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PROCEEDINGS

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A COMPUTER ORIENTED PROFIT PLANNING AND CONTROL SYSTEM*

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I INTRODUCTION

In an industry of intense price competition and narrow profit margins, continued profit planning and control is a necessary ingredient for business survival and growth. Despite good management, average industry profit for many firms in the food industry has hovered at a critical one to two percent of sales. Unfavorable and unexpected market conditions may readily turn this margin into a loss.

In this type of environment, use of traditional management information and planning techniques is not proving satisfactory by present day standards. This paper describes the development of a computer oriented profit planning and control system (PPCS) designed to meet the needs of modern management. The system is oriented toward maximizing profits from routine, short-run decisions - primarily those relating to sales planning, market strategy, operations and inventory control, and procurement strategy. The system can also be used to develop longer run strategy and policy through a simulation of past, present and predicted conditions.

The system is designed for manufacturing, wholesaling and retailing operations in the food industry. While the illustrations in this report relate to food processing applications, the system is under development for applications to wholesaling and retailing. It was developed on the IBM 7094/1401 computers and has been successfully implemented for individual forms within the food industry. It is currently being adapted for the IBM 360 computer. The system is generally applicable to any computer having a FORTRAN compiler, an advanced linear programming code, and scientific simulation capability. A schematic of the system is given in Figure 1. The reader can skip over the more technical sections in the following report without loss of continuity.

* Presented at North Carolina Agricultural and Technical State University, Greensboro, June 18, 1968.

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I.1 Components and Features

A major feature of the system is the computer generation of three types of management reports. These include:

1. Management Information Reports. A detailed set of reports on forecasted sales levels, marketing strategy analysis, and inventory position is generated by the system. These reports provide management with important decision data. More importantly they provide the necessary data input to the profit planning and control analysis.
2. Profit Planning Reports. A detailed set of computer generated planning guides giving the most profitable sales, promotion, operations, and procurement plan for the next week or any selected decision period, i.e., day, month, quarter, etc.
3. Profit Performance Reports. A detailed set of profit performance guides comparing actual performance with planned performance during the last week or selected decision period.

The system emphasizes the synthesis of traditional market, accounting, and operational data with the use of modern mathematical and statistical techniques. These modern techniques permit generation of decision information of a quality superior to that obtained from automated data processing. Exponential smoothing, market simulation, inventory simulation, linear programming, and variance analysis are the major techniques used in the system. An explanation of these techniques is given in the selected references.

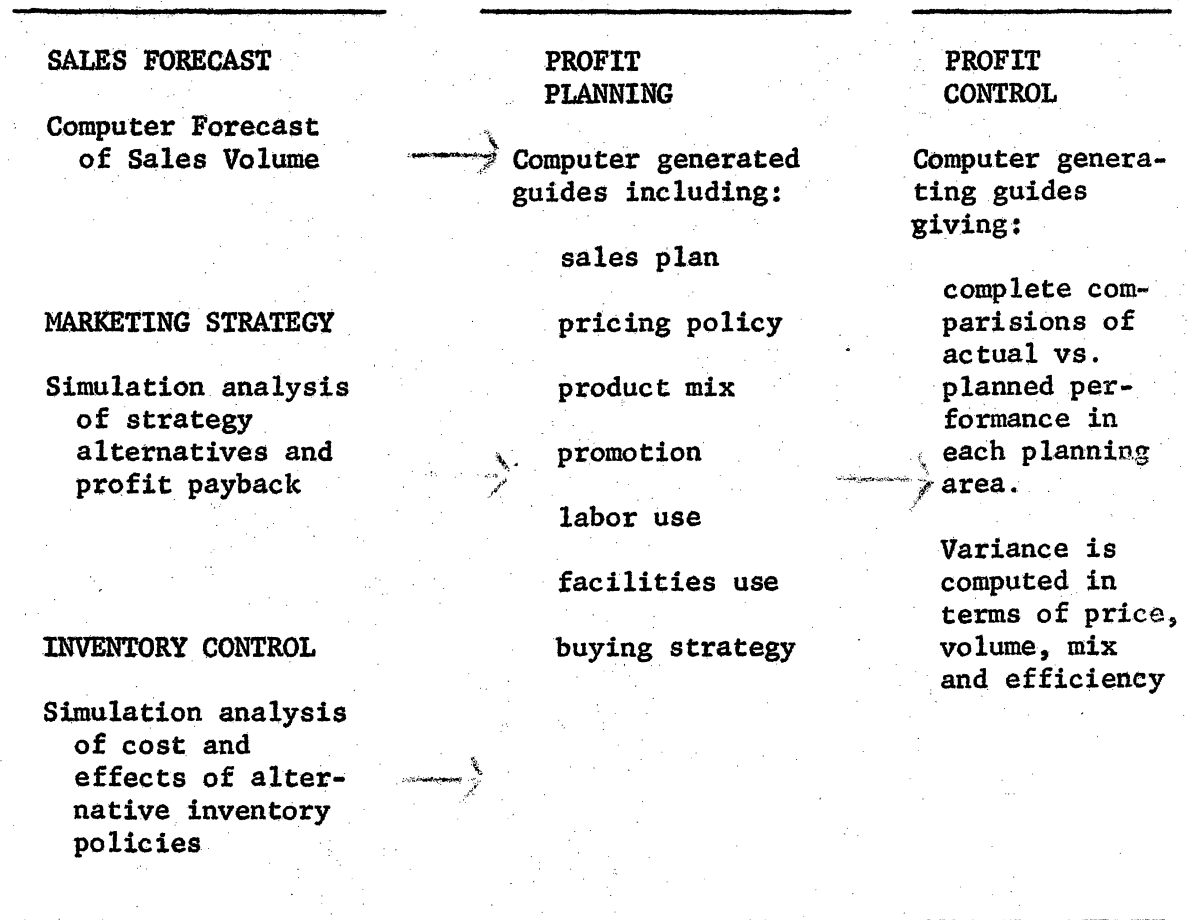


Figure 1. Schematic of Profit Planning and Control System.

II MANAGEMENT INFORMATION REPORTS

Three major types of management information reports are illustrated including: sales forecasts, analysis of marketing strategy alternatives, and inventory simulation.

II. I Sales Forecasts

Accurate forecasts are a basic prerequisite of sound management planning. In a very real sense they form the basis for most other plans formulated by management and provide fundamental data for decisions in these critical areas:

1. "Product" mix, demand for individual services, investment opportunities.
2. Pricing and promotional potential, competitive position.
3. Operations planning and control, efficient utilization of labor and equipment.
4. Financial budgeting: planning for optimum utilization of future funds.
5. Long-range planning, development of an operating and marketing strategy to maximize long-run profit position.

For many years management opinion, informal estimates, and consumer surveys have provided useful approaches to forecasting. They will remain important building blocks and should be continued irrespective of other approaches. Use of statistical techniques, in conjunction with these traditional ones, will give guides for management decision making in many cases.

To date the exponential and adaptive smoothing techniques /3,4/ have been effective for short-run forecasts of product sales. Smoothing is an effective way of handling random fluctuations as well as seasonal and trend variations. It has the advantages of a simple computation procedure, requires a modest amount of historical data and involves a minimum of computational expense. An indication of the effectiveness of this approach in our research is given in Figure 3.

Another type of forecasting technique being considered is an explanatory model involving such techniques as regression analysis and simultaneous equations systems. This type of model is needed to identify major economic relationships relevant to food management decisions. Although effective explanatory models are usually complex, major improvements in this direction will likely occur in the next few years. In the interim, there is excellent opportunity for increased profitability through improved monthly and quarterly forecasts using the smoothing techniques.

