A Cost Accounting and Control System

for an

Olive Oil Processor in Lebanon

by

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Abstract

The purpose of this thesis is to design and evaluate a cost and control system for an olive oil processing firm in Lebanon.

To justify such an undertaking, many reasons and arguments have been presented. The most important of all reasons emphasized throughout the thesis has been the control of costs. It has been contended that in order to realize the objectives of the firm, namely, profitability and growth, management must have control over costs, which can hardly be achieved without a properly designed cost system. The emphasis of the proposed system has been diverted from the old view of finding the full unit cost of the products to the modern view of providing management with information that will be of value in the process of decision making and forward planning. The system, therefore, has been designed in such a way as to enable management to enforce a (and according to some authors "the") fundamental law of management, i.e., control by exception. The system directs attention to the points that need study and analysis; it forcibly attracts attention to the items that are out of line.

It has also been suggested that a cost and control system alone does not improve efficiency. The system is one of many measures the management of the firm can and should take so as to increase profitability. Some of these measures, as emphasized in the thesis, should be taken even before a system as proposed here can be actually and advantageously installed and operated.

Finally, it has been suggested that the effectiveness of any new idea in the firm depends on the very men who direct and lead the activities of the firm. The manager should fully understand the value of the new ideas and should apply them sincerely and faithfully.

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I. INTRODUCTION

A. The General Framework

"It was the naturalist, John Burroughs, who admitted that he was born with a chronic anxiety about the weather."[1] In the same way, to use a simile, the writer, and perhaps the reader, has developed a similar feeling, and a chronic one in all likelihood, about the business weather. "Business weather" needs a clear-cut definition to fit into the framework developed here. To some the term may mean changes and/or fluctuations in business conditions such as the prices of the factors of production, changes in revenues, Schumpeter's status-quo disruptions, etc.[2] Still to others it may mean something entirely different. Here it is employed to mean the health and quality of a business firm as determined by expert opinion based on the past, present, and projected future of the firm. This measure of quality is assumed to improve as more doses of techniques developed by economists, accountants, managers, social scientists, and the like are injected into the firm. In broad terms, the farther away a business firm stands from the methods developed by above functional specialists in the conduct of its business, the

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(1) Ray R. Eppert, "Storm Signals of the Sixties", Business Topics, Spring 1961, P. 26.

(2) Schumpeter in his Theory of Economic Development held innovations as cause of profits. Some economists, including Schumpeter himself, expound the innovation-profit theory as an explanation of business cycles.

less satisfactory is considered to be its quality and hence its business weather. Depending on the individual firm, the "weather" may change in a number of directions, as new doses of techniques, referred to above, are introduced into the firm, before it sets out on its expected path; psychologically, the change may be resented, in which case the "weather" will be "stormy", which would have its repercussions in all sides of the business firm. Obviously all those who pursue business as their careers are concerned, either consciously or unconsciously, with business weather as defined here,

But the indisputable fact is that the business firms in the developing areas of the world, such as the whole area called the Middle East, have a gloomy, cloudy, turbulent weather. There is no need to try to justify the statement put forth here.(3) A few random visits to the firms in any town or village will do to arrive at the above conclusion.

A "business weather" thus described has a rationale to be lamented. The typical management, as an author(4) states, knows very little, if anything at all, about the many varieties of business techniques, say a cost accounting system or production control, let alone industrial psychology, the theory of the firm, correlation analysis or linear programming. Here is where the educated generation can be useful in bringing about a "wise and calculated" reform. And it is also for these reasons why we should have a "chronic anxiety" about the business weather as interpreted here.

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(3) Many works have been compiled in support of this statement. The whole series published by the International Bank of Reconstruction and Development entitled, The Economic Development of Syria, The Economic Development of Iraq, and the like, have much evidence of the "gloomy weather of business" referred to above. Another book is a published thesis by A.E. Mills, Private Enterprise in Lebanon.

(4) Ibid.

The anxiety about the "business weather" does not disappear completely once the new measures as developed in the West are applied in the firms of the Middle East. However, new problems, such as those discussed by authors like W. H. Whyte in The Organization Man or Seidenberg in The Post-Historic Man, namely, the implications of mass production and organization and finally a "mass society" do arise.(5) The theses of these authors are presented not to be discussed or defended, but to point out that we should develop within ourselves a chronic anxiety about the "business weather" regardless of the degree of economic advancement, both at a business level or total economic level.

The reason why we should develop such an attitude within ourselves is perhaps very clear. Given the world conditions of today and the voice of economic development already so high in developing countries, it becomes our major objective to win the tug-of-war against poverty and ignorance by taking the lead in our areas of specialization. To discharge our moral duties, we would inevitably run into the business world, where the "weather" would always need "prediction" and"manipulation", and there is evidence that it is at present very dull in the Middle East. It is an established fact that business firms in the Middle East are facing problems for which solutions are already available and it well lies within our "area of freedom" to remove their shortcomings by using our training and experience, and then tackling the new problems that stem from these changes and improvements. Our anxiety would consist of diagnosing the existing problems in a given

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(5) The above writers have prophesied that the present trend of organization and mass production may well lead to a "mass society" where individualism, as we understand the term, may vanish.

business firm, solving them and then being always on guard to predict the problems that might arise as a result of the new environment or, to use our simile, in response to the "changing weather".

The argument presented above can also be looked at from a macro-economic standpoint. All the countries today, and particularly the underdeveloped ones, have economic development as their firm goal and perhaps the best way for us to contribute to this end to the extent our capabilities permit, is to develop the "anxiety about business weather" as meant above. Although the authors, T. F. Dernburg and D. M. McDougall, maintain that "aggregate economic behavior does not correspond to the summation of individual activities",(6) but if the majority of business firms in a given economy are "well-managed", profit-making and expanding, or in other words, if the constituent cells of an economy, which are the numerous business firms in a competitive society, are doing fine in terms of production and marketing, then the GNP and with it the standard of living are likely to rise, which in turn may guarantee the health of the nation, both material and non-material.

An education in business is primarily intended to train specialists at the micro-economic level. The importance of these specialists to the progress of any nation and specially to the so-called developing countries was briefly shown in the preceding few paragraphs. The initiative should, in my opinion, come from the business students by applying their training and experience in real-life business situations. The study to be presented in this paper is a typical example where problems could be solved by modern business

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(6) Macro-Economics, P. 2.

techniques and results evaluated from all possible angles.

To put into more specific terms, the roles of people who are trained to handle economic and business problems at the firm level can be summarized as follows:

1. Cathartic Effects. The term "cathartic effect", borrowed from medical sciences, is employed to signify a purifying action tending to wipe out irregularities and anomalies from a solution or an environment. Here it is used to denote an action or an effect upon the socio-economic environment that produces the same result as a cathartic medicine on an organism, creating a clean, workable, and desirable area for the furtherance of an over-all objective. In the case of a firm like the one to be discussed in the ensuing part of this paper, the cathartic action of a trained business specialist can produce noticeable changes and improvements in the "business weather" surrounding or enveloping the firm. Like Adrenaline stimulating the beatings of the heart, new managerial techniques can stimulate and activate the "heart", and hence all the other parts dependent on a good heart, of the firm.

2. Catalytic Effects. This term is taken from chemical usage and means the influences exerted by a substance to combine two or more elements without the substance itself being affected or changed. Applying this to the business world, the term may be used to signify an action whereby an economic activity, defined broadly as any activity that involves the use of scarce resources - including time - in the provision of goods and services, results more readily by the presence of the "micro-economists" then otherwise would.

B. Purpose

The purpose of this paper can be, with great brevity, summarized as introducing one of the innumerable "cathartic

effects" referred to above into a business firm, and then evaluating the results thereof. In the business jargon, this paper will set up a cost and control system for an olive oil processing firm in Lebanon that will be helpful for management in the process of decision-making and forward planning.(7)

C. Justifications

Indeed the foregoing discussion has stated in broad terms the justifications for this study. To reduce them to more specific terms, the following important reasons may be mentioned.

1. The present state of underdevelopedness from which a substantial part of the world is suffering has many causes. One of them, and I think a very important one, is the gap that separates the top elite from the laymen. The "missing-link" that gives rise to the so-called "inverted-mushroom",(8) is the absence of a "business elite" at the firm and industry level. To reduce this chasm, the business firms should modernize and adopt the modern techniques, one of which is advocated in this study.

2. The firm to be studied provides an ideal case material to be analyzed and thoroughly discussed. It is a manufacturing firm that presents problems: managerial, accounting, financial, etc., which fall under the broad line of studies called "Business Administration", and which can be solved by the techniques developed under this same heading.

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(7) The identifications of the firm and management are not, in compliance with their own request, to be disclosed.

(8) A term borrowed from A.E. Mills, Private Enterprise in Lebanon.

3. It is high time that these problems be solved at the business-firm level. In order to preserve the very being of the system of private enterprise, these difficulties and obstacles should be removed at the managerial level so as to allow the people to feel and to see the potentialities of a competitive system. It is hoped that the study to be presented will set an example as to how one of these problems can be solved through a system of cost accounting.

4. The writer's field of concentration is accounting, which puts him in a good position to undertake the task of making the study the nature of which is essentially accounting.

Other reasons can be put forth to justify the present work, but the ones mentioned above are perhaps the most important ones.

D. Limitations

There are a few limitations to the study. The first is that there is no such thing as the "best" accounting system, at least when one is being devised. Time and experience are the best guides to indicate what is necessary and what is not. As such whatever that will appear later is only an attempt to set up a system which in the opinion of the writer is the best under the present conditions and "state of the arts", as will be described in the ensuing chapters. Another limitation is that the firm with its new machinery and processing system is relatively new and hence lacks the work experience necessary for a "good" system. Still another and probably the most important limitation is that the problem of setting up a cost accounting system is not purely an accounting one. Many talents like managerial and engineering are needed for a fairly

good system. Such talents are absent in this study and an effort will be made to secure them whenever the need for such kinds of advise arises.

There are other, but relatively less important, limitations such as the communication problem, travelling, etc. which do not present a serious problem.(9)

(9) The owners of the firm are Italian and speak very little English.

II. FINDINGS ABOUT THE COMPANY

Part II will attempt to give a brief outline of the history of the firm and a simple, non-technical exposition of the nature of the firm's operations, followed by some other information. Though all the contents of this part may not be thought essential for a cost system per se, but the intention is to give a thorough background (subject to the disinclination of the owner-manager to reveal many details to the writer) to the reader that may stimulate further thoughts and discussion.

A. History of the Company

Mr. A.K., the late owner and founder of the present firm, originally set out as silk manufacturer in Lebanon.(10) He had come to Lebanon from his home country, Italy, because of his acquaintance with some Italians residing in Lebanon, and more important, because of his enterprising spirit to do business in Lebanon. His choice of the country for business was not at all unreasonable. Lebanon, being situated on the eastern coast of the Mediterranean, has much in common with Italy. Almost the same agricultural products such as citrus fruits and olives are produced in both countries. Mr. K's

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(10) The names of the owners are, for their own reasons, kept anonymous.

earlier experience in silk and olive oil extraction was sufficient assurance for his successful business career in Lebanon where such activities were conducted on very small scale.

However, Mr. K. began business just like many other local businessmen do, i.e. without bothering to go into a formal analysis of demand, cost, product line, capital-budgeting, pricing, etc. In 1911, he purchased a silk plant from the father of Henri Faroun, the well-known Lebanese millionaire, in a village in Lebanon. Before establishing the business into a"going-concern", the K's had to flee to Italy because of the war between Turkey and Italy. However, they returned after a while and operated the plant upto 1914. They were again forced to go back to Italy because of World War I, after which they returned to Lebanon again in 1921 and after a major overhaul began operations again. New equipment was imported from Italy in 1927, and by 1931, another silk plant was built in a nearby village. World War II also caused a series of interruptions in their business activities and sent them back to Italy and forth to Lebanon several times.

However, the major interruption, and perhaps the one that curtailed their silk manufacturing to a noticeable extent, came from a different kind of war. The synthetic silk was in the market by 1946, and Mr. K., like many of his competitors, had to submit to the impersonal dictates of the market. In 1948, he built an olive oil extraction plant in the place of the silk factory.

The extraction plant had an input capacity of 10 tons of olive residue a day. Soon a small soap plant was added, but had to be removed because the product could not at all be sold at a profit. The reason was that almost all the natives in villages had their own home-made soap, and were not ready

to pay any price for soap, the cost of which to them is practically negligible.(11)

In 1951, a small olive oil refinery with an output capacity of 2 tons a day was constructed. A few days later while trying to operate the extraction plant and the refinery simultaneously, the former burned down, which brought all the operations to a standstill in that year.(12) A new extraction plant with a capacity of 18 tons was rebuilt in the subsequent year.

During 1957 and 1958, fundamental changes were made. The capacity of the extraction plant was increased, elevators were added to the Drying plant and two Dryers and three electric generators were purchased. For all these improvements and additions, expenditures totalling about LL.200,000.00 were made. A pre-refinery process was added last year.

Mr. AK. died about 5 years ago. The complete ownership and control of the business were inherited by his two sons who are now partners.

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(11) Such soap was, and still is, produced by village housewives, from non-salable oil, which collects in particles at the bottom of oil tanks. If we define the cost of a product as the foregone income had the present resources been employed in the next best alternative, then the cost of producing soap by village housewives becomes infinitesimal, as the alternative to their time spent on making soap is idleness and the alternative use of the material is not to use them. The addition of this line and its subsequent dropping is another evidence of not carefully evaluating the market.

(12) A 4-year insurance policy on the extraction plant had expired only one month prior to the accident. They had failed to renew the policy.

The firm has thus survived many ups and downs and is still struggling for survival.

B. Nature of Operations

The firm, as it stands today, is engaged in extracting oil from olive residue, called "olive cake", and refining the extracted oil or oil extracted directly from fresh olives in mills. However, it is the refining function that is significant for the firm (i.e. is a cause of pride and optimistic expectations of the owners).

To complete the production cycle, i.e. in order for the olive cake to be converted into refined olive oil, the raw material should pass through the following processes, which are dictated by the existing machinery and equipment in the firm.

1. Drying Process. The olive cakes are carried to the drying plant and put into process. This step is necessary so as to remove all the moisture of the olive cakes and make them ready for extraction. The raw material is mixed with the hot air coming from the steam plant (to be described later) and by a final centrifugal operation, the olive cakes turn into soft powder-like material, devoid of any moisture. The resulting steam is released into the air through a chimney.

This plant alone can dry 30 tons of olive cake a day with an average water content of approximately 10%.

2. Extraction Process. The dried material is then piled up on the roof of the drying plant by small elevators, moving on a chain, which continually lift the dried olive cake and empty on the roof. From here on, small hand-carriages

are used to transfer the material to the extraction plant. While still on the roof, the material is transferred a short distance and each one of the 5 tanks (each with a capacity of 2¼ tons) is filled. Then a solvent called "S.B.P." is added and mixed with the dried material.

In this same plant, there are two distillers, each one with a capacity big enough to receive the output of 4 of the above tanks. The distillers receive the mixture from the tanks and steam from the steam plant. The mixture is heated upto 100°C to remove all the "S.B.P." content of the mixture. The "S.B.P." evaporates at 75°C and subsequently passes in pipes through a water storage, which becomes liquid again and returns to its original tank, ready to be reused. However, about 0.5% to 0.8% of "S.B.P." per ton of dried residue is lost in the production, i.e. does not retun to the "S.B.P." storage after distillation. About 90% of the extracted oil is sold and only the remainder is forwarded for refining.

The resulting residue is used for burning in the steam plant and for sale. The present input capacity of the extraction plant is about 25 tons a day.

3. Pre-Refinery Process. The pre-refinery process receives oil from the extraction plant and also oil which is either purchased and/or received to be refined for others. Oil from outside, and not the oil from extraction, constitutes almost all the oil fed into this process at present. According to the partner in charge of the factory, the oil coming from extraction is not good for further refining. However, this is a problem which can be solved by chemical engineers. Partially refined oil which requires further work is also received from the refinery.

A powder called "activated powder" and sulphuric acid are mixed with oil according to a definite ratio,[13] after which the powder is taken off by a filter. The mixture then is steam-heated upto 220°C, which comes from a special furnace,[14] to remove all impurities and non-oil ingredients. The final products of this plant are 1) oil which needs further processing, and 2) activated powder which contains about 90% oil. This powder used to be returned to the extraction plant for extraction, but this practice is no longer in force because it was discovered that the extraction plant is not well-equipped to do this job and hence resulted in a lot of waste. A new plant is at the time of this writing under construction to further process the oil-containing activated powder which comes out of pre-refining and refining plants.

The pre-refining plant can receive and process about 5 tons of oil a day.

4. Refinery. The refining process receives oil from the pre-refining, from the extraction, and/or oil purchased or received from others for refining. The criterion of putting oil purchased or received to be refined into the refining or pre-refining is the acidity (i.e. per centage acid content) of the oil. Usually, oil with acidity of 10% goes directly to refinery without having to pass through the pre-refinary, and all the oil with higher acidity passes first through the pre-refinery.

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(13) Management does not know the ratio for certain. An estimate of 1 unit of powder to 20 units of oil was given.

(14) This is different from the steam plant referred to earlier. Further description on steam plant follows.

In this process, warm caustic soda is thoroughly mixed with oil, resulting in the formation of soap. The mixture is stored in funnels for about 10 to 12 hours, during which time the soap material, being heavier, collects at the bottom of the funnel while oil collects on top of it. Oil is thus separated and transferred into pots where activated powder is added. By heating and vaccum cleaning, all the unnatural color and odor of the oil are removed completely. Oil then is cooled down to 25°C before being sent to the next process.

The capacity of this plant is also 5 tons per day.

5. Demargarinization. Refined oil is received from the refining process. It is first cooled down to 2°C, then by passing the oil through a big filterring machine (there are two of them), margarine is absorbed by the filter while oil, the final product, flows through pipes into a small reservoir. It is then taken off and filled in barrels, after which it is ready for sale or delivery.

The capacity of this process is also 5 tons a day.

In addition to the above plants, there are two auxiliary or service departments, namely power and steam. The power plant consists of 4 German-made Deutz generators, 3 of which have a capacity of 50 H.P. each and one with a capacity of 75 H.P. The latter was newly added and is supposed to take care of the additional needs for power created by a newly-dug deep well and provide for the future expansions.

The steam plant consists of a furnace and a boiler, which mainly serves the Drying plant. The fuel used for

burning is the final residue of olive cakes resulting from the extraction process. However, since the burning is still partial (because of the pressure resulting from heaping up the residue in the furnace) a final residue which looks like coal or charcoal is formed. This is usually sold for the consumption of people.(15) There ia another smaller but more efficient steam plant which serves the particular requirements of the pre-refining plant only. The fuel used in this plant is fuel oil and not the residue of olive cakes.

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The accompanying chart of operations illustrates the production activities of the firm, as the material moves from one process to the next, and as the "value added"starts rising until it culminates in the final product.(16)

C. Existing Accounting System

There is no cost accounting system at all. There is a simple system, or rather a special book-keeping method, which records some financial data. When raw material is received, a receipt, which is the only printed form in use, is issued in two copies: the original is given to the supplier as evidence of receipt of material, and the copy is retained by the worker who supervises the delivery. The receipts of

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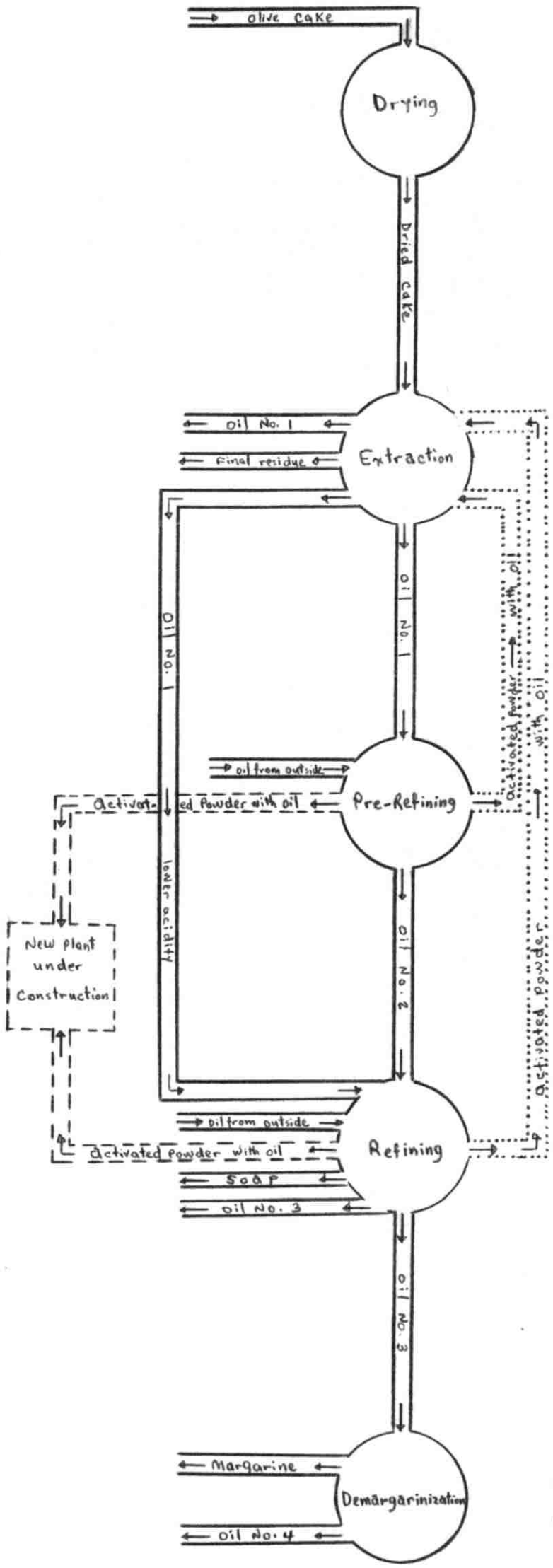
(15) 100 tons of residue put into the furnace is burned down to about 10 tons, which is then sold for LL.70.00.

