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Expert group meeting on pre-investment considerations and technical and economic production criteria in the oilseed processing industry
Vienna, Austria, 16 - 20 October 1972

SUMMARY

PRE-INVESTMENT CONSIDERATIONS AND APPROPRIATE INDUSTRIAL PLANNING IN THE VEGETABLE OIL INDUSTRY 1/

by
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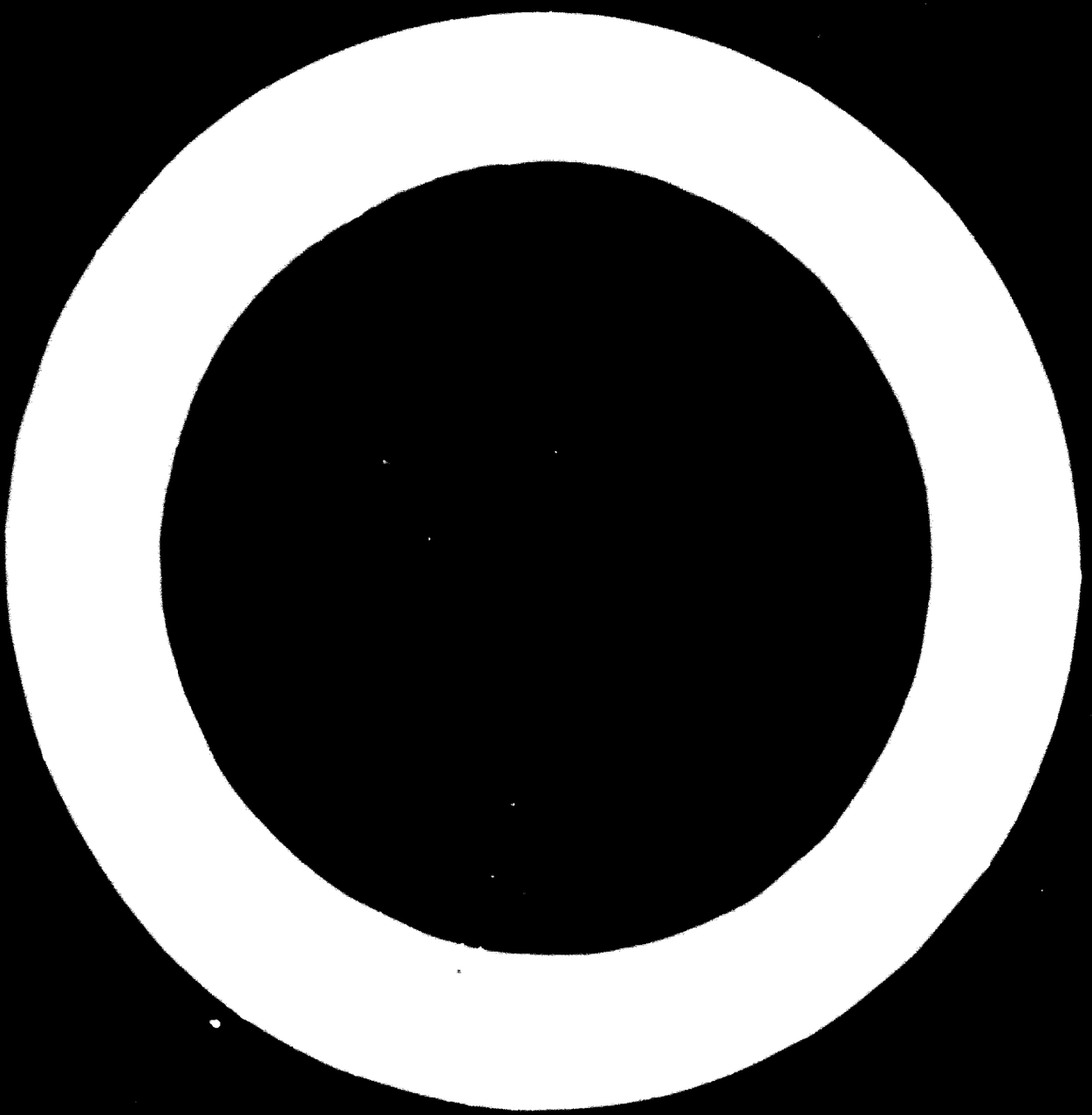

PREFACE

The aim of [illegible] considerations in the vegetable oil industry, is [illegible] to outline the conditions which basically influence an investment in that field. The study hopes to facilitate the decision-making and planning which precede the investment itself: and should help the prospective investor to avoid errors of planning too large or too small a plant and in estimating market capacities and calculating financial needs. A preliminary idea is given on how to proceed in purchasing the appropriate machinery, and be able to judge the relative importance of factors necessary to process.