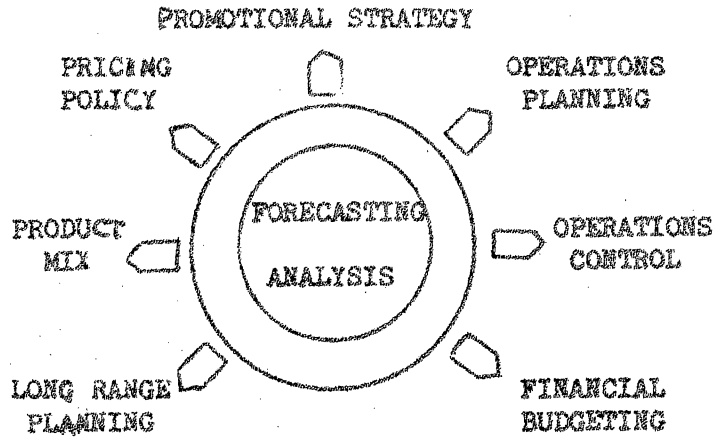


Figure 2. Role of Forecasting.

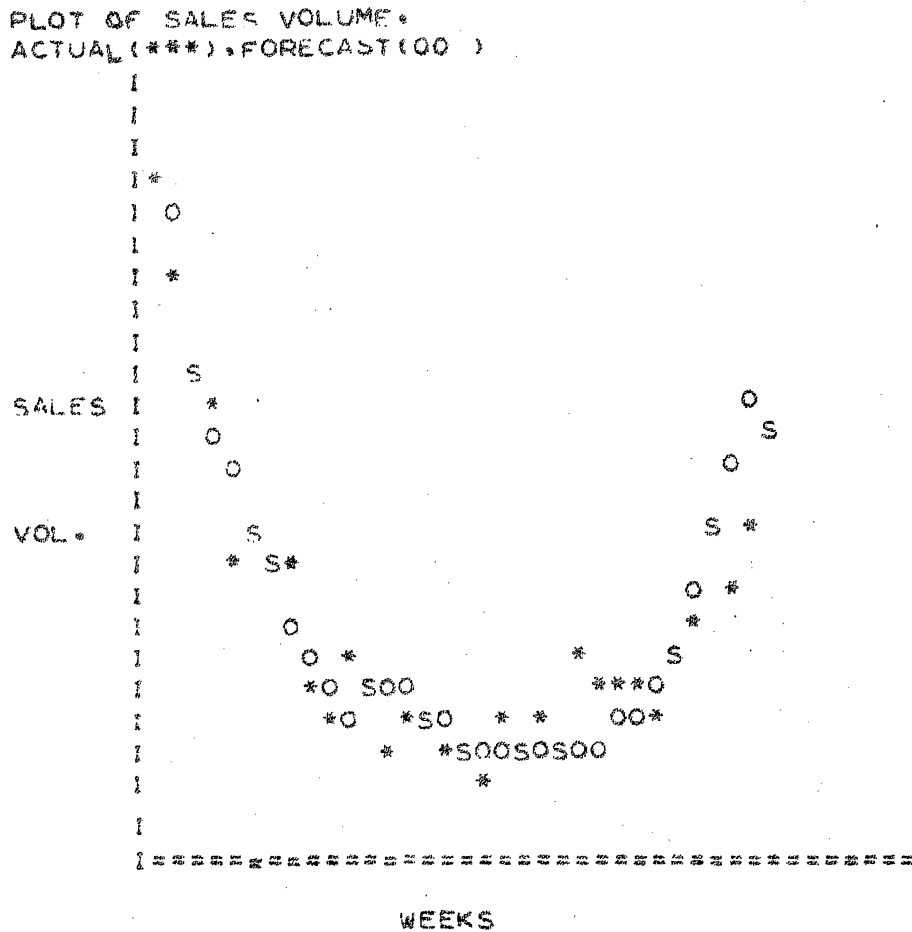


Figure 3. Computer Forecasts.

Forecasting, as used in the PPCS, provides a starting point for profitable market planning. Information is given indicative of current demand, customer preference, and market trends. More importantly, as specific promotional and market strategy programs are developed, the forecast system provides an excellent vehicle for monitoring and measuring changes in marketing effectiveness.

II. 2 Simulation

The major emphasis of the marketing simulation analysis focuses on issues relative to price, promotion, personal selling and quality of service. Data is generated by a market simulation system that allows management to make strategy decisions based on a knowledge of their probable consequences. /2 Using traditional techniques, such analysis is time consuming, highly arbitrary and subject to wide margins of error. One of the major benefits of the simulation technique as used in this system is the reduction it brings in terms of market planning time and inaccuracies. Moreover, it provides an effective vehicle for developing profit maximizing strategies that will not normally be attained using traditional approaches. /1

Figure 4 shows the major subdivisions and logic of a marketing simulator. The major subdivisions in the system were input, calculation and output. The logic of the models describes in equation form the structure of industry competition and marketing activities. Inputs are accepted in the form of strategy decisions and environmental assumptions; and revenue, costs and profits of alternative strategies are calculated. The results are then printed in the form of sales reports, financial statements, and other relevant ancillary reports.

The system is designed to include a definition of the (1) industry structure, (2) firm structure, (3) relevant decision variables, and (4) interrelationships among variables. To this end, considerable time must be spent in the analysis of secondary data. However, subjective data in the form of management experience and feelings are also of importance. Collection of this type of information requires many hours of formal and informal discussions with top management personnel. This activity can best be viewed as a translation process in which management's subjective perceptions are converted to explicit statements about the market.

The two major methods of model validation were face validation and use of the pseudo-predictive tests. Face validation procedures consisted of exposing the simulator models to industry knowledgeable executives who then judge how well it portrays the actual characteristics of their industry. Changes can be made in the model until it corresponds to executive's conception of the real world.

In the pseudo-predictive test historical decisions of the cooperating firm were inputted as decisions to the model. Model results from these decision inputs were then compared with known outcomes of the cooperating firm. This provides a vehicle by which statistical tests can be used to determine model accuracy.