(16) From the standpoint of society, "value added" represents the added social utility of a certain product, as shown by its uses in meeting the unlimited wants of the people.

Fig. 1 - Flow of Operations



Olive cake is dried by steam-heating and centrifugal action.

With the aid of a chemical called "S.B.P" and other chemicals, oil is extracted from olive cake.

Sulphuric acid & activated powder act on oil which needs further preparation before being sent for refining.

Caustic soda and activated powder through chemical effects refine oil.

Filtering presses separate margarine from oil.

Abandoned practice .....

the day are then recorded on a piece of paper by the same worker and forwarded to the owner-manager of the factory, who in turn copies the information in a daily-receipts book, which is an ordinary bound copy-book, and later transcribes the information to a two-column book under the name of each supplier from whom the material was received. On the right-hand side is recorded the quantities of raw materials received and on the left-hand side the cash payments made. The second copies of the materials receipts, referred to above, are forwarded to the owner when all the originals in a given set of bound receipts are used up, after which the owner compares them with the suppliers ledger book, to make sure that the information is correctly recorded. The payments to suppliers are made on account which are finally settled after the last shipment of olive cake is made to and received by the firm.

The purchasing procedure is very informal. The owners of the firm know several of the olive pressing mills who sell the olive residue to the owners. There is no written contract to regulate such activities, nor the price of the raw material, which is later determined when the time for settlement comes. However, the price of the raw material[17] is known and fluctuates between 28 to 30 Lebanese pounds per ton.[18] No invoice accompanies the delivery of the raw material either. The payments are usually in the form of advances to the suppliers, who sometimes become net debtors to the firm. However, a receipt is secured from the suppliers whenever payments are made.

A cash book is also maintained, which shows the cash payments, with explanation, and the balance. In addition to this, one account is kept for each worker in which his earnings and payments to him are recorded. All the workers are

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(17) Contains about 7% oil.

(18) According to the owner.

are on a daily wage basis and very often do not cash their pays until a need for them arises - e.g. a marriage, a child-birth, illness etc. In other words, the firm also acts as a banker for the workmen, but with no interest for the use of their money. The presence of the workmen is noticed by the owner himself or his son or his mechanic if both the father and the son are away. A list of attendance is prepared daily on a piece of paper and filed. This serves as a basis of computation of wages, or more accurately, the open accounts of the workers.

Under the Lebanese Code of Commerce, the company under study must keep a daily journal book, register for outgoing letters, and an inventory book and have them all initialled by the district Magistrate or the President of the Court of First Instance. However, none of the books presently maintained by the firm carries the required initials. It seems that the firm has never bothered to abide by the above law, and the Government officials have never bothered to strictly enforce the law either.

D. Other Significant Facts

Although the firm in its present capacity has existed since World War II, it was not registered in the Commercial Register until 1958. There is no written partnership deed between the two brothers, who, consequently, never knew how much the net income of the business for a period was, let alone the problem of profit-distribution. What is done at present is that whenever any of the brother-partners needs money, he simply withdraws some from the business and records the amount withdrawn in the cash book. What all this amounts to is that the business firm is a "family affair" and hence there is not a clear-cut borderline between the business and the families.

One of the sons of Mr. A. K. is in charge of purchases, sales, production, hiring, firing, etc. He makes decisions of all sorts involving payments ranging from petty expenses to large capital expenditures, keeps the books of the firm and does most of the clerical jobs as well. His brother is in charge of the silk factory established in 1931, and also runs a restaurant in Beirut. The division of responsibility as described here does not mean that there is a clear-cut definition of responsibility so that each partner would try his best to improve the efficiency and profitability of the areas under his jurisdiction. This concept does not at all exist there.

The firm deals with Banco Di Roma. It seems the bank has never bothered to ask for a balance sheet and/or income statement of the firm, none of which has ever been prepared; all the bank has asked for so far has been a statement of debtors and creditors of the firm. A long-term loan of LL.70,000.00 was obtained a few years ago from AIREB,(19) which was soon settled after a loan of $.100,000.00 was negotiated with MIDEC(20) in July 1961. The loan agreement gives the debtor an option of either repaying the loan within 2 years or allowing a 20% share of business to MIDEC, which will become a partner.

The whole factory was temporarily shut down in late May, 1962, because the management had realized that the water

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(19) Agricultural, Industrial, and Real Estate Bank.

(20) Middle East Industrial Development Projects Corporation S.A. The rate of interest on the loan is 10%. Though this rate is almost double the prevailing rate demanded by AIREB, but the size of the loan extended by MIDEC, which is about 4½ times that previously given by AIREB, may be a justification for the higher rate charged by MIDEC.

supply of the village was not sufficient to meet the demand of the village and that of the factory, which uses water for cooling purposes. A deep well which has so far cost about LL.26,000.00 has recently been completed and is ready for use. The well is capable of producing about 30 cubic meters of water per hour; there is no definite indication of the water needs of the existing plants, but one could safely assume that the well can produce more water than the whole factory can absorb.

The imported equipment, other than power generators, comes from Italy. The owners have made this choice because they believe Italy is the best manufacturer of olive-oil refinery equipments. All machinery and equipment have been installed and put into operation by Italian experts.

E. Conclusions

A brief survey of the firm soon leads the observer to the conclusion that the "business weather",(21) of the firm is extremely gloomy from any angle he might choose to view the firm. As a start we can say that the firm is a one-man business and virtually devoid of any systematic plans or policies. The brother in charge of the oil operations is a manager, an accountant, a cashier, a typist, a production foreman, a salesman, a policy-maker, and what-not. He makes all kinds of decisions and no wonder he has missed quite a few.(22) He becomes so much involved in the daily routines of

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(21) See Introduction for the meaning of the term.

(22) He has forgotten to make some decisions which he should have made and has also miscalculated the outcome of a number of other plans. Some of these situations have already been outlined in this chapter.

the business such as bargaining with workers or seeing that they don't get paid one pound more, that he suddenly finds himself short of water which forces an interruption of production activities. Naturally, they are not worried about a shutdown, rather they think they would avoid wages to workers. They do not think in terms of idle time loss or the revenues foregone as a result of a cessation in activities.

There is no such thing as delegation of authority and division of responsibility. Nobody knows who is responsible for whatever that happens. The business is so much intermingled with family affairs that the drive for efficiency and competition has been completely forgotten. There is no evidence to indicate whether the business has been profitable or not, and if so how much. Consequently there is no knowledge of where the underlying reasons for inefficiency lie and how they could be improved.

The general diagnosis is that summarized in "bad business weather". The firm needs not only a cost and control system but a major overhaul and redesigning. A new "managerial attitude" is needed so as to be competitive, growing and progressive. The owners do not believe in the value of new measures being set up in the firm; they consider the services of functional men such as cost accountants as unnecessary and waste. The new ideas should be sold to them and their practical value demonstrated.

The installation of a cost accounting system alone would not improve efficiency unless the management realizes its usefulness and the urge for efficiency is reflected in all the plans and policies of the firm as well. The marketing policies, the choice of channels of distribution, purchasing and production practices have all grown out autonomously

without any studying and weighing or trying various alternatives. Continued search and effort are prerequisites for increasing productivity.

A case can be cited to support the view that little has been done to improve efficiency. The extraction plant is operated half a year only because of fermentation and decayance of the raw material due to heat and pressure. This results in shutting down the drying and the extraction plants for almost 6 months, which also results in idle capacity in the auxiliary departments that render service to the drying and extraction plants. It would be interesting to study the possibilities of improving the situation and then comparing the costs of such improvements with the additional benefits derived from operating the plants. Incremental costs and revenues can provide us with some information for decision-making. To improve the situation, we may ask: Could any kind of chemical be added to the raw material to prevent decay or fermentation? Could any physical alteration in the present storage facilities be made to provide better storing of the raw materials in order to maximize exposure to heat and air and minimize pressure from piling the olive cake in large lots and thus reduce, if not eliminate completely, fermentation? A solution will certainly emerge which may or may not be adopted depending on how much it will contribute to the overall profitability of the firm. This problem will be brought up again later.

III. NEED FOR A COST ACCOUNTING AND CONTROL SYSTEM

This part attempts to explore and discuss the need for a cost and control system to be designed for the particular business firm under consideration. The fundemental question to be asked is: why is there a need, if any at all, for a system, and if there is what should be the objectives of the system? Once we agree on the objectives, we can develop a system that comes closest to those targets.

The management of the firm in question is making numerous decisions every day. In order to make sound decisions that would ultimately benefit the society which would in turn compensate the management in the form of added revenue and better reputation and fame, both of which are the immediate as well as long-run goals of the company, information and facts are indispensable.(23) Decisions can be made in the absence of any information by intuition or subjective evaluation of a problem, but the chances of making a wrong decision are not by any means negligible because of the great number of alternatives that are open to management. The business firm in question has limited capital and cannot withstand the consequences of many wrong decisions. Sound decisions, therefore, should be made so as to attain the objectives of the management, i.e. profitability and growth.

Information can reach the management through a variety of media and from many different sources. In broad terms, we can say that information is originated either inside or

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(23) See page 30 - Professor Voris' statement.

outside the firm. We shall be concerned with the first of these two sources. Such facts should be collected, recorded, classified and arranged in such a way as to guide management in its decision-making.

One of the sources, and perhaps a very important one, within any manufacturing firm, is the cost records and the cost accounting system of the firm. The criteria of its uses to management are both the quantity and quality of cost data that flow to management.

Almost all business decisions involve a comparison of costs and revenues that would arise as a result of executing the decision. When the management of the firm under consideration decided to dig a deep well to have a continuous water supply, or when a decision was made to set up a new plant to extract the high oil contents of the activated powder, a comparison of incremental costs and revenues, however informal, was certainly made and, to be sure, the execution of the decisions are clear indications that management was convinced of their profitability. Cost data enter into decisions and one prerequisite to making sound decisions, which, as we have seen, are vital, is the quality of such data and the extent to which they are relevant to the problem at hand.

Therefore, to make a tentative deduction from the above arguments, we can say that sound decisions, which are essential to the successful operation of a business firm, require reliable cost information, which could best be provided through a system of cost accounting, hence the need for a cost accounting system. The illustrations cited above plus many more such as deciding whether soap should be manufactured, or other detergents could be made, or which one of the present products, such as oil between the processes (after extraction,

after pre-refinery operations and after refinery but before demargarinization) is most profitable and should be pushed, all need fairly accurate cost data, which can only be obtained through a properly-designed system. Such information is essential and can hardly be made by intuition.

In more specific terms, the cost information is needed in the follwoing areas:

A. Pricing

We have seen that the firm produces and sells a number of different products, namely, residue for burning, partially-burnt residue (which resembles coal), soap (not in blocks, but in liquid form), oil after extraction, oil after pre-refinery, oil after refinery, oil after demargarinization and margarine. The quality of oil at each stage is different and the best one is the refined oil obtained after the separation of margarine from oil. In addition to these products, the firm also sells refining services, i.e. receives oil from households or retailers, refines it and charges the customers a fee for the service. In most of these instances, the management inevitably faces a pricing problem. An analysis of the market in which the firm operates is presented below together with how the management has solved its pricing problem and how cost data produced by a system can help solve some pricing problems.

The market structure in which the firm operates decidedly affects the ability of management to set or manipulate prices. The firm under consideration actually operates in different market structures with regard to the different products it manufactures or the service it renders. The

residue for burning, the partially burnt residue and the soap are sold at whatever the traffic can bear and their prices are determined in the market. The residues are mainly consumed by households in villages for heating bathrooms and is to a large extent restricted to the village in which the factory is located due to the transportation problem. The revenues from this source are according to the owner relatively small because the factory itself is the major consumer of the residue for the steam plant and the market for such stuff is small. The soap stuff faces a similar problem, in that there is no market for unbranded soap in the cities and the villagers either produce their own soap or buy it at very cheap prices from their own village friends. Moreover all these products are treated as by-products and to some extent undesirable; they are produced irrespective of whether they are wanted or not, and the management certainly would prefer not to have them at all rather than have them and then face the problem of how to move them.(24) Getting just enough residue to suffice the needs of the steam plant and getting complete burning rather than partial would have been ideal.

However, there is no need to go further into this problem because of its relative insignificance to management and because it falls outside the scope of this paper. A fact-finding management can certainly find satisfactory solutions.

The oil products present a more interesting problem.

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(24) The undesirability of soap, for example, can be seen in management's decision to stop manufacturing soap in 1949.

There are nine extraction plants in Lebanon which extract olive oil from olive cake and an almost innumerable mills that extract oil from fresh olives.(25) There is, however, only one olive-oil refinery (which is owned and operated by the firm under consideration) in Lebanon. The firm, therefore, has monopoly powers (in the sense of being the sole producer of refined oil) over the refined oil and the refining services, but can be considered to operate in a highly competitive market. However, informal talks with about 100 Lebanese households carried out by the writer indicate that olive oil is included in the daily consumption basket of families, and there is very little differentiation as to the kind of oil i.e. refined oil, demargarinized oil etc. Almost to all, the ordinary oil from pressing mills or extraction plants is acceptable. This may mean a high cross elasticity for the refined oil, which puts a ceiling on the monopoly powers of management to raise prices of the refined oil or the refining services. The practical problem is to find a price that would be low enough to induce consumers to buy the refined oil and still high enough to bring in a rate of return on investment satisfactory to the investors.

It so seems to the writer that the supply of olive oil in any given year is fixed and the demand for it is, upto a point, highly inelastic as its consumption enters into the consuming habits of the population and is regarded a necessity. However, substitute competition from other vegetable oils and animal fats etc. is strong and puts a narrow limit to rises in the price of olive oil. Thus the price of oil is essentially

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(25) According to the records of the Ministry of Economy.

determined by the forces of supply and demand and is outside the control of any one firm or individual. But there are possibilities, such as branding, for the firm to differentiate its products, and particularly the refined oil, and charge higher prices than those prevailing in the market.

When the management was asked the question of how they determine the selling price of their products (referring to oil products), the answer was that they add a certain percentage to the cost of the product to arrive at the price. But the next question was: How do you determine the cost of each product and how much the percentage of markup should be? The answer was that costs and related markups were merely assumed to be the appropriate figures.

The foregoing arguments may be taken at their face value to jump to the conclusion that since prices are dictated in the market, cost information flowing from a cost accounting system are irrelevant for pricing decisions. But this conclusion is not entirely true. The following discussion attempts to show the uses that could be made of cost data in arriving at sound pricing decisions.

The conditions of the olive oil industry, though highly competitive do involve some imperfection and thus give each firm in the industry some latitude, narrow as it might be, within which the firm can change its prices. This latitude would increase as products (substitutable or complementary products) by any one firm increases in number and become more differentiated from the products produced by competing firms physically or psychologically, in the eyes of the consuming public. The firm under discussion is a multi-product firm and its competitive position should have supposedly improved after assuming the refining function,

which gives the management greater power over the prices charged. Therefore, the pricing problem cannot be assumed to be completely outside the control of management, which faces, in broad terms, the old puzzle of maximizing profits for the entire product line. The various products manufactured by the company (different types of oil, etc.) are clearly interdependent in that they could be considered as substitutes. Assuming a relatively high cross-elasticity of demand ($\frac{\Delta Q_2 / Q_2}{\Delta P_1 / P_1}$ or a percentage change in the quantity sold of extracted oil as a result of one percentage change in the price of, say, refined oil) among the different types of oil produced by the firm, we can certainly manipulate prices in such a way that would give the optimum product-mix.(26) To show the role of cost in such pricing decisions, the following few paragraphs are presented from Joel Dean:

> "Correctly used, cost estimates are indispensable for accurate analysis of almost every kind of pricing problem. The valid practical questions concern the kind of cost concept to be used in deriving estimates and the role of cost estimates in pricing.
>
> "Cost estimates are needed in product-line pricing to project roughly the effects upon profits of different price structures. Each set of prices will produce a particular product-mix and a corresponding total revenue and total cost. Although different price structures can be designed to yield equal revenues, they will nevertheless involve different total costs, since costs varies with the product-mix. The pricing problem, then, is to find the price structure with the biggest expected difference between total cost.
>
> "A common approach to such profit estimates is to compare for each product its unit

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(26) Because the various types of oil produced by the firm are substitutes, charging different prices for each type would influence the decision of the potential purchaser and hence the sales of different types of oil.

> full cost (current or normal) with its price, and thus get unit net profit. But this method brings into the pricing problem the conventional overhead allocations of cost accounting and ignores the non-cash opportunity costs that are measured by alternative uses of plant. A more promising approach is to compare the incremental costs of each product with its price. Such comparison, together with sales estimates, indicates the contribution to overhead and profit for each alternative price for each product. Experimentation with prices in this way shows the pattern that produces the greatest total contribution of all products combined to overheads and profits. This method is free from the arbitrary cost allocations of overheads in the net margin method which may complicate and observe the maximizing process." (27)

It is clearly shown how cost data in conjunction with demand factors (i.e. demand elasticity and competitive development of a product) can be useful in, to borrow Professor Voris' philosophy, "rendering the maximum service to society for maximum remuneration".(28)

Another function of cost in the firm under discussion is to set a floor below which price of any one of the products should not ordinarily go without stimulating doubts whether the product should remain in the line or not. Again the incremental cost of the product is the relevant cost concept to be used.

A very important role of cost in pricing comes when we can manufacture and sell for a market, such as another

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(27) Managerial Economics, pp. 482-483.

(28) Professor William Voris was visiting professor in the Department of Business Administration, American University of Beirut, during the year 1961-62.

country, which is completely sealed off and segregated from the Lebanese market. For example, if we receive an order from a merchant in Syria for 50 tons of refined oil with a price per ton far below the prevailing market price here, the only criterion for acceptance or rejection of the offer would be the comparison of incremental costs with incremental revenues, which, when the former is less than the latter, would enhance the profit position of the firm. This is clearly a pricing decision: we decide whether or not to sell at this price, and cost data play the dominant role. This is what is called by Joel Dean as "refusal pricing".(29)

The importance of cost data in business decisions cannot be overemphasized. Turning to pure economic theory, we see that a firm, regardless of the market structure under which it is operating, tends to equate marginal revenue with marginal cost to reach the profit-maximization point. For each of the products handled by the firm under consideration, one could imagine a two-dimensional graph measuring cost as a function of output (sales) and determine theoretically the quantity of each product that should be manufactured and sold in order to arrive at the "most desirable" level of activity. The volume to be produced of each type of product is, therefore, the result of the interplay of price and cost.

The above arguments attempt to illucidate the first objective of cost data produced by a properly-designed cost system. The arguments are presented only in broad terms for a number of reasons: (1) They are, to some extent, beyond the topic of this paper; (2) More specific discussions require

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(29) Ibid. p. 455.

empirical research in each of the fields outlined above;
3) The amount of accumulated data regarding prices and costs are almost nil, due to the fact that no books have ever, until recently, been maintained and no cost system has ever been in operation. The second major objective, and the one with which we are very much concerned, of cost information is to enable and enpower the management to exercise one of their most basic functions, namely that of control.

B. Control

The basic functions of management fall into 4 groups: planning, organizing, control, and finally motivation. The functions are interdependent and must all exist at the same time in a given organization for the realization of goals or objectives. We are concerned with the third of these functions, i.e. control. All these functions have been covered comprehensively elsewhere and here we shall tackle the control afforded by a regular flow of cost data from a cost system to the management.

Control may be effected by a variety of methods among which the following could be mentioned:

1. Policies. By setting up policies to regulate certain activities or functions, it is possible, to control the performance of a group or a decision in an organization.

2. Performance Reports. Another common method of controlling the activities of subordinates, divisions etc. is to require them to submit periodic reports on their achievements and then compare those reports with other periods or other yardsticks for evaluation.

