219.13	406838.20
1986	150932.30	266321.84	417254.14	150932.30	319013.23	406432.30
1987	146796.47	276137.07	422933.54	146796.47	319456.29	406075.36
1988	142289.47	284130.22	426419.69	142289.47	319149.63	405768.70
1989	137541.68	290854.71	428396.39	137541.68	318894.63	405513.70
1990	132635.93	296662.94	429298.87	132635.93	318692.74	405311.81
1991	127720.12	301790.08	429510.20	127720.12	318545.46	405164.53
1992	122810.40	306399.15	429209.56	122810.40	318454.36	405073.43
1993	117918.21	310606.83	428525.04	117918.21	318421.07	405040.15
1994	113051.84	314498.88	427550.72	113051.84	318447.31	405066.38
1995	108920.82	318139.81	427060.63	108920.82	318534.83	405153.90
1996	105417.23	321579.19	426996.42	105417.23	318685.50	405304.57
1997	102414.50	324855.73	427270.23	102414.50	318901.24	405520.31
1998	99839.62	328000.22	427839.84	99839.62	319184.06	405803.13
1999	97627.81	331037.46	428665.27	97627.81	319536.04	406155.12
2000	95726.61	333987.75	429714.36	95726.61	319959.38	406578.45
2001	94093.12	336867.85	430960.97	94093.12	320456.34	407075.41
2002	92691.87	339691.84	432383.71	92691.87	321029.27	407648.34
2003	91493.33	342471.61	433964.94	91493.33	321680.64	408299.71
2004	90472.69	345217.36	435690.04	90472.69	322413.00	409032.07
2005	89608.94	347937.90	437546.84	89608.94	323229.01	409848.09
2006	88884.20	350640.95	439525.15	88884.20	324131.46	410750.53
2007	88283.14	353333.31	441616.45	88283.14	325123.22	411742.30
2008	87792.55	356021.02	443813.57	97792.55	326207.30	412826.37
2009	87400.97	358709.54	446110.51	87400.97	327386.81	414005.88
2010	87098.43	361403.82	448502.25	87098.43	328665.00	415284.08
2011	86876.20	364108.38	450984.58	86876.20	330045.27	416664.34
2012	86726.61	366827.41	453554.02	86726.61	331531.11	418150.18
2013	86642.90	369564.80	456207.70	86642.90	333126.19	419745.26
2014	86619.07	372324.23	458943.30	86619.07	334834.32	421453.39

C.7--Estimated Costs for the Retort Pouch Packaging System Using Preformed Pouches at a Filling Machine Rate of 40 PPM - Firm A

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 1450000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	124032.50	266214.23	390246.73	124032.50	263395.09	315056.01
1981	120112.51	275926.51	396039.02	120112.51	279724.58	332184.70
1982	108742.69	286374.25	395116.94	108742.69	297939.73	350399.85
1983	106745.63	297628.86	404374.68	106745.83	318277.90	370730.02
1984	99509.83	309769.23	409279.06	99509.83	341085.32	393465.44
1985	97223.70	320739.13	417962.83	97223.70	354829.24	406489.36
1986	91277.26	329056.51	420333.77	91277.26	353519.46	405979.58
1987	88779.99	335723.85	424503.84	88779.99	353057.96	405510.08
1988	86058.47	341298.35	427356.82	86058.47	352646.01	405106.13
1989	83191.45	346114.59	429306.04	83191.45	352284.93	404745.05
1990	80229.00	350385.70	430614.70	80229.00	351976.11	404436.23
1991	77260.47	354253.99	431514.46	77260.47	351720.99	404181.11
1992	74295.61	357818.20	432113.81	74295.61	351521.09	403981.21
1993	71341.33	361149.07	432490.41	71341.33	351377.97	403838.08
1994	68402.65	364298.67	432701.33	68402.65	351293.27	403753.39
1995	65913.07	367306.26	433219.33	65913.07	351268.70	403728.82
1996	63792.90	370202.04	433994.94	63792.90	351306.04	403766.16
1997	61980.15	373009.70	434989.85	61980.15	351407.16	403867.28
1998	60425.89	375748.14	436174.03	60425.89	351573.97	404034.09
1999	59090.98	378432.66	437523.64	59090.98	351808.49	404268.61
2000	57943.73	381075.81	439019.54	57943.73	352112.03	404572.95
2001	56958.21	383688.09	440646.30	56958.21	352489.17	404949.29
2002	56113.00	386278.32	442391.32	56113.00	352939.78	405399.90
2003	55390.25	388854.06	444244.31	55390.25	353467.03	405927.15
2004	54774.98	391421.02	446196.00	54774.98	354073.39	406533.51
2005	54254.49	393987.32	448241.81	54254.49	354761.43	407221.55
2006	53817.98	396555.61	450373.59	53817.98	355533.01	407993.93
2007	53456.19	399131.20	452587.39	53456.19	356393.33	408853.45
2008	53161.14	401718.18	454879.32	53161.14	357342.87	409802.99
2009	52925.90	404320.28	457246.18	52925.90	358385.45	410845.57
2010	52744.45	406940.95	459685.39	52744.45	359524.21	411984.33
2011	52611.51	409583.38	462194.89	52611.51	360762.40	413222.52
2012	52522.46	412250.59	464773.05	52522.46	362103.42	414563.54
2013	52473.20	414945.45	467418.65	52473.20	363550.00	416018.92
2014	52468.12	417670.70	470130.82	52468.12	365108.21	417568.32

C.8--Estimated Costs for the Retort Pouch Packaging System Without Investment Credit Allowance - Firm A

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 1830000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	156484.50	198834.41	355318.91	156484.50	196729.40	265677.23
1981	151536.22	210537.31	362073.53	151536.22	217682.11	286629.94
1982	146638.80	223163.74	369802.54	146638.80	241804.85	309951.88
1983	141791.97	236803.71	378595.69	141791.97	266993.54	335941.37
1984	136995.46	251556.69	388552.15	136995.46	295986.33	364934.16
1985	132249.01	264827.42	397076.44	132249.01	312720.28	381668.11
1986	127552.35	274745.34	402297.69	127552.35	312361.16	381308.99
1987	122905.21	282575.52	405480.73	122905.21	312050.07	380997.90
1988	118307.31	289021.06	407328.38	118307.31	311788.33	380736.16
1989	113758.40	294504.08	408262.48	113758.40	311577.30	380525.13
1990	109258.21	299293.40	408551.61	109258.21	311418.41	380356.24
1991	104877.21	303568.51	408445.72	104877.21	311313.15	380260.98
1992	100598.44	307453.86	408052.30	100598.44	311263.08	380210.91
1993	96409.71	311038.56	407448.28	96409.71	311269.80	380217.64
1994	92302.02	314388.17	406690.19	92302.02	311335.02	380282.85
1995	88810.96	317552.06	406363.02	88810.96	311460.49	380498.32
1996	85827.16	320568.18	406395.34	85827.16	311648.03	380595.66
1997	83265.57	323466.24	406731.81	83265.57	311899.56	380847.39
1998	81059.02	326269.89	407328.91	81059.02	312217.06	381164.89
1999	79153.79	328998.26	408152.04	79153.79	312602.61	381550.44
2000	77506.38	331666.99	409173.37	77506.38	313058.35	382006.18
2001	76081.21	334289.10	410370.31	76081.21	313586.54	382534.37
2002	74848.89	336875.51	411724.41	74848.89	314189.51	383137.34
2003	73784.93	339435.54	413220.46	73784.93	314869.68	383817.51
2004	72868.74	341977.17	414845.91	72868.74	315629.60	384577.43
2005	72082.91	344507.38	416590.29	72082.91	316471.90	385419.73
2006	71412.62	347032.28	418444.89	71412.62	317399.31	386347.14
2007	70845.15	349557.31	420402.46	70845.15	318414.70	387362.53
2008	70369.55	352087.36	422456.91	70369.55	319521.02	388468.85
2009	69976.31	354626.85	424603.17	69976.31	320721.37	389669.20
2010	69657.18	357179.85	426837.03	69657.18	322018.97	390966.80
2011	69404.90	359750.09	429154.99	69404.90	323417.15	392364.98
2012	69213.13	362341.07	431554.20	69213.13	324919.39	393867.22
2013	69076.25	364956.09	434032.33	69076.25	326529.31	395477.14
2014	68989.29	367598.25	436587.54	68989.29	328250.67	397198.50

C.9--Estimated Costs for the New Canning System Without Investment Credit Allowance - Firm A

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 100000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	8742.50	362164.32	370906.82	8742.50	358331.19	362425.23
1981	8475.65	367967.33	376442.99	8475.65	365959.11	370034.05
1982	8211.58	373922.97	382134.54	8211.58	373895.18	377970.22
1983	7950.25	380038.42	387988.67	7950.25	382159.39	386234.43
1984	7691.66	386321.46	394013.12	7691.66	390774.47	394849.51
1985	7435.79	392632.64	400068.44	7435.79	398911.06	402986.10
1986	7182.63	398872.20	406054.83	7182.63	406309.75	410384.78
1987	6932.17	405111.76	412043.93	6932.17	413912.09	417987.13
1988	6684.38	411392.32	418076.70	6684.38	421723.20	425798.24
1989	6439.26	417739.57	424178.83	6439.26	429748.33	433823.37
1990	6196.78	424170.89	430367.68	6196.78	437992.87	442067.91
1991	5960.81	430698.87	436659.68	5960.81	446462.40	450537.44
1992	5730.41	437333.12	443063.53	5730.41	455162.63	459237.67
1993	5504.92	444081.43	449586.35	5504.92	464099.44	468174.48
1994	5283.84	450950.36	456234.20	5283.84	473278.90	477353.94
1995	5096.45	457945.65	463042.10	5096.45	482707.24	486782.28
1996	4936.77	465072.51	470009.28	4936.77	492390.88	496465.92
1997	4800.14	472335.79	477135.92	4800.14	502336.42	506411.46
1998	4682.90	479740.05	484422.95	4682.90	512550.66	516625.69
1999	4582.11	487289.73	491871.84	4582.11	523040.59	527115.63
2000	4495.40	494989.14	499484.54	4495.40	533813.42	537888.46
2001	4420.82	502842.55	507263.37	4420.82	544876.57	548951.61
2002	4356.77	510854.20	515210.97	4356.77	556237.66	560312.70
2003	4301.91	519028.33	523330.23	4301.91	567904.56	571979.60
2004	4255.10	527369.22	531624.32	4255.10	579885.37	583960.41
2005	4215.41	535881.19	540096.60	4215.41	592188.41	596263.44
2006	4182.02	544568.60	548750.62	4182.02	604822.26	608897.30
2007	4154.23	553435.90	557590.14	4154.23	617795.76	621870.80
2008	4131.46	562487.61	566619.07	4131.46	631118.02	635193.06
2009	4113.17	571728.33	575841.50	4113.17	644798.41	648873.45
2010	4098.91	581162.76	585261.68	4098.91	658846.58	662921.61
2011	4088.30	590795.71	594884.01	4088.30	673272.47	677347.51
2012	4080.98	600632.98	604713.07	4080.98	688086.33	692161.37
2013	4076.65	610676.90	614753.55	4076.65	703298.71	707373.75
2014	4075.04	620935.31	625010.35	4075.04	718920.49	722995.53