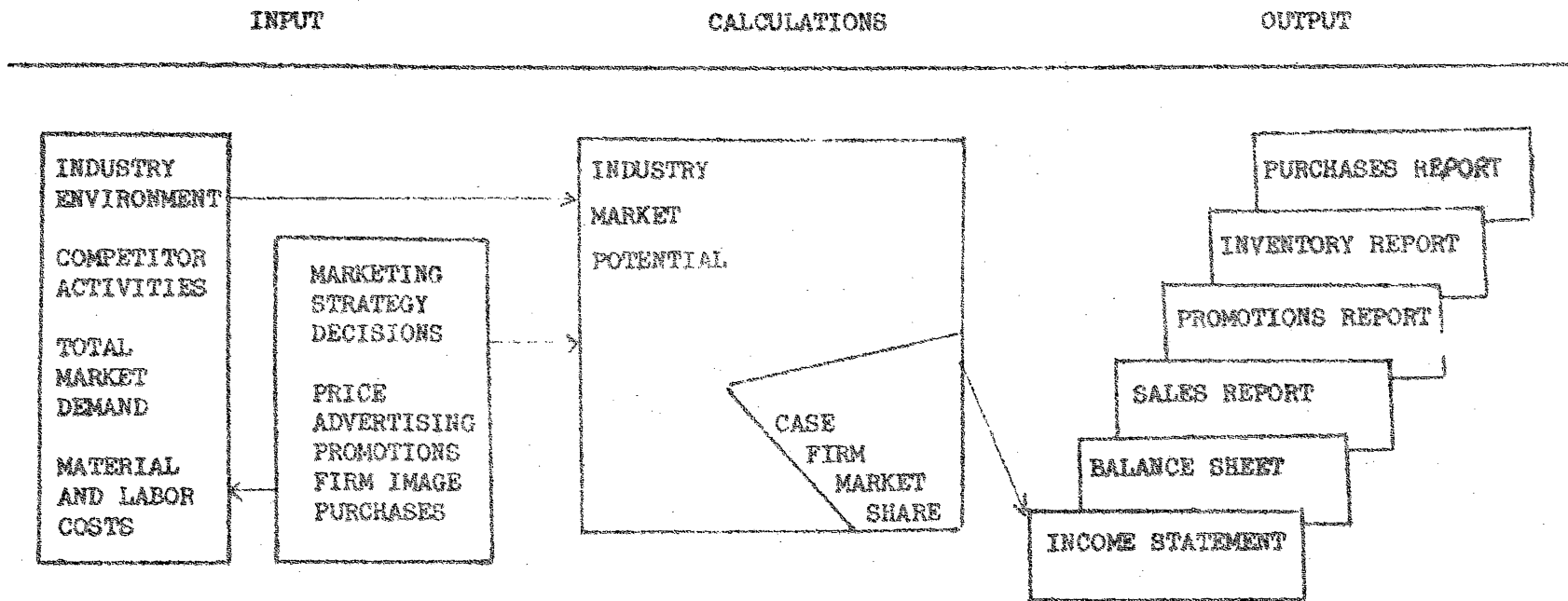


Figure 4

Use of System

The system can be used in two major ways. The first major use is that of business gaming. It has the following benefits: to observe and evaluate the actual planning process employed by industry managers, to determine the types of information more useful in the decision making process, and to determine management's perception of the effectiveness of marketing mix ingredients. An example of the computer output from the marketing simulation is given in Figure 5.

Another important way in which the system was used is in conjunction with decision theory to test a large number of specific strategies under numerous states of nature over a five year period. The consequences were then organized in a payoff matrix, which indicated the projected return for each strategy under each state of nature. A strategy selection system was devised using a criterion of choice model and five decision criteria--Laplace, Maximin, Maximax, Minimax and Bayesian. The experiments were run four times, each time varying key parameters to note their effect on the stability of the solution. Figure 6 illustrates the outcomes of different marketing strategies under the assumed states of nature. Under test conditions, the best strategy tested in the experiments yielded a 7-8% higher return on investment than the current strategy used by the case firms.

Benefits from Use of the System

Based on their research experiences, the authors think the following advantages of market simulation are most important:

1. "Testing" Strategies. In that the model describes in highly specific detail the marketplace in which a firm competes, it can be used to "test" proposed strategies. This "testing" can be accomplished very quickly, showing projected profit, market shares, sales revenue, and other consequences. In this way, large irrevocable strategy decisions might be checked out prior to execution to insure that no major factor has been overlooked or slighted in the intuitive analysis. Compared with a less systematic analysis, the computer model approach is more consistent and logical, and has the memory capacity for including in the analysis all the variables originally considered to be important.
2. Idea Generation. Perhaps the most intangible benefit attributable to the market simulator is that of idea generation. It makes executives think. It beguiles them into planning because it makes planning enjoyable. By inducing the managers into the "future" the model helps them to obtain perspective. This forward-looking perspective is conducive to idea generation.

As one vice president stated, "One thing I've found is that this whole experience makes me think deeper about our

OPERATING STATEMENT

	DOLLARS	PERCENT
SALES DOL.		
PRODUCE DEPARTMENT	1930.62	0.0721
MEAT DEPARTMENT	6517.28	0.2436
GROCERY DEPARTMENT	15544.67	0.5809
DAIRY DEPARTMENT	2766.62	0.1034
TOTAL	26759.19	
COST OF GOODS SOLD DOL.		
PRODUCE DEPARTMENT	1451.19	
MEAT DEPARTMENT	5162.43	
GROCERY DEPARTMENT	13457.61	
DAIRY DEPARTMENT	2487.86	
TOTAL	22559.10	0.8430
GROSS MARGIN DOL.		
PRODUCE DEPARTMENT	479.42	0.2483
MEAT DEPARTMENT	1354.84	
GROCERY DEPARTMENT	2087.07	0.3143
DAIRY DEPARTMENT	278.76	0.1008
TOTAL	4200.09	0.1570

Figure 5. Illustrative Management Reports, Marketing Strategy Simulator

States of Nature	Total Demand Increasing Slowly	Total Demand Increasing Rapidly	Total Demand Increasing Irregularly
Price competitive, Select high margin produce. Modest use of gimmicks	13.0	17.0	12.0
Quality Image, Prices Firm, No Gimmicks	7.0	19.0	13.0
Special Promotions Gimmicks, Firm Prices, Average Image	9.0	12.0	10.0

Figure 6. Return on Investment From Alternative Marketing Strategies.

market situation." It's difficult to estimate the benefit derived from aiding management to a sort of telescopic vision. But if in business, to foresee is to rule, then the benefits are quite high.

3. Assimilation. A key initial advantage involves the use of the system as an assimilator. The model can be used as a container to hold a large amount of relevant fact and feeling on the firm, its competitors, the market in which it competes and the economic environment in which the industry lives. The model assimilates into one total framework an espionage system, economic projections, marketing research measurements, and a firm profit budget. Used in this fashion, it is a library of fact and feeling, organized and classified into an information retrieval system.
4. Communications Device. An important benefit is derived from the model as a communications link in the top management ranks. It can help change invisible planning to visible planning by forcing the key executives to identify their intuitions about the market. It requires them to place their perceptions and best estimates down in writing for others to see. Since most businesses operate successfully on the intuitions of top managements, a market simulator can help to communicate these important intuitions or experiences to others, be they board members, subordinates or colleagues.

To date the positive managerial response to market simulation has been encouraging. Present plans call for enlargement and further refinement of the basic system, followed by further emphasis on pseudo-predictive tests and formal decision theory experimentation. Validated output from the strategy simulation will provide useful data for market planning. More importantly, these data and relationships will provide important parameters and constraints to the planning and control system.

II. 3 Modular Inventory Simulation

Investments in inventory for food processing, wholesaling, and retailing firms often ranges up to 35 percent of total firm assets. This constitutes a major use of funds, providing ample opportunity for cost reduction or incursion of excess expense. Inventory levels and policies are also of importance in (1) terms of customer services, (2) operations scheduling, and (3) optimum order size, commonly known as economic lot size. Our discussion considers one modern method of inventory control, modular simulation, useful in improving customer service and operating efficiency while reducing actual inventory costs.

Modular simulation provides management with a systematic method of analyzing modern inventory problems. /5 A wide range of different inventory policies can be compared in terms of inventory cost, customer service, and production scheduling. A distinguishing feature of modular

simulation is the flexibility permitted through the use of alternative options, each of which represents a unique inventory policy (Figure 7). Specifically, the system consists of five components designed to (1) forecast product demand, (2) estimate lead time, (3) evaluate back-order alternatives, (4) establish an order point, and (5) calculate an order quantity. Through simultaneous analysis of these five areas, management is able to choose policies or decision rules that will optimize company results in terms of inventory cost, production efficiency, and customer service.

Inventory Management Terms

The modular inventory management simulator uses standard inventory terminology. Lead time is the replenishment time required from the time an order is placed until the merchandise is on hand and available for issue. For the demonstration problem, lead time is set at one month. The basic time unit for simulation is also in months though it could have been in weeks. Review time is the time at which stock on hand and order point are examined to determine if a replenishment order should be placed. In the sample problem, review time occurs once monthly. Average monthly demand over the forecast interval for the simulation is used as the demand forecast for the first period. Stock on hand is the amount of merchandise in inventory at the start of the simulation. It must be sufficient to last until the first replenishment order is received. Unit cost is the per item purchase cost used in computing economic order quantities. Order cost is the cost of placing an order which includes paper work, inspection and other related ordering costs. Carrying cost represents the expense of carrying a unit of inventory for one forecast interval. Order point specifies when it is time to order, and order quantity designates the amount to order. These two parameters are used in fixed order point programs that are not dependent on a forecasting routine or automatic ordering system. For simulation programs using a forecasting system to guide inventory order placement, the forecast interval is the basic time unit for which a demand forecast is required. Under these programs, orders are placed based on the next period's demand forecast and an adjustment for the past forecast error.