3. Budgets. Budgets are estimates made in advance in an effort to penetrate into the future with an eye on how a given situation will look like after a given decision is carried out. If budgets are made with great care and after careful analysis and study, they can be extremely useful for control purposes. Budgets prepared in this manner can serve as a standard yardstick against which actual performances is compared and evaluated.(30)

4. Control by Exception. This method is actually an offspring of the previous one and will be studied in greater detail. "Control by exception", is the prided feature of a cost accounting system and is the one expounded in this paper. The reason for merely outlining the others and concentrating on this method of control is simply because it is most relevant to our topic, and, above all, is the most important reason underlying the installation of a cost system.

The fallacy common among some accountants is that they often think of the purpose of a system of cost accounts to be primarily finding the cost of the completed product to serve as a basis of price-determination. A system that accomplishes this end only is not a cost accounting system, but rather a price-finding system. A few of the uniform, so-called systems have as their objectives the finding of selling price. Although they may achieve the purpose for which they are designed, they are not, however, true cost systems, and they do not supply management with information that are emphasized in this paper and are so essential to the conduct of the business.(31)

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(30) It should be noted that these methods are not exclusive of one another; on the contrary they are often used at the same time and are in fact complementary to each other.

(31) The ideas in the following few paragraphs have been taken from C.F.Schlatter and W.J.Schlatter, Cost Accounting, pp. 1-2.

While the finding of the cost of a product is admittedly important, but it is by no means the most important of all the objectives. The first and foremost objective of every cost system should be to make it possible for management to control the costs i.e. to help management in every way possible to bring and to keep the costs down to the level they should be. To accomplish this aim it is necessary to guard expenditures carefully and to get full use of time and money. Safeguards must be set up at the points where costs enter into the process of production rather than at the point where costs cumulate in the form of finished goods.

We have argued that selling prices are largely outside the control of the management of the firm in question; even if management were in control of prices, variations in selling prices, particularly if they are frequent, are not commendable for reasons such as consumer reactions to such "down-and-up shuttlings" of prices, rivals' reactions and the like. On the basis of the assumption of price-rigidity, both because of the dictates of the market and/or the reluctance of the management to pursue a fluctuating-price policy, we can conclude that the most important tool and perhaps the only one, available to the firm under consideration to approach the profit maximization point is to manipulate the cost curves.(32) We know from our economic theory that such a point is reached when the marginal costs of the last unit of product produced and sold equals to its marginal revenue. These two curves like the two blades of scissors cut each other at a point that signals the "equilibrium" point of production and sales for the firm. Now assuming one of these curves is given, we

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(32) From year to year the price of olive products change about 5-10 per cent (See Table of Olive Oil Prices - 2nd class - next chapter). The term "price rigidity" is used to mean the uncontrollability of olive "basic prices" by management in a given year. (For definition of "basic price" see Joel Dean, op.cit., p. 398).

should move the other one as much as to obtain the desired point. It should, therefore, be made quite clear that costs, and hence profits, should and can be controlled. With the exception of extremely simple situations, it is impossible to have adequate control over costs without good cost accounting procedures to provide a complete system of guards at the points where costs enter into production functions.

Such a procedure which shows what costs should be under the prevailing conditions puts into effective operation the fundamental law of management, it focuses attention forcibly to the exception, to the functions that need study and coordination, to those items "that are out of line".(33)

Plans are necessary not only for the activity of production, the quality and quantity of material, the method and place of performance of labor, but also equally adequate plans are necessary for the important costs to be incurred. Cost accounting should exercise its chief function by helping in cost planning, by detecting the cost deviations from the planned, and by making it possible to report these deviations and their causes to management in time for corrective measures.

This is the type of system the writer plans to propose for the firm in question. With the arguments presented above, it is hard to think of anybody to follow an opposite line of reasoning.

C. Problems.

To put the plan outlined so far into operation for the company under discussion faces certain limitations some

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(33) C.F. Schlatter & W.J. Schlatter, op. cit., p. 514.

of which are shortcomings of the present management, and which are removable, while some others are attributable to the inherant characteristics of the firm's operations and are harder to solve.

1. Management's Shortcomings. The most important shortcoming of the management is its unfavorable attitude towards any detailed study or interference in the operations of the firm. In the course of the writer's visits to the plant site, it proved very difficult, if not impossible and sometimes embarassing, to get a correct answer to the questions posed. Such an attitude is not only discouraging, but would in all likelihood lead any analyst astray by giving him wrong information or none at all. To get the desirable results, management must cooperate in every way possible to supply all kinds of facts about the firm, the problems encountered etc. Unless the analyst is presented with all facts concerning the delicacies of operations, he will not be able to suggest any realistic solution for the problem under study, be it a cost system or operations analysis etc. The management by following a secretive policy has less than full confidence in anybody, an analyst or otherwise, who may choose to be more curious than expected. Very few facts about the nature of operations of the refinery process were revealed to the writer due to the fact that management feels this process is a key one and its secrets should under no circumstances leak out.

The second problem under this category is that no data about the operations of previous years exist. As it was pointed up above no records of production or costs have ever been maintained and there is, therefore, no accumulated data to be analyzed and studied. Such data would have provided us with an idea of how costs vary with changes in

output in each plant. By approximation and isolation of the effect of output on costs of each plant, one could get a fairly clear idea about the behavior of costs at different levels of output. The results of such an analyses could be used in plotting cost-output relations, in preparing cost budgets, and help us with controlling costs.

The third problem is one of engineering. According to partner in charge of the refinery operations, there are many problems of a technical nature, such as the various standard relationships that exist between the raw material and the various catalysts, that are vague and undefined. To implement the controlling aspect of cost accounting, it is essential to set up standards for a batch or unit of product into which should enter the costs of material, supplies (such as the "S.B.P." or the activated powder, etc.) and labor, etc. which bear a definite relationship to each other. For example, we should know for certain how much of activated powder should be used for a unit of finished product (however the unit is defined).

The number of workers in each department, both producing and service, should be adjusted to the optimum. To have an objective criteria for the determination of the optimum number of men in each department, we certainly need to use a scientific approach, which may or may not be justified depending on whether earnings produced from cost savings and increased efficiency are high enough to induce to undertake the project. The number of men for a machine, say a power generator, may be prescribed by the manufacturer, but the optimum number of men in other plants may need some study and research. A simple yet objective method of determining the optimum number of men for the repairs services is suggested in the appendix to this paper.

Such procedures should reveal to us the costs that we should incur to achieve a certain level of production. These standards are prerequisites for a cost system with a built-in control function.

2. Production Characteristics. It has already been pointed out that the firm produces a number of products. These products result along the production line as the raw material moves from one stage to the next. We noticed that oil and final residue resulted from the extraction plant, activated powder and oil from pre-refinery, oil, soap and powder from refinery and oil and margarine from demargarinization process. Inevitably, we run into the problem of allocating costs that are common among the products in the same plant and those that are incurred for all plants. The problem of cost allocation among the products is not so easy as most cost accounting procedures assume to be. Our avowed intention has been to produce data that could be used by management in its planning and decision making. If such data are going to accomplish the results for which they are intended, they should be meaningful, and indubitably, their meaningfulness would be impaired, and significantly so, as will be shown, if arbitrary methods of cost allocation are employed.

To show the difficulty more clearly, we have to distinguish between joint and alternative products. "When an increase in the production of one product causes an increase in the output of another product, then the products and their costs are traditionally defined as joint. In contrast, when an increase in the output of a product is accompanied by a reduction in the output of other products, it is a case of what may be called alternative products."(34) What prevails in each plant under the prevailing "state of the arts" in the firm is a case

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(34) Joel Dean, op. cit., p. 317.

of joint products and joint costs with fixed proportions of end-products. In the refinery, for example, we have soap, oil, and activated powder coming out of the plant. Although we may point that the soap material does contain some oil which could be extracted and hence change the proportion of soap to oil, but the counterpoint comes when 1) it becomes doubtful to extract the last drop of oil at a cost that does not justify its extraction, and 2) the proportion of soap to oil is basically fixed because the quantity of soap and oil are determined by molecules and atoms and chemical reactions, and the oil accompanying the soap is only there because separation of the two materials is imperfect with the existing plant and equipment, the perfection of which may not be worthwhile.(35)

The jointness of costs and fixity of end-products-ratio in the refining and demargarinization plants makes the task of allocation of costs almost impractical, and perhaps impossible.(36) In fact, in an analytic production situation like the one we are facing, all costs in a given plant, say the refinery, are common to all the products, oil, soap, and powder in this case, that flow out of the plant as finished goods. What this implies is clear: it is impossible to allocate the costs in a definite, logical way. Arbitrariness and conventionality will surely be the ultimate resort if any attempt is made to allocate the costs to each product

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(35) Such a problem should indeed be studied by comparing the benefits that would accrue to the firm and the costs if more efficient devices are used.

(36) See Appendix II.

alone. If such a procedure is going to impair our effort and convey an unrealistic impression to management which might mislead management in its decision-making, the best alternative is, therefore, not to allocate the costs that cannot be traced to a product and the next step would be to define the package of products that results from the activities of a plant, i.e. the package of products means, for example, 3 units of soap, 5 units of oil, and 2 units of powder, defined as one unit of final product for the refinery.

Such a problem is not at all serious. It is not our aim to give the management the unit full cost of each product alone, since this would be neither true nor useful. Rather it is our intention to provide information that can be utilized by the management to make sound decisions.

The nature of the indeterminacy of unit average (and marginal) costs can be clearly illustrated by the following graph.(37) For the sake of simplicity, let us take the demargarinization plant. This plant receives oil from the refinery and the result is two products: oil and margarine.(38) If we assume that in order to produce A units of oil and B units of margarine, we have to incur, in the demargarinization plant, costs totalling to C, the data could be plotted as below:

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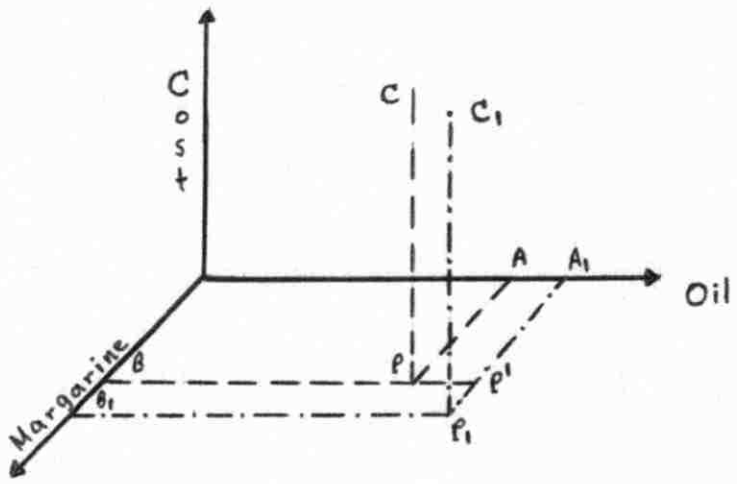
(37) The idea of such a graph was expressed by Professor John O. Blackburn in the B.A. 303 course, offered by the Department of Business Administration, American University of Beirut, fall semester 1961-62.

(38) It is doubtful whether the proportion of oil and margarine is fixed or not, because the demargarinization process is not, like refining, a chemical process but a filtering one. However, it is certain that increasing the output of one increases the output of the other.



Point C is situated in a plane which embraces all the various total cost points that may result as the output of oil and margarine change. Now if we want to find the unit cost (average or marginal) of oil, and increase the output of oil by one unit from A to A_1, point P will not remain at P, but will shift to P_1 because of the necessary shift in the output of margarine resulting in a new total cost of $P_1C_1 > PC$. In other words the output, and hence the costs, of these two products are interdependent and cannot, except by highly sophisticated and expensive methods, be isolated. If there were no change in the output of margarine, then P would have only shifted to P^1 and any increase in the total cost would have been the marginal cost of the additional unit of oil. In such a case it would have been possible to find with precision the unit full cost of each product alone. But the impossibility of such an effort should not bring disappointment at all; we can still work and produce reliable information for managerial decision-making.

3. Other Problems. A problem which was frequently heard from the management was about the raw material or

"grignons" as they call it. When the material is purchased, it contains oil and moisture. The latter evaporates slowly - surface evaporation only - when the raw material is stored for some time. At present, the storage is for a period of six months, which begins with the olive crop season in November - and lasts until May.(39) It has already been suggested that some method, preferably a better way of storage, should be worked out so as to make it possible to operate the now idle capacity for the entire year, and get maximum exposure to the sun and air for utmost evaporation. In addition to recouping the currently foregone revenue due to idleness, it would thus be possible to avoid the idle time loss and perhaps make relatively significant savings in the cost of drying.(40)

One could safely assume that in the months of November, December, January, February, and even part of March, the weather in the village where the plant is situated is too damp and the temperature too cold to cause any significant amount of evaporation that may call for adjustment. For the rest of the period, presumably the rest of the year if the new suggestions to operate for the entire year is adopted, the problem can be solved by statistical methods. By taking samples at intervals, say in April, May, June, and July, it is possible to plot the amount of evaporation (net loss of weight) against the respective months and then by finding the regression line we can find the rate of evaporation (which is the slope of the regression line). By extrapolation, we can find

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(39) The reason for this together with a solution was suggested earlier.

(40) Empirical research is needed to arrive at objective conclusions.

the loss of weight in different months of the year.[41] For further accuracy, it is possible to find the actual amounts of evaporation for different months in a year and comparing them with the extrapolated data, we could compute the margin of error by finding the standard deviation. If the error thus computed is offset in different months and the resulting net error is considered too insignificant to impair the accuracy of the computations based on such data, the problem is then solved. If, however, the margin of error is considered significant, then adjustments can be made.

Having found the percentage of evaporation for a given month, we can adjust the per-unit cost of the raw material thus:

$$\frac{100 \times \text{original per-unit cost of raw material}}{100 - \text{Relative Evaporation}}$$

Still another more promising approach to the problem is through correlation analysis. We can a priori say that the effective unit cost of the raw material in any given period, a month for instance, is a function of the temperature, existing moisture in the air, water contents or humidity of the raw material itself, original unit cost of the material itself and perhaps some other factors.[42] The correlation equation should not necessarily be comprehensive and if it embraces, say, 85% or more of the factors affecting a certain phenomenon, the results obtained could be used confidently. This functional relationship can be written as $E = f(T,M,W,O,...)$ where E stands for effective unit cost, T for temperature, M for existing

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(41) It has been assumed that evaporation does not become significant enough to affect the cost figures over a month and that after a month a different figure should be used. This is subject to empirical study.

(42) Effective unit cost is defined as the unit cost of raw material in any given period after evaporation or loss of weight while in storage.

moisture in the air, W for water contents of the material itself, and O for original unit cost. After considering the manner in which each of these factors affects the effective unit cost, we can tentatively write the equation thus:

$$E = \frac{aT^e \cdot dO^h}{bM^f \cdot cW^g} ,$$

where a, b, c, and d are parameters and e, f, g, and h exponents.[43] This equation would be used if management decides to have more precise information concerning monthly evaporation and its effect on the unit cost of raw material than that obtainable by other methods. The values of T,M, and W for the month can be predicted and by fitting the data in the equation, the effective unit cost can be computed. However, the equation can also be used as a substitute to the formulae suggested on the previous page. By finding the average values of the independent variables, the value of E can be computed.

The derivation of actual results from such an equation may be "too expensive" for the firm to undertake, but it should be kept in mind that once the formulae is developed, it can be used for ever, and hence the rate of return from such a capital expenditure should be considered over an indefinite time period.

D. Conclusions

From the foregoing discussions, the following conclusions readily emerge:

1. The firm under consideration does need a cost accounting system;

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(43) Evaporation is significant enough to warrant adjustment. The cost of a 5% weight loss is LL.2.00 per ton, LL.60.00 in a day, LL.1800.00 in a month, and LL.21,600.00 in a year. Both in absolute and relative terms, the figure is significant.

2. The system must provide management with information to serve as a basis for "sound" decision making;
3. The system should avoid arbitrariness to the extent that it may impair the reliability of cost data;
4. The principal control objective of the system should be to enforce a fundamental law of management, i.e. control by exception;
5. As a prerequisite to the installation of a system to meet the above objective, the firm must do the following:
   a. Find and define the relationships that exist between or among the various inputs fed into each process;
   b. Define the capacities that could be attained in each plant under <u>current</u> conditions;
   c. Find the unit of product for those plants that produce two or more products jointly;
   d. Study and set up budgets for each plant. The budgets should be drawn up after thourough study and analysis so as to satisfy ourselves of their accuracy and reliability;
   e. Collect and keep all data relating to costs, production, prices, etc. for later analysis and study.
6. Intensify the drive for efficiency throughout the firm by:
   a. Studying and analyzing each problem scientifically as it arises;
   b. Studying the possibility of operating the drying and extraction plants for the whole year rather than the present practice of half a year only;

c. Planning the future course of activities so as to avoid such escapable interruptions in operations as water shortage;
d. Increasing the maintenance of machinery and optimizing the number of technicians, as suggested in the appendix;
e. Delegating authority and assigning responsibility wherever the net result is added efficiency and productivity;
f. Initiating and encouraging a "mental revolution" on the part of the management so as to drop off the excessive and perhaps undesirable secretive attitude and pessimism about change and scientific approach.

7. Take corrective action whenever possible to improve the faults; and finally, we may add,
8. The approach to the people working with the firm should be within the framework of their values and standards or if a change is desired, it must be made with due regard to these values, so as to minimize friction and dissatisfaction.

From these conclusions the general model of a cost system is formed, the specific details of which will be laid down in the following part.

IV. A COST ACCOUNTING SYSTEM

Having discussed the need for and the objectives of a cost system, this part will lay down the skeleton of a system within the framework of those objectives. Practice and experience will put the flesh on the skeleton presented here and will "tailor" it to the needs of the firm by putting more or less "flesh" on a specific point. The skeleton is designed here only, which is the basis for future build-up and development. It should be borne in mind that there is no such thing as a perfect system, at least when one is being designed. Experience and time alone will single out the practicable and the useful. The ensuing part attempts to lay down the procedural framework that is considered necessary and desirable in the light of the arguments presented in the preceding chapter.

A. Materials

The quantity of raw materials to be purchased for any given period is a function of sales forecast for that period. It was aggued in the previous part that the consumption of olive oil, though not of different types of oil (i.e. extracted oil, oil from fresh olive, etc.) can be considered relatively inelastic, it can be concluded that the firm should penetrate into this "fixed consumption pattern" of the people by establishing firm business relations with several wholesalers and large retailers and differentiating its own products, with special attention to the refined oil, so that the level

of activity can constantly be at full maximum capacity and the purchasing of raw materials should naturally be geared to this capacity.(44)

The price of olive cakes fluctuates from year to year. There are both a priori and a posteriori proofs for this statement. In the first place, the olive oil crop, and hence the olive cake, is abundant in one year and poor in the next. The implication of such an alternate cycle of olive oil crop from year to year is a shift in the vertical supply curve of olives and all its derivatives (such as oil and olive cakes) from right to left and vice versa. Assuming a demand curve of whatever elasticity (less than infinite elasticity, of course), one may expect a price fluctuation, and perhaps a rather significant one if the demand curve is inelastic, from year to year. In the second place, five consumers, two retailers, and one mill-owner were asked about the behavior of olive prices. The figures obtained, shown below, indicate the price volatility of olive (and its derivatives).(45)

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(44) By the term "capacity" here is meant the maximum output for which any one plant or process is equipped for. Since all the raw materials, i.e. olive cakes, have to pass through the drying process the capacity of which is 30 tons a day, therefore the total volume of raw material to be purchased during the olive season should be 30 x 330 = 9900 or approximately 10,000 tons after allowing for unavoidable stoppages (assuming we can operate the entire year).

(45) The prices of olive oil change even within a year. It is lowest at time of olive-picking and rises as time passes. No figures could be collected for price variations within a year.

Prices of Olive Oil and Olive Cakes
for the Period 1958-1962.
(in Lebanese Pounds)

Year	Olive Oil[a]			Olive Cakes[b]
	1st Class	2nd Class	3rd Class	
1958	45.00	34.00	24.00	.40
1959	45.00	35.00	25.00	.36
1960	40.00	34.00	24.00	.32
1961	50.00	36.00	26.00	.34
1962	40.00	32.00	22.00	.30

(a) per tin of 16.25 Klgs. net.
(b) per 2½ Klgs.

Source: Compiled from interviews with five consumers, two retailers, and one mill-owner.