C.10--Estimated Costs for the Retort Pouch Packaging System Without Interest Deductions - Firm A

ACQUISITION YEAR IS 1980
ACQUISITION COST IS 1830000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	156484.50	318566.69	475051.19	156484.50	315194.11	381317.81
1981	151536.22	319946.56	471502.78	151536.22	314612.68	380736.38
1982	137185.74	321383.67	458569.41	137185.74	314073.56	380197.2[illegible]
1983	134664.58	322818.48	457483.07	134664.58	313577.63	3797[illegible]1.33
1984	125531.28	324271.51	449802.80	125531.28	313126.17	379249.87
1985	122645.05	325743.27	448388.33	122645.05	312720.28	378843.98
1986	115139.28	327234.30	442373.58	115139.28	312361.16	378484.86
1987	111986.59	328745.16	440731.74	111986.59	312050.07	378173.77
1988	108550.87	330276.41	438827.28	108550.87	311788.33	377912.[illegible]3
1989	104931.54	331828.65	436760.20	104931.54	311577.30	377701.00
1990	101191.77	333402.51	434594.28	101191.77	311418.41	377542.11
1991	97444.33	334998.61	432442.94	97444.33	311313.15	377436.85
1992	93701.53	336617.63	430319.15	93701.53	311263.08	377386.78
1993	89972.08	338260.23	428232.31	89972.08	311269.80	377393.51
1994	86262.33	339927.13	426189.46	86262.33	311335.02	377458.72
1995	83119.37	341619.07	424738.44	83119.37	311460.49	377584.19
1996	80442.63	343336.81	423779.43	80442.63	311648.03	377771.73
1997	78153.89	345081.10	423234.99	78153.89	311899.56	378023.26
1998	76191.38	346852.81	423044.19	76191.38	312217.06	37834[illegible].76
1999	74505.71	348652.74	423158.45	74505.71	312607.41	378726.31
2000	73056.88	350481.78	423538.66	73056.88	313058.35	379182.05
2001	71812.17	352340.84	424153.01	71812.17	313586.54	37971[illegible].24
2002	70744.55	354230.84	424975.39	70744.55	314189.51	380313.21
2003	69831.48	356152.77	425984.25	69831.48	314869.68	380993.38
2004	69054.06	3581[illegible]7.62	427161.68	69054.06	315629.60	381753.3
2005	68396.27	360096.43	428492.70	68396.27	316471.90	382595.6
2006	67844.47	362120.29	429964.76	67844.47	317399.31	383523.01
2007	67386.97	364180.31	431567.28	67386.97	318414.70	384538.4
2008	67013.70	366277.64	433291.34	67013.70	319521.02	385644.72
2009	66715.93	368413.68	435129.41	66715.93	320721.37	386845.[illegible]7
2010	66486.04	370589.08	437075.12	66486.04	322018.97	388142.67
2011	66317.39	372805.72	439123.11	66317.39	323417.15	389540.85
2012	66204.12	375064.73	441268.85	66204.12	324919.39	391043.09
2013	66141.08	377367.50	443508.58	66141.08	326529.31	392653.01
2014	66123.70	379715.45	445839.15	66123.70	328250.67	394374.37

C.11--Estimated Costs for the New Canning System Without Interest Deductions - Firm A

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 100000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	8742.50	368707.07	377449.57	8742.50	364083.67	368719.93
1981	8475.65	373947.07	382422.73	8475.65	371255.76	375172.02
1982	7695.02	379290.18	386985.19	7695.02	377080.05	381004.31
1983	7560.77	384738.68	392299.46	7560.77	384704.97	388621.73
1984	7065.20	390294.95	397360.15	7065.20	391711.08	395627.34
1985	6910.99	395961.38	402872.36	6910.99	398911.06	402827.32
1986	6504.32	401740.45	408244.77	6504.32	406309.75	410226.01
1987	6335.52	407634.70	413970.22	6335.52	413912.09	417828.35
1988	6151.24	413646.71	419797.95	6151.24	421723.20	425639.46
1989	5956.92	419779.16	425736.08	5956.92	429748.33	433664.59
1990	5756.00	426034.70	431790.70	5756.00	437992.07	441909.14
1991	5554.64	432416.36	437971.00	5554.64	446462.40	450378.66
1992	5353.53	438926.77	444280.30	5353.53	455162.63	459078.89
1993	5153.14	445560.95	450722.09	5153.14	464099.44	468015.70
1994	4953.81	452345.93	457299.73	4953.81	473278.90	477195.17
1995	4785.44	459260.79	464046.22	4785.44	482707.24	486623.51
1996	4642.53	466316.70	470959.23	4642.53	492390.88	496307.14
1997	4520.81	473516.93	478037.74	4520.81	502336.42	506252.68
1998	4416.91	480864.80	485281.71	4416.91	512550.66	516466.92
1999	4328.12	488363.74	492691.86	4328.12	523040.59	526956.85
2000	4252.26	496017.27	500269.53	4252.26	533813.42	537729.68
2001	4187.54	503828.98	508016.53	4187.54	544876.57	548792.83
2002	4132.49	511802.57	515935.06	4132.49	556237.66	560153.92
2003	4085.87	519941.84	524027.71	4085.87	567904.56	571820.83
2004	4046.65	528250.67	532297.32	4046.65	579885.37	583801.63
2005	4013.95	536733.05	540747.00	4013.95	592188.41	596104.67
2006	3987.04	545393.08	549380.12	3987.04	604822.26	608738.52
2007	3965.26	554234.97	558200.24	3965.26	617795.76	621712.03
2008	3948.08	563263.04	567211.11	3948.08	631118.02	635034.29
2009	3935.00	572481.70	576416.70	3935.00	644798.41	648714.67
2010	3925.63	581895.51	585821.14	3925.63	658846.50	662762.84
2011	3919.59	591509.13	595428.72	3919.59	673272.47	677188.73
2012	3916.56	601327.36	605243.92	3916.56	688086.33	692002.59
2013	3916.26	611355.12	615271.38	3916.26	703298.71	707214.97
2014	3918.45	621997.45	625915.90	3918.45	718920.49	722836.75

C.12--Estimated Costs for the Existing Canning System - Firm B

YEAR	AMORTIZED PRODUCTION COSTS	PV TOTAL COSTS	MAINTENANCE
1980	902639.64	893083.65	15700.00
1981	915478.27	908899.76	16285.83
1982	928567.01	925149.92	16871.66
1983	941911.47	941845.10	17457.49
1984	955517.41	958996.60	18043.32
1985	969390.74	976616.02	18629.15
1986	983537.51	994715.30	19214.98
1987	997963.91	1013306.74	19800.81
1988	1012676.31	1032402.96	20386.65
1989	1027681.23	1052016.98	20972.48
1990	1042985.35	1072162.17	21558.31
1991	1058595.53	1092852.29	22144.14
1992	1074518.80	1114101.51	22729.97
1993	1090762.36	1135924.40	23315.80
1994	1107333.62	1158335.97	23901.63
1995	1124240.15	1181351.65	24487.46
1996	1141489.74	1204987.33	25073.29
1997	1159090.36	1229259.36	25659.12
1998	1177050.21	1254184.57	26244.95
1999	1195377.67	1279780.31	26830.78
2000	1214081.37	1306064.40	27416.61
2001	1233170.15	1333055.22	28002.44
2002	1252653.09	1360771.67	28588.28
2003	1272539.48	1389233.23	29174.11
2004	1292838.90	1418459.95	29759.94
2005	1313561.14	1448472.48	30345.77
2006	1334716.28	1479292.10	30931.60
2007	1356314.64	1510940.69	31517.43
2008	1378366.84	154344[illegible].82	32103.26
2009	1400883.76	1576815.74	32689.09
2010	1423876.59	1611089.37	33274.92
2011	1447356.80	1646286.39	3386[illegible].75
2012	1471336.18	1682432.21	34446.58
2013	1495826.83	1719553.00	35032.41
2014	1520841.20	1757675.74	35618.24

OPERATING EXPENDITURES

YEAR	LABOR COSTS	P OF TOT	CAN COSTS	P OF TOT	BEFORE FREIGHT COSTS	P OF TOT	AFTER FREIGHT COSTS	P OF TOT	INSURANCE
1980	20217.60	.012	1237524.48	.750	84395.52	.051	294036.48	.178	6900.00
1981	20217.60	.012	1278115.28	.754	85022.78	.050	299370.82	.177	6927.65
1982	20217.60	.012	1320037.46	.756	85681.41	.049	304971.87	.175	6955.31
1983	20217.60	.011	1363334.69	.759	86372.97	.048	310852.97	.173	6983.13
1984	20217.60	.011	1408052.07	.762	87099.11	.047	317028.13	.172	7011.06
1985	20217.60	.011	1454236.18	.765	87861.55	.046	323512.05	.170	7039.11
1986	20217.60	.010	1501935.13	.767	88662.12	.045	330320.17	.169	7067.26
1987	20217.60	.010	1551198.60	.769	89502.71	.044	337468.69	.167	7095.53
1988	20217.60	.010	1602077.91	.772	90385.33	.044	344974.64	.166	7123.92
1989	20217.60	.009	1654626.07	.774	91312.09	.043	352855.88	.165	7152.41
1990	20217.60	.009	1708897.80	.776	92285.18	.042	361131.18	.164	7181.02
1991	20217.60	.009	1764949.65	.777	93306.93	.041	369820.26	.163	7209.75
1992	20217.60	.009	1822840.00	.779	94379.76	.040	378943.78	.162	7238.58
1993	20217.60	.008	1882629.15	.781	95506.24	.040	388523.48	.161	7267.54
1994	20217.60	.008	1944379.39	.782	96689.04	.039	398582.17	.160	7296.61
1995	20217.60	.008	2008155.03	.784	97930.98	.038	409143.79	.160	7325.80
1996	20217.60	.008	2074022.52	.785	99235.01	.038	420233.49	.159	7355.10
1997	20217.60	.007	2142050.45	.786	100604.25	.037	431877.68	.159	7384.52
1998	20217.60	.007	2212309.71	.787	102041.95	.036	444104.07	.158	7414.06
1999	20217.60	.007	2284873.47	.788	103551.54	.036	456941.79	.158	7443.71
2000	20217.60	.007	2359817.32	.789	105136.60	.035	470421.39	.157	7473.49
2001	20217.60	.007	2437219.33	.790	106800.92	.035	484574.97	.157	7503.38
2002	20217.60	.006	2517160.12	.791	108548.45	.034	499436.23	.157	7533.40
2003	20217.60	.006	2599722.97	.791	110383.37	.034	515040.55	.157	7563.53
2004	20217.60	.006	2684993.88	.792	112310.02	.033	531425.09	.157	7593.78
2005	20217.60	.006	2773061.68	.792	114333.01	.033	548628.86	.157	7624.16
2006	20217.60	.006	2864018.11	.793	116457.15	.032	566692.82	.157	7654.66
2007	20217.60	.005	2957957.90	.793	118687.49	.032	585659.97	.157	7685.27
2008	20217.60	.005	3054978.92	.793	121029.36	.031	605575.48	.157	7716.01
2009	20217.60	.005	3155182.23	.793	123488.31	.031	626486.77	.157	7746.86
2010	20217.60	.005	3258672.21	.793	126070.22	.031	648443.62	.158	7777.87
2011	20217.60	.005	3365556.65	.793	128781.22	.030	671498.31	.158	78[illegible]8.98
2012	20217.60	.005	3475946.91	.793	131627.76	.030	6957[illegible]5.74	.159	784[illegible].21
2013	20217.60	.004	3589957.97	.793	134616.64	.030	721123.54	.159	7871.57
2014	20217.60	.004	3707778.59	.792	137754.96	.029	747812.22	.160	7903.06