A Sample Simulation Problem

The following sample problem demonstrates how alternative inventory policies can be simulated. Tendermeat is a regional meatpacker producing a full line of processed and canned meat specialties. Having decided to evaluate existing supply inventory control policies, Tendermeat elected to study inventory control of a can used for packaging boned, precooked hams. This bulky packaging item is a persistent inventory strage and cost control problem. Present policy calls for an average inventory level of 40,000 cans, but the plant material manager does not know if this is the best policy. He especially wants to know if a

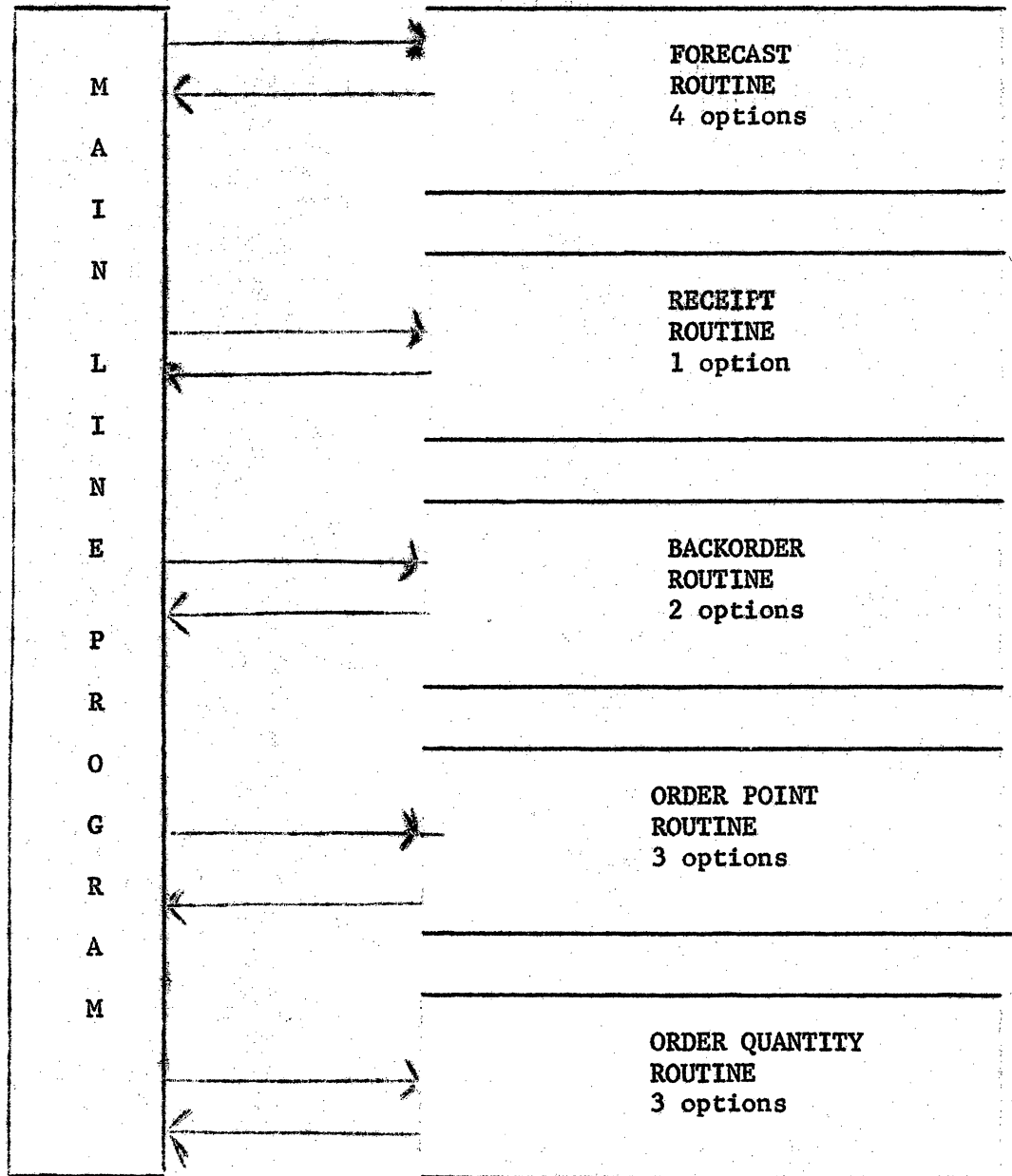


Figure 7. Schematic of Modular Inventory Simulator.

lower average inventory level could still provide a high level of customer service and also minimize carrying, order, and stockout costs. Using the past two years of demand history for this item as a simulation base, three alternative control policies were selected for evaluation.

Inventory Control Policies for Simulation

Policy No. 1 is a fixed order point, fixed order quantity program. No formal demand forecasting is involved. The plant material manager examined the demand history for ham cans and selected an order point and order quantity. To arrive at an order point he used the formula: (lead time + review time) X average monthly use + safety stock. The order quantity is specified as one month's supply. From these initial values the order point and order quantity are ranged until the "best fit" from optimum average inventory and minimized costs is found.

Policy No. 2 is an automatically controlled ordering program. The order point floats depending on the next period's demand forecast and the forecast error of the past period. A smoothing coefficient for the forecasting routine and a safety stock factor are the parameters to be simulated. The computer evaluates the given information and generates an order point and order quantity each review period. The object of this policy is to find the combination of smoothing coefficient and safety stock level that minimizes both average inventory level and carrying, order, and stockout costs consistent with the service desired. Safety stock is considered a function of time. Thus, a safety factor of .5 would call for a safety stock of one-half month's supply in inventory.

Policy No. 3 is called a running E.O.Q. (economic order quantity) program. Like Policy No. 2, it also relies on a demand forecasting routine to guide order placement; however, it includes provision for automatically considering the order cost and unit cost in determining the economic quantity to order. Instead of considering safety stock as a time function, this policy uses a statistical measure of forecast error to adjust the order so that an adequate quantity of safety stock is maintained. Again, several smoothing coefficients and safety factors can be simulated within this policy framework to find the best combination of forecast and safety stock for minimizing average inventory level and associated costs.

Common to all three programs is a policy of filling all back orders. Policy No. 2 uses a simple exponential smoothing routine; whereas, Policy No. 3 uses a trend adjusted forecast routine. These three policies represent only a few of the many combinations possible through use of an inventory simulator. In management's opinion, the policy most consistent with Tendermeat's goals should be used.

Sample Output from Simulation

In each of the three policy solutions, carrying cost equals \$.02/month times the average monthly inventory. Order cost equals \$6.57 times the number of orders placed. Stockout cost, representing lost sales and loss of customer satisfaction, is difficult to quantify and has arbitrarily been set at \$1.76 per unit. The outputs of the fixed order and economic order quantity policies are presented in summary form. Each of these solutions represents only one of several simulations using different parameters. The printed output of the floating order point policy, as illustrated, includes a period running report that shows the stepwise simulation and gives an error measure of the forecast's accuracy (Figure 8).

One possible method of contrasting these policies is to compare the combined carrying, stockout, and other costs of each policy with the average inventory level that it requires. In this way, the best policy with respect to cost minimization at an adequate service level can be identified. Figure 9 shows such a comparison.

Summary

What can be concluded from these inventory control simulations? Of first importance, the Tendermeat Plant material manager learned that his arbitrary inventory policy of maintaining a 40,000-unit average inventory level of ham cans is excessive. The same high level of service, at a lower average inventory, can be provided using an accurate forecasting simulation-control system. Also, the simulation called to his attention the narrowness of the optimum inventory level and the severity of the stockout penalty which rose rapidly when the average inventory level fell below 27,000 units. Of fundamental importance is the appreciation gained by the supply manager of the many interrelated factors of inventory management and the ability of computer programs to consider them simultaneously.