In view of this price volatility, the firm would be well-advised if it signs long-term contracts with a number of press-mills to supply the firm with specified quantities of raw materials. Such a procedure will enable the management to set a standard price for the raw material purchases and deviations from this standard, if any, be isolated as purchases are made. A standard price for raw materials should be set and kept up-to-date even if the conclusion of such agreements proves impractical due to the illiteracy and/or unwillingness of the millowner-suppliers. The establishment of a standard price in this case would even be more useful because the price variations from the standard would signal

a bad buying practice or other bottlenecks to management. This does not necessarily imply that the present practice of assuming the purchasing function by the owner-manager be abandoned. However, the price variances may force the manager to delegate the function to a capable subordinate if he finds himself too busy to carry on all his jobs effectively and select only what may be considered a few most important functions that require his personal attention and consideration. Problems like expansion, contraction, capital expenditures, marketing channels etc. are among the few that do probably need utmost attention and let it be emphasized that the limits of efficiency and improvement can never be reached in any organization or firm. There is always a better and more efficient way of doing the same thing, what is lacking is perhaps the "searching mind" to discover these latent opportunities. The search for efficiency is an unending process.

One important use of such a standard in this particular case is that it will enable us to compute the "effective unit cost" of the raw material in advance for different seasons of the year during which the evaporation changes significantly. Such advance calculation is permissible because the variations of temperature and humidity of the air in Lebanon, being geared to the standard Mediterranean climate, follows on the average a calculable path. As a tentative suggestion, we can perhaps divide the year into 2 periods: period I extending from November to April during which no adjustment of cost is perhaps necessary as the weather is not warm enough to warrant an adjustment, period II runs from May to October during which an adjustment in the cost of raw materials would presumably be required.

Under this system, which is imposed by the nature of business, materials should be bought all at once and must be

enough to last for the entire year if the consuming plant operates at practical capacity. There is, therefore, no need to keep the conventional materials card with a minimum-maximum quantities etc. All is needed is a materials ledger account that would indicate the volume and cost of the materials received and the volume and cost of the withdrawals, thus showing at any time the volume and cost of the raw materials on hand. Adjustment to volume would, of course, be made when volume shrinkage becomes "a problem". As was suggested before, empirical investigation is necessary to determine the periods and the amount of such an adjustment. This method of perpetual inventory would provide us with a figure for the cost of raw materials for balance sheet purposes.(46)

When the raw materials are purchased during the olive crop season, the following entry should be made in the General Journal:

Dr.		Materials(47) (at standard)
Dr.	or Cr.	Materials price variance
Cr.		Accounts payable

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(46) If the financial year is so chosen as to end at October 31, the volume of raw materials then would be at a minimum or almost nil if the actuals coincide with the budgets, and hence the chances of misstating the cost of raw materials on the balance sheet would be minimized as well.

(47) The receipt slips currently in use may be continued. A storekeeper, referred to later, will be in charge of issuing them, after which he will detach the second copies and forward them to the accounting department. No materials card should necessarily be kept by storekeeper. All accounts is to be done by the accounting department.

MATERIALS

Withdrawals should be shown in red.

Date	Explanation	Quantity	Unit cost	Total	Balance	
					Quantity	Cost

MATERIALS PRICE VARIANCE

Credit entries must be shown in red.

Date	Explanation	Quantity	Unit var.	Total variance

ACCOUNTS PAYABLE CONTROL

Debit entries must be shown in red.

Date	Explanation	Amount	Balance

Fig. 2

The ledger accounts for materials, the materials price variance, and accounts payable are suggested in Fig. 2. They are designed in such a way as to show the balance of the account at any time. Loose cards can be used as ledger accounts. A chart of cost accounts for the firm is suggested in Fig. 3. - Cost Flow Chart.

The entries, as indicated, will be made in the General Journal, which may take the form of a long book with the name of various accounts on top as may suit the financial requirements of the firm. The number of entries arising from materials purchases should not exceed ten in a year. This is so because 1) the season is only about one and half months, and 2) quantities should be bought in large lots for savings in transportation, obtaining quantity discounts, if any, and possible savings in unloading and clerical costs. Postings from the journal to the ledger accounts can be made monthly, i.e. totals of debit and credit columns can be found and postings be made. This is to reduce the frequency of postings and at the same time provide the management with monthly changes in the accounts balances.

Anytime materials are withdrawn for production, they must be weighed and the following form filled out:

Transfer Slip+	
No.	From:
Date:	To:
Type of Material	Units*

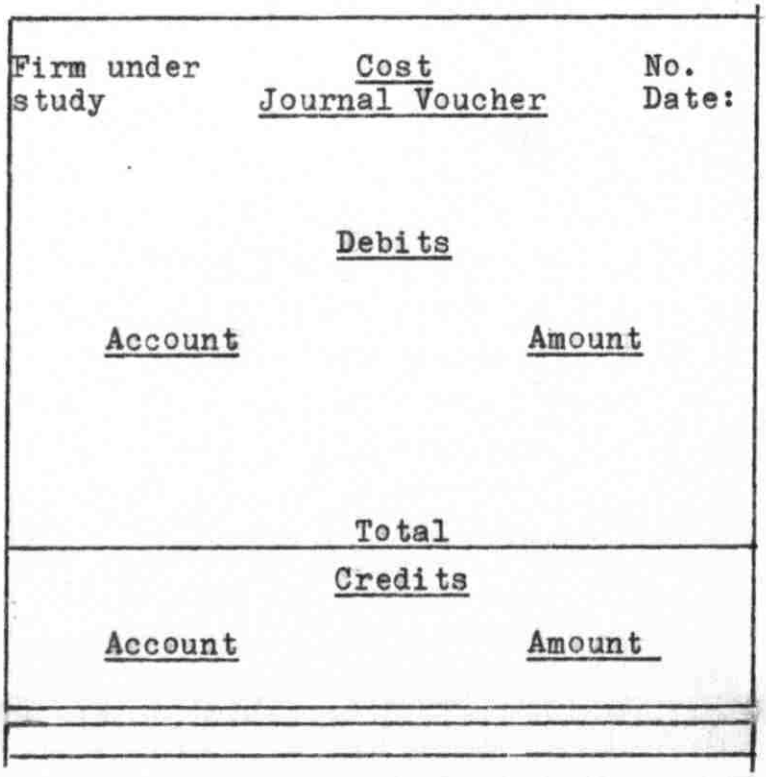
\+ Other uses of this slip will be explained later.

* Unit means ton, Kg., or any other appropriate measure.

The slips should be turned in daily, which will be filed by a cost clerk who will add them up once a month and pass an entry, which for raw materials will be:

Dr. Drying
Cr. Materials (at standard cost)

The entries reflecting transactions within the company (as contrasted with those between this firm and other firms) should be journalized on special forms called "cost journal voucher", for which the following form is suggested:



These forms could be typewritten, if possible, for the sake of orderliness and accuracy. Each of the items on the voucher should then be posted to their respective ledger cards. As will be demonstrated later all the transfers among different processes, etc. will be first journalized on these vouchers and then posted. Needless to repeat that facts are

collected, summarized, journalized on these vouchers and then posted all once a month. Each voucher, therefore, should be backed up with all the documents, such as transfer slips when materials are moved to the drying plant, supporting the entries.

The monthly credits are thus posted to the materials ledger card and balance of both quantities and cost are always shown. It should be clearly understood that we have two separate but interrelated standards for raw materials: 1) the standard price set specially for purchases of raw materials; 2) the same standard but adjusted for evaporation by one of the formulas suggested in Chapter III, to be used for crediting the materials account and charging the drying process. The latter standard may be computed at the time the raw materials are bought by using an estimated average evaporation over a year, or, as was previously suggested adjustment may be made for half a year only. Although evaporation is to some extent beyond managerial control, but a distinction between a purchase standard and a standard cost for consumption is based on the contention that accounting should reflect what actually takes place, i.e. when evaporation becomes significant, the effective unit cost should be raised.

The accounting for raw materials is almost over. For the physical storage of the raw materials, the writer strongly suggests that the possibility of storing the raw materials in small lots for utmost exposure to the air thus minimizing decay be considered seriously. If this could be done, total revenues would appreciably increase due to (1) increased productivity and recovery of the revenues being foregone at present, and (2) avoiding the idle time loss in the drying, extraction, power, and steam plants (and in the newly-dug well as well).

B. Chemicals and Supplies

The procedures for chemicals and other supplies should, however, be more formal than for the raw material for two reasons: (1) Chemicals like sulphuric acid are much more expensive than the raw material, and (2) Such materials are liable to be stolen and are, furthermore, dangerous if improperly handled. Therefore, for reasons of cost and safety, both of the assets of the company and of individuals using the chemicals, safeguards should be imposed on the receipt, maintenance, and issuance of chemicals and supplies.

Orders to suppliers are ordinarily placed by telephone calls or visits to the supplier's premises. However, because the specifications demanded by the operations of the firm are such that they should be put in writing and require the supplier to comply with those specifications strictly, a formal purchase order should be used.(48) A copy of such order could be retained by a technician, a chemist, a storekeeper to check the orders as they arrive from the supplier to make sure that they are in accordance with the order specifications.

However, a storekeeper, for reasons explained above, should be in charge of such chemicals and supplies.(49) The transfer slips, must, therefore, be filled in advance and must carry the initials of the partner in charge or anybody

(48) There is no need to design a form for a purchase order. The order can simply be typed anytime a purchase is to be made. The number of purchases, the owner feels, does not warrant to use a special form for purchase orders.

(49) The same storekeeper could be in charge of preparing transfer slips for raw materials.

else to whom such authority is delegated. As these materials are withdrawn, the storekeeper would enter them in the appropriate bin card and then forward the transfer slips to the accounting department for entry. The bin cards would show the type of the material, maximum and minimum points of the specific material to be on hand, and three columns to show the quantities received, issued, and the balance. In the receipts and issue columns a space should be provided to correlate the entries in the stock cards with purchase orders, if any is used, and/or transfer slips.

A storekeeper is thus needed. He will fill out the transfer slips when the raw materials are to be issued and will issue other chemicals and supplies against a filled-out, initialed transfer slip. He will further turn in all such transfer slips to the accounting department where they will be filed temporarily to be later summarized on a cost journal voucher by debiting the process to which the supplies were taken and crediting the chemicals and supplies.

C. Labor

It has already been observed that all of the laborers work on a daily-wage basis. At present there is a mechanic on the monthly payroll and in the near future more employees - a chemist, a mechanic, and perhaps an accountant - will be joining the firm.

The workers engaged on a day-to-day basis are all the natives of the village. They have had little, if any, schooling and are not in any way accustomed to the factory routines and disciplines. They have no idea of punctuality, business (as we understand the term), efficiency, accounting etc., etc. In spite of these adverse conditions, the firm under discussion

has to keep adequate records for accounting and control purposes. The firm has to keep track of the earnings of each employee for the computation of their wages and the charge to the plant for which they have worked.

The long-run solution of the problem is clear enough: thanks to the educability of human beings, the workers can be taught what is required of them. In fact, this has to be adopted as a long-run policy if the firm is after maximizing profits. By so doing, the firm renders a social service in the effort it exercises for the training of the workers, and will succeed in attracting the loyalty of the native villagers and hence keeping a group of experienced and "seasoned" work force. This may require increased wages for the laborers, but the corresponding rise in their productivity and efficiency will ultimately put the classic of management, namely, increasing wages and decreasing costs (per unit), into reality. This long-run measure, from the viewpoint of the factory, is necessary for the following reasons: 1) To have the workers sign in and out on a time control register, or any other device that management may find suitable, to check the attendance of the workers;(50) 2) To make the workers familiar with such ideas as factory organization, responsibility and authority, supervision and so on; and finally 3) To raise the productivity of the workers by raising their morale and providing sufficient material and nonmaterial incentive.

In the present circumstances, however, the only way to control the workers for the purposes mentioned before is,

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(50) Since the workers are not many, about 50, it should be relatively simple to control the workers after they have signed in.

as is being done at present, to take the attendance of those present and send the information to the accounting department for the computation of the earnings of the workers and charges to various departments. While not losing sight of the long-run solution, we should accept tardiness and absences. However, the management must see to it that such irregularities do not cause interruptions in production activities.

The daily attendance reports thus collected will be sent to the accounting department for processing. Depending on the frequency of wage payments - i.e. once a month or once a fortnight - the attendance reports will be totalled and an entry passed in the cost records. The entry will be thus:

Dr. Drying
Extraction
Pre-refinery
Refining
Demargarinization
Cr. Accrued wages payable(51)

The criterion for splitting up the payroll into the above components is the number of men who spend all their time in each one of the above processes. If we have 8 men in the Drying, the total of their wages will be charged to the Drying process, and the same will be true of other processes.(52)

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(51) According to the Lebanese Labor Code, the daily rate wage-earners are exempted from income taxes for the first LL.8.00 per day. The daily-wage workers in the employ of the firm in question do not earn more than this minimum. There is, therefore, no need to set up a withholding income tax account.

(52) Obviously, the attendance sheets should provide a space for the plant where the workers are working.

The previous entry takes care of the producing departments only. There are, however, other centers where labor costs are incurred. For the two service departments presently active, the charge will be made directly to the departments themselves by the following entry:

Dr. Power Cost
Steam Cost
Cr. Accrued Wages Payable

A third service department envisaged by the writer is a repair shop - to which reference has already been made - which will be composed of a number of mechanics and necessary repairs tools.(53) The wages in this department will also be charged to the new department itself by a similar entry. A fourth newly-added service department is the deep well that supplies water to the steam plant, extraction plant, and prerefinery for cooling down the hot materials in process. A similar entry will charge this service department with its labor cost.

There remains the salaries paid to supervisors whose time and effort are spent on all the plants, the members of managerial staff, if any is hired in the future, other functional men, like accountants and purchasing men, office clerks and secretaries, storekeeper, and so on. The salaries of such employees can be grouped under the headings of "supervisory", administrative salaries, or any other label the

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(53) A scientific approach to the determination of the number of workmen in this department is found in Appendix I. The creation of this department is only an extension of the mechanics presently rendering repairs services to all the departments.

management chooses. However, it would be desirable to have a breakdown of these salaries by departments to which they belong, such as accounting and stores etc., which could be tabulated and forwarded for the information or action of management.

The important point to emphasize here is that the salaries of the employees who do not spend all or part of their time with specific plants, are not to be prorated to any plant. By saying "part of their time", it is meant a time long enough as to be practically determinable, and which must continue as such. For example, if a supervisor ordinarily spends his time on the entire operations of the firm, and once in a while he happens to spend one day or a few hours on a special plant, it would be impractical to keep track of such occasional requirements. Here it will be assumed that such common labor costs cannot be easily identified with any particular process or product. This type of common costs, furthermore, remains fixed in relation to any short-run variations in output. Any practical attempt to allocate such common fixed costs would involve arbitrariness and unrealistic conventionality, both of which are in conflict with the arguments presented thus far. The distribution of these costs to the various plants would not only destroy the usefulness of the cost data, but would render them footless for most, if not all, kinds of managerial decisions.(54) Information thus obtained will not only defeat

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(54) This phase of cost accounting, i.e. arbitrary allocation of fixed overhead costs to various products and/or processes, has been the target of sharp criticism. The unrealistic nature of such allocation on a basis selected by management can be easily demonstrated by the fact that equally defensible bases may render quite different results. For some of the criticisms, see Joel Dean, op. cit., pp. 315-316.

the very intentions with which a cost system start, but may mislead management if used indiscriminately. To preserve the meaningfulness of cost figures, therefore, it is best not to attempt to distribute the common fixed costs referred to here. By so doing we are not denying the fact that these costs arise as a result of production (i.e. there would have been no such costs had there been no production) and should in principle be included as part of the cost of the finished or semi-finished products, but it would do us no harm if we exclude this cost from the total cost of the final product by not distributing the common cost to various processes, so far as we are aware of what each of the alternatives cost figures means.

A very important point in connection with labor accounting concerns the setting up of some standards for wages. The firm is the only organization that formally hires workers in the village where the firm operates, it can be thought to have monopsony over the buying of the native workers' services.(55) This does not mean that the management should pay as low wages as it can; far from it. A wage system correlated with the productivity (though a vague concept) of a class of workers would be ideal to work out, but the cost and complexity of such an undertaking may not be within the ability of the firm to afford. A simple wage system can be worked out

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(55) There is, however, a ceiling over the monopsony powers of the firm with regard to buying of the laborers' services. If the wage is too low, the workers will not be induced to work, or may prefer to work in a nearby village, i.e. the wages to be paid by the firm are, in final analysis, competitively determined. Moreover, the Lebanese Minimum Wage Law (LL.125.00 a month for unskilled workers) sets a floor for wages paid to workers.

by preparing job descriptions and then evaluating the jobs. A detailed approach to this problem should not deter us at this point. However, an outcome of such a study would be to enable the management to establish a standard wage for any category of workers that fairly agrees with the requirements of the job. The establishment of such standards and strict adherence thereto would help the cost sytem to achieve its main objective. It is worth mentioning that standards are not set up once and for all but are subject to modification and adjustment as the underlying factors change. Such standards are called "current standard costs".

D. Burden

All costs other than materials and labor incurred in any one of the producing and/or service departments will be considered as burden of that department.(56) These costs grouped under the heading of departmental burden include costs that are indirect or nontraceable to the final product of a department and cannot be readily identified with the products.

However, a burden budget must be set up at the beginning of any accounting period for each one of the producing and service departments. The budget should be carefully drawn up to show what the departmental burden costs should be at the practical capacity of the plant - i.e. the capacity for which the plant is equipped as determined from past experience, technological knowledge, and available resources. These departmental budgets will include all the non-traceable costs of the

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(56) It should be noted that department, plant, and process have been used interchangeably.

department and the costs allocated to the department only from those centers from which the department receives some direct service. The burden budget of all the plants, producing and service, will be developed here on the basis of assumed figures to demonstrate the mechanisms involved.

Before we go into these budgets, it must be made clear that each process or department will be charged with three cost elements thus: 1) Raw materials, as far as any one plant is concerned,(57) actually fed into the plant; 2) Cost of labor actually incurred in that plant; and 3) Other costs falling under the heading of burden that are actually incurred in the plant. All these three cost elements will make up the total cost charged to any process or plant. The outflow of cost from these accounts will be discussed and illustrated later in this chapter.

The preparation of budgets is not easy at all. A lot of study, effort, patience, and perhaps courage is needed to develop and maintain truly reliable standard budgets for gauging the actual achievement. The prerequisites enumerated in the preceding chapter must be carried out. An engineering survey and study should be done to determine the practical capacities attainable in each plant. The attached burden budgets have been developed on the basis of assumed figures (only the financial data, but not all the figures concerning capacities)(58) for several purposes: 1) To illustrate the

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(57) The raw material for one plant may be the finished product of a previous plant, such as extraction and drying plants, or pre-refinery, refinery and demargarinization plants. The olive cake enters production at a standard price as we saw earlier.

(58) See Notes to Budgets on Page 65.

ILLUSTRATIVE BURDEN BUDGETS

For the Producing and Service Departments
of the
Firm under Study
(Excluding the plant under construction)

For all complutations and explanation, see the accompanying Notes to Budgets.

The monetary unit is Lebanese Pound.

Explanation	Power plant 1,000,000 kwhr/yr.	Repair shop 16,800 d.l.hr.	Deep well 216,000 c.m./yr.	Steam plant 15,000 b.t.u.	Drying 8,400 m.h./yr.	Extraction 8,400 m.h./yr.	Pre-refinery 8,400 m.h./yr.	Refinery 8,400 m.h./yr.	Demarga-rinization 8,400 m.h./yr.
Fixed Costs									
1. Foremen's salaries					6,000.00	6,000.00	6,000.00	6,000.00	6,000.00
2. Depreciation - buildings	100.00	100.00	100.00	150.00	150.00	200.00	200.00	200.00	250.00
3. Depreciation - machinery	5,000.00	500.00	800.00	1,000.00	2,500.00	1,500.00	3,000.00	3,000.00	2,000.00
4. Fire insurance - machinery	900.00	100.00	300.00	200.00	350.00	500.00	500.00	500.00	250.00
5. Totals (1-4)	6,000.00	700.00	1,200.00	1,350.00	9,000.00	8,200.00	9,700.00	9,700.00	8,500.00
6. Power fixed cost apportioned	(1,500.00)	60.00	180.00	60.00	300.00	240.00	300.00	300.00	60.00
7. Totals (5-6)	4,500.00	760.00	1,380.00	1,410.00	9,300.00	8,440.00	10,000.00	10,000.00	8,560.00
8. Idle time loss of power due to excess capacity (Closed to the Profit & Loss Account)	(4,500.00)								
9. Repair shop fixed cost apportioned	100,00	(760.00)	50.00	100,00	100,00	100,00	150.00	100.00	60.00
10. Totals (7-9)	100.00	-	1,430.00	1,510.00	9,400.00	8,540.00	10,150.00	10,100.00	8,620.00
11. Balance of power plant apportioned	(100.00)		12.00	4.00	21.00	16.00	21.00	21.00	5.00
12. Totals (10-11)			1,442.00	1,514.00	9,421.00	8,556.00	10,171.00	10,121.00	8,625.00
13. Deep well fixed cost apportioned			(1,442.00)	1,000.00		200.00	100.00	142.00	
14. Totals (12-13) - c/f				2,51400	9,421.00	8,756.00	10,271.00	10,263.00	8,625.00

ILLUSTRATIVE BURDEN BUDGETS (cont'd.)