OPERATING EXPENDITURES

YEAR	NATURAL GAS COSTS	P OF TOT	ELECTRICITY COSTS	P OF TOT	FUEL OIL COSTS	P OF TOT	BEFORE ENERGY FREIGHT COSTS	P OF TOT	AFTER ENERGY FREIGHT COSTS	P OF TOT
1980	12[illegible].69	.008	1[illegible]0.12	.000	0.00	.000	12545.28	.008	106686.72	.065
1981	13314.72	.008	1[illegible]5.13	.000	0.00	.000	13172.54	.008	112[illegible]21.06	.066
1982	139[illegible].46	.008	11[illegible].39	.000	0.00	.000	13831.17	.008	117622.11	.067
1983	14679.48	.008	115.91	.000	0.00	.000	14522.73	.008	123503.21	.069
1984	15413.45	.008	121.70	.000	0.00	.000	15248.87	.008	129678.37	.070
1985	16184.13	.009	127.79	.000	0.00	.000	16011.31	.008	136162.29	.072
1986	16993.33	.009	134.18	.000	0.00	.000	16811.88	.009	142970.41	.073
1987	17843.00	.009	140.89	.000	0.00	.000	17652.47	.009	150118.93	.074
1988	18735.15	.009	147.93	.000	0.00	.000	18535.09	.009	157624.88	.076
1989	19671.91	.009	155.33	.000	0.00	.000	19461.85	.009	165506.12	.077
1990	20655.50	.009	163.09	.000	0.00	.000	20434.94	.009	173781.42	.079
1991	21688.28	.010	171.25	.000	0.00	.000	21456.69	.009	182470.50	.080
1992	22772.69	.010	179.81	.000	0.00	.000	22529.52	.010	191594.02	.082
1993	23911.33	.010	188.80	.000	0.00	.000	23656.00	.010	201173.72	.083
1994	25106.89	.010	198.24	.000	0.00	.000	24838.80	.010	211232.41	.085
1995	26362.24	.010	208.15	.000	0.00	.000	26080.74	.010	221794.03	.087
1996	27680.35	.010	218.56	.000	0.00	.000	27384.77	.010	232883.73	.088
1997	29064.37	.011	229.49	.000	0.00	.000	28754.01	.011	244527.92	.090
1998	30517.58	.011	240.96	.000	0.00	.000	30191.71	.011	256754.31	.091
1999	32[illegible]43.46	.011	253.01	.000	0.00	.000	31701.30	.011	269592.03	.093
2000	33645.64	.011	265.66	.000	0.00	.000	33286.36	.011	283071.63	.095
2001	35327.92	.011	278.94	.000	0.00	.000	3495[illegible].68	.011	297225.21	.096
2002	37094.31	.012	292.89	.000	0.00	.000	36698.21	.012	312086.47	.098
2003	38949.03	.012	307.54	.000	0.00	.000	38533.13	.012	327690.79	.100
2004	40896.48	.012	322.91	.000	0.00	.000	40459.78	.012	344075.33	.101
2005	42941.31	.012	339.06	.000	0.00	.000	42482.77	.012	361279.10	.103
2006	45088.37	.012	356.01	.000	0.00	.000	44606.91	.012	379343.06	.105
2007	47342.79	.013	373.81	.000	0.00	.000	46837.25	.013	398310.21	.107
2008	49709.93	.013	392.50	.000	0.00	.000	49179.12	.013	418225.72	.109
2009	52195.42	.013	412.13	.000	0.00	.000	51638.07	.013	439137.01	.110
2010	548[illegible]5.70	.013	432.73	.000	0.00	.000	54219.98	.013	461[illegible]93.86	.112
2011	57545.45	.014	454.37	.000	0.00	.000	5693[illegible].98	.013	484148.55	.114
2012	6[illegible]422.73	.014	477.[illegible]	.000	[illegible].00	.000	59777.52	.014	5[illegible]8355.98	.116
2013	63443.96	.014	5[illegible]0.94	.000	[illegible].00	.000	62766.4[illegible]	.014	533773.78	.118
2014	6661[illegible].[illegible]	.014	525.99	.[illegible]	0.00	.000	659[illegible]4.72	.014	[illegible]0462.46	.12[illegible]

OPERATING EXPENDITURES

YEAR	TOTAL FREIGHT COSTS	P OF TOT	TOTAL PACKAGES COSTS	P OF TOT	TOTAL ENERGY PROCESSING COSTS	P OF TOT	TOTAL ENERGY FREIGHT COSTS	P OF TOT	TOTAL ENERGY COSTS	P OF TOT	TOTAL COSTS N EQUIP
1980	378437.10	.229	1237524.68	.750	12780.81	.008	119232.00	.072	132012.81	.080	1648954.89
1981	384393.60	.227	1278115.28	.754	13419.85	.008	125193.60	.074	138613.45	.082	1696146.33
1982	390653.28	.224	1320037.46	.756	14090.84	.008	131453.28	.075	145544.12	.083	1744999.19
1983	397225.94	.221	1363334.69	.759	14795.39	.008	138025.94	.077	152821.33	.085	1795573.62
1984	404127.24	.219	1408052.07	.762	15535.16	.008	144927.24	.078	160462.40	.087	1847932.07
1985	411373.60	.216	1454236.18	.765	16311.91	.009	152173.60	.080	168485.52	.089	1902139.30
1986	418982.28	.214	1501935.13	.767	17127.51	.009	159782.28	.082	176909.79	.090	1958262.52
1987	426971.40	.212	1551198.60	.769	17983.88	.009	167771.40	.083	185755.28	.092	2016371.48
1988	435359.97	.210	1602077.91	.772	18883.18	.009	176159.97	.085	195043.05	.094	2076538.56
1989	444167.97	.208	1654626.07	.774	19827.23	.009	184967.97	.086	204795.20	.096	2138838.87
1990	453416.36	.206	1708897.80	.776	20818.59	.009	194216.36	.088	215034.96	.098	2203350.36
1991	463127.18	.204	1764949.65	.777	21859.52	.010	203927.18	.090	225786.71	.099	2270153.96
1992	473323.54	.202	1822840.00	.779	22952.50	.010	214123.54	.092	237076.04	.101	2339333.64
1993	484029.72	.201	1882629.15	.781	24100.12	.010	224829.72	.093	248929.84	.103	2410976.59
1994	495271.20	.199	1944379.39	.782	25305.13	.010	236071.20	.095	261376.34	.105	2485173.32
1995	507074.76	.198	2008155.03	.784	26570.39	.010	247874.76	.097	274445.15	.107	2562017.78
1996	519468.50	.197	2074022.52	.785	27898.91	.011	260268.50	.099	288167.41	.109	2641607.53
1997	532481.93	.195	2142050.45	.786	29293.85	.011	273281.93	.100	302575.78	.111	2724043.83
1998	546146.02	.194	2212309.71	.787	30758.55	.011	286946.02	.102	317704.57	.113	2809431.88
1999	560493.33	.193	2284873.47	.788	32296.47	.011	301293.33	.104	333589.80	.115	2897880.87
2000	575557.99	.193	2359817.32	.789	33911.30	.011	316357.99	.106	350269.29	.117	2989504.21
2001	591375.89	.192	2437219.33	.790	35606.86	.012	332175.89	.108	367782.75	.119	3084419.68
2002	607984.69	.191	2517160.12	.791	37387.20	.012	348784.69	.110	386171.89	.121	3182749.61
2003	625423.92	.190	2599722.97	.791	39256.56	.012	366223.92	.111	405480.48	.123	3284621.06
2004	643735.12	.190	2684993.88	.792	41219.39	.012	384535.12	.113	425754.51	.126	3390165.99
2005	662961.87	.189	2773061.68	.792	43280.36	.012	403761.87	.115	447042.23	.128	3499521.52
2006	683149.97	.189	2864618.11	.793	45444.38	.013	423949.97	.117	469394.35	.130	3612830.05
2007	704347.46	.189	2957957.90	.793	47716.60	.013	445147.46	.119	492864.06	.132	3730239.56
2008	726604.84	.189	3054978.92	.793	50102.43	.013	467404.84	.121	517507.27	.134	3851903.79
2009	749975.08	.189	3155182.23	.793	52607.55	.013	490775.08	.123	543382.63	.137	3977982.46
2010	774513.83	.189	3258672.21	.793	55237.93	.013	515313.83	.125	570551.76	.139	4108641.57
2011	800279.52	.189	3365556.65	.793	57999.82	.014	541079.52	.127	599079.35	.141	4244653.60
2012	827333.5?	.189	3475946.91	.793	60899.82	.014	568133.5?	.130	629033.32	.143	4384397.83
2013	855740.18	.189	3589957.97	.793	63944.81	.014	596540.18	.132	660484.98	.146	4529860.55
2014	885567.19	.189	3707708.59	.792	67142.05	.014	626367.19	.134	693509.23	.148	4680635.42