POLICY NO. 2
 FLOATING ORDER POINT
 ALL BACKORDERS FILLED
 SIMPLE EXPONENTIAL SMOOTHING
 TENDERMEAT CASE DATA ITEM NO. 3

ITEM NO.	TIME INTERVALS	TIME REVIEW/FORE/LEAD	AVE. STOCK USE	STOCK ON HAND	UNIT COST	ORDER COST	CARRY COST	FIXED ORDER POINT	FIXED ORDER QTY.
3	1.	1. 1.	35000.	60000.	.220	6.57	.0200	0.	0.

TIME PER.	INV. ON HAND	CURRENT DEMAND	BACK ORDERS	ORDER QTY.	RECEIPT QTY.	DEMAND FORE.	FORECAST TRU LEAD TIME	S. DEV. FORE. ERROR	ERR. SIG.
1	28500	31500.		27500.		35000.	70000.	17500.	+0.0
2	22000.	34000.		25375.	27500.	32375.	64750.	16625.	+0.2
3	13875.	33500.		34743.	25375.	33375.	66750.	15368.	+0.3
4	10618.	38000.		32056.	34743.	33406.	66812.	13863.	+0.3
5	7675.	35000.		44574.	32056.	36812.	73625.	13625.	-0.5
6	15750.	36500.		31887.	44574.	35710.	71421.	12715.	-0.2
7	10887.	36750.		36769.	31887.	36382.	72765.	11641.	-0.1
8	11657.	36000.		36447.	36769.	36767.	73535.	10569.	-0.0
9	11004.	37100.		34193.	36447.	36296.	72593.	9704.	-0.1
10	10397.	34800.		37596.	34193.	36929.	73859.	8934.	-0.0
11	11494.	36500.		31390.	37596.	35405.	70811.	8573.	-0.0
12	9385.	37500.		37401.	31390.	36148.	72296.	7989.	-0.1
13	11786.	35000.		29410.	37401.	34171.	68343.	7852.	+0.2
14	6196.	35000.		35347.	29410.	34634.	69269.	7274.	+0.2
15	5044.	36500.		34777.	35347.	34841.	69683.	6638.	+0.1
16	3322.	34500.		38683.	34777.	36058.	72116.	6389.	-0.2
17	6005.	36000.		36800.	38683.	36472.	72945.	5860.	-0.2
18	2806.	40000.		35003.	36800.	36208.	72416.	5392.	-0.0
19	309.	37500.		46172.	35003.	39089.	78179.	5801.	-2.2
20	7981.	38500.		35463.	46172.	38162.	76325.	5618.	-1.5
21	7444.	36000.		36727.	35463.	36515.	77030.	5141.	-1.0
22	10172.	36000.		32533.	36727.	36724.	73449.	5255.	-0.0
23	7205.	35500.		34397.	32533.	36095.	72191.	4911.	-0.2
24	4103.	37500.		34045.	34397.	35539.	71079.	4569.	-0.0

ITEM NO.	AVE. INV.	PERCENT SERVICE	NO. BACK ORDER RUN WITHOUT BACK ORDERS	NO. PER FILLED	DEMAND WITHOUT BACK ORDERS	TOTAL DEMAND	NO. OF ORDERS PLACED	AVE. OF FORE ERROR	ALPHA VALUE	SAFETY FACTOR
3	27799.	100.00	0	24	100.00	863150.	24	-2.50	1.00	

Figure 8

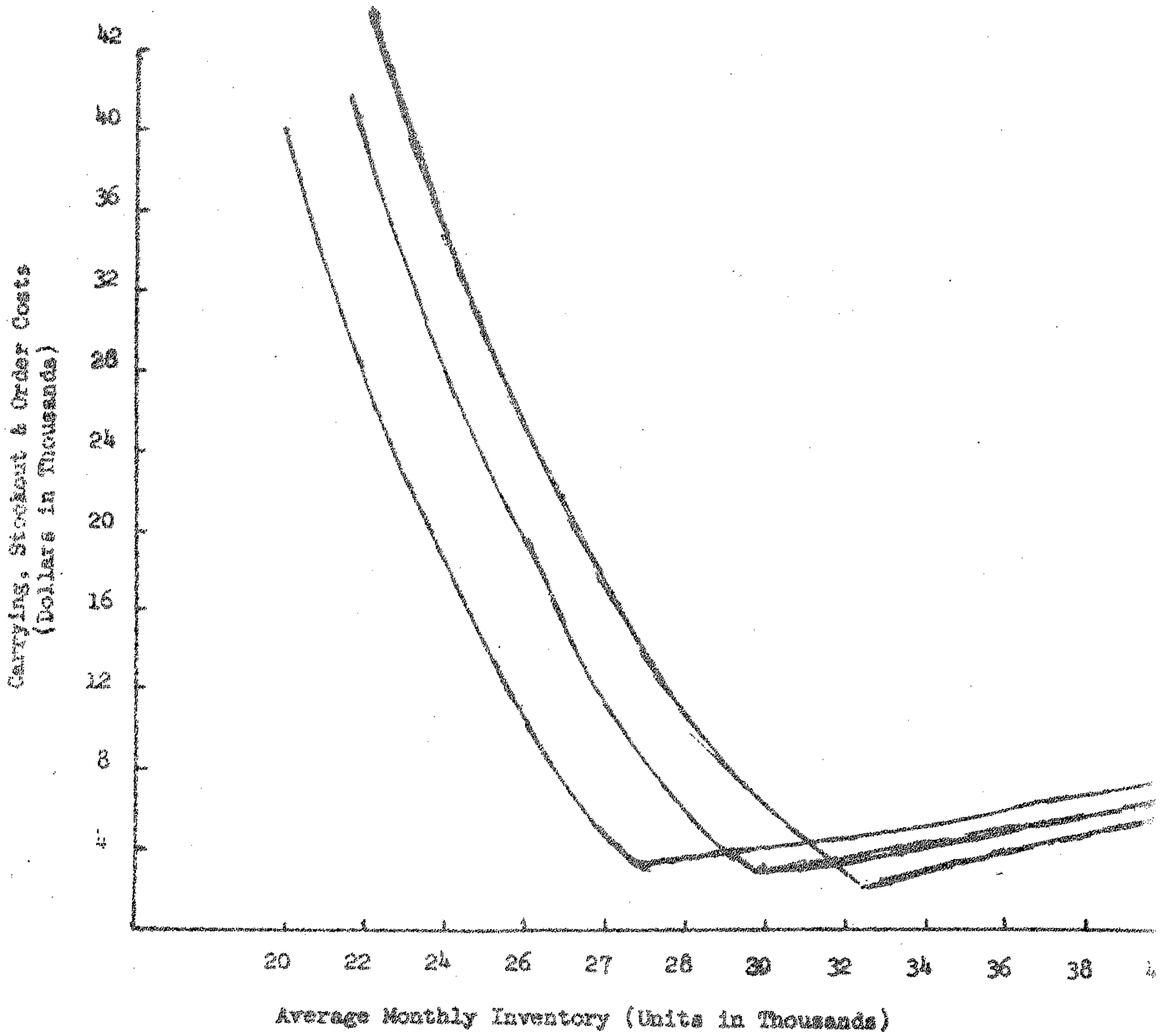


Figure 9. Comparison of inventory policy performance as measured by minimized cost per average inventories.

III PROFIT PLANNING SYSTEM

The profit planning system is now used routinely on a weekly basis wherein computer reports are generated midweek for the following week. The system can also be used for daily, biweekly, monthly or annual decision periods.

The planning system uses a modular linear programming model representing the major activities of the firm. Input data to the planning system includes data from (1) the forecast analysis, (2) marketing strategy simulation, (3) inventory control simulation and (4) routine market, engineering and accounting data. Moreover, constraints relating to managerial policy and legal requirements are stated explicitly in the system. The system is structured in a modular fashion to facilitate the addition or deletion of activities and constraints as is needed to accurately reflect current conditions.