Explanation	Power plant	Repair shop	Deep well	Steam plant	Drying	Extraction	Pre-refinery	Refinery	Demarga-rinization
15. Totals b/f				2,514.00	9,421.00	8,756.00	10,271.00	10,263.00	8,625.00
16. Steam plant fixed cost apportioned				(2,514.00)	1,000.00	314.00	1,000.00	200.00	
17. Total Fixed Burden	6,100.00	760.00	1,442.00	2,514.00	10,421.00	9,070.00	11,271.00	10,463.00	8,625.00
18. Fixed Burden Rate	0.0061	0.0452	0.0067	0.1676	1.2406	1.0797	1.3417	1.2455	1.0267
Variable Costs									
19. Repair parts	1,000.00	500.00	600.00	500.00	300.00	100.00	200.00	300.00	100.00
20. Supplies	2,000.00	500.00	400.00	500.00	200.00	1,000.00	2,000.00	2,000.00	
21. Depreciation - Machinery	5,000.00	500.00	500.00	1,000.00	3,000.00	1,000.00	2,000.00	2,000.00	1,000.00
22. Totals (19-21)	8,000.00	1,500.00	1,500.00	2,000.00	3,500.00	2,100.00	4,200.00	4,300.00	1,100.00
23. Power variable cost apportioned	(2,000.00)	80.00	240.00	80.00	400.00	320.00	400.00	400.00	80.00
24. Totals (22-23)	6,000.00	1,580.00	1,740.00	2,080.00	3,900.00	2,420.00	4,600.00	4,700.00	1,180.00
25. Cost of power wasted - closed to Profit & Loss	(6,000.00)								
26. Repair shop variable cost apportioned	200.00	(1,580.00)	100.00	200.00	200.00	280.00	200.00	200.00	200.00
27. Totals (24-26)	200.00		1,840.00	2,280.00	4,100.00	2,700.00	4,800.00	4,900.00	1,380.00
28. Balance of power cost apportioned	(200.00)		24.00	8.00	42.00	32.00	42.00	42.00	10.00
29. Totals (27-28)			1,864.00	2,288.00	4,142.00	2,732.00	4,842.00	4,942.00	1,390.00
30. Deep well variable cost apportioned			(1,864.00)	1,000.00		364.00	200.00	300.00	
31. Totals (29-30)				3,288.00	4,142.00	3,096.00	5,042.00	5,242.00	1,390.00
32. Steam plant variable cost apportioned				(3,288.00)	1,558.00	504.00	1,008.00	218.00	
33. Total Variable Burden	8,200.00	1,580.00	1,864.00	3,288.00	5,700.00	3,600.00	6,050.00	5,460.00	1,390.00
34. Variable Burden Rate	0.0082	0.094	0.0086	0.2192	0.6785	0.4285	0.7202	0.65	0.1655
35. Total Fixed & Variable Burden (17 plus 33)	14,300.00	2,340.00	3,306.00	5,802.00	16,121.00	12,670.00	17,321.00	15,923.00	10,015.00
36. Total Fixed & Variable Burden Rate (13 plus 34)	0.0143	0.1392	0.0153	0.3868	1.9191	1.5082	2.0619	1.8955	1.1922

procedures involved in making burden budgets; 2) To show the method of allocating the costs of service departments to the producing departments that consume such services; 3) To use the results in the standard cost per unit of product in each producing plant; and 4) To show how control can be excercised and responsibility localized.

Notes to Budgets

1. The first point to note about the sample budget is its division into fixed and variable costs. Though the costs items enumerated under each heading are not conclusive, yet their all-inclusiveness is not significant for our purposes either. Our interest lies in demonstrating the underlying principles without being unduly precise on minute procedures. The fixed costs in any one of the plants are those that remain constant, or nearly so, regardless of the fluctuations in volume of production of the plant. On the other hand, variable costs are those that fluctuate, not necessarily proportionately, with volume of output.

2. The second point to consider is the choice of the bases for computing burden per unit of activity. There are admittedly differences of opinion among cost accountants as to what constitutes a true basis for deriving burden rates. In the budgets presented, a constant burden rate divorced of the present or expected level of production or sales of any one of the plants has been suggested. The selected basis for computing the burden rates of all the plants have been the practical capacities of these plants, a concept frequently referred to. Having committed ourselves to this concept, we have to rise to defend it.(59)

(59) Needless to say that the pre-determined burden rate of a given department, plant, or factory is the quotient of a dividend, which is the total budgeted burden for a time-period, and a divisor which is the point of debate here.

Choosing any other base such as the expected level of activity, thus dividing the budgeted burden by fluctuating basis, would result in unit costs inversely related to the volume of activity. "Such unit cost figures are worthless for managerial and inventory purposes because they are not true."(60) The greatest fault with choosing some basis that results in fluctuating unit figures is not so much the fluctuation in results as such but the conviction that true costs are not revealed. To arrive at a clear understanding of why burden methods that result in fluctuating rates are undesirable, it is necessary, though at the expense of reiteration, to summarize the purpose of cost accounting:

> "1. To control costs, that is, to keep costs down. Distribution and analysis of costs by functions are primarily for purposes of control. Costs can be controlled only at their sources, and accurate distribution to functional accounts and the subsequent analysis of these accounts furnish the information at the point at which they enter the line of production. Because, in the flow of cost data, burden application begins only where overhead distribution leaves off, the particular method of application can have no effect on control. (61)
>
> "2. To furnish reliable data to be used in forming policies of meeting competition and policies of manufacturing. The information needed for this purpose must contain as its most important base the unit cost of the product unaffected, or affected as little as possible, by fluctuations in volume. Sound policies can be formulated only on a knowledge of level unit costs of products."(62)

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(60) Some of the ideas here, including the quotation, have been taken from C.F. Schlatter and W.J. Schlatter, op. cit., pp. 400-402.

(61) Referring to the burden rates that fluctuate from period to period due to a change in the basis of burden application, such as different levels of actual or expected activity.

(62) Ibid., p. 401.

For the important reason that unit costs of products (which includes fixed and variable burden) unaffected by changes in volume are so vital to sound management, cost accounting techniques were called upon to devise a method to attain the objectives. Clearly the goal is to give the product its true cost, but what constitutes "true" cost is not universally agreed upon. A method generally accepted by, what the Schlatters call, "good cost accountants" is based on the so-called "the theory of normal burden."(63)

The theory may be stated thus: "The burden atributable to a unit of product is an amount equal to the amount of budgeted burden per unit of activity at normal capacity, multiplied by the number of units of activity required to produce a unit of product."(63) The amount of burden applied to a unit of product, according to this theory, is not affected by the volume of actual or expected activity.

To put the theory into application, one has to arrive at a satisfactory concept of normal rate activity and then construct a budget of burden at standard amounts for the department at that rate of activity. These two steps were followed in preparing the budgets presented (but on assumed cost figures) earlier. We have argued that expected or actual levels of activity are inappropriate as a basis of burden application, and below we shall show that the only appropriate concept is the "practical capacity" we have heretofore referred to.

The normal rate of activity means "not an average rate based on expected sales volume of a period of future years but the rate at which the factory is equipped to operate - the

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(63) Ibid., p. 401.

rate at which the production is most economical - the rate at which it would operate if there were no lack of sales orders. This most economical rate is known as the rate at practical capacity."(64)

It is, of course, obvious that theoretical capacity is greater than practical capacity for the simple reason that no plant can operate without some unavoidable stoppages such as "some" idleness of men and machinery, employee absenteeism, machine failure, clearaways, etc., all of which are ignored under the theoretical-capacity concept.

Strong arguments have been put forth in defense of the practical-capacity burden rate. It is contended that unit costs determined by some concepts of cost do not provide management with correct information for policies of manufacturing and of selling, and this is particularly true of those concepts which do not distinguish between the actual costs of burden in a period on the one hand and the costs resulting in the production of goods on the other. There must be no confusion between the fixed burden of capacity used and that of capacity not used. A burden rate that does make such a distinction affords management three important advantages:

1) The unit cost so computed is, so far as the burden element is concerned, as closely true cost of production as possible to obtain. Cost figures thus derived do not carry with themselves the cost of idle capacity, which had nothing to do with production of goods. Equipped with such a knowledge, one is better able to decide what products to make and which ones to buy, and what policies to follow in meeting competition.

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(64) Ibid., p. 402.

2) The inventories of finished and unfinished goods are not inflated by the cost of idle capacity. It is a generally accepted principle of accounting to follow a conservative business practice by avoiding inflation of assets on the balance sheet by an amount which, in reality, is a loss for the period.

3) As part of furnishing reliable cost data to management, a burden rate based on the practical capacity would enable us to show the fixed cost incurred on unused capacity by analyzing the burden balance. Management would then be correctly informed of the real losses arising from the failure to utilize the available capacity fully. Corrective action will then be taken whenever possible to improve the situation, whereas an understatement of such losses by using an incorrect burden rate could keep management uninformed for long.

The figures used to represent capacities in the heading boxes of the budget presented are intended to represent the practical capacities of the plants. They are, of course, crude approximations. To arrive at the true figures for practical capacities require experience, research, time, and analysis.

For the power plant the method employed was as follows. There are three generators with a capability of 50 H.P. each and one with a capability of 75 H.P. It was assumed that at all times 150 H.P. can be put to work, allowing for 75 H.P. to stand by. On the basis of this assumption, the practical capacity of the power plant in Kilowatt hours for one year will be:

$$150 \text{ H.P.} = 150 \times 0.746 \text{ Kilowatt/Sec.}$$
$$= \frac{150 \times 0.746}{3600} \text{ Kwhr./Sec.}$$
$$= \frac{150 \times 0.746 \times 60 \times 60}{3600} \text{ Kwhr./hr.}$$
$$= 150 \times 0.746 \times 24 \times 365 \text{ Kwhr./year}$$

or approximately 1,000,000 Kilowatt-hours a year.(65)

For the repair shop, with a work force of four repairmen, two on duty at any time, the direct labor hours available in one year was computed as follows:(66)

48 hours available each day of 24 hours
48 x 350 hours available in a year, allowing for absences, sick leaves, etc.

or 16,800 direct labor hours.

For the deep well, based on the assumption of 30 cubic meters of water per hour, the total volume of water to be drawn out of the well for a year at practical capacity was computed by

30 x 24 x 300 (allowing for unavoidable stoppages etc.)

or about 216,000 cubic meter of water.

For the steam plant, a figure of 15,000 B.T.U. (British Thermal Unit) was assumed, since management has no knowledge about the technical nature of this plant.

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(65) The constant 0.746 was obtained from power conversion tables available in most textbooks on power and electricity.

(66) According to the analysis in Appendix I.

For each one of the producing plants, practical capacity was computed on the basis of machine hours as follows:

24 x 350 = 8400 machine hours available in each one of the producing departments.(67)

3. The third point regarding the budgets is the interdependence of the power plant and the repair shop. These two departments render service to and receive service from each other, and hence, to be exact, reciprocal distributions should be done to clear the balances completely.(68) This can be solved by two methods which are basically the same, i.e. simultaneous equations and repeated distributions until the balance of the accounts become insignificant.(69) In the illustrative budget presented, it was found that the balances turn out to be insignificant after the first redistribution entry, i.e. after redistributing the balance of the power plant cost received from the distribution of the repair shop cost.(70) Therefore it was considered best to avoid any further redistribution and include the balance in the charge to other departments.

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(67) The number of days in a year during which all the plants can work is not, as shown by the above computations, the same for all. This is not necessarily so, depending on what can be practically achieved, in any one of the plants.

(68) Some accountants, including John J.W. Neuner, Cost Accounting, call such a case "viscious circle" and hence avoid any reciprocal cost distributions.

(69) For illustrations, see C.F. Schlatter and W.J. Schlatter, op.cit., pp. 127-141.

(70) About LL. 4.00 for fixed costs.

4. The annual consuming capacities of electricity of the plants were assumed to be as follows:

Plant	Consuming capacity of power
Repair Shop	10,000 Kwhrs.
Deep Well	30,000 "
Steam Plant	10,000 "
Drying	50,000 "
Extraction	40,000 "
Pre-refinery	50,000 "
Refinery	50,000 "
Demargarinization	10,000 "
T o t a l	250,000 Kwhrs.

It is thus assumed that there is much more power than needed. This cost, as shown on the budget, will continue to be a loss to the firm unless management sells power to the households in the village at any price they can pay for. If this excess power has no other use except being produced and wasted, the opportunity cost to the firm may be zero and therefore, any price given for the sale of power to the households will be a gain.

It is further assumed that the producing capacities of other service departments match with the consuming capacities of the plants to which they render services.(71) This assumption is not realistic, but is made because no knowledge of such capacities exists at present.

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(71) All working at their practical capacities. Hence the distribution of service department costs to the departments that consume these services must be proportional to their consumption capacities.

5. The rest of the budget is self-explanatory and should be easily understood by anybody with an eye for figures and a background in cost accounting.

E. Procedural Framework

The accompanying cost flow chart has been developed to assist the reader to understand the skeleton of the cost system. It is based on the present "state of affairs" prevailing in the firm under study. The emphasis on the present "state of affairs" is because, as was shown in part II of this paper, the former practice of sending the oil-containing activated powder resulting from the pre-refinery and refinery process back to extraction was abandoned because it was found "inefficient".(72) In its place, a new plant is under construction at the time of this writing, that will separate the oil contents of the powder.(73)

The chart clearly shows how costs are originated when a transaction takes place between the firm and an external party resulting in the creation of a liability. The increase in the liability accounts results in a corresponding increase in the asset accounts (like raw materials) or in current expense accounts (like wages). From these accounts, costs in turn flow out to the centers where they really belong (i.e. where they are actually incurred). Most of the entries, therefore, are merely transfer entries.

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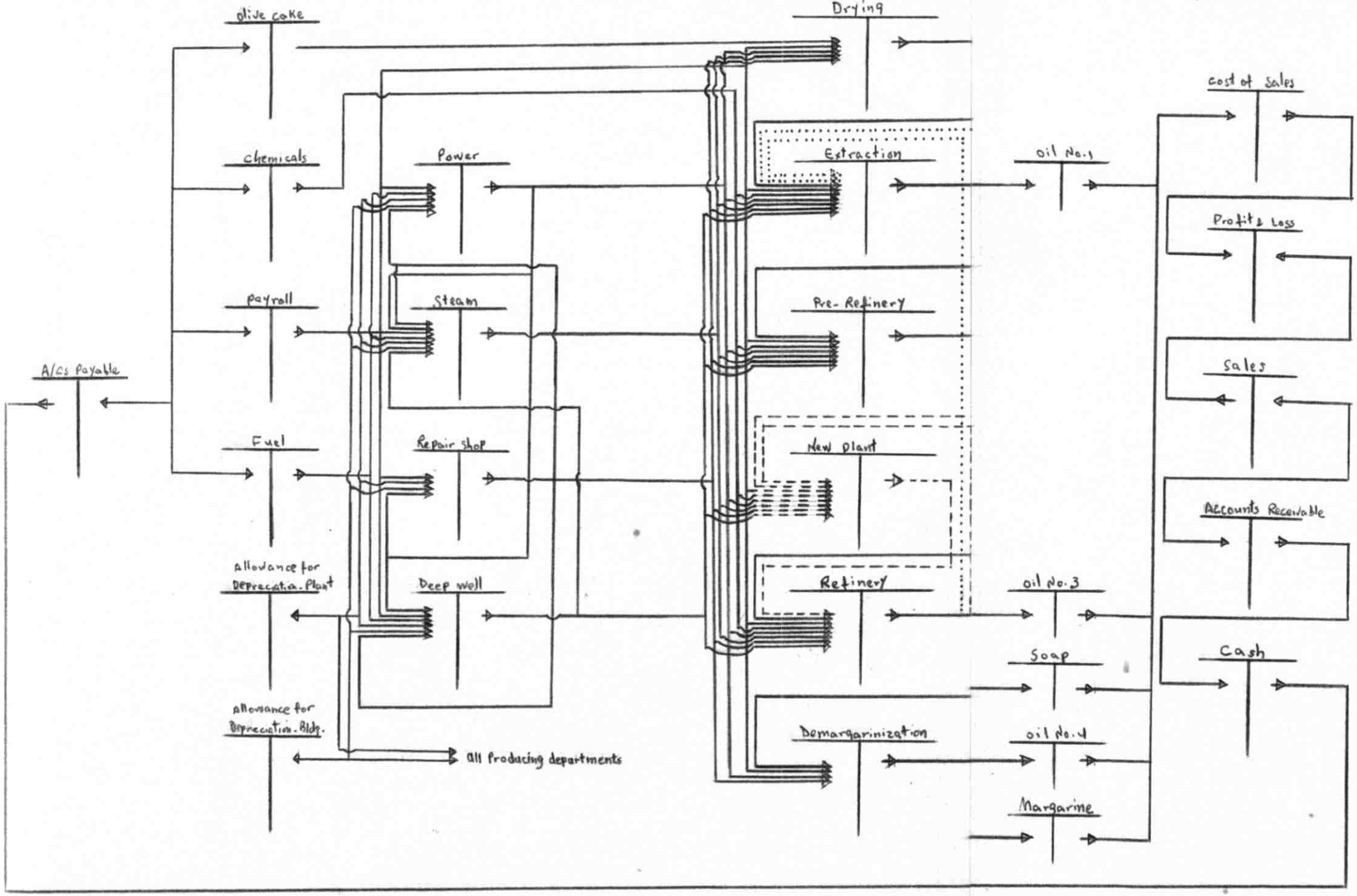
(72) Fig. 1, Flow of Operations. The abandoned practice is shown in dotted lines.

(73) This plant has not begun work yet and the owner-manager of the firm had little knowledge about how its behavior may be. This plant was excluded from the Illustrative Budgets.

Fig 3 - Cost Flow Chart

Abandoned Practice .....
Planned Practice _____



Note: A payroll account is not suggested, but shown here only to bring the labor element into the total cost fl picture.

Increases in the assets and expense accounts are indicated by debits and decreases by credits. In other words, costs flow into the asset and expense accounts on the debit side and flow out from the credit side. The flow lines show these increases and decreases by the direction to which the arrows point. In the case of raw materials, for example, the flow line points in to the debit side, meaning an increase in the raw materials account, and in to the credit side of the accounts payable, indicating an increment to the accounts payable account.

Flow charts are essential to a systematic approach to a cost system. It emphasizes the organizational or managerial point of view of cost accounting rather than the point of view of the cost clerk, often misnomered as a "cost accountant".

It should be explicitly stated, though it has been implicit throughout the paper, that a standard cost system is the one advocated by the writer. "Standard costs are ideal or 'par' costs."(74) Comparisons between the actual and standard costs have considerable value in furnishing information that are useful in the control of costs. Because such data should flow to management, as we have so far argued, and because standard costs can best provide them, therefore, we go on to deduce, a system incorporating standard costs is the best choice.

To install a standard cost system in the firm under study is not by any means easy. It has already been pointed

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(74) C.F. Schlatter and W.J. Schlatter, op. cit., p. 9.

out that certain prerequisites should be met before the cost system, as proposed here, can achieve its objectives.(75)

1. Drying. We have seen that the drying process is charged with the cost of raw material (at standard price), wages paid to the workers whose work can be easily and practically identified with the process, and any other costs incurred in the plant including depreciation, insurance etc. The illustrative budgets show the typical items of cost that may be charged to this process. In addition to the costs incurred directly in the plant, there are costs apportioned to the plant from the service departments that serve the drying plant.(76) How the costs of service departments should be apportioned to the drying as well as other plants will be discussed later while considering the service departments.

Drying thus is loaded with costs from these sources, and should naturally be unloaded by accumulating these costs in the final product, which is dried (devoid of any moisture) olive cakes. As the drying process continues, costs, which have become part of the dried material, also flow out from the credit side of the account, thus offsetting the debits. The question to be considered here is the procedure involved in crediting the drying in order to unload the charges made to the account.

In casting about for the correct procedure consistent with the arguments heretofore presented, the most logical route leads to what is called "the standard budget for one unit

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(75) See Chapter III.

(76) As indicated by the Flow Chart.

of processed olive cake." The following budget presumes that the standard specifications regarding the manufacture of one unit of dried olive cake have already been studied and installed.

Standard Specifications for one unit of processed olive cake(77)

Raw material : 1100 Kgs. at LL.04	LL.44.00
Labor : 1 hr. at LL. 5.00	5.00
Burden : 1 hr. at LL. 1.92+	1.92
Total standard cost of 1 unit of processed olive cake.	LL.50.92

+ The burden rate is taken from the Illustrative Budgets and rounded to the second decimal.