C.13--Estimated Costs for the New Canning System - Firm B

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 690000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	58926.00	843995.95	902921.95	58926.00	835060.60	859870.99
1981	57058.84	860572.89	917631.72	57058.84	858849.49	883659.67
1982	51646.59	877742.53	929389.12	51646.59	883955.28	908765.47
1983	50694.58	895544.28	946238.86	50694.58	910501.17	935311.35
1984	47249.48	914021.19	961270.67	47249.48	938624.56	963434.75
1985	46159.83	932200.48	978360.31	46159.83	962581.99	987392.18
1986	43328.39	949382.68	992711.07	43328.39	980562.16	1005372.35
1987	42138.29	966050.80	1008189.09	42138.29	999039.86	1023850.04
1988	40841.47	982476.11	1023317.58	40841.47	1018027.67	1042837.86
1989	39475.43	996824.07	1036299.50	39475.43	1037538.56	1062348.74
1990	38063.98	1015202.50	1053266.48	38063.98	1057585.85	1082396.03
1991	36649.64	1031685.71	1068335.35	36649.64	1078183.26	1102993.45
1992	35237.06	1048327.42	1083564.48	35237.06	1099344.92	1124155.11
1993	33829.52	1065168.19	1098997.71	33829.52	1121085.37	1145895.56
1994	32429.41	1082239.89	1114669.30	32429.41	1143419.57	1168229.76
1995	31243.01	1099568.45	1130811.46	31243.01	1166362.92	1191173.11
1996	30232.41	1117175.69	1147408.10	30232.41	1189931.29	1214741.47
1997	29368.11	1135080.52	1164448.63	29368.11	1214140.99	1238951.18
1998	28626.81	1153299.75	1181926.56	28626.81	1239008.84	1263819.02
1999	27989.91	1171849.68	1199838.59	27989.91	1264552.14	1289362.32
2000	27442.31	1190741.54	1218183.84	27442.31	1290788.72	1315598.91
2001	26971.67	1209991.73	1236963.41	26971.67	1317736.93	1342547.11
2002	26567.81	1229612.13	1256179.95	26567.81	1345415.66	1370225.84
2003	26222.24	1249615.21	1275837.45	26222.24	1373844.37	1398654.56
2004	25927.81	1270013.19	1295941.00	25927.81	1403043.12	1427853.31
2005	25678.49	1290818.11	1316496.61	25678.49	1433032.55	1457842.74
2006	25469.15	1312041.99	1337511.14	25469.15	1463833.93	1488644.11
2007	25295.36	1333696.80	1358992.16	25295.36	1495469.15	1520279.34
2008	25153.34	1355794.58	1380947.92	25153.34	1527960.79	1552770.98
2009	25039.79	1378347.46	1403387.25	25039.79	1561332.10	1586142.29
2010	24951.84	1401367.72	1426319.56	24951.84	1595607.02	1620417.21
2011	24886.98	1424867.79	1449754.77	24886.98	1630810.25	1655620.44
2012	24843.02	1448860.30	1473703.31	24843.02	1666967.20	1691777.39
2013	24817.99	1473358.10	1498176.09	24817.99	1704104.09	1728914.28
2014	24810.19	1498374.29	1523184.48	24810.19	1742247.91	1767058.10

OPERATING EXPENDITURES

YEAR	LABOR COSTS	P OF TOT	CAN COSTS	P OF TOT	BEFORE FREIGHT COSTS	P OF TOT	AFTER FREIGHT COSTS	P OF TOT	NATURAL GAS COSTS	P OF TOT	ELECTRICITY COSTS	P OF TOT	FUEL OIL COSTS	P OF TOT	BEFORE ENERGY FREIGHT COSTS	P OF TOT	AFTER ENERGY FREIGHT COSTS	P OF TOT
1980	10108.80	.006	1237524.48	.755	84395.52	.051	294836.48	.18	13376.13	.008	215.83	.000	0.00	.000	12545.28	.008	166686.72	.065
1981	10108.80	.006	1278115.28	.758	85022.78	.050	299370.82	.18	14044.93	.008	226.62	.000	0.00	.000	13172.54	.008	112021.06	.066
1982	10108.80	.006	1320037.46	.760	85681.41	.049	304971.87	.18	14747.18	.008	237.95	.000	0.00	.000	13831.17	.008	117622.11	.068
1983	10108.80	.006	1363334.69	.763	86372.47	.048	310852.97	.17	15484.54	.009	249.85	.000	0.00	.000	14522.73	.008	123503.21	.069
1984	10108.80	.005	1406052.07	.766	87099.11	.047	317028.13	.17	16258.77	.009	262.34	.000	0.00	.000	15248.87	.008	129678.37	.071
1985	10108.80	.005	1454236.18	.768	87861.55	.046	323512.05	.17	17071.70	.009	275.46	.000	0.00	.000	16011.31	.008	136162.29	.072
1986	10108.80	.005	1501935.13	.771	88662.12	.045	330320.17	.17	17925.29	.009	289.23	.000	0.00	.000	16811.88	.009	142970.41	.073
1987	10108.80	.005	1551198.60	.773	89502.71	.045	337468.69	.17	18821.55	.009	303.69	.000	0.00	.000	17652.47	.009	150118.93	.075
1988	10108.80	.005	1602077.91	.775	90385.33	.044	344974.64	.17	19762.63	.010	318.88	.000	0.00	.000	18535.09	.009	157624.88	.076
1989	10108.80	.005	1654626.07	.777	91312.09	.043	352855.88	.17	20750.76	.010	334.82	.000	0.00	.000	19461.85	.009	165506.12	.078
1990	10108.80	.005	1708897.80	.779	92285.18	.042	361131.18	.16	21788.30	.010	351.56	.000	0.00	.000	20434.94	.009	173781.42	.079
1991	10108.80	.004	1764949.65	.780	93306.93	.041	369820.26	.16	22877.72	.010	369.14	.000	0.00	.000	21456.69	.009	182470.50	.081
1992	10108.80	.004	1822840.00	.782	94379.76	.040	378943.78	.16	24021.60	.010	387.60	.000	0.00	.000	22529.52	.010	191594.02	.082
1993	10108.80	.004	1882629.15	.784	95506.24	.040	388523.48	.16	25222.68	.010	406.98	.000	0.00	.000	23656.00	.010	201173.72	.084
1994	10108.80	.004	1944379.39	.785	96689.04	.039	398582.17	.16	26483.82	.011	427.33	.000	0.00	.000	24838.80	.010	211232.41	.085
1995	10108.80	.004	2008155.03	.786	97930.98	.038	409143.79	.16	27808.01	.011	448.69	.000	0.00	.000	26080.74	.010	221794.03	.087
1996	10108.80	.004	2074022.52	.788	99235.01	.038	420233.49	.16	29198.41	.011	471.13	.000	0.00	.000	27384.77	.010	232883.73	.088
1997	10108.80	.004	2142050.45	.789	100694.25	.037	431877.68	.16	30658.33	.011	494.69	.000	0.00	.000	28754.01	.011	244527.92	.090
1998	10108.80	.004	2212309.71	.790	102041.95	.036	444104.07	.16	32191.24	.011	519.42	.000	0.00	.000	30191.71	.011	256754.31	.092
1999	10108.80	.003	2284873.47	.791	103551.54	.036	456941.79	.16	33800.81	.012	545.39	.000	0.00	.000	31701.30	.011	269592.03	.093
2000	10108.80	.003	2359817.32	.791	105136.60	.035	470421.39	.16	35490.85	.012	572.66	.000	0.00	.000	33286.36	.011	283071.63	.095
2001	10108.80	.003	2437219.33	.792	106800.92	.035	484574.97	.16	37265.39	.012	601.29	.000	0.00	.000	34950.68	.011	297225.21	.097
2002	10108.80	.003	2517160.12	.793	108548.45	.034	499436.23	.16	39128.66	.012	631.36	.000	0.00	.000	36698.21	.012	312086.47	.098
2003	10108.80	.003	2599722.97	.793	110383.37	.034	515040.55	.16	41085.09	.013	662.93	.000	0.00	.000	38533.13	.012	327690.79	.100
2004	10108.80	.003	2694993.88	.794	112310.02	.033	531425.09	.16	43139.34	.013	696.07	.000	0.00	.000	40459.78	.012	344075.33	.102
2005	10108.80	.003	2773061.60	.794	114333.01	.033	548628.86	.16	45296.31	.013	730.88	.000	0.00	.000	42482.77	.012	361279.10	.103
2006	10108.80	.003	2864018.11	.794	116457.15	.032	566692.82	.16	47561.13	.013	767.42	.000	0.00	.000	44606.91	.012	379343.86	.105
2007	10108.80	.003	2957957.90	.794	118687.49	.032	585659.97	.16	49939.18	.013	805.79	.000	0.00	.000	46837.25	.013	398310.21	.107
2008	10108.80	.003	3054978.92	.795	121029.36	.031	605575.48	.16	52436.14	.014	846.08	.000	0.00	.000	49179.12	.013	418225.72	.109
2009	10108.80	.003	3155182.23	.795	123488.31	.031	626486.77	.16	55057.95	.014	888.39	.000	0.00	.000	51638.07	.013	439137.01	.111
2010	10108.80	.002	3258672.21	.794	126078.22	.031	648443.62	.16	57810.85	.014	932.80	.000	0.00	.000	54219.98	.013	461093.86	.112
2011	10108.80	.002	3365556.65	.794	128781.22	.030	671498.31	.16	60701.39	.014	979.44	.000	0.00	.000	56930.98	.013	484148.55	.114
2012	10108.80	.002	3475946.91	.794	131627.76	.030	695705.74	.16	63736.46	.015	1028.42	.000	0.00	.000	59777.52	.014	508355.96	.116
2013	10108.80	.002	3589957.97	.794	134616.64	.030	721123.54	.16	66923.28	.015	1079.84	.000	0.00	.000	62766.40	.014	533773.78	.118
2014	10108.80	.002	3707708.59	.793	137754.96	.029	747812.22	.16	70264.45	.015	1133.83	.000	0.00	.000	65904.72	.014	560962.46	.120

OPERATING EXPENDITURES

YEAR	TOTAL FREIGHT COSTS	P OF TOT	TOTAL PACKAGES COSTS	P OF TOT	TOTAL ENERGY PROCESSING COSTS	P OF TOT	TOTAL ENERGY FREIGHT COSTS	P OF TOT	TOTAL ENERGY COSTS	P OF TOT	TOTAL COSTS
1980	374432.00	.231	1237524.48	.755	13591.96	.008	119232.60	.073	132823.96	.081	1639657.24
1981	384393.60	.228	1278115.28	.758	14271.55	.008	125193.60	.074	139465.15	.083	1686889.24
1982	390653.28	.225	1320037.46	.760	14985.13	.009	131453.28	.076	146438.41	.084	1735784.68
1983	397225.44	.222	1363334.69	.763	15734.39	.009	138025.94	.077	153760.33	.086	1786483.83
1984	404127.24	.220	1408052.07	.766	16521.11	.009	144927.24	.079	161448.35	.088	1838809.22
1985	411373.68	.217	1454236.18	.768	17347.16	.009	152173.60	.080	169520.77	.090	1893065.75
1986	418982.28	.215	1501935.13	.771	18214.52	.009	159782.28	.082	177996.80	.091	1949240.73
1987	426971.40	.213	1551198.60	.773	19125.25	.010	167771.40	.084	186896.65	.093	2007404.04
1988	435354.97	.211	1602077.41	.775	20081.51	.010	176159.97	.085	196241.48	.095	2067628.19
1989	444167.97	.209	1654626.07	.777	21085.59	.010	184967.97	.087	206053.55	.097	2129988.42
1990	453416.36	.207	1708897.28	.779	22139.86	.010	194216.36	.088	216356.23	.099	2194562.83
1991	463127.10	.205	1764949.65	.780	23246.86	.010	203927.10	.090	227174.04	.100	2261432.49
1992	473323.54	.203	1822840.00	.782	24409.20	.010	214123.54	.092	238532.74	.102	2330681.54
1993	484029.72	.201	1882629.15	.784	25629.66	.011	224829.72	.094	250459.38	.104	2402397.33
1994	495271.20	.200	1944379.39	.785	26911.14	.011	236071.20	.095	262982.35	.106	2476670.53
1995	507074.76	.199	2008155.03	.786	28256.70	.011	247874.76	.097	276131.47	.108	2553595.30
1996	519468.50	.197	2074022.52	.788	29669.54	.011	260268.50	.099	289938.04	.110	2633269.35
1997	532481.43	.196	2142050.45	.789	31153.01	.011	273281.93	.101	304434.94	.112	2715794.20
1998	546146.02	.195	2212309.71	.790	32710.66	.012	286946.02	.102	319656.69	.114	2801275.20
1999	560493.33	.194	2284873.47	.791	34346.20	.012	301293.33	.104	335639.52	.116	2889821.79
2000	575557.99	.193	2359817.32	.791	36063.51	.012	316357.99	.106	352421.50	.118	2981547.62
2001	591375.89	.192	2437219.33	.792	37866.68	.012	332175.89	.108	370042.57	.120	3076578.70
2002	607484.69	.191	2517160.12	.793	39760.02	.013	348784.69	.110	388544.70	.122	3175013.62
2003	625423.92	.191	2599722.97	.793	41748.02	.013	366223.92	.112	407971.94	.124	3277083.71
2004	643735.12	.190	2684993.82	.794	43835.42	.013	384535.12	.114	428370.53	.127	3382673.22
2005	662961.87	.190	2773061.68	.794	46027.19	.013	403761.87	.116	449789.06	.129	3492159.54
2006	683149.97	.189	2864018.11	.794	48328.55	.013	423949.97	.118	472278.51	.131	3605605.42
2007	704347.46	.189	2957957.90	.794	50744.98	.014	445147.46	.120	495892.44	.133	3723159.14
2008	726604.84	.189	3054978.92	.795	53282.22	.014	467404.84	.122	520687.06	.135	3844974.78
2009	749975.38	.188	3155182.23	.795	55946.34	.014	490775.06	.124	546721.41	.138	3971212.44
2010	774513.83	.189	3258672.21	.794	58743.65	.014	515313.83	.126	574057.49	.140	4102030.49
2011	800279.52	.189	3365556.65	.794	61680.83	.015	541079.52	.128	602760.36	.142	4237625.81
2012	827333.50	.189	3475946.91	.794	64764.88	.015	568133.50	.130	632898.38	.145	4378154.09
2013	855740.18	.189	3589957.97	.794	68003.12	.015	596540.18	.132	664543.30	.147	4523810.07
2014	885567.19	.189	3707708.59	.793	71403.28	.015	626367.19	.134	697770.46	.149	4674787.85