Linear programming is no stranger to modern management. Its use first became commercially significant in the early fifties, and the technique has become increasingly important in the last decade as a superior method of allocating the resources of business to achieve maximum profit or minimum cost. An explanation of this technique is given in the technical appendix and selected references. /6,7/

Profit Planning Guides

Eight main types of decision guides are provided for management personnel responsible for the general areas of procurement, operations scheduling, inventory control and product sales.

The guides are illustrated below. The illustrations given are adapted from our cooperative research in processed meats manufacturing.

The general guides are of similar nature for other food processing and marketing firms.

Product Sales Plan

The PPS provides computer generated forecasts of weekly sales volumes of individual products as indicated in the Product Sales Forecast figure (Figure 10). Also included are actual sales by product for the past three weeks. This guide provides the sales manager, sales supervisors and production-sales coordinator with a reference base for planning the coming week's sales program.

It is valuable in evaluating the product mix, examining price-volume relationships and keeping the total sales picture in focus.

When used in conjunction with the other PPS reports and after appropriate management review and possible adjustment, it provides the basis for the scheduling of current production to meet a specified sales plan.

PRODUCT SALES FORECAST

MANAGEMENT PLANNING REPORT

PRODUCT DESCRIPTION	ACTUAL SALES			FORECAST
	WEEK 1	WEEK 2	WEEK 3	SALES WEEK 4
WIENERS - 12 oz. Pac	1080	920	890	980
2 Lb. Bag	25560	31570	26840	28305
4 Lb. Bag	8470	10890	13100	12320
30 Lb. Box	1460	1780	1690	1870
1 Lb. Pac	5760	5230	4740	5125
BOLOGNA - 12 Oz. Pac	18210	16320	15100	15230
1 Lb. Pac	19870	27140	26230	24300
2 Lb. Pac	7010	6760	6090	6985
SALAMI - 1 Lb. Pac Sliced	7090	7620	7740	7430
1 Lb. Pac Loaf	7630	8150	8970	8470
BRAUNSCHWEIGER - Chunks	17370	15140	16990	15325
1 Lb. Pac	8040	7920	7540	7525
TOTAL VOLUME	127550	139440	135920	133865

Figure 10.

Product Mix Analysis

A weekly profit margin guide is given for each product included in the manufacturer's line. This margin is the difference between selling price and all variable costs including ingredients, manufacturing labor, supplies and variable overhead. It provides management with a specific indication of the profit contribution of each item under current market conditions, i.e., sales potential, manufacturing costs, formulas used and raw material costs and availabilities. Using this data, management can make improved decisions relating to the most profitable type and amount of product to produce.

The information generated in the Product Profitability Guide is typical of the management guides provided by the system (Figure 11). In column two, management is given the most profitable mix and volume of product for the current market conditions. Column three gives the current market price and column four indicates the amount prices could be lowered without changing the most profitable mix and volume product. Profit margins by product are given in column five.

The report serves as an aid to sales management in evaluating the product profitability, sales performance and market potential. It can thus serve as a marketing control and also as a marketing planning technique.

Promotion Guides

Information of importance in planning promotional programs is given in the Sales Promotion Guide (Figure 12). This guide shows the gain in profit possible - by individual product - if additional sales can be made (column 3). This column also indicates profit loss if sales drop off. The range over which this profit margin holds is indicated in columns four and five. For example, the 1 Lb. Pac Bologna with current sales volume of 24,300 lbs. has a profit margin of \$13.00 over a sales range of 21,370 lbs minimum to 27,110 maximum, other sales remaining constant. Sales above the maximum would bring decreased unit profit whereas sales below the minimum would bring unit profits above the \$13.00 level.

Examination of these values and associated ranges over a period of time may indicate that a change in promotional effort is desirable. Consider the effect of increased promotional efforts to obtain additional sales of 2 Lb Bag Wieners. Each increase in sales would be worth \$13.20 per cwt, up to a sales level of 32,840 lbs. If the cost of obtaining added volume in this range is less than \$13.20 per cwt, management would be justified in expanding promotional efforts to pick up this added volume.

PRODUCT PROFITABILITY GUIDE

MANAGEMENT PLANNING REPORT

PRODUCT DESCRIPTION	SALES VOLUME (LBS)	SELLING PRICE (\$/CWT)	LOWEST PRICE (\$/CWT)	PROFIT MARGIN (\$/CWT)
WIENERS				
12 OZ. PAC	980	49.50	36.20	13.30
2 LB. BAG	28305	48.00	34.80	13.20
4 LB. BAG	12320	44.00	34.30	9.70
30 LB. BOX	1870	43.50	30.90	12.60
1 LB. PAC	5125	49.00	35.60	13.40
BOLOGNA				
12 OZ. PAC	15230	48.50	35.20	13.30
1 OZ. PAC	24300	47.50	34.50	13.00
2 LB. PAC	6985	42.00	33.20	8.80
SALAMI				
1 LB. PAC-SLICE	7430	68.00	41.60	26.40
1 LB. PAC-LOAF	8470	57.00	38.10	18.90
BRAUNSCHWEIGER				
BRAUN CHUNKS	15325	52.00	30.70	21.30
BRAUN 1 LB. PAC	7525	54.00	32.40	21.60
TOTALS 133865 LBS.				

Figure 11.

PROMOTION GUIDE

MANAGEMENT PLANNING REPORT

PRODUCT DESCRIPTION	POTENTIAL SALES (LBS)	PROFIT MARGIN (\$/CWT)	MARGIN VALID THIS	
			RANGE OF SALES (LOWER)	(UPPER)
WIENERS				
12 OZ PAC	980	13.30	910	1100
2 LB. BAG	28320	13.20	27460	32840
4 LB. BAG	12320	9.70	10340	15870
30 LB. BOX	1870	12.60	1520	2020
1 LB. PAC	5125	13.40	4950	5340
BOLOGNA				
12 OZ. PAC	15230	13.30	13330	16450
1 LB. PAC	24300	13.00	21370	27110
2 LB. PAC	6985	8.80	6170	7590
SALAMI				
1 LB. PAC - SLICED	7430	26.40	6640	8360
1 LB. PAC - LOAF	8470	18.90	7480	10220
BRAUNSCHWEIGER				
BRAUN CHUNKS	15325	21.30	14920	15980
BRAUN 1 LB. PAC	7525	21.60	7120	7630
TOTAL		133865 LBS.		

Figure 12

In our Purdue research, the PPS has provided a markedly improved method of sales promotion planning through:

1. Immediate calculation of profit margins by individual products.
2. Computation of pay-back on special promotions.
3. Analysis of cost-volume-profit relationship for each product as well as total production and sales.

Plant Labor Requirements Guides

Several types of labor requirements guides are generated. Only one is included in this paper, in this case, labor involved in product manufacturing (Figure 13). This Labor Requirements Guide represents the total number of hours of regular and overtime labor required. If all regular labor is used, a shortage penalty in dollars per hour occurs. This guide provides an effective planning aid in scheduling operations and controlling the use of regular and overtime labor. It also indicates when a second shift would become more economical than overtime.

The breakdown of labor needs by job type is also based upon standards and is useful as a scheduling and variance control aid. The cost of unearned labor represents the difference between requirements at standards and guaranteed time. It is the cost of unproductive labor.

Equipment Utilization Guide

This management guide (Figure 14) is designed to show predicted equipment needs to meet the scheduled production for the coming week. It is intended to serve as an aid in scheduling equipment use, detecting approaching bottlenecks, evaluating actual usage, and justifying new equipment additions or deletions of unused equipment.

The capacity penalty is the sacrifice in profit per hour of machine time, incurred because of a machine constraint.

Buying Guide

The Buying Guide (Figure 15) provides optimum purchase quantities (from known availabilities) necessary for production of the coming week's forecasted demand for finished product. Buying the recommended purchase amounts, adjusted by inventory position, assures adequate raw material for least-cost formulation of all products lines.