The units of output leaving the drying process should be measured and recorded by somebody on transfer slips referred to earlier. The slips will be turned over once every 24 hours to the accounting department which will keep them in special binders for periodical entries on the cost journal referred to earlier. The ultimate effect of the entry on the assumption that 600 units of processed olive cakes have passed from drying to extraction during a given period will be:

Dr.	Extraction	LL.30,552.00	
Cr.	Drying (600 x 50.92)		LL.30,552.00

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(77) The unit may be expressed in terms of any measure management may think suitable. Here a ton = 1000 Klgs. is taken as a unit.

It was pointed in Part II that dried olive cake is first piled up on the roof and them carried to the extraction plant. This case seems to the writer as one of imperfect adaptation of the output and input capacities between the two processes respectively. However, the size of this inter-process inventory may grow large if both plants continue to work at their full practical capacities.(78) To be accurate, two transfer slips should be used: one when the dried olive cake piles up on the roof and two when it enters the extraction plant. But this may require more time and hence greater cost. The ultimate selection is, of course, clear: prevent any piling up of inter-process inventory by adjusting the input capacity of extraction to the output capacity of drying as nearly as possible. A detour to the problem in the short run, which will necessarily result in idle time in the drying process, is to charge all the output of the drying to extraction and make a periodic adjusting entry, at the time of preparing monthly reports and cost statements, to account for the cost of dried cake finished but not transferred to extraction. This entry will be:

Dr. Dried Olive Cake Inventory
Cr. Extraction

The quantity piled up on the roof of the drying plant can, for the purposes of this entry, be estimated fairly accurately. To the belief of the writer, this is a case where a

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(78) If the drying plant can produce 30 tons of dried cake while the extraction plant can take in only 25, there will be 5 tons left over at the end of each day, which will reach 30 x 5 = 150 tons a month (costing LL.7638.00 according to figures used here) and approximately 150 x 12 = 1800 tons a year (costing LL.91,652 according to figures assumed in this paper). For the figures of capacities, see Part II.

pragmatic solution for the problem does not sacrifice "too much" accuracy, and the marginal cost of deriving an additional unit of accuracy offsets the additional benefit obtained from it.

According to the owner, there would not be a problem of evaluating the work-in-process inventory in this plant as the time duration for one ton of olive cake to dry is relatively short. This simplifies the problem as it is better to start and end a period with no inventory in process. The time of no in-process inventory can be made to coincide with the forced shut-down period due to the existing disharmony between the capacities of drying and extracting. Even if after careful empirical study we may conclude that it is necessary to account for the work in process at the end of a period, we should do this after carefully setting up certain criteria to measure the degree of completion of the material in process. A ticklish question in connection with estimating the degree of completion in this and other plants is to come to an appropriate concept of "completion". Is the degree of completion measured by the lapse of time, by the cost expended, or by other yardsticks? Since we are interested in the costs incurred, the practical problem is, therefore, one of establishing a definite relationship between costs incurred and whatever concept of completion that is chosen. This is a complex problem and its significance to the cost system of the firm has a direct relationship with the volume of work in process. If the latter is small in relation to the total inventory of finished goods, the problem can be dismissed without bothering much about it. The reverse would be when the work in process is relatively large. Since cost of production reports, to be discussed later, are prepared as of the last moment of the last day of a month, we

can manipulate the drying plant in such a way as to avoid the work in process in the drying plant. The problem, therefore, will be dismissed at this point.

In consequence of charges to this plant account and credits thereto as dried material flows out, there will, at the end of a month, remain in the drying process account, as well as the accounts of other plants, a balance which, if considered material, should be analyzed by employing the various tools developed by cost accounting techniques.(79)

2. Extraction. The second process center is the extraction plant. We have seen that it is debited with the labor cost incurred in this department, the cost of all supplies and chemicals issued and used directly in the plant, and the dried olive cake transferred from the drying plant. The resulting products are two: extracted oil (oil No. 1, as called by the writer) and the final residue, which does not contain oil. It has already been explained in Chapter II that the residue is mainly burned in the steam plant, and the extracted oil is preferrably sold and the rest transferred for refining.

To split the cost of production between these two products is a nut that has not as yet, to the knowledge of the writer, been cracked open by any cost accounting techniques with a logical and realistic approach. Different methods, therefore, can be used to account for costs, none of which can be said to be right or wrong. But whatever methods used, it should be kept in mind that the costs belong to the whole package and since the percentage content of oil in the olive cake

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(79) It is assumed that cost-of-production reports together with the analyses of remaining balances in the cost accounts are made monthly. An illustration of variation analyses is given for the refining process account.

is almost fixed, it is impracticable to produce more oil without producing proportionally more residue. The procedure followed here is to disregard the production of the final residue and assume that oil No. 1 is the only product produced. This is done for a number of reasons:

1) Management is essentially interested in extracting oil and not in producing residue;
2) The output of residue by itself is not particularly desired by management because:
   a. it is bulky and occupies space;
   b. it is difficult to market the residue because of the problem of weight, high transportation costs and the relatively low utility it has to consumers. It is good for burning, but the heat and energy produced is low in relation to other materials used for burning;(80)
3) Any attempt to allocate costs between the two products would necessarily be arbitrary and hence unrealistic; and
4) The accounting work is simplified.

On the basis of this the following standards are set up for one unit of olive oil, thus:

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(80) It is interesting to speculate whether the existance of the final residue has not worked against sound decisions. Since they were produced, management built a steam plant that could use the residue for burning, but later found out that greater heat was needed for the pre-refinery process and therefore another more efficient steam plant was added. If there were no olive residue, the capital expenditures would have probably been diverted to another use by having one steam plant instead of two but sufficient efficiency to supply the needs of all plants.

Standard Specifications of one unit
of Extracted oil (oil No. 1)

Materials: 10 units of dried cake at LL.50.92	LL.509.20
Labor : 4 hours at LL.5.00	20.00
Burden : 4 hours at LL. 1.51	6.04
	LL.535.24

As oil No. 1 is finished and transferred out, either for stock, pre-refinery or refinery, the information will be recorded first on the transfer slips, to be forwarded to the accounting department once a day, where it will be temporarily filed for monthly entry on the cost journal voucher thus:

Dr. Oil No. 1
Pre-refinery
Refinery
Cr. Extraction
(all at pre-determined standard costs)

At the end of the month, the degree of completion of the work in process should be estimated and standard costs assigned thereto on the basis of equivalent units of production. The entry will be

Dr. Work-in-process - oil No. 1
Cr. Extraction

Since materials are added at the beginning of the process, the work in process will be valued as follows:

Cost of x units in process y% complete	
Materials:	LL x . 509.20
Labor: x . y% = z	LL z . 20.00
Burden:x . y% = z	LL z . 6.04
T o t a l	LL 509.20x + 26.04z

The estimates of completion should be made by qualified people in the factory and sent to the accountant who will then pass the necessary entries. The form could be designed in such a way as to show the date, the name of the plant, the units in process, and the degree of completion.(81)

3. Pre-Refining. This process receives oil No. 1, oil purchased and/or received for refining, and oil from the refinery that needs further processing. The resulting products are two: oil No. 2 and activated powder containing oil. Presumably all these types of oil must be of approximately the same grade or quality to fit into the pre-refining plant. In the case of extraction above, we saw that part of the oil No.1 is transferred directly to the refinery. Mixed with this oil, there is some oil that is not still fit for refining which has to be returned to the pre-refining stage. It could, therefore, be assumed that no cost has been added to this oil, after leaving the extraction plant and that it is still oil No. 1 with the same standard unit cost. The oil coming from outside, either purchased or received for processing (neutralizing its acidity), a different procedure should be followed. For oil received for processing for a client, an equivalent amount of processed oil could be given in advance and a price charged for the service. The cost of rendering this service

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(81) The balance of the account at end of period should also be analyzed into variances and furnished to management for control purposes.

is the standard labor and burden required to complete the work. The entry for this kind of transaction could be recorded in the General Journal like this:

Dr. Oil (at standard)
Cash
Cr. Oil No. 3 (at standard cost)
Income from refining services (assuming a profit was made).

The cost information can reach the accounting office by the receipts and transfer slips sent by the storekeeper. Oil purchased can be treated in the same manner. Because the volume of oil purchased for refining is large in relation to the oil coming from extraction, then a standard price should be set for unprocessed oil thus received and price fluctuations be isolated in the same manner as was done for raw materials. Thus oil received for refining in exchange of which processed oil is given is a kind of purchase (or trade-in, to be more accurate) and must be set on the books at standard cost.(82) It was explained by the owner that little oil from extraction flows to the pre-refinery and therefore we could assume that the large proportion of the oil fed into pre-refining is purchased either by cash or trade-ins. A perpetual stock card can be kept to show the barrels received, issued and on hand. The procedures will be like those explained in connection with supplies.

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(82) Depending on the acidity of oil (see Chapter II) oil flowing out of extraction and/or purchased from outside will be sent to either pre-refinery or refinery. Oil received from outside can be set on the books at the same standard cost at which oil flowing from extraction is recorded.

The resulting products are oil No. 2 and oil-containing powder. The powder is valuable only because it contains oil, and in reality, therefore, only one product flows out of this process, i.e. oil No. 2 part of which comes out mixed with powder. To extract the oil contents of this powder, a small plant is being constructed. By knowing the percentage oil content of the powder, we can express all the output of this plant in terms of oil No. 2 and make a standard budget for it as was shown for the preceding plants. As oil No. 2 flows out, it is recorded on a transfer slip, which will be accumulated in the accounting office and a summary entry made monthly on the cost voucher already referred to. The entry will be:

Dr. Refinery
New Mill
Cr. Pre-Refinery

Procedures to compute the cost of the work-in process are the same as explained for the extraction plant. The balance left in the account at the end of the period should, if considered material, be analyzed into the components to be mentioned.(83)

4. Refining. We have also seen that this plant receives oil from extraction, pre-refining, and oil from outside the plant. However, the latter constitutes a small proportion of the total volume of oil put into the process because of the extremely low acidity requirement, as seen earlier, for which the ordinary olive oil does not qualify. The rarity of feeding

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(83) The materiality of a balance cannot be found by merely looking at the figure because the balance may be material and yet"look immaterial" if a variation loss has been offset by a variation gain.

the plant with outside oil may justify the decision of excluding the cost of such oil from the materials and including it in the variable burden.

The output of the plant are two joint products, oil No. 3 and soap.(84) The jointness of the products forbids a correct distribution of the cost of the plant to each product alone. However, the arbitrariness involved does not in any way impair the accuracy of cost data. Based on the fixed relation that exists between soap and oil No. 3, a package of products can be defined and taken as one unit and standard specifications be drawn up. The total standard costs can then be distributed between the two products on the basis of their sales value. However, the refinery process will be credited as the package of products leave the plant. Since oil No.3 has to go to demargarinization, while soap is sold, a cost should be assigned to them. The assigned cost to oil, though arbitrary, does not impair the validity of cost data as far as control is concerned. Since a standard figure, regardless of its face value, should be debited to demargarinization and credited as the finished material leaves, little change will occur so far as the analysis of the balance of its account for control purposes is concerned.

However, the limitations of this method should be recognized. The profitability of the package should be taken together; it would be wrong to talk of one without the other. Any increase in the sale of refined oil necessitating an increase in the production of soap should take care of the fall in the unit sales price of soap for example. The contribution of the

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(84) See Appendix II.

package to the recovery of the total fixed cost of the firm should be taken rather that of each product alone.

A standard cost budget should also be developed for refinery for a package of oil No. 3 and soap, defined as one unit of output. Then by recording the output of each product on a transfer slip, an entry can be passed on the cost voucher debiting demargarinization and soap each at the allocated cost and a credit to refinery for the total standard cost of the units finished and transferred.

For the work in process, a procedure similar to that explained before can be followed.

Following is an illustration of the variation analysis of the refinery process account. For the sake of simplicity, all the figures have been assumed with no regard to those assumed before. The purpose of the illustration is to demonstrate the mechanism involved in analyzing the balances of the process accounts.

The standard specifications for 4 units of refined oil and one unit of soap are assumed to be as follows:

Unrefined oil : 10 units at LL 1.50	LL. 15.00
Labor: 5 hr. at LL 2.00	10.00
Burden: 5 hr. at LL 2.00 fixed and LL 3.00 variable	25.00
Total standard cost of 4 units of oil and one unit of soap.	LL. 50.00

Production data for the month of August 1962 are assumed to be as follows:

No work in process at beginning.

Finished and transferred out of the process:

3600 units of refined oil

900 units of soap

August 31 work in process:

200 units of oil, 3/5 finished. When completed, this should result in 80 units of refined oil and 20 units of soap.

Costs actually charged to the refinery process during August 1962 are assumed to be as follows:

Unrefined Oil: 9700 units at 1.50	LL.14,550.00
Labor: 5000 hr. at 1.90	9,500.00
Fixed Burden:	15,000.00
Power: 7,700 units	1,155.00
Other variable burden items	14,480.00
T o t a l	LL.54,685.00

It is further assumed that the practical capacity of the refinery process for August is 7,600 machine hours and that actual labor hours and machine hours were the same.

The refinery account, therefore, will in summary form reflect the following:

Refinery

Total charges as detailed above	LL.54,685.00	Finished & Transferred+	LL.45,000.00
		Work in Process+	720.00
		T o t a l	LL.45,720.00
		Balance to be analyzed	8,965.00
	LL.54,685.00		LL.54,685.00

+ Computed on the basis of standard costs.

The analysis of the balance will be as follows:

1. Material-Usage Variation:

(Actual quantity of unrefined oil - standard quantity of unrefined oil) standard unit cost.

(9700 - 9200) 1.50 = LL. 750.00

Standard quantity is computed as follows:

Standard quantity of unrefined oil in goods finished	9000 units
Standard quantity of unrefined oil in work in process	200
	9200 units

2. Wage-Rate Variation:

(Actual wage rate - standard wage rate) actual labor hours.

(1.90 - 2.00) 5000 = (500.00)

3. Labor-Efficiency Variation:

(Actual labor hours - standard labor hours) standard wage rate.

(5000 - 4560) 2.00 = 880.00

Standard hours are computed as follows:

Standard hours required to finish 3600 units of refined oil and 900 units of soap	4500
Standard hours required to finish 80 units of refined oil and 20 units of soap upto 60%	60
	4560

Total carried forward LL.1,130.00

Total brought forward LL.1,130.00

4. Burden-Budget Variation:

(Actual burden incurred during month - budgeted burden for month)

Actual burden	LL.30,635.00	
Budgeted burden:		
Fixed : LL.15,000.00		
Variable: 15,000.00	30,000.00	635.00

Fixed burden for month is assumed to be LL.15,000.00 or 1/12 of total annual burden.

Variable burden is found by multiplying the variable burden rate 3 by total actual machine hours of 5000.

5. Calendar Variation:

(Annual budgeted hours at practical capacity / 12 - monthly budgeted hours at practical capacity) fixed burden rate.

(7,500 - 7,600) 2 = (200.00)

6. Idle-Time Loss:

(Monthly budgeted hours at practical capacity - Actual hours for month) fixed burden rate.

(7,600 - 5,000) 2 = 5,200.00

7. Burden-Efficiency Variation:

(Actual labor hours - standard labor hours)burden rate

(5,000 - 4,560) 5 = 2,200.00

Total variation of refining process account LL.8,965.00

5. Demargarinization. The plant receives oil No. 3 from refinery and results in two joint products: oil No. 4 and margarine. The procedures followed for this process are similar to those explained for refinery above.

6. Service Departments. To the unit operating costs of the service departments developed in conjunction with the Illustrative Budgets (called burden rates there) must be added the supplies and labor that would be needed for one year at practical capacity in order to compute the standard unit cost of service. Thus we can find the total cost of one kilowatt hour of power, one hour of repair services, one unit of steam, and one unit of water. The procedures involved in one of these service departments will be taken for illustration.

The power plant will, like the producing plants, receive charges for all the costs incurred in the plant such as fuel, wages, insurance, depreciation etc. The same transfer slips will be used again wherever applicable to convey the information to the accounting department.

The power plant will be credited at the power standard cost; the charge going to those departments that consume the energy. Each consuming department should, therefore, have a meter to record the consumption of the period. The information can be collected on transfer slips periodically and sent to the accounting department. By analyzing the balance of the power department, we can find out which one of the consuming departments, if any, has failed to consume its budgeted power, thus localizing responsibility for the idle-time balance in the power plant. Such a balance, to the extent that other departments are responsible for it, should be allocated to the consuming departments in the ratio of their failure to consume their budgeted share of power.

If the power plant is equipped with capacity in excess of what all the other departments put together can consume at their full practical capacities, then no other department but the power plant itself is responsible for it.

Thus it is seen how these specific procedures put flesh on the skeleton of accounts developed in the cost flow chart and how cost data can be effectively used to furnish management with information necessary for the conduct of the business firm.

F. Cost Reports

The last but by no means the least important step is to classify and process the information flowing from the system into comprehensive and understandable forms for use by management. Any data tapped from the system are "raw data" for which management might have neither the time nor the training to understand. Therefore, a series of forms and reports must be built into our system so as to transmit the information to management in an organized, summarized, intelligible, and yet simple manner. Cost reports and statements, therefore, become the modus operandi for accomplishing the final stage of the cost system. These statements are generally known, and very truly so, as the final product of any system.

The type, number, and frequency of cost reports depends on the desires of management. Some types of reports that may be useful to management are illustrated below:

1. Cost- and quantity-of-production report: A report may be prepared once a month for all producing plants to

show the standard cost of products in process at beginning, costs put into process, cost of goods finished, cost of products in process at end of period and the remaining debit or credit balance in the plant accounts. The suggested form is attached.

The "Cumulative Cost Total" appearing in the middle of the statement shows the total costs accumulated by the plant and the part below the foregoing label indicates how each plant disposed these costs. Part of the costs charged to the plant were transferred to the next department, part to stock, part of the costs are still in the form of unfinished goods, and part may have been spoiled. The function of this statement can be likened to that of the conventional balance sheet that shows how funds (costs in the case of the statement in question) have been obtained and how they have been used.

A further point about the statement is the spoiled goods. When goods are spoiled in any plant, an estimate of the stage of completion and the relevant standard cost should be made and a procedure similar to that explained in connection with completed goods should be followed.(85) When the spoiled goods are sold, their sales revenue and related standard costs will be reflected in the income statement. Although spoilage can and should be avoidable with better machinery and production techniques but the chances of having no spoilage would hardly disappear completely and the accounting system should make a provision for the spoiled products. Reasons for what may be considered excessive spoilage should be traced and causes removed.

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(85) Debit spoiled goods (oil No. 1, 2, etc.) and Credit the related process account. Because spoilage is an exception rather than a rule, it has been briefly covered here.

2. Integrated Reports: A series of periodical statements can be prepared to convey to management useful information from the accounting system. To make the statements more comprehensive, some accounts, like sales, have been introduced which have not been covered in the proposed system.(86) The balances of these accounts are assumed to be obtainable from the financial records of the firm. The first report to appear is supported by the ensuing statements, called schedules, that show the breakdown of the composite figures appearing on the consolidated report.

The interesting point about the consolidated statement of operations is that it shows what a differently designed form does not; namely, that those facilities which were used were used efficiently or inefficiently as indicated by the "Net Operating Profit (Loss) on Volume of Business"; and that a low income or loss as shown by the "Net Operating Profit (Loss)", as the case may be, was due largely to lack of volume to make fuller use of facilities of production (i.e. available practical capacity) and to absorb the fixed costs of such facilities.(87)

G. Conclusions

This chapter has emphasized standard costs for two reasons: 1) Standard costing has the outstanding virtue of simplicity. In the words of the Schlatters, "Instead of spending time and effort uselessly in recording all details of all actual costs at all times, time and effort are spent only on the exceptions."(88) 2) In addition to the built-in simplicity

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(86) The reason is obviously because these accounts fall outside a cost accounting system proper.

(87) The idea has been taken from C.F. Schlatter and W.J. Schlatter, op. cit., p. 443.

(88) Ibid., p. 538.

standard costing has great value in disclosing waste and inefficiencies. The application of cost standards for controlling costs renders standard costing a unique tool for management to fulfil efficiently one aspect of its overall controlling function.

Tracing exceptions and effecting control begin with the analysis of variations appearing in each process account. These variations, therefore, must be interpreted before further breakdown is made. The following questions should be considered in connection with variations:

1. Is the variation (material-usage, labor-efficiency, etc.) small enough to be ignored? After all, standard cost is an ideal and any actual cost at a reasonable variance from the ideal is satisfactory.

2. Is the variation large enough to justify the cost of further analysis? Obviously, management should agree on what may be considered a "large enough variation" from the standard. If a burden budget variation loss of 20 per cent for refinery is thought to be large, then the accountant will be required to break down the actual burden further and compare it item by item with the standard budget of burden of the refining process to locate the cause of the loss.

It should be made clear that a percentage of variation alone with no regard to the absoluteaamount involved cannot be the basis for a decision to go on with further analysis. To give an example, a 50 per cent variation in an item may be only LL.20.00, which would hardly justify the cost of further analysis in a search for the cause of the excess.