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 690000.00

YEAR	SALVAGE VALUE	DEPRECIATION	INSURANCE	INTEREST	MAINTENANCE
1980	598000.00	69000.00	6900.00	83601.77	3450.00
1981	512571.43	69000.00	6927.60	69136.84	4682.34
1982	433714.29	69000.00	6955.31	52675.28	5914.68
1983	361428.57	69000.00	6983.13	33941.44	7147.02
1984	295714.29	69000.00	7011.06	12621.83	8379.36
1985	236571.43	69000.00	7039.11	0.00	9611.70
1986	184000.00	69000.00	7067.26	0.00	10844.04
1987	138000.00	69000.00	7095.53	0.00	12076.38
1988	98571.43	69000.00	7123.92	0.00	13308.72
1989	65714.29	69000.00	7152.41	0.00	14541.06
1990	39428.57	0.00	7181.02	0.00	15773.40
1991	19714.29	0.00	7209.75	0.00	17005.74
1992	6571.43	0.00	7238.58	0.00	18238.08
1993	0.00	0.00	7267.54	0.00	19470.42
1994	0.00	0.00	7296.61	0.00	20702.76
1995	0.00	0.00	7325.80	0.00	21935.10
1996	0.00	0.00	7355.10	0.00	23167.44
1997	0.00	0.00	7384.52	0.00	24399.78
1998	0.00	0.00	7414.06	0.00	25632.12
1999	0.00	0.00	7443.71	0.00	26864.46
2000	0.00	0.00	7473.49	0.00	28096.80
2001	0.00	0.00	7503.38	0.00	29329.14
2002	0.00	0.00	7533.40	0.00	30561.48
2003	0.00	0.00	7563.53	0.00	31793.82
2004	0.00	0.00	7593.78	0.00	33026.16
2005	0.00	0.00	7624.16	0.00	34258.50
2006	0.00	0.00	7654.66	0.00	35490.84
2007	0.00	0.00	7685.27	0.00	36723.18
2008	0.00	0.00	7716.01	0.00	37955.52
2009	0.00	0.00	7746.88	0.00	39187.86
2010	0.00	0.00	7777.87	0.00	40420.20
2011	0.00	0.00	7808.98	0.00	41652.54
2012	0.00	0.00	7840.21	0.00	42884.88
2013	0.00	0.00	7871.57	0.00	44117.22
2014	0.00	0.00	7903.06	0.00	45349.56

C.14--Estimated Costs for the Retort Pouch Packaging System - Firm B

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 2556000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	218282.40	587060.07	805370.47	218282.40	580872.73	672770.38
1981	211365.78	604930.97	816296.75	211365.78	609844.29	701749.85
1982	191316.94	624084.66	815401.59	191316.94	642173.92	734079.48
1983	187790.37	644675.46	832465.83	187790.37	678279.63	770185.19
1984	175028.50	666842.92	841871.42	175028.50	718631.78	810537.35
1985	170992.07	686962.87	857954.93	170992.07	741914.89	833920.45
1986	160503.43	702423.27	862926.70	160503.43	741378.41	833283.97
1987	156094.87	714991.81	871086.67	156094.87	740965.28	832870.84
1988	151291.01	725651.21	876942.22	151291.01	740679.00	832584.56
1989	146230.72	734991.80	881222.52	146230.72	740523.21	832428.77
1990	141002.23	743389.84	884392.07	141002.23	740501.72	832407.28
1991	135763.03	751096.79	886859.82	135763.03	740618.48	832524.04
1992	130530.33	758287.31	888817.64	130530.33	740977.63	832783.19
1993	125316.32	765086.70	890403.02	125316.32	741283.46	833189.03
1994	120129.82	771567.43	891717.25	120129.82	741840.47	833746.03
1995	115734.99	777859.36	893594.35	115734.99	742553.32	834458.88
1996	111991.36	783956.43	895947.79	111991.36	743426.87	835332.43
1997	108789.68	789921.13	898710.81	108789.68	744466.19	836371.76
1998	106043.68	795787.51	901831.18	106043.68	745676.56	837582.12
1999	103684.35	801583.30	905267.66	103684.35	747063.46	838969.02
2000	101655.85	807331.49	908987.33	101655.85	748632.61	840538.17
2001	99912.46	813051.35	912963.80	99912.46	750389.96	842295.53
2002	98416.42	818759.32	917175.74	98416.42	752341.71	844247.27
2003	97136.29	824469.59	921605.88	97136.29	754494.30	846359.86
2004	96045.63	830194.60	926240.23	96045.63	756854.44	848760.00
2005	95122.08	835945.36	931067.44	95122.08	759429.11	851334.67
2006	94346.58	841731.77	936078.35	94346.58	762225.57	854131.13
2007	93702.82	847562.81	941265.63	93702.82	765251.38	857156.95
2008	93176.73	853446.74	946623.46	93176.73	768514.40	860419.97
2009	92756.09	859391.23	952147.32	92756.09	772022.81	863928.38
2010	92430.30	865403.50	957833.79	92430.30	775785.12	867690.6[illegible]
2011	92190.05	871490.37	963680.42	92190.05	779810.17	871715.73
2012	92027.17	877658.39	969685.56	92027.17	784107.16	876012.72
2013	91934.47	883913.86	975848.34	91934.47	788685.66	880591.22
2014	91985.56	890262.93	982168.49	91985.56	793555.63	885461.20

OPERATING EXPENDITURES

YEAR	LABOR COSTS	P OF TOT	POUCH COSTS	P OF TOT	CARTON COSTS	P OF TOT	BEFORE FREIGHT COSTS	P OF TOT	AFTER FREIGHT COSTS	P OF TOT
1980	30326.40	.022	829440.00	.605	259200.00	.189	23224.32	.017	212647.68	.16
1981	30326.40	.022	837236.74	.605	259200.00	.187	23499.07	.017	216504.58	.16
1982	30326.40	.022	845186.76	.605	259200.00	.186	23787.56	.017	220554.32	.16
1983	30326.40	.021	853050.76	.605	259200.00	.184	24090.48	.017	224806.54	.16
1984	30326.40	.021	861069.44	.605	259200.00	.182	24408.54	.017	229271.38	.16
1985	30326.40	.021	869163.49	.604	259200.00	.180	24742.50	.017	233959.47	.16
1986	30326.40	.021	877333.63	.604	259200.00	.178	25093.16	.017	238881.95	.16
1987	30326.40	.021	885580.57	.603	259200.00	.177	25461.35	.017	244050.56	.17
1988	30326.40	.020	893905.03	.603	259200.00	.175	25847.96	.017	249477.60	.17
1989	30326.40	.020	902307.73	.602	259200.00	.173	26253.89	.018	255175.99	.17
1990	30326.40	.020	910789.43	.601	259200.00	.171	26680.12	.018	261159.30	.17
1991	30326.40	.020	919350.85	.600	259200.00	.169	27127.66	.018	267441.78	.17
1992	30326.40	.020	927992.74	.599	259200.00	.167	27597.58	.018	274036.38	.18
1993	30326.40	.019	936715.88	.598	259200.00	.165	28091.00	.018	280964.81	.18
1994	30326.40	.019	945521.00	.597	259200.00	.164	28609.08	.018	288237.57	.18
1995	30326.40	.019	954408.90	.595	259200.00	.162	29153.07	.018	295873.96	.18
1996	30326.40	.019	963380.35	.594	259200.00	.160	29724.26	.018	303892.17	.19
1997	30326.40	.018	972436.12	.592	259200.00	.158	30324.01	.018	312311.29	.19
1998	30326.40	.018	981577.02	.590	259200.00	.156	30953.75	.019	321151.36	.19
1999	30326.40	.018	990803.84	.588	259200.00	.154	31614.97	.019	330433.44	.20
2000	30326.40	.018	1000117.40	.586	259200.00	.152	32309.26	.019	340179.63	.20
2001	30326.40	.018	1009518.50	.584	259200.00	.150	33038.26	.019	350413.12	.20
2002	30326.40	.017	1019007.98	.582	259200.00	.148	33803.70	.019	361158.29	.21
2003	30326.40	.017	1028586.65	.579	259200.00	.146	34607.43	.019	372440.71	.21
2004	30326.40	.017	1038255.37	.577	259200.00	.144	35451.33	.020	384287.26	.21
2005	30326.40	.017	1048014.97	.574	259200.00	.142	36337.44	.020	396726.14	.22
2006	30326.40	.016	1057866.31	.571	259200.00	.140	37267.84	.020	409786.96	.22
2007	30326.40	.016	1067810.25	.568	259200.00	.138	38244.77	.020	423500.82	.23
2008	30326.40	.016	1077847.67	.565	259200.00	.136	39270.55	.021	437900.37	.23
2009	30326.40	.016	1087979.44	.561	259200.00	.134	40347.61	.021	453019.90	.23
2010	30326.40	.015	1098206.44	.558	259200.00	.132	41478.53	.021	468895.41	.24
2011	30326.40	.015	1108529.58	.554	259200.00	.130	42665.99	.021	485564.69	.24
2012	30326.40	.015	1118949.76	.550	259200.00	.127	43912.82	.022	503067.43	.25
2013	30326.40	.015	1129467.89	.546	259200.00	.125	45222.00	.022	521445.32	.25
2014	30326.40	.014	1140084.89	.542	259200.00	.123	46596.64	.022	540742.10	.26