LABOR REQUIREMENTS -- MANUFACTURING

MANAGEMENT PLANNING REPORT

SKILL TYPE	HOURS AVAILABLE	HOURS REQUIRED	HOURS EXCESS	HOURLY RATE	SHORTAGE PENALTY	MAXIMUM RATE
FORMULATION REG	400	366	34	\$3.38-	\$3.38-	\$0.
FORMULATION OVT	165	0	165	5.07-	0.	5.07
STUFF REGULAR	420	387	33	3.38-	3.38-	0.
STUFF OVERTIME	100	0	100	5.07-	0.	5.07
SMOKEHOUSE REG	120	78	42	3.38-	3.38-	0.
SMOKEHOUSE OVT	30	0	30	5.07-	0.	5.07

JOB TYPE	HOURS REQUIRED
FORMULATION	366.
STUFF	387
SMOKEHOUSE	78.

PRESENT GANG SIZE IS 23.5 MEN.

EARNED LABOR AT 100 PERCENT PROFICIENCY	731 Hours	\$2470.78-
WASTE TIME	100	338.00-
TOTAL HOURS AND COST OF FORMULATION LABOR	831 Hours	\$2808.78-

Figure 13

EQUIPMENT UTILIZATION

MANAGEMENT PLANNING REPORT

EQUIPMENT TYPE	HOURS AVAILABLE	HOURS REQUIRED	HOURS EXCESS	CAPACITY PENALTY \$/HR
VACUUM PAC	80.	18.6	61.4	0.
FRANKOMATIC	58.	58.0	0.	12.+2
STUFFER	174.	49.1	124.9	0.
PEELER	80.	28.1	51.9	0.
SMOKEHOUSE	3456.	1947.1	1508.3	0.

Figure 14

The maximum price and buy more price indicate the effective price range over which each raw material is a good buy. Maximum prices of \$99.99 indicate a raw material essential to production regardless of how high prices may rise. Zero buy more prices merely indicate that the raw material becomes a good buy at any lower price. These effective price ranges mean that as long as other raw material prices and quantities remain as given, the optimal solution will not change with purchase of the given raw material at any price within the effective range.

Reserve Procurement Guide

The Reserve Procurement Guide (Figure 16) indicates raw materials that are available but are not required for the coming week of production.

Two sources of reserve raw materials exist.

The first guide gives information on raw material availability in addition to the minimum requirements. These sources are the most economical alternatives if additional raw material is needed.

Should a recommended source not be available, then purchase from the second reserve guide would be necessary. If this is done, the penalty cost will give an indication of the profit-loss impact of the purchase.

Estimated Operating Statement

An Estimated Operating Statement (Figure 17) is prepared for the coming week's projected operations. Revenue is based on forecasted sales. Meat costs are based upon the recommended raw material procurement. Variable costs are based upon accounting costs. Fixed costs are those relevant for the current period.

There are many potential uses for this guide including:

1. Analysis of the impact of expected price changes upon profit.
2. Assessment of profit performance of sales promotion.
3. Evaluation of changes in raw material, labor and equipment costs.
4. Profit budgeting.

The system can also be used to develop longer run strategy and policy through a simulation of past, present and predicted conditions.

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RAW MATERIAL PROCUREMENT GUIDE

MANAGEMENT PLANNING REPORT

RAW MATERIAL	QUANTITY OFFERED (LBS)	PURCHASE AMOUNT (LBS)	PRICE PER CWT	MAXIMUM PRICE \$/CWT	BUY MORE PRICE \$/CWT
PORK HEARTS	5000	4370	\$25.80-	\$26.90	\$25.25
BEEF HEARTS	4000	3580	21.00-	21.75	20.25
PORK CHEEKS	3100	3100	43.25-	44.10	42.75
BEEF CHEEKS	20060	15050	38.00-	38.70	37.50
BEEF PLATES	42500	42500	20.50-	20.95	20.10
BEEF FRONTS	7500	7170	46.25-	47.50	46.10
PORK LIVER	15000	10890	17.00-	18.15	16.60
PORK STOMACHS	9000	2850	7.25-	7.90	7.10
BEEF TRIPE	15000	11220	8.50-	9.40	8.15
PORK JOWLS	6500	5060	13.00-	14.00	12.50
BACON ENDS	4000	2970	17.10-	18.05	16.85

TOTAL LBS OF RAW MEAT PURCHASED 108760 LBS.

TOTAL COST OF RAW MEAT PURCHASED \$25144.94

Figure 15

ESTIMATED OPERATING STATEMENT

MANAGEMENT PLANNING REPORT

TOTAL SALES		\$66592.55
MEAT COSTS		25144.94-
		<hr/>
GROSS MARGIN		\$41447.61
VARIABLE COSTS		
ADDITIVES	\$3744.37-	
PACKAGING	4853.29-	
VARIABLE OVERHEAD	1338.65-	
LABOR	6088.94-	
	<hr/>	
TOTAL VARIABLE COSTS		\$16025.25-
		<hr/>
CONTRIBUTION TO FIXED COST		\$25422.36
FIXED COSTS		
FIXED OVERHEAD	\$2200.00-	
SELLING, GNL., ADM.	3900.00-	
	<hr/>	
TOTAL FIXED COSTS		\$6100.00-
		<hr/>
CONTRIBUTION TO PROFIT		\$19322.34
		<hr/>
		<hr/>

Figure 17.

IV PROFIT CONTROL SYSTEM

The Profit Control System (PCS) provides a detailed set of performance evaluation guides comparing actual performance of the past week with the MPS planned performance for this week. It also analyzes where the differences in performance occurred, including:

1. Differences in level of production of sales.
2. Differences in efficiency of use of raw materials or labor.
3. Differences in prices paid or prices received.
4. Differences in the mix of raw materials used or products sold.

Figures 18-21 illustrate information generated for the PCS; this is by and large similar in nature to that required for the MPS, and in fact must include for comparison data used for the corresponding report in the MPS.

In the figures that follow (18-23) variances may be interpreted as follows: A minus sign following a variance indicates an "unfavorable" variance, that is, this variance has the effect of causing actual net income to be less than projected. A positive variance has the effect of causing actual income to be greater than projected.

The production level (volume) variance is the difference between planned performance and actual operations that is attributable solely to differences in the volume of products produced or sold.

The efficiency or yield variance measures the difference that is due solely to differences in yields on formulations or efficiency in the use of labor. Using the planned performance as a standard it measures the dollar effect of variations from the standard.

Price variance isolates the effect due to actual prices and projected prices being different.

A mix variance is calculated for raw materials used and for products sold. It isolates the dollar difference between planned and actual due to different combinations of raw materials used or products sold.

Limitations in space do not permit a detailed discussion of each of these reports, which also include (Figures 22 and 23) evaluation of variance effects on profit contribution.

PRODUCT SALES COMPARISON

COMPARATIVE PERFORMANCE REPORT

PRODUCT DESCRIPTION	PLANNED			ACTUAL		
	SALES VOLUME	SELLING PRICE	TOTAL SALES	SALES VOLUME	SELLING PRICE	TOTAL SALES
	LBS	\$/CWT	\$	LBS	\$/CWT	\$
Wieners						
12 Oz. Pac	980	49.50	485.10	1240	49.50	613.80
2 Lb. Bag	28305	48.00	13586.40	29910	47.00	14057.70
4 Lb. Bag	12320	44.00	5420.54	11797	42.50	5013.73
30 Lb. Box	1870	43.50	813.45	2305	44.00	1014.20
1 Lb. Pac	5125	49.00	2511.25	5440	49.00	2600.60
Bologna						
12 Oz. Pac	15230	48.50	7386.55	15980	47.75	7630.45
1 Lb. Pac	24300	47.50	11542.50	21770	47.25	10284.50
2 Lb. Pac	6985	42.00	2933.70	6600	42.50	2805.60
Salami						
1 Lb. Pac (Sliced)	7430	68.00	5052.40	7690	68.00	5412.00
1 Lb. Pac (Loaf)	8470	57.00	4827.90	8118	57.00	4627.26
Braunschweiger						
Braun Chunks	15325	52.00	7969.00	16043	52.25	8382.47
Braun 1 Lb. Pac	7525	54.00	4063.50	5195	53.75	2792.80
TOTALS	133865 LBS		\$66592.55	132358 LBS.		\$65301.65
VOLUME VARIANCE	\$ 749.67-					
PRICE VARIANCE	578.69-					
MIX VARIANCE	37.46-					
TOTAL VARIANCE	\$1290.90-					

Figure 18.