3. Is the variation large enough to cause concern but not too large to require further analysis at this time? For example, if a labor-efficiency-variation loss of 10 per cent in the pre-refinery process is considered large but not large enough to require further analysis at this time, then the behavior of this item must be watched carefully, for the next few months to see if it decreases, increases or keeps as high. In any case, further analysis becomes advisable because management should know more details concerning any of the prevailing three cases just mentioned.

4. Are the idle-time losses arising from operating below the full practical capacity because of a lack of a large enough market or because of inept management of production activities? If the volume of sales is small, ways and means should be sought to expand the market. If the management cannot cope with the requirements of the job, better management must be provided.

The information provided by the system are tabulated and forwarded to management for further instructions. The reports should be carefully studied and compared with those of the preceding periods, which will enable the management to locate and correct the weak points in the various processes.

A more detailed evaluation of the proposed system follows in the next chapter.

FIRM UNDER STUDY

Statement of Cost and Quantity of Production for the Month of _____,19__

	DRYING		EXTRACTION		PRE-REFINING		REFINING		DEMARGARINIZATION	
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Cost Transferred from Preceding Department:										
Work-in-process at beginning.....										
Transferred into department during month....										
Total cost of work done in preceding dept....										
Costs in Department:										
Work-in-process at beginning:										
Materials.....										
Labor.....										
Burden.....										
Costs for month:										
Materials.....										
Labor.....										
Burden.....										
Total departmental costs.....										
CUMULATIVE COST TOTAL..										
Transferred to Next Dept.										
Transferred to Stock....										
Work-in-Process at End:										
Materials.....										
Labor.....										
Burden.....										
Total work-in-process										
Cost of Goods Spoiled..										
Total cost of goods transferred, in process, & spoiled.....										
Variations.....										
CUMULATIVE COST TOTAL..										

Fig. 4

FIRM UNDER STUDY

Statement of Operations
For the Month of ..... , 19..

S A L E S		
	Amounts	Schedule
Sales:		
Gross Sales		1
Less: Returns and Allowances .		2
Net Sales		
Cost of Sales:		
Standard Cost of Net Sales ...		3
Gross Manufacturing Margin ...		4
Selling Expenses		5
Administrative Expenses		
Net Operating Profit (Loss) on Volume of Business		
M A N U F A C T U R I N G		
Variations from Standards :		6
Price Variations:		
Raw Materials		
Labor		
Total		7
Efficiency Variations:		
Materials Usage Variation .		
Labor Efficiency Variation.		
Burden:		
Budget Variation		
Idle Time Variation		
Burden Efficiency Var. ..		
Calendar Variation		
Total		
Total Efficiency Var. ...		
Total Variations		
Net Operating Profit (Loss) ...		

Fig. 5

FIRM UNDER STUDY
Sales Analysis
For the Month of _____,19__

Schedule 1

Product	Budget	Actual	Per Cent of Budget

FIRM UNDER STUDY
Sales Returns & Allowances
For the Month of _____,19__

Schedule 2

Reason	Amount

Fig. 6

FIRM UNDER STUDY Schedule 3

Analysis of Gross Manufacturing Margin for the

Month of ___,19

EXPLANATION	Net Sales		Gross Mfg. Margin	
	Amount	% of total	Amount	% of sales
Wholesale:				
Oil No. 1				
Oil No. 2				
etc.				
Subtotal				
Retail:				
Oil No. 1				
Oil No. 2				
etc.				
Subtotal				
Others:				
Oil No. 1				
Oil No. 2				
etc.				
Subtotal				
Total				

Fig. 7

FIRM UNDER STUDY Schedule 3

Analysis of Gross Manufacturing Margin for the Month of ___,19

EXPLANATION	Net Sales		Gross Mfg. Margin	
	Amount	% of total	Amount	% of sales
Wholesale:				
Oil No. 1				
Oil No. 2				
etc.				
Subtotal				
Retail:				
Oil No. 1				
Oil No. 2				
etc.				
Subtotal				
Others:				
Oil No. 1				
Oil No. 2				
etc.				
Subtotal				
Total				

Fig. 7

FIRM UNDER STUDY
Selling Expense Analysis
For the Month of _____,19__

Schedule 4

ITEM	Summary		
	Budget	Actual	Over (Under)
Salesmen:			
Salaries & Commissions			
Travel			
Total			
General:			
Advertising			
Samples			
Total			
Others			
Grand Total			

FIRM UNDER STUDY
Administrative Expense Analysis
For the Month of _____,19__

Schedule 5

ITEM	Summary		
	Budget	Actual	Over (Under)
Salaries			
Entertaining			
Stationery			
Insurance			
Depreciation - Office Building			
Depreciations- Furniture and Fixtures			
Light			
Others			
Total			

Fig. 8

FIRM UNDER STUDY Schedule 6

Price Variations

For the Month of _____,19__

Explanation	Standard Price	Actual Price	Quantity Used	Total Value at Standard	Total Value at Actual	Price Variations
Raw Materials.....						
Labor:						
Drying.....						
Extraction.....						
Pre-Refining...						
Refining.....						
Demargarinization						
Subtotal.....						
Power.....						
Steam.....						
Repair Shop....						
Deep Well.....						
Subtotal.....						
Total wage-rate variations...						
Total Price Variations						

Fig. 9

FIRM UNDER STUDY

Schedule 7

Analysis of Efficiency Variations

For the Month of _____, 19__

Department	Material Usage	Labor Efficiency	Burden					Total Variations
			Budget	Idle time	Efficiency	Calendar	Total	
I. Producing:								
1.Drying								
2.Extraction								
3.Pre-Refining								
4.Refining								
5.Demargarinization								
Total								
II.Service:								
1.Power								
2.Steam								
3.Repair Shop								
4.Deep Well								
Total								
TOTAL								

Fig. 10

V. CONCLUSIONS

We have discussed the conditions under which the firm in question operates, the need for a cost and control system, and finally the system itself. In the jargon of Chapter I of this paper, we have demonstrated the business weather enveloping the company, hence giving rise to a "need", which was met in the fourth chapter. The bad business weather was seen in almost every aspect of the firm's operations. In broad terms, none of the managerial functions - i.e. planning, organizing, control, and motivation - referred to earlier is deliberately implemented in the firm. By "deliberate implementation" is meant conscious following of the managerial functions in the conduct of business operations. Though these functions are inseparable from a business entity and are unavoidably "born" when a business organization, no matter how informal, is formed, but a conscious understanding of their significance and the extent of their application in the conduct of the business operations distinguish good management from bad management. The absence of a formal and intelligent application of the functions of management in the firm under study is the source of all confusion and disturbance in the business weather.(89) To emphasize this point further, let us

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(89) Examples were cited in Chapter II showing the absence of formal adherence to the managerial functions.

turn to the fourth function of management, i.e. motivation, and see how it is being handled in the firm.

All the workers are recruited from the local labor force. However, the recruiting is not governed by a formal policy etc. but employment is handled like that of casual labor. The workers in the village know of the employment opportunities in the firm and any time a worker wishes to work, he sees the owner who may or may not consent to his employment depending on the worker's age, physical ability, past record with the firm, etc. However, the whole process is even more informal than this. Having worked two days, the worker may not show up for the next week for various reasons. The owner can easily call for someone else to handle the day's job. In other words, as has been mentioned before, no permanent work force is maintained, and the management has never encouraged the idea of training and keeping workers for jobs requiring some skill and experience. The wage is set as low as possible with no consideration to the possibility of motivating the worker by more pay and consequently obtain much higher "productivity" from him in the form of his more attentive, conscientious, and willing work, punctuality, regular attendance, prevention of waste of materials and time, and finally higher morale and esprit de corps. These points were mentioned to management in the course of the writer's visit to the firm. It was also recommended that uniform overalls be made for the workers for use during work hours instead of the worker's own wide pants and rags. In short, no such concept as motivation of workers and the means to achieve it exists in the firm.(90)

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(90) To convince management of the role of motivation, the widely-known psychological formulae $O \leftrightarrow S \rightarrow A$ (O for organism, S for stimulus, and A for achievement) can be presented. Any organism's achievement,

The complete absence of motivation and inadequate planning, organizing, and control are the real causes of unpleasant business weather. But since our business weather is a function of all these factors, we can hardly conclude a noticeable improvement in the weather by introducing a cost and control system into the firm which effects only part of the overall control function and provides only a fraction of all the data that should be provided for managerial planning and organizing. Following Seidenberg's anatomy of organization, the cost and control system, (which in itself is an organization if we define organization as coordinated functioning of parts for the achievement of a common goal) demands an organized environment for its smooth and effective functioning.(91) In fact, planning and organizing have logical precedence over control. As it was pointed out in Chapter III, a number of studies and surveys should be done before a cost system as proposed in this paper can be installed and the efficiency tone must be reflected throughout the firm. The

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particularly that of human beings, is an interplay of its hereditary and early-acquired characteristics that form the makeup of its mentality and the immediate situation in which the organism stands.

(91) In his Posthistoric Man (Boston; Beacon Press, 1957, pp. 6-8) Roderick Seidenberg in talking of organization writes, "Viewed as a purposive agency, it is a mode of procedure dealing with the systematic disposition of the parts in the functioning of the whole .... Conceived as a process, organization might be defined as the agency of attaining effective relationships; of marshaling means towards focused ends .... These are internal characteristics. Externally, in respect to the medium in which it operates, organization may be said to create a field of influence which it seeks to dominate or assimilate .... Inevitably, organization demands further organization."

cost system, moreover, does not guarantee efficiency; it only provides some information that could be used to achieve efficiency and economy. Taking corrective measures and minimizing costs are the steps to be taken by management. These final steps should be taken if the cost system is to contribute its share to the overall profitability of the firm.

A. Evaluation of the Proposed System

Having set forth a cost and control system, we will now attempt to evaluate it.

1. Built-in Simplicity. It has been noted that only one form, i.e. the Transfer Slip, has been recommended. This form is flexible enough to be used for reporting all the daily movements of materials, semi-processed, and finished goods to the accounting department. The data for debits and credits to various departments are obtained from these slips. The journal entries are made monthly on the cost journal voucher after finding the totals of transfer slips relating to each department (or more accurately, cost center) - e.g. total of materials, labor, and other charges incurred in the drying plant and the corresponding dried materials transferred out of this plant. In order to avoid mistakes and maintain orderliness, one cost voucher should be prepared for each specific type of transaction, i.e. one voucher for materials used in, say, the drying process, one for labor, one for other costs grouped under the heading of burden, and finally one for the dried materials transferred out of the process. The postings are then made to individual accounts. The details of these procedures have already been covered; the purpose of summarizing them here is to show the simplicity of the mechanism involved in the proposed system. The cost journal vouchers have dispensed with any type of bound journal for cost transfer entries

or cost flow within the firm. The frequency of postings to ledger accounts have been reduced to once a calendar month and only twelve times a year. Moreover, the cost journal vouchers are filed in special binders by months with their transfer slips that support the entries. This would facilitate any future references and verification of entries as all that is to be done is to run the transfer slips on the adding machine again.

The mechanism is so simple that even a non-accountant can be taught to handle the routine work of summarizing, journalizing, and posting the entries from the transfer slips to the cost journal vouchers and on to the ledger accounts respectively. However, the interpretative part of the system needs a skilled and trained mind. The data provided by the system must be interpreted, which, as we have seen, will provide a basis for decision making. The interpretation of the data does not make the system complex; after all the system was so designed as to provide those data for interpretation. Consequently, the interpretative work, and not the system, needs insight, judgement, and skill.

A difficulty, though not of the system, is the development of standards. The work of setting standards should be divided among those who are best qualified to do so by virtue of the positions they occupy in the firm. The cost accountant is not qualified to set all the standards; but, because he occupies a focal point toward which all cost information flow and from which the results must come, he is perhaps best qualified to present the idea of standards, lay out the plans and divide the work among those who should handle the details.

Obviously, chemical and mechanical engineers should be called upon to determine standards for consumption of materials,

supplies, power, repairs, depreciation rates and other items of like nature. It was already suggested long-term contracts with vendors would make it easy, to establish a standard price for materials, and a standard wage system must be developed for different types of jobs available in the firm.

The development of standards is not an easy task at all. Experience, technical know-how, and empirical study and research are indispensable for setting up the standard costs and specifications.

2. Installation and Operating Costs. The installation costs of the system may at first sight appear to be large in absolute terms. This is true because the standards should be developed from scratch. Engineering and cost studies are needed, which may demand a relatively large cash outlay. But a large cash outlay does not and should not frighten the management from considering the project.(92)

The cost can be easily estimated by considering the different talents - engineering, managerial, accounting, and economic - that should be employed to construct and install the system. Here the estimate has been assumed to be LL.50,000.00. The decision whether to go ahead with the project or not can be reached by the techniques developed under

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(92) The fact that it does not frighten the management is seen in its heavy investment in machinery and equipment. The digging of the deep well alone cost about LL.30,000.00, and the new addition to plant and equipment, including the 75 H.P. generator, totaled about LL.200,000.00.

"capital budgeting".[93] The annual net cash earnings of the project - i.e. expected annual gross cost savings as a result of installing the system less the annual cost of operating the system, which is mainly the salary of a cost accountant - can be estimated for computing the "marginal efficiency of capital."[94] Since the flow of expected annual net earnings, as defined here, is uniform and for an indefinite period of time, the following equation can be employed to compute the expected rate of return:

$$I = \frac{U}{r},$$

where I is the present cost outlay for the project, U is the uniform annual net cash earnings (or more accurately cost savings) for an unlimited period of time, and r is the rate of return that makes the equation true. If we assume U = LL.10,000.00 a year, r will be 0.2 or 20%, which, so far as the judgement of the writer permits, would compare favourably with alternative opportunities for investment.[95]

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(93) It is the opinion of the writer that some capital expenditures such as the construction and installation of a cost and control system have such obvious benefits that do not require an elaborate analysis of finding an expected rate of retun on the investment.

(94) Defined as the "ratio of the expected retun on an investment over its useful life to its present cost. Or it may be expressed as the expected future returns on a particular investment discounted by that rate which will yield its present cost." Taken from Richard M. Alt & William C. Bradford, Business Economics, Principles and Cases, p. 434.

(95) It should be remembered that the current cost of obtaining funds from the Agricultural, Industrial, and Real Estate Bank is 5½% per annum. The cost of obtaining funds therefore is far below the assumed rate of return.

The simplicity of the system is by itself an important factor in low operating cost of the system. Anybody with a fair knowledge of book-keeping can be hired, perhaps for a monthly emolument of LL.500.00, to handle the routime of classifying and recording the information flowing daily to the accounting department. For the interpretative part of the system, the services of a professional accounting firm can be engaged whenever management decides on the necessity of further interpretation and analysis. Any accounting firm would be glad to render such services, particularly if the services are required at regular intervals, against a relatively small fee.

It is seen that the operating cost is quite low.(96) The capital expenditure required to set up the system can, in the opinion of the writer, be justified along the lines presented above.

3. Managerial Uses. The uses of the proposed system to management have been emphasized throughout this paper. The major point of emphasis has been the control of costs. In Chapter III the statement was made that a cost system should be more concerned with setting proper guards at all the points where costs enter than with guarding only the door through which the finished products pass out of the plant in the form of finished goods.

The cost flow chart in Chapter IV showed that costs are incurred in the processes of manufacture and service

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(96) If we assume the firm's monthly cash outlay for wages is LL.15,000.00, which probably is the case in view of about 50 workers presently employed, the hiring of an accountant will increase the total monthly wages paid by only 3.3%.

departments. In other words, it is these cost centers that "spend the money".(97) Their cost accounts, as developed in Chapter IV give management information as to how much money was spent and where. Through the proposed system, management can judge whether the expenditures were justified in view of the results achieved. These cost centers are the points where costs enter the production processes.

To increase the effectiveness of control over costs, the designed system provides monthly reports to enable management to detect the avoidable excesses in time to be brought under control before the wastage becomes very great. Enough has been said about control and so it is fitting to bring the notes on control to an end here.

It was also pointed out in Chapter III that cost data flowing from the system can be used in reaching pricing decisions. To elaborate the question further, we shall attack the problem by saying that cost does play a role in all pricing decisions. Even under perfect competition, the prevailing price is based on someone's idea of costs somewhere in the industry. It is also an unarguable fact that perfect competition does not and cannot exist in real life because of ever existing imperfections and the omnipresence of transportation, which the perfect competition theory assumes away. These arguments imply that the demand curves facing the firm in question are not horizontal, though they may be highly elastic because of close substitute competition. The degree of elasticity of the demand curves facing the firm for the various types of products manufactured can be reduced, as has already been indicated, by differentiating the various products

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(97) C.F. Schlatter and W.J. Schlatter, op. cit., p. 59.

manufactured (oil No. 1, No. 2, etc.) artificially (i.e. using a special trade mark), and advertising heavily for them. Advertising will do one or both of the follwoing: 1) shift the demand curves to the right, and 2) make the demand curves less elastic. The latter will give management greater latitude to manipulate prices.

To return to the statement that cost plays a role in pricing decisions, economic theory dictates that price is determined by the intersection of demand and supply curves. But for a firm including the firm in question, the supply curve is the marginal cost curve itself which at the point of intersection with the marginal revenue curve will signal the level of output and the price of the product.

But the question is whether the system proposed does provide the kind of information discussed above. Obviously not. Management would hardly be interested in a system that gives marginal cost information only, since it is neither very necessary nor easy to design and operate. Marginal cost is a short-term, static quantum and hence is extremely difficult, if not impossible, to isolate. Therefore, the marginal cost data are not provided by the proposed system. "In general, the cost information needed for pricing is distinctly different from that required for income-determination or for internal management control."(98)

But there are specific situations in which cost data from the proposed system can be used for pricing decision.

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(98) Richard M. Alt and William C. Bradford, op. cit., p. 147.

The incremental or differential costs are important for determining what price to accept or charge for a special order.(99) Before arguing further, let us illustrate the use of differential costs in pricing decisions. Suppose an order for 1000 units of refined oil is received from a wholesaler in Jordan offering a unit price 30% below the selling price prevailing in Lebanon. Should we accept the order? Here what is needed is clearly differential costs, which will be obtained from the standard costs developed. For any type of pricing decisions, actual costs are irrelevant for a number of reasons: 1) Actual costs are not necessarily the costs of production; as we have seen, all the costs actually incurred in a period are not chargeable to production because they were due to inefficiency and waste. 2) "Future costs, not current or past costs, are relevant for most price policy decisions."(100) "The businessman is interested in the costs which will be incurred, those which lie ahead ... not those which have already been incurred, those to which the business is already committed."(101) Standard costs, therefore, are in a strategic position to be used for making a pricing decision like the above. But the next question is: if the standard costs are to be used, which are predetermined and hence independent of the system, therefore the standard costs, and not the system, are useful in reaching some pricing decisions. However, this argument is not entirely true. Standard costs are

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(99) Incremental and differential have been used interchangeably.

(100) Joel Dean, "Cost Forecasting and Price Policy." Journal of Marketing, Vol.XIII, January 1949, p. 279, quoted Ibid.

(101) Malcolm P. McNair and Richard S. Merian, Problems in Business Economics, p. 167.

not entirely independent of the cost system, but can be thought to be actual (future) costs adjusted for those costs that are not necessary for production. Standard costs therefore will change whenever the underlying facts change. Moreover, the development of standards needs time and hence a system to collect and classify the costs.[102] If in a given year there are too many variations (debit and/or credit) from the standards, suspicion may be aroused as to the propriety and accuracy of the standards themselves. The system, therefore, would help management in its pricing decisions by providing cost figures that are most accurate under the circumstances. Adjusted and reliable standard costs are, therefore, a by-product of the proposed system. Besides, as it was pointed above, the development of correct standard costs takes time and their deterioration is usually signaled by the system.[103] The cost system, therefore, is necessary for 2 reasons: 1) to provide and accumulate sufficient data of actual costs to serve as a basis for the development of standards, and 2) to adjust the standard costs whenever management fails to discover a change in the factors underlying the standards, or wherever such changes have been gradual and become significant only after the lapse of a few years.

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(102) The proposed system collects actual costs on the debit side of accounts and emits standard costs from the credit side. The variations in the first few years of operation may not be taken so seriously but utilize the actual costs for the correction and improvement of standards.

(103) One concern, the Drybak Corporation in the U.S., developed its standard cost system over a period of 14 years. Source: Richard M. Alt and William C. Bradford, op. cit., p. 179.

The standard costs can also be used in determining the contribution profit (total revenue - total standard variable cost) of each product. This will help management to find an objective measure of desirability of any one of the products by computing the contribution of each product to the recovery of fixed costs and profits. The analysis will be particularly useful in the case of oil after extraction, after pre-refinery, after refinery, and after demargarinization (called oil N_o.1, 2, 3, and 4 respectively in this paper). The information can be obtained by rearranging the ordinary income statement thus:

FIRM UNDER STUDY

Contribution to Fixed Costs and Profits of Products for the Month of ___, 19__.