OPERATING EXPENDITURES

YEAR	NATURAL GAS COSTS	P OF TOT	ELECTRICITY COSTS	P OF TOT	FUEL OIL COSTS	P OF TOT	BEFORE ENERGY FREIGHT COSTS	P OF TOT	AFTER ENERGY FREIGHT COSTS	P OF TOT
1980	13515.21	.010	2976.57	.002	0.00	.000	5495.04	.004	77137.92	.056
1981	14190.96	.010	3125.40	.002	0.00	.000	5769.79	.004	80994.82	.059
1982	14900.52	.011	3281.67	.002	0.00	.000	6058.28	.004	85044.56	.061
1983	15645.55	.011	3445.75	.002	0.00	.000	6361.20	.005	89296.78	.063
1984	16427.83	.012	3618.04	.003	0.00	.000	6679.26	.005	93761.62	.066
1985	17249.22	.012	3798.94	.003	0.00	.000	7013.22	.005	98449.71	.068
1986	18111.68	.012	3988.89	.003	0.00	.000	7363.88	.005	103372.19	.071
1987	19017.26	.013	4188.34	.003	0.00	.000	7732.07	.005	108540.80	.074
1988	19968.13	.013	4397.75	.003	0.00	.000	8118.68	.005	113967.84	.077
1989	20966.53	.014	4617.64	.003	0.00	.000	8524.61	.006	119666.23	.080
1990	22014.86	.015	4848.52	.003	0.00	.000	8950.84	.006	125649.54	.083
1991	23115.60	.015	5090.95	.003	0.00	.000	9398.38	.006	131932.02	.086
1992	24271.38	.016	5345.50	.003	0.00	.000	9868.30	.006	138528.62	.089
1993	25484.95	.016	5612.77	.004	0.00	.000	10361.72	.007	145455.05	.093
1994	26759.20	.017	5893.41	.004	0.00	.000	10879.80	.007	152727.81	.096
1995	28097.16	.018	6188.08	.004	0.00	.000	11423.79	.007	160364.20	.100
1996	29502.02	.018	6497.48	.004	0.00	.000	11994.98	.007	168382.41	.104
1997	30977.12	.019	6822.36	.004	0.00	.000	12594.73	.008	176801.53	.108
1998	32525.98	.020	7163.47	.004	0.00	.000	13224.47	.008	185641.60	.112
1999	34152.27	.020	7521.65	.004	0.00	.000	13885.69	.008	194923.68	.116
2000	35859.89	.021	7897.73	.005	0.00	.000	14579.98	.009	204669.87	.120
2001	37652.88	.022	8292.62	.005	0.00	.000	15308.98	.009	214903.36	.124
2002	39535.53	.023	8707.25	.005	0.00	.000	16074.42	.009	225648.53	.129
2003	41512.30	.023	9142.61	.005	0.00	.000	16878.15	.010	236930.95	.133
2004	43587.92	.024	9599.74	.005	0.00	.000	17722.05	.010	248777.50	.138
2005	45767.31	.025	10079.73	.006	0.00	.000	18608.16	.010	261216.38	.143
2006	48055.68	.026	10583.72	.006	0.00	.000	19538.56	.011	274277.20	.148
2007	50458.46	.027	11112.90	.006	0.00	.000	20515.49	.011	287991.06	.153
2008	52981.39	.028	11668.55	.006	0.00	.000	21541.27	.011	302390.61	.158
2009	55630.46	.029	12251.97	.006	0.00	.000	22618.33	.012	317510.14	.164
2010	58411.98	.030	12864.57	.007	0.00	.000	23749.25	.012	333385.65	.169
2011	61332.58	.031	13507.80	.007	0.00	.000	24936.71	.012	350054.93	.175
2012	64399.21	.032	14183.19	.007	0.00	.000	26183.54	.013	367557.67	.181
2013	67619.17	.033	14892.35	.007	0.00	.000	27492.72	.013	385935.56	.187
2014	71000.12	.034	15636.97	.007	0.00	.000	28867.36	.014	405232.34	.193

OPERATING EXPENDITURES

YEAR	TOTAL FREIGHT COSTS	P OF TOT	TOTAL PACKAGES COSTS	P OF TOT	TOTAL ENERGY PROCESSING COSTS	P OF TOT	TOTAL ENERGY FREIGHT COSTS	P OF TOT	TOTAL ENERGY COSTS	P OF TOT	TOTAL COSTS
1980	235872.00	.172	1088640.00	.794	16491.79	.012	82632.96	.060	99124.75	.072	1371330.19
1981	240003.65	.173	1096436.74	.792	17316.30	.013	86764.61	.063	104080.90	.075	1384083.16
1982	244341.00	.175	1104306.76	.790	18182.19	.013	91102.84	.065	109285.03	.078	1397157.23
1983	248897.02	.176	1112250.76	.789	19091.30	.014	95657.98	.068	114749.28	.081	1410565.49
1984	253679.92	.178	1120269.44	.787	20045.87	.014	100440.88	.071	120486.75	.085	1424321.63
1985	258701.96	.180	1128363.49	.784	21048.16	.015	105462.92	.073	126511.09	.088	1438440.02
1986	263975.11	.182	1136533.63	.782	22100.57	.015	110736.07	.076	132836.64	.091	1452935.71
1987	269511.91	.184	1144780.57	.780	23205.60	.016	116272.87	.079	139478.47	.095	1467824.48
1988	275325.56	.186	1153105.03	.777	24365.88	.016	122086.52	.082	146452.40	.099	1483122.86
1989	281429.88	.188	1161507.73	.775	25584.17	.017	128190.84	.086	153775.02	.103	1498848.19
1990	287839.42	.190	1169989.43	.772	26863.38	.018	134600.38	.089	161463.77	.107	1515018.63
1991	294569.44	.192	1178550.85	.769	28206.55	.018	141330.40	.092	169536.95	.111	1531653.24
1992	301635.96	.195	1187192.74	.767	29616.88	.019	148396.92	.096	178013.80	.115	1548771.99
1993	309055.81	.197	1195915.88	.763	31097.72	.020	155816.77	.099	186914.49	.119	1566395.81
1994	316846.65	.200	1204721.00	.760	32652.61	.021	163607.61	.103	196260.22	.124	1584546.66
1995	325027.03	.203	1213608.90	.757	34285.24	.021	171787.99	.107	206073.23	.129	1603247.57
1996	333616.43	.206	1222580.35	.754	35999.50	.022	180377.39	.111	216376.89	.133	1622522.68
1997	342635.30	.209	1231636.12	.750	37799.48	.023	189396.26	.115	227195.73	.138	1642397.30
1998	352105.11	.212	1240777.02	.746	39689.45	.024	198866.07	.120	238555.52	.143	1662897.90
1999	362048.41	.215	1250003.84	.742	41673.92	.025	208809.37	.124	250483.30	.149	1684052.58
2000	372488.08	.218	1259317.40	.738	43757.62	.026	219249.84	.129	263007.46	.154	1705890.30
2001	383451.30	.222	1268718.50	.734	45945.50	.027	230212.34	.133	276157.83	.160	1728441.78
2002	394961.99	.225	1278207.90	.730	48242.77	.028	241722.95	.138	289965.73	.166	1751739.14
2003	407048.14	.229	1287786.65	.725	50654.91	.029	253809.10	.143	304464.01	.171	1775816.11
2004	419738.99	.233	1297455.37	.721	53187.66	.030	266499.55	.148	319687.21	.178	1800708.02
2005	433063.57	.237	1307214.97	.716	55847.04	.031	279824.53	.153	335671.57	.184	1826451.90
2006	447054.80	.241	1317066.31	.711	58639.39	.032	293815.76	.159	352455.15	.190	1853086.90
2007	461745.59	.246	1327010.25	.706	61571.36	.033	308506.55	.164	370077.91	.197	1880653.60
2008	477170.91	.250	1337047.67	.700	64649.93	.034	323931.87	.170	388581.81	.204	1909194.91
2009	493367.51	.254	1347179.44	.695	67882.43	.035	340128.47	.175	408010.90	.210	1938755.77
2010	510373.93	.259	1357406.44	.689	71276.55	.036	357134.89	.181	428411.44	.218	1969383.32
2011	528230.68	.264	1367729.58	.683	74840.38	.037	374991.64	.187	449832.01	.225	2001127.04
2012	546980.26	.269	1378149.76	.676	78582.40	.039	393741.22	.194	472323.61	.232	2034038.82
2013	566667.32	.274	1388667.49	.671	82511.52	.040	413428.20	.200	495939.79	.240	2068173.12
2014	587338.73	.274	1399284.49	.665	86637.04	.041	434099.19	.206	520736.78	.248	2103587.11

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 2556000.00

YEAR	SALVAGE VALUE	DEPRECIATION	INSURANCE	INTEREST	MAINTENANCE
1980	2215200.00	255600.00	25560.00	309690.85	12780.00
1981	1898742.86	255600.00	25662.24	256186.92	17345.02
1982	1606628.57	255600.00	25764.89	195127.57	21910.03
1983	1338857.14	255600.00	25867.95	125731.09	26475.05
1984	1095428.57	255600.00	25971.42	46755.65	31040.06
1985	876342.86	255600.00	26075.31	0.00	35605.08
1986	681600.00	255600.00	26179.61	0.00	40170.10
1987	511200.00	255600.00	26284.33	0.00	44735.11
1988	365142.86	255600.00	26389.46	0.00	49300.13
1989	243428.57	255600.00	26495.02	0.00	53865.14
1990	146057.14	0.00	26601.00	0.00	58430.16
1991	73028.57	0.00	26707.40	0.00	62995.18
1992	24342.86	0.00	26814.23	0.00	67560.19
1993	0.00	0.00	26921.49	0.00	72125.21
1994	0.00	0.00	27029.18	0.00	76690.22
1995	0.00	0.00	27137.29	0.00	81255.24
1996	0.00	0.00	27245.84	0.00	85820.26
1997	0.00	0.00	27354.83	0.00	90385.27
1998	0.00	0.00	27464.25	0.00	94950.29
1999	0.00	0.00	27574.10	0.00	99515.30
2000	0.00	0.00	27684.40	0.00	104080.32
2001	0.00	0.00	27795.14	0.00	108645.34
2002	0.00	0.00	27906.32	0.00	113210.35
2003	0.00	0.00	28017.94	0.00	117775.37
2004	0.00	0.00	28130.01	0.00	122340.38
2005	0.00	0.00	28242.53	0.00	126905.40
2006	0.00	0.00	28355.50	0.00	131470.42
2007	0.00	0.00	28468.93	0.00	136035.43
2008	0.00	0.00	28582.80	0.00	140600.45
2009	0.00	0.00	28697.13	0.00	145165.46
2010	0.00	0.00	28811.92	0.00	149730.46
2011	0.00	0.00	28927.17	0.00	154295.50
2012	0.00	0.00	29042.88	0.00	158860.51
2013	0.00	0.00	29159.05	0.00	163425.53
2014	0.00	0.00	29275.69	0.00	167990.54