LABOR COMPARISON - MANUFACTURING

COMPARATIVE PERFORMANCE REPORT

DESCRIPTION	MODEL LABOR			ACTUAL LABOR		
	HOURS	HOURLY RATE	TOTAL COST	HOURS	HOURLY RATE	TOTAL COST
Regular Labor-- Earned at 100 Pct Proficiency	731	3.38-	2470.78-	807	3.34-	2695.34
Waste Labor	100	3.38-	338.00-	44	3.34-	146.96
Overtime Labor-- Earned at 100 Pct Proficiency	0	5.07-	0.	0	5.12-	0.
Waste Labor	0	5.07-	0.	18	5.12-	92.14
TOTALS	831 Hrs		\$2808.78-	869 Hrs.		\$2934.50
PERCENT PROFICIENCY			87.97			92.87

VARIANCES

Production Level	\$256.88-
Regular Hourly Rate	34.76
Overtime Penalty Rate	1.62-
Efficiency	98.02
Overtime Penalty Hours	0.

TOTAL MANUFACTURING LABOR VARIANCE \$125.72-

Figure 19.

RAW MATERIAL PROCUREMENT

COMPARATIVE PERFORMANCE REPORT

RAW MATERIAL	PLANNED			ACTUAL		
	PURCHASE QUANTITY	PRICE PER CWT	TOTAL COST	PURCHASE QUANTITY	PRICE PER CWT	TOTAL COST
	LBS	\$	\$	LBS	\$	\$
PORK HEARTS	4370	25.80-	1127.46-	8760	25.80-	2260.08-
BEEF HEARTS	3580	21.00-	751.80-	0	21.50-	0.
PORK CHEEKS	3100	43.25-	1340.75-	3070	43.10-	1323.17
BEEF CHEEKS	15050	38.00-	5719.00-	15970	38.11-	6086.17-
BEEF PLATES	42500	20.50-	8712.50-	36200	20.25-	7330.50-
BEEF FRONTS	7170	44.25-	3316.13-	13530	46.80-	6332.04-
PORK LIVER	10890	17.00-	1851.30-	10175	17.05-	1734.84-
PORK STOMACHS	2850	7.25-	206.63-	1210	7.40-	89.54-
BEEF TRIPE	11220	8.50-	953.70-	12260	8.50-	1042.10-
PORK JOWLS	5060	13.00-	657.80-	3700	12.90-	477.30-
BACON ENDS	2970	17.10-	507.87-	2775	17.25-	478.69-
TOTALS	108760 LBS.		\$25144.94-	107650 LBS.		\$27154.43-
TOTAL LBS. OF FINISHED PROD	133865			132358		
AVERAGE YIELD	123.08			122.95		
TOTAL NET VARIANCE			\$2009.49-			

Figure 20

ESTIMATED OPERATING STATEMENT

COMPARATIVE PERFORMANCE REPORT

	PLANNED	ACTUAL
TOTAL SALES	\$66592.55	\$65301.65
MEAT COSTS	25144.94-	27154.43-
GROSS MARGIN	<u>41447.61</u>	<u>38147.22</u>
VARIABLE COSTS		
ADDITIVES	3744.37-	3693.14-
PACKAGING	4853.29-	4513.44-
VARIABLE OVERHEAD	1338.65-	1323.58-
LABOR	6088.94-	6409.60-
TOTAL VARIABLE COSTS	<u>16025.25-</u>	<u>15939.74-</u>
CONTRIBUTION TO FIXED COST	\$25422.36	\$22207.44
FIXED COSTS		
FIXED OVERHEAD	\$ 2200.00-	\$ 2200.00-
SELLING, GNL., ADM.	3900.00-	3900.00-
TOTAL FIXED COSTS	<u>6100.00-</u>	<u>6100.00-</u>
CONTRIBUTION TO PROFIT	<u>19322.36</u>	<u>16107.44</u>

Figure 21.

VARIANCE EFFECT ON PROFIT CONTRIBUTION BY COST CENTER

COMPARATIVE PERFORMANCE REPORT

MODEL CONTRIBUTION TO PROFIT		\$19322.36
SALES VARIANCES		
VOLUME VARIANCE	\$ 749.67-	
PRICE VARIANCE	578.69-	
MIX VARIANCE	37.46	
	<hr/>	
NET SALES VARIANCE		1290.90-
RAW MATERIAL USAGE VARIANCES		
PRODUCTION LEVEL VARIANCE	154.44	
FORMULATION MIX VARIANCE	2150.93-	
PRICE VARIANCE	2.49-	
YIELD VARIANCE	10.51-	
	<hr/>	
NET RAW MATERIAL USAGE VARIANCE		2009.49-
LABOR VARIANCES		
PRODUCTION LEVEL VARIANCE	53.20-	
REGULAR HOURLY RATE VARIANCE	32.50-	
OVERTIME PENALTY RATE VARIANCE	1.62-	
EFFICIENCY VARIANCE	233.34-	
OVERTIME PENALTY HOURS VARIANCE	0.	
	<hr/>	
NET LABOR VARIANCE		320.66-
ADDITIVE, PACKG., AND VAR. OVHD.		406.15
		<hr/>
ACTUAL CONTRIBUTION TO PROFIT		\$16107.46
		<hr/> <hr/>

Figure 22.

VARIANCE EFFECT ON PROFIT CONTRIBUTION BY VARIANCE TYPE
 COMPARATIVE PERFORMANCE REPORT

	VARIANCES		
	FAVORABLE	UNFAVORABLE	
MODEL CONTRIBUTION TO PROFIT			\$19322.36
VOLUME VARIANCES			
SALES		\$ 749.67-	
RAW MATERIAL USAGE	\$154.44		
LABOR		53.20-	
ADDITIVES, PACKG., AND VAR. OVHD	406.15		
NET VOLUME VARIANCE			242.28-
PRICE VARIANCES			
SALES		\$ 578.69-	
RAW MATERIAL USAGE		2.49-	
NET PRICE VARIANCE			581.18-
MIX VARIANCES			
SALES	\$ 37.46		
RAW MATERIAL USAGE		\$2150.93-	
NET MIX VARIANCE			2113.47-
YIELD VARIANCE--RAW MATERIAL USAGE		\$ 10.51-	10.51-
LABOR VARIANCES (EXC PROD LEVEL)			
EFFICIENCY		233.34-	
REGULAR HOURLY RATE		32.50-	
OVERTIME PENALTY RATE		1.62-	
OVERTIME PENALTY HOURS		0;	
NET LABOR VARIANCE (EXC PROD LEVEL)			267.46-
ACTUAL CONTRIBUTION TO PROFIT			\$16107.46

Figure 23.

In Evaluation

Joint use of the MPS and PCS provides management with planning and control information superior to that obtained from merely automating the data processing system. Planning guides generated by the MPS represent an optimum course of action. Control is achieved through the PCS with a routine weekly analysis comparing planned actions to actual results. Flexibility of the system allows reports to be tailored to the specific needs of individual decision makers.

Planning guides as well as comparative performance guides are generated for each major area of the firm permitting individual departments to identify their contribution to profitability of the entire firm. Specific areas of weakness (and strength) are identified permitting immediate remedial action where necessary. Improved decision rules for procurement, formulation, production scheduling, promotional campaigns and marketing are major factors in improved efficiency and overall profitability.

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