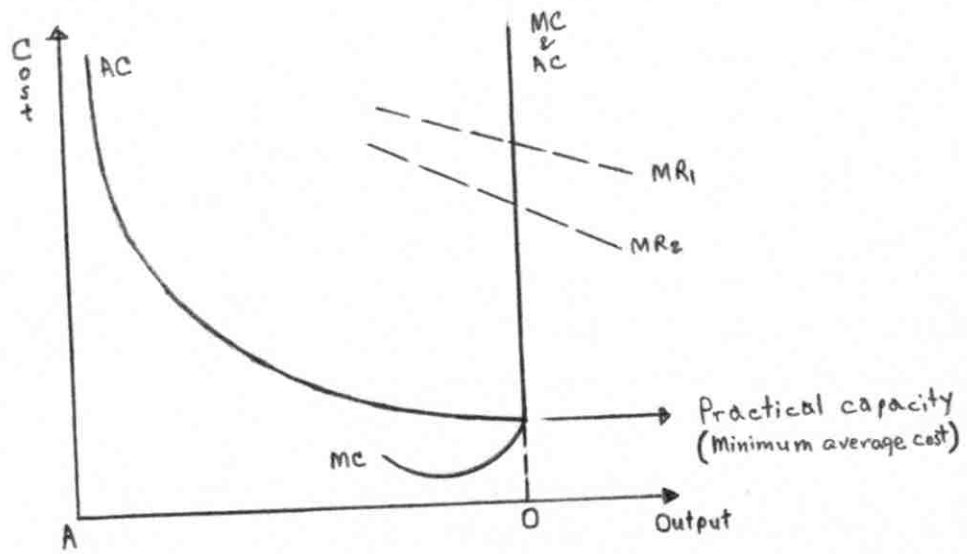
	Oil No.1	Oil No.2	Oil No.3	Oil No.4	Total
Sales	LL 100	LL 50	LL 100	LL 200	LL 450
Standard Variable Manufacturing Costs	LL 30	LL 35	LL 45	LL 50	LL 160
Variable Distribution Costs	10	10	15	20	55
Total Variable Costs	LL 40	LL 45	LL 60	LL 70	LL 215
Contribution to Fixed Costs and Profits..	LL 60	LL 5	LL 40	LL 130	LL 235

Note: Figures are assumed and have no relationship with those presented before.

4. Economic Consistency. It is recalled that in preparing burden budgets for the computation of standard burden, practical capacity, as defined and elaborated in Chapter IV, was chosen as the basis for the application of burden to production. Practical capacity, as was implied, is the point where the average full cost in a process, say drying, is minimum. We are thus implicitly telling management to operate the plant at practical capacity where the average cost is lowest. But, on the other hand, economic theory dictates that the plant should continue producing until marginal cost is equated with marginal revenue. This point may well fall after the minimum point of the average cost curve resulting in credit balances (variations) in the process accounts. It is also possible that the economic point of profit-maximization may fall before the minimum average-cost point, which would result in debit balances in the process accounts. This latter case has already been discussed in Chapter IV. It was concluded that the appearance of debit balances (in the form of idle-time loss) may be due to lack of sufficient sales (demand), in which case management should explore ways of shifting the demand curve facing the firm so as to utilize the available capacity of the plant. Under these conditions, we are, therefore, telling management one thing, namely, to try to shift output, if other economic considerations permit, to the level of practical capacity where the average unit cost is minimum.

But what about the case where the profit-maximization point falls beyond the minimum point of the average cost curve, resulting in credit balances in the process accounts? Would we thus not be contradicting the principle of economic theory? We certainly would if we do not carefully define the meaning of practical capacity. It has been implied that practical capacity is a point where maximum activity can take place

given the capability of the available equipment and machinery, and beyond which marginal and hence average cost would rise sharply. The marginal and average cost curves have been assumed to demonstrate the following behavior:



It is seen that output should be at point O within both the proposed system, because average unit cost is at its lowest, and the economic theory, because regardless of the slope of the marginal revenue curve (MR_1, MR_2, etc.) the profit-maximization point (i.e. intersection of marginal revenue and marginal cost curves) will indicate an output of AO. There is, therefore, perfect agreement between the system proposed and economic theory, and by telling management to operate at practical capacity, we are also implying the point where profits are maximized.

B. Concluding Remarks

We have presented one of the many problems, with occasional reference to others, facing the firm under study.

It has been concluded that the existence of such problems in the firm and the fact that they are ignored and neglected give rise to a bad business weather. The real cause of the prevailing bad weather in the firm, therefore, can be traced to the mentality and attitude of the people who manage, guide, and lead the affairs of the business. The human element indeed cannot be isolated from a discussion of the type conducted in this paper.

Some remarks have already been made on the attitude of the owner-managers of the firm. In the opinion of the writer, a feeling of secrecy, suspicion and fear of change, uncertainty, and perhaps ignorance prevails in the firm. Management rejoices at having chosen a far-off locality in Lebanon, where there are no intruders, governmental and otherwise, to interfere into the running of the business. Also, management seems to have no faith in the benefits that might accrue to the firm from introducing the techniques developed in the West under the broad title of "Business Administration". Moreover, management seems to have been caught amidst a new and sudden expansion and hence does not quite understand what to do. All these are symptoms of a bad and inefficient management that does not anticipate the problems but waits until they occur and then starts thinking what to do.

Obviously, what is needed is Taylor's "mental revolution". A vigorous shake-up and reform in the management's thinking is an important pre-requisite and a basic foundation to any significant improvement in the firm's business weather. Management must be convinced of the importance of any new measure to be adopted before the benefits of the new ideas can be harvested.

It has been emphasized throughout the paper that a cost and control system is one of the many measures management

should take in order to improve the business weather of the firm. A brief list of these measures were given in the conclusions to Chapter III. However, this list is in broad terms and it is certain that many more detailed and specific situations demanding improvement would arise upon further study and research in the firm.

However, it was indicated in Chapter I, and supported with evidence, that the business weather of any firm would never be in perfection or equilibrium, but would always need prediction and manipulation. In other words, the drive for efficiency, however it might be defined, is an unending process. It is the hope of the writer to have demonstrated this fact to management by tackling only one facet of the many problems facing the firm. It is, therefore, fitting to bring these observations to a close at this point.

APPENDIX I

NUMBER OF REPAIRMEN

In an effort to minimize costs, the number of workmen in the firm should be optimized. The optimum number of workers in some plants, like drying, extraction etc., can be determined by trial and error, and, moreover, the cost of having one more or less worker in any of the producing plants is insignificant. Besides, the possibility of hiring a worker in the village on demand simplifies the problem of adjusting the number of workers to as many as desired in any one day, and hence there is no need to undertake a formal study to find the optimum number of workers in each of the processes because of the cost involved and also because of the reason stated above.

However, the preceding explanation hardly applies to a service department like the repair shop for various reasons: 1) It is not easy, as is the case with the producing departments, to find qualified repairmen in the village; 2) The repairmen's wages, by virtue of their skill and proficiency, are relatively high; and 3) The cost of having a breakdown and hence a halt in production is also not easy for an efficiency-minded management to tolerate. It is, therefore, logical to spend some time thinking about this problem, which in simple terms, is one of having as few repairmen as possible and at the same time minimizing losses arising from machine breakdowns. Following is a simple, objective, practical, and inexpensive method of solving the problem. Because no data are available at present, all figures have been assumed, but this does not impair the logical consistency of the solution.

The firm has about 30 machines and the cost of one machine's being out of work for one hour is assumed to be LL.30.00. Repairmen are assumed to be paid LL.40.00 per day of 24 hours. The following observation is assumed to have been made:

Breakdowns per day (x)	No. of days (f)	(fx)
0	99	0
1	70	70
2	24	48
3	6	18
4	1	4
	200	140
	Σ(f)	Σ(fx)

The form of the distribution fits into what in the statistical jargon is known as the Poisson distribution. The mean, represented by the letter Z, can be computed as follows:

$$Z = \frac{\Sigma(fx)}{\Sigma(f)} = \frac{140}{200} = 0.7$$

The probabilities of having 0, 1, 2, 3, or 4 breakdowns per day can be computed by fitting the data into the Poisson formula, which is

$$P = E^{-z}\left(1+Z+\frac{Z^2}{2!}+\frac{Z^3}{3!}+\frac{Z^4}{4!}+\ldots\frac{Z^n}{n!}\right),$$

where P stands for probability, E is a constant value of 2.7183, and Z is the mean calculated above. The value of E^{-z} is found in the Poisson Distribution Table, and is equal to 0.4966. The probabilities can be computed by multiplying the constant of 0.4966 by 1 to get the probability of having zero breakdown, by 0.7 to get the probability of having 1 breakdown, and so on. The usefulness of the equation is that the data can be extrapolated to get the probability of having 5, 6, or n breakdowns. The probabilities of our observations have been rounded for the sake of simplicity and presented below:

Breakdowns per day	No. of days	Probability
0	99	0.495
1	70	0.350
2	24	0.120
3	6	0.030
4	1	0.005
	200	1.000

On the average, one machine breaks down every 1.429 days (1÷0.7 = 1.429).

Since one consideration in this decision problem is the cost of having machines out of operation we need some information about the length of time it takes to restore a machine to operation. Assume that similar computations have produced the following results concerning the repair hours.

Hours to Repair	Probability
1	0.021
2	0.051
3	0.099
4	0.143
5	0.165
6	0.160
7	0.132
8	0.096
9	0.062
10	0.036
11	0.019
12	0.009
13	0.004
14	0.002
15	0.001
	1.000

Mean = 1(0.021) + 2(0.051) + 3(0.099) + 4(0.143) + 5(0.165) + 6(0.160) + 7(0.132) + 8(0.096) + 9(0.062) + 10(0.036) + 11(0.019) +12(0.009) +13(0.004) +14(0.002) + 15(0.001) = 5.80

It might appear that there is no decision problem at all, because on the average a machine will break down every 1.429 days and it will take a repairman, on the average, 5.8 hours to fix it. Therefore, one repairman working 4 hours a day can handle all the necessary repairs. But this conclusion is not correct, because granted that it takes 5.8 hours to repair a machine, what about the times when he is occupied on other machines and a new breakdown occurs. During this time, LL.30.00 per hour is lost as well as the actual repair time. It is this cost which we want to investigate. A special theory called the waiting-line, or queuing, theory has been developed for such purposes. Here, we shall use a statistical method called the Monte Carlo technique for the solution of the problem. The idea behind Monte Carlo is to use random sampling to construct a simulated version of the process under study. By this technique, blocks of three-digit numbers are assigned to the different possibilities in proportion to their probabilities. In order to do this, we have to change the machine breakdown data into an hourly basis to match the repair-time data. This is done by a mathematical transformation of the data, the result of which is shown here only:

Breakdowns per hour	Probability
0	0.916
1	0.080
2	0.004
	1.000

Now we can assign three-digit numbers to each of the above three possibilities in accordance with the given probabilities, and similarly for the repair times:

Breakdowns per hour	Probability	Nos. Assigned	Repair Times	Probability	Nos. Assigned
0	0.916	000-915	1	0.021	000-020
1	0.080	916-995	2	0.051	021-071
2	0.004	996-999	3	0.099	072-170
			4	0.143	171-313
			5	0.165	314-478
			6	0.160	479-638
			7	0.132	639-770
			8	0.096	771-866
			9	0.062	867-928
			10	0.036	929-964
			11	0.019	965-983
			12	0.009	984-992
			13	0.004	993-996
			14	0.002	997-998
			15	0.001	999

We have assigned 1000 three digit numbers. For example 80 of them (916-995) will represent one breakdown in an hour.+ Now we use a table of random numbers to obtain a sample of the behavior of our system. The first random number chosen is 573 and since this falls between 000 and 915 it means that there was no machine breakdown during the first hour. The second number is 608, again no breakdown. We keep on choosing numbers until the ninth number which is 919, meaning that a breakdown occured in this hour. Proceeding similarly, a sample of 800 hours or 33.33 days (800/24 = 33.33) is chosen. Now we have to determine the repair times by the same procedure. The first number chosen is 257, which falls between 171 and 313 designating a repair time of 4 hours. This is the repair time for the first breakdown. Our data are recorded in the following table:

+ This is a probability of 80/1000 = 0.080.

Breakdown Number (i)	Breakdown Hour (Bi)	Repair Time (Ri)
1	9	4
2	26	4
3	35	4
4	59	2
5	62	6
6	75	8
7	94	6
8	104	3
9	110	4
10	111	6
11	111	7
12	135	6
13	153	8
14	156	2
15	157	5
16	171	1
17	173	5
18	187	4
19	189	8
20	223	9
..	...	.
..	...	.
..	...	.
69	763	9
70	764	10
71	796	13

Let us assume Bi to designate the hour at which the ith breakdown occured and Ri to designate the hours required for the repair of the ith breakdown, and finally Ti to designate the hour at which the repair of the ith breakdown was finished. We can, therefore, conclude Ti = Bi + Ri. This simply means that the termination hour of the ith repair is equal to the hour at which the breakdown occured plus the total hours spent on repairing. Now if the ith breakdown occurred during the time that the breakdown prior to i or (i-1) was still in process, the equation must be written thus: $T_i = T_{(i-1)} + R_i$. Here we assume $Bi < T_{(i-1)}$ or the hour the ith breakdown happened is before the termination hour of the (i-1)st breakdown. In the equation Ti = Bi + Ri we assume $Bi \geqslant T_{(i-1)}$ or the occurence hour of the ith breakdown is coincident with or after the termination hour of the preceding breakdown. We can compute Ti for our sample:

Breakdown Hour (Bi)	Termination Hour (Ti)
9	13
26	30
35	39
59	61
62	68
75	83
94	100
104	107
110	114
111	120
111	127
135	141
153	161
156	163
157	168
171	172
173	178
187	191
189	199
223	232
...	...
...	...
...	...
763	772
764	782
796	809

(For example Ti = Bi + Ri = 9 + 4 = 13; Ti = $T_{(i-1)}$ + Ri = 114 + 6 = 120 etc.)

Whenever Bi $<$ $T_{(i-1)}$, or whenever the breakdown on a machine occurs while the repairman is still occupied on another machine breakdown, or mathmetically speaking, whenever $T_{(i-1)}$ - Bi is positive, we shall have a waiting time. We can find the positive values of $T_{(i-1)}$ - Bi, which are as follows:

Breakdown Hour (Bi)	Waiting Time ($T_{(i-1)}$ - Bi)
111	3
111	9
156	5
157	6
189	2
...	.
...	..
...	.
764	8
Total waiting hours (Assuming one repairman)	202

The computation is like this:

$$T_{(i-1)} - Bi = 114 - 111 = 3$$
$$\text{and} \qquad 120 - 111 = 9 \text{ etc.}$$

There were 202/33.33 = 6.06 hours waiting time for each of the 33.33 days represented by the sample. At the stated cost of LL.30.00 per hour for a machine out of operation this amounts to 30 x 6.06 = 181.80 loss due to waiting time. An additional repairman costs LL.40.00 a day, we should investigate the possibility of hiring another man. In case we hire two repairmen, if $Bi < T_{(i-1)}$ and $Bi < T_{(i-2)}$, a breakdown must wait for a repairman. This means that if a breakdown occurs while the two men are occupied on the two previous breakdowns, the machine should wait. From the same data, a table showing the new Ti can be constructed and the waiting-time, shown below, can be computed:

Breakdown	Waiting Time
111	3
157	1
226	2
318	1
436	1
509	2
538	1
	11

For example when the 11th breakdown occurs at 111th hour, both repairmen would be occupied on the 10th and 9th breakdowns, and the 9th breakdown would be the one to finish at 114th hours, therefore there is a waiting time of 3 hours, etc.

The total waiting hours of 11 represent an average waiting time of 0.33 hours per day (11/33.33 = 0.33). At LL.30.00 per hour this is LL.9.90 per day. The additional repairman has decreased the average daily waiting time cost by 181.80 - 9.90 = 171.90. This saving has been achieved at the cost of the additional man's salary so that the net saving is 171.90 - 40.00 = LL.131.90. Therefore the additional man should be employed, and the total number of repairman should be two in the repair shop.

NOTE: The case is heavily based on David W. Miller and Martin K. Starr, Executive Decisions and Operations Research, pp. 270 - 280.

APPENDIX II

FIXITY OF OIL-TO-SOAP RATIO+

The world's annual oil production of one million tons is extracted from the fruits of the Olea Europea Culta - family Oleaceae.

The fruits are usually crushed with the seeds and then exposed to pressure in special containers thus yielding from 40% to 60% oil by weight. The oil is then diverted into special centrifuges where it is seperated from the water and other impurities. The resulting oil is mainly olien (84.2%) with palmitin and stearin along with oleic acid (C_{17} H_{33} COOH), stearic acid ($C_{17}H_{35}$ COOH) and palmitic acid (C_{15} H_{31} COOH). Thus the main problem encountered in the refining of olive oil is to remove the acids and mainly the oleic acid.

In general there are three methods for getting rid of the acids:

1) Esterification
2) Removal of acids by fractional distillation.
3) Saponification

Esterification is the transformation of the acids into esters and thus oil, while fractional distillation involves the use of sensitive fractionating towers to remove oil from acids as the two products have different boiling points. These two methods are not involved here as the third method i.e. saponification, is utilized in the firm under study.

+ For the compilation of the chemical data in this Appendix the writer is indebted to Mr. Ramiz H. Sadakah, graduate of the School of Agriculture, American University of Beirut, Beirut, Lebanon.

Saponification is the removal of acids, mainly oleic acid by turning it into metallic oleates (sodium or potassium) or soaps thus

$$\underset{\text{Oleic acid}}{C_{17}H_{33}COOH} + \underset{\text{Sodium hydroxide}}{NaOH} \longrightarrow \underset{\text{Soap (or Pate)}}{C_{17}H_{33}COONa} + \underset{\text{Water}}{H_2O}$$

The same follows with regards to the other acids. Usually the weight loss of refined oil is 2.5 times the amount of acids it originally contains. The chemical reaction as shown by the preceding formulae has an inherent fixity in the sense that a certain amount of soap is always formed and the remaining oil flows out.

The process is very sensitive and the addition of excess base such as NaOH will react with the oil itself producing more soap and glycerols thus:

$$\underset{\text{Triolein}}{\begin{array}{l} C_{17}H_{35}COO-\underset{H}{\overset{H}{C}}-H \\ C_{17}H_{35}COO-\underset{|}{C}-H \\ C_{17}H_{35}COO-\underset{H}{\overset{|}{C}}-H \end{array}} + 3NaOH \longrightarrow \underset{\text{Sodium Oleate or Pate}}{3C_{17}H_{35}COONa} + \underset{\text{Glycerol}}{C_3H_5(OH)_3}$$

Glycerols obtained from soap-making may be added to low quality, high-acid-content oil producing esters (oil) thus:

$$\underset{\text{Glycerol}}{\begin{array}{l} H-\overset{H}{C}-OH \\ H-\underset{|}{C}-OH \\ H-\underset{H}{\overset{|}{C}}-OH \end{array}} + \underset{\text{Oleic acid}}{\begin{array}{l} HOOC\,C_{17}H_{33} \\ HOOC\,C_{17}H_{33} \\ HOOC\,C_{17}H_{33} \end{array}} \longrightarrow \underset{\text{Olein (ester)}}{\begin{array}{l} H-\overset{H}{C}-O-\overset{O}{\overset{\|}{C}}-C_{17}H_{33} \\ H-\underset{|}{C}-O-\overset{O}{\overset{\|}{C}}-C_{17}H_{33} \\ H-\underset{H}{\overset{|}{C}}-O-\overset{O}{\overset{\|}{C}}-C_{17}H_{33} \end{array}} + \underset{\text{Water}}{3H_2O}$$

It is seen that the basic fixity between oil and soap does not change. The addition of excess base only destroys the oil that should be retained. However, as was noticed in the above formulae, the glycerols obtained are reconvertible into oil again. The point to emphasize is that the fixed relationship between

the units of soap and those of oil obtainable from a given unit of unrefined oil does not change by merely destroying one of the resulting joint products. Besides, it is certainly an unsound decision to add the relatively expensive base to obtain soap at the sacrifice of a more profitable product, namely oil.

Since the main purpose is to remove the acids only no excess base should be used. It is advisable that a competent chemist be employed to supervise the reactions. It must be pointed out that the ignorance of the delicate chemical processes has led, in the plant under study, to the production of at least 30 tons of red oil which is useless as a table oil and can be used only for soap making.

NOTE: The material in this Appendix has been heavily taken from:

Charles T. Kingzett, Chemical Encyclopedia; and
Dr. Adib Sarkis, Department of Chemistry, American University of Beirut, Beirut, Lebanon.

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