C.15--Estimated Costs for the Retort Pouch Packaging System Using Preformed Pouches - Firm B

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 1596000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	136290.40	738607.64	874906.04	136290.40	738780.21	788179.25
1981	131979.57	751402.97	883382.55	131979.57	748237.27	885624.31
1982	119460.81	765033.98	884494.79	119460.81	767823.31	825210.35
1983	117258.77	779579.99	896838.76	117258.77	789808.32	847195.37
1984	109290.10	795120.60	904410.70	109290.10	814487.86	871874.10
1985	106769.69	809417.33	916187.02	106769.69	820550.92	885937.98
1986	100220.45	820815.68	921036.14	100220.45	827705.92	885172.98
1987	97467.69	830427.95	927895.63	97467.69	827143.51	884538.59
1988	94460.10	838868.30	933336.39	94460.10	826627.11	884814.18
1989	91308.38	846505.89	937814.27	91308.38	826248.29	883627.33
1990	88043.64	853576.24	941619.89	88043.64	825986.76	883373.88
1991	84772.22	860236.98	945009.20	84772.22	825870.39	883297.43
1992	81504.85	866597.77	948102.62	81504.85	825895.21	883282.25
1993	78249.16	872737.50	950986.66	78249.16	826065.44	883492.60
1994	75010.64	878714.58	953725.21	75010.64	826385.46	883772.50
1995	72266.45	884573.30	956839.75	72266.45	826859.83	884246.87
1996	69928.88	890348.07	960276.95	69928.88	827493.31	884880.35
1997	67929.71	896066.16	963995.87	67929.71	828290.86	885677.98
1998	66215.87	901749.59	967964.65	66215.87	829257.64	886644.68
1999	64741.87	907416.47	972158.34	64741.87	830399.82	887786.86
2000	63475.25	913081.97	976557.21	63475.25	831720.60	889107.64
2001	62306.65	918750.97	981145.62	62306.65	833220.28	890619.24
2002	61452.51	924458.62	985911.13	61452.51	834927.88	892314.92
2003	60653.18	930190.89	990843.87	60653.18	836825.97	894213.01
2004	59972.15	935963.89	995936.05	59972.15	838929.82	896318.86
2005	59395.47	941786.08	1001181.55	59395.47	841243.87	898630.91
2006	58911.25	947664.44	1006575.68	58911.25	843777.64	901164.68
2007	58509.28	953605.63	1012114.90	58509.28	846537.72	903924.76
2008	58180.77	959615.90	1017796.67	58180.77	849531.82	906918.87
2009	57918.12	965701.17	1023619.29	57918.12	852767.96	910155.00
2010	57714.69	971867.09	1029581.79	57714.69	856254.45	913641.49
2011	57564.68	978119.16	1035683.84	57564.68	859999.98	917387.02
2012	57462.98	984462.70	1041925.67	57462.99	864013.56	921400.60
2013	57405.09	990902.94	1048308.03	57405.09	868304.56	925691.60
2014	57387.04	997445.07	1054832.11	57387.04	872882.75	930269.79

C.16--Estimated Costs for the Retort Pouch Packaging System Using Roll Stock Material at a Filling Machine Rate of 40 PPM - Firm B

ACQUISITION YEAR IS 1980
ACQUISITION COST IS 3456000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	295142.40	539349.28	834491.68	295142.40	533639.34	657976.02
1981	285793.36	562289.48	848079.83	285790.36	573144.23	697410.90
1982	258682.05	586986.79	845668.84	258682.05	617153.66	741420.33
1983	253913.74	613611.59	867525.32	253913.74	666231.87	790498.54
1984	236658.76	642352.10	879010.36	236658.76	721013.86	845280.53
1985	231200.54	668307.58	899508.12	231200.54	752677.63	876944.30
1986	217018.73	687945.79	904964.52	217018.73	752094.61	876361.29
1987	211057.85	703656.34	914714.19	211057.85	751637.22	875903.90
1988	204562.49	716767.49	921329.99	204562.49	751309.00	875575.68
1989	197720.41	728076.88	925797.29	197720.41	751113.66	875380.33
1990	190650.90	738092.71	928743.61	190650.90	751055.06	875321.72
1991	183566.91	747154.42	930721.33	183566.91	751137.18	875403.85
1992	176491.72	755497.58	931989.29	176491.72	751364.25	875630.93
1993	169441.78	763291.02	932732.80	169441.78	751740.63	876007.31
1994	162429.05	770659.10	933088.15	162429.05	752270.87	876537.55
1995	156486.75	777695.66	934182.41	156486.75	752959.70	877226.38
1996	151424.94	784472.95	935897.90	151424.94	753812.06	878078.73
1997	147095.90	791047.73	938143.63	147095.90	754833.09	879099.76
1998	143383.00	797465.29	940848.29	143383.00	756028.14	880294.81
1999	140192.93	803762.42	943955.34	140192.93	757402.78	881669.46
2000	137450.16	809969.37	947419.53	137450.16	758962.83	883229.50
2001	135092.90	816111.43	951204.33	135092.90	760714.31	884980.98
2002	133070.10	822209.99	955280.08	133070.10	762663.51	886930.18
2003	131339.21	828283.38	959622.59	131339.21	764816.98	889083.65
2004	129864.51	834347.51	964212.02	129864.51	767181.52	891448.20
2005	128615.76	840416.35	969032.12	128615.76	769764.23	894030.90
2006	127567.21	846502.33	974069.54	127567.21	772572.47	896839.14
2007	126696.78	852616.59	979313.37	126696.78	775613.91	899880.58
2008	125985.43	858769.28	984754.71	125985.43	778896.53	903163.21
2009	125416.69	864969.71	990386.40	125416.69	782428.64	906695.32
2010	124976.17	871226.53	996202.70	124976.17	786218.87	910485.55
2011	124651.33	877547.83	1002199.16	124651.33	790276.21	914542.88
2012	124431.11	883941.26	1008372.37	124431.11	794609.98	918876.66
2013	124305.77	890414.14	1014719.90	124305.77	799229.92	923496.59
2014	124266.68	896973.48	1021240.16	124266.68	804146.11	928412.79

C.17--Estimated Costs for the Retort Pouch Packaging System Using Preformed Pouches at a Filling Machine Rate of 40 PPM - Firm B

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 2016000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	172166.40	724638.26	896804.64	172166.40	716966.69	789455.59
1981	166711.04	739810.78	906521.82	166711.04	739241.27	811730.17
1982	158097.87	756827.24	906925.10	158097.87	764188.69	836677.58
1983	148116.35	773387.49	921503.84	148116.35	792139.16	864628.05
1984	138050.65	792001.87	930052.51	138050.65	823464.25	895953.15
1985	134066.90	809012.12	943079.10	134066.90	841352.32	913841.21
1986	126594.26	822358.36	948952.61	126594.26	848479.61	912968.58
1987	123117.08	833435.87	956552.15	123117.08	839731.33	912228.22
1988	119328.12	843017.69	962345.81	119328.12	839118.90	911599.79
1989	115336.91	851572.12	966909.03	115336.91	838621.89	911118.79
1990	111213.02	859395.46	970608.48	111213.02	838268.04	910796.94
1991	107080.70	866686.36	973767.06	107080.70	838853.23	910542.13
1992	102953.58	873582.94	976536.44	102953.58	837981.51	910478.48
1993	98041.04	880184.38	979025.42	98041.04	838857.10	910945.99
1994	94750.28	886563.98	981314.25	94750.28	838284.48	910773.29
1995	91283.94	892777.21	984061.15	91283.94	838667.99	911156.89
1996	88331.22	898867.04	987198.25	88331.22	839212.66	911701.58
1997	85805.94	904867.37	990673.31	85805.94	839923.38	912412.27
1998	83640.08	910805.48	994445.56	83640.08	840805.33	913294.23
1999	81779.21	916703.70	998482.91	81779.21	841863.91	914352.01
2000	80179.26	922580.59	1002759.85	80179.26	843104.74	915593.04
2001	78804.19	928451.84	1007256.03	78804.19	844533.67	917022.57
2002	77624.22	934330.89	1011955.12	77624.22	846156.80	918645.69
2003	76614.54	940229.46	1016844.00	76614.54	847980.45	920469.35
2004	75754.30	946157.87	1021912.17	75754.30	850011.24	922580.14
2005	75025.86	952125.35	1027151.21	75025.86	852256.03	924744.98
2006	74414.21	958140.26	1032554.47	74414.21	854721.98	927210.87
2007	73906.45	964210.27	1038116.73	73906.45	857416.51	929905.40
2008	73491.50	970342.51	1043834.01	73491.50	860347.37	932836.26
2009	73159.73	976543.65	1049703.38	73159.73	863522.61	936011.50
2010	72902.77	982820.02	1055722.79	72902.77	866950.61	939439.50
2011	72713.28	989177.69	1061890.96	72713.28	870640.07	943128.97
2012	72584.01	995622.58	1068207.31	72584.01	874600.00	947088.97
2013	72511.78	1002160.13	1074671.85	72511.78	878840.04	951328.94
2014	72488.89	1008796.23	1081285.13	72488.89	883369.78	955858.67

C.18--Estimated Costs for the Retort Pouch Packaging System Without Investment Credit Allowance - Firm B

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 2556000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	218282.40	587086.07	805378.47	218282.40	588072.73	876713.76
1981	211365.78	604930.97	816296.75	211365.78	609844.29	785685.32
1982	204520.22	624084.66	828604.88	204520.22	642173.92	738014.95
1983	197745.34	644675.46	842420.80	197745.34	679279.63	774120.65
1984	191840.77	666042.92	857883.69	191840.77	710631.78	814472.01
1985	184486.12	686962.87	871360.99	184486.12	741914.09	837755.92
1986	177841.04	702423.27	880264.31	177841.04	741370.41	837219.44
1987	171345.13	714991.81	886336.94	171345.13	740965.28	836806.31
1988	164910.04	725651.21	890564.25	164910.04	740679.88	836528.03
1989	158559.38	734991.88	893551.18	158559.38	740523.21	836364.24
1990	152268.79	743389.84	895658.63	152268.79	740501.72	836342.74
1991	146144.69	751096.79	897241.48	146144.69	740610.40	836453.51
1992	140163.40	758287.31	898450.70	140163.40	740877.63	836710.65
1993	134307.89	765086.70	899394.59	134307.89	741283.46	837124.49
1994	128565.58	771587.43	900153.01	128565.58	741840.47	837681.58
1995	123604.55	777859.36	901543.91	123604.55	742553.32	838394.35
1996	119512.05	783956.43	903468.48	119512.05	743426.87	839267.90
1997	115929.27	789921.13	905850.40	115929.27	744466.19	840307.22
1998	112842.41	795787.51	908629.91	112842.41	745676.56	841517.59
1999	110176.41	801583.30	911759.72	110176.41	747063.46	842904.49
2000	107870.55	807331.49	915202.04	107870.55	748632.61	844473.64
2001	105875.12	813051.35	918926.46	105875.12	750389.96	846230.99
2002	104149.06	818759.32	922908.37	104149.05	752341.71	848182.74
2003	102658.15	824469.59	927127.74	102658.15	754494.38	850335.33
2004	101373.67	830194.60	931568.27	101373.67	756854.44	852695.47
2005	100271.29	835945.36	936216.65	100271.29	759429.11	855270.14
2006	99330.30	841731.77	941062.07	99330.30	762225.57	858066.60
2007	98532.94	847562.81	946095.75	98532.94	765251.38	861092.41
2008	97863.91	853446.74	951310.65	97863.91	768514.48	864355.43
2009	97309.94	859391.23	956701.17	97309.94	772022.01	867863.04
2010	96859.49	865403.50	962262.99	96859.49	775785.12	871626.15
2011	96502.44	871490.37	967992.82	96502.44	779810.17	875651.19
2012	96229.92	877658.39	973888.31	96229.92	784107.16	879948.18
2013	96034.88	883913.46	979947.34	96034.88	788685.66	884526.69
2014	95907.99	890262.43	986170.52	95907.99	793555.63	889396.66

C.19--Estimated Costs for the New Canning System Without Investment Credit Allowance - Firm B

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 690000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	58926.00	843995.95	902921.95	58926.00	835068.00	860933.30
1981	57058.04	860572.33	917631.72	57058.04	858049.69	884722.07
1982	55210.06	877742.53	932953.39	55210.06	883955.20	909827.06
1983	53381.96	895544.28	948926.23	53381.95	910501.17	936373.75
1984	51572.04	914021.19	965593.23	51572.04	938624.56	964497.16
1985	49781.00	932200.48	981981.47	49781.00	962501.99	988454.57
1986	48008.73	949382.68	997391.41	48008.73	980562.16	1006434.76
1987	46255.14	966050.80	1012305.95	46255.14	999039.86	1024912.48
1988	44520.13	982476.11	1026996.24	44520.13	1018027.67	1043900.25
1989	42803.59	998824.07	1041627.66	42803.59	1037538.56	1063411.13
1990	41105.42	1015202.50	1056307.92	41105.42	1057585.05	1083458.62
1991	39452.20	1031685.71	1071137.92	39452.20	1078103.26	1104055.86
1992	37837.54	1048327.42	1086164.96	37837.54	1093344.92	1125217.50
1993	36256.82	1065168.19	1101425.02	36256.82	1121005.37	1146957.95
1994	34706.67	1082239.89	1116946.56	34706.67	1143419.57	1169292.15
1995	33389.02	1099568.45	1132957.47	33389.02	1166362.92	1192235.50
1996	32262.64	1117175.69	1149438.34	32262.64	1189931.29	1215883.86
1997	31295.46	1135080.52	1166375.98	31295.46	1214140.99	1240013.57
1998	30462.15	1153299.75	1183761.90	30462.15	1239080.04	1264881.62
1999	29742.46	1171848.68	1201591.14	29742.46	1264552.14	1290424.72
2000	29119.98	1190741.54	1219861.52	29119.99	1290784.72	1316661.30
2001	28581.31	1209991.73	1238573.04	28581.31	1317736.93	1343609.50
2002	28115.36	1229612.13	1257727.49	28115.36	1345415.66	1371280.23
2003	27712.88	1249615.21	1277328.09	27712.89	1373844.37	1399716.95
2004	27366.13	1270013.19	1297379.32	27366.13	1403043.12	1428915.70
2005	27068.54	1290818.11	1317886.65	27068.54	1433032.55	1458905.13
2006	26814.52	1312041.99	1338856.51	26814.52	1463833.93	1489706.50
2007	26599.27	1333696.80	1360296.06	26599.27	1495469.15	1521341.73
2008	26418.66	1355794.58	1382213.24	26418.65	1527960.79	1553833.37
2009	26269.12	1378347.46	1404616.58	26269.12	1561332.10	1587204.68
2010	26147.52	1401367.72	1427515.24	26147.52	1595607.02	1621479.60
2011	26051.13	1424867.79	1450918.92	26051.13	1630810.25	1656682.83
2012	25977.56	1448860.30	1474837.86	25977.56	1666967.20	1692839.78
2013	25924.69	1473358.10	1499282.79	25924.69	1704104.09	1729976.67
2014	25890.65	1498374.29	1524264.95	25890.65	1742247.91	1768120.49

C.20--Estimated Costs for the Retort Pouch Packaging System Without Interest Deductions - Firm B

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 2556000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	218282.40	754320.70	972603.10	218282.40	746334.92	838240.48
1981	211365.78	757773.14	969138.92	211365.78	745229.29	837134.85
1982	191316.94	761270.52	952587.45	191316.94	744231.58	836137.14
1983	187790.37	764814.12	952604.49	187790.37	743344.62	835250.10
1984	175028.50	768405.27	943433.77	175028.50	742571.36	834476.93
1985	170992.07	772045.33	943037.40	170992.07	741914.89	833820.45
1986	160503.43	775735.73	936239.16	160503.43	741378.41	833283.97
1987	156094.87	779477.92	935572.79	156094.87	740965.28	832870.84
1988	151291.01	783273.43	934564.44	151291.01	740679.00	832584.56
1989	146230.72	787123.84	933354.56	146230.72	740523.21	832428.77
1990	141002.23	791030.76	932032.98	141002.23	740501.72	832407.28
1991	135763.03	794995.88	930758.91	135763.03	740618.48	832524.04
1992	130530.33	799020.96	929551.29	130530.33	740877.63	832783.19
1993	125316.32	803107.78	928424.10	125316.32	741283.46	833189.03
1994	120129.82	807258.24	927388.06	120129.82	741840.47	833746.03
1995	115734.99	811474.26	927209.25	115734.99	742553.32	834458.88
1996	111991.36	815757.84	927749.20	111991.36	743426.87	835332.43
1997	108789.68	820111.07	928900.75	108789.68	744466.19	836371.76
1998	106043.68	824536.09	930579.77	106043.68	745676.56	837582.12
1999	103684.35	829035.14	932719.49	103684.35	747063.46	838969.02
2000	101655.85	833610.51	935266.36	101655.85	748632.61	840538.17
2001	99912.46	838264.60	938177.06	99912.46	750389.96	842295.53
2002	98416.42	842999.88	941416.30	98416.42	752341.71	844247.27
2003	97136.29	847818.91	944955.20	97136.29	754494.30	846399.86
2004	96045.63	852724.35	948769.97	96045.63	756854.44	848760.00
2005	95122.08	857718.93	952841.01	95122.08	759429.11	851334.67
2006	94346.58	862805.52	957152.11	94346.58	762225.57	854131.13
2007	93702.82	867987.06	961689.88	93702.82	765251.38	857156.95
2008	93176.73	873266.60	966443.33	93176.73	768514.40	860419.97
2009	92756.09	878647.31	971403.40	92756.09	772022.81	863928.38
2010	92430.30	884132.46	976562.75	92430.30	775785.12	867690.68
2011	92190.05	889725.45	981915.49	92190.05	779810.17	871715.73
2012	92027.17	895429.80	987456.97	92027.17	784107.16	876012.72
2013	91934.47	901249.15	993183.62	91934.47	788685.66	880591.22
2014	91905.56	907187.27	999092.84	91905.56	793555.63	885461.20

C.21--Estimated Costs for the New Canning System Without Interest Deductions - Firm B

ACQUISITION YEAR IS 1980

ACQUISITION COST IS 690000.00

YEAR	AMORTIZED REPLACEMENT COSTS	AMORTIZED PRODUCTION COSTS	AMORTIZED TOTAL COSTS	AMORTIZED REPLACEMENT COSTS	PRODUCTION COSTS	TOTAL COSTS
1980	58926.00	889140.91	948066.91	58926.00	879727.82	904538.01
1981	57058.84	901833.10	958891.93	57058.84	895397.08	920207.27
1982	51646.59	914776.28	966422.87	51646.59	911506.06	936316.24
1983	50694.58	927976.07	978670.66	50694.58	928065.66	952875.85
1984	47249.48	941438.26	988687.74	47249.48	945087.12	969897.31
1985	46159.83	955168.75	1001328.58	46159.83	962581.99	987392.18
1986	43328.39	969173.60	1012501.99	43328.39	980562.16	1005372.35
1987	42138.29	983459.03	1025597.31	42138.29	999039.86	1023850.04
1988	40841.47	998031.41	1038872.88	40841.47	1018027.67	1042837.86
1989	39475.43	1012897.27	1052372.70	39475.43	1037538.56	1062348.74
1990	38063.98	1028063.31	1066127.29	38063.98	1057585.85	1082396.03
1991	36649.64	1043536.40	1080186.05	36649.64	1078183.26	1102993.45
1992	35237.06	1059323.59	1094560.65	35237.06	1099344.92	1124155.11
1993	33829.52	1075432.10	1109261.62	33829.52	1121085.37	1145895.56
1994	32429.41	1091869.33	1124298.74	32429.41	1143419.57	1168229.76
1995	31243.01	1108642.90	1139885.91	31243.01	1166362.92	1191173.11
1996	30232.41	1125760.58	1155992.99	30232.41	1189931.29	1214741.47
1997	29368.11	1143230.39	1172598.49	29368.11	1214140.99	1238951.18
1998	28626.81	1161060.52	1189687.33	28626.81	1239008.84	1263819.02
1999	27989.91	1179259.39	1207249.30	27989.91	1264552.14	1289362.33
2000	27442.31	1197835.64	1225277.95	27442.31	1290788.72	1315598.91
2001	26971.67	1216798.13	1243769.80	26971.67	1317736.93	1342547.11
2002	26567.81	1236155.95	1262723.76	26567.81	1345415.66	1370225.84
2003	26222.24	1255918.43	1282140.67	26222.24	1373844.37	1398654.56
2004	25927.81	1276095.16	1302022.97	25927.81	1403043.12	1427853.31
2005	25678.49	1296695.95	1322374.45	25678.49	1433032.55	1457842.74
2006	25469.15	1317730.91	1343200.06	25469.15	1463833.93	1488644.11
2007	25295.36	1339210.39	1364505.75	25295.36	1495469.15	1520279.34
2008	25153.34	1361145.01	1386298.35	25153.34	1527960.79	1552770.98
2009	25039.79	1383545.70	1408585.49	25039.79	1561332.10	1586142.29
2010	24951.84	1406423.66	1431375.50	24951.84	1595607.02	1620417.21
2011	24886.98	1429790.40	1454677.39	24886.98	1630810.25	1655620.44
2012	24843.02	1453657.74	1477500.76	24843.02	1666967.20	1691777.39
2013	24817.99	1478037.81	1502855.80	24817.99	1704104.09	1728914.28
2014	24810.19	1502943.07	1527753.26	24810.19	1742247.91	1767058.10

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