First, we examine some oil plants in order to gain fundamental knowledge about their growing conditions, the chemical composition of the oil produced, and the possibilities for using their main by-product: meal. With the exception of the oil palm and the coco, which need absolutely tropical climates, oil plants can be grown at latitudes of about 40 to 50 on both sides of the equator - an area comprising much more than half of the surface of the earth. Adverse climatic conditions can be overcome with irrigation; and the plants themselves can be adapted by means of modern genetics to different temperatures, humidities, soils and periods of daily insolation. Thus, the range of the existing oil plant family can be extended with other types of planned seeds, on that portion of the earth.

The second decisive element for a factory, which we review, is the market. Procedure is outlined on effective market research. No exact data is needed on the market; approximate figures suffice for making decisions concerning the plant. The new factory itself will influence the market.

Recent [illegible] of being a new factory [illegible], was presented. The home market is stable, predictable, and can be manipulated; the export market fluctuates and is influenced by factors completely beyond the control of the local manufacturer. Whereas the domestic market allows for working with low stocks on oil and meal, for export purposes one must maintain a large storage capacity in order to be able to profit from chance opportunities.

I did not dwell on the domestic meal market; rather, I outlined the differences in the manner of producing animal feed and vegetable oil. If a local animal-feed manufacturer already exists, the meal should be sold to him, and only the amount which cannot be consumed locally should be destined for export. The same problems accompany the exporting of meal as those of oil-exporting; and meal-exporting should be attempted only if it cannot be avoided without disadvantage.

The other by-product of oil-producing is soapstock. The best policy is to use the soapstock for soap-making and to distribute the soap, since distribution of both oil and soap can be organized through the same channels.

Manufacturing costs are discussed in some detail; the corresponding electricity, steam, water and manpower needs are listed, and figures supplied for orientation. I have continuously emphasized that production costs have not as significant a bearing on the final price of oil, as does the attainment of a high yield on a product of good quality. Production expenses are not more than about 6-7% of sales volume, and it would be difficult to save even a

thirds of such expenses; while an improperly functioning plant might easily lose 1% of the oil in crushing and solvent-extraction, and another 1 or 2% in neutralization, bleaching and deodorizing.

Financing a vegetable oil factory requires substantial funds, because the seed must be purchased and paid for within a month's time, but earnings are delayed because the oil will be produced and sold over the space of a whole year. At the same time, six to eight weeks' sales volume must be stored; and customers do not pay in cash but usually on 60 to 90 day terms. It would not be commercially sound to tie up such a large sum; a wise and efficacious procedure therefore is to request financial aid from a bank, in the form of a loan. The extent of loans is discussed; and it is calculated that a company's own capital should amount to about 40% of the yearly sales volume.

Joint venture possibilities with other oil factories, with marketing and distributing companies, with governments and with constructors, are investigated and the conditions defined which must be fulfilled if the venture is to function successfully. The best scheme in a developing country is to have a big - possibly majority - shareholder initiate and manage the company, with the government as well as a large number of seed-producers also holding shares.

The plant site; the type machinery to be utilized; the procedure for requesting quotations on the machinery; the evaluation of tenders - these are the topics analyzed in the subsequent chapter. Whether exporting is contemplated, and if so, the proportion of export to local market capacities,

will determine the plant site. Experience has shown that the most desirable location for crude oil production is where the meal will be used. Refining can be carried on together with crude oil production, but can also be near to the most important consumption centers. The size of the plant will depend on the results of market research. Three tenders - for 70%, 100% and 150% of the calculated plant size - must be solicited from three different constructors.

Neutralization can be batch-type at the beginning of operations; switching to continuously working centrifuges can be effected at a later date. Bleaching is always batch-type, but employs closed presses. Deodorizing must invariably be continuous. Hydrogenation is always batch-wise, and the hydrogen may be produced by electrolysis of water, or cracking natural gas.

The whole plant, with the exception of margarine production, must work a 24-hour day from the beginning. The plant manager should be hired at the latest by the date of the ordering of the plant, since he will have a great deal of preparatory work prior to the arrival of the machinery. Usually, 20 to 22 months must elapse between the ordering of equipment and the plant's getting on stream.

Finally, as the result of the foregoing preliminary work, steps in the preparation of the feasibility study are outlined. First, statistical data concerning the market must be verified; and with it, a projection of production and sales is prepared for the first five year period, by extrapolation. Special attention is given to the initial stage of operations. The meaning of break-even

point and marginal costs is clarified: knowledge of those production levels is important in taking business decisions. Calculated and uncalculated risks are explained. Lastly, the necessity of preparing cash-flow charts for the initial period and the first year, is pointed out, because this establishes the amount of the working capital. The cash-flow chart, profit and loss preview, and pro forma opening balance will be used to set up the estimated general balance sheet for the first years of operation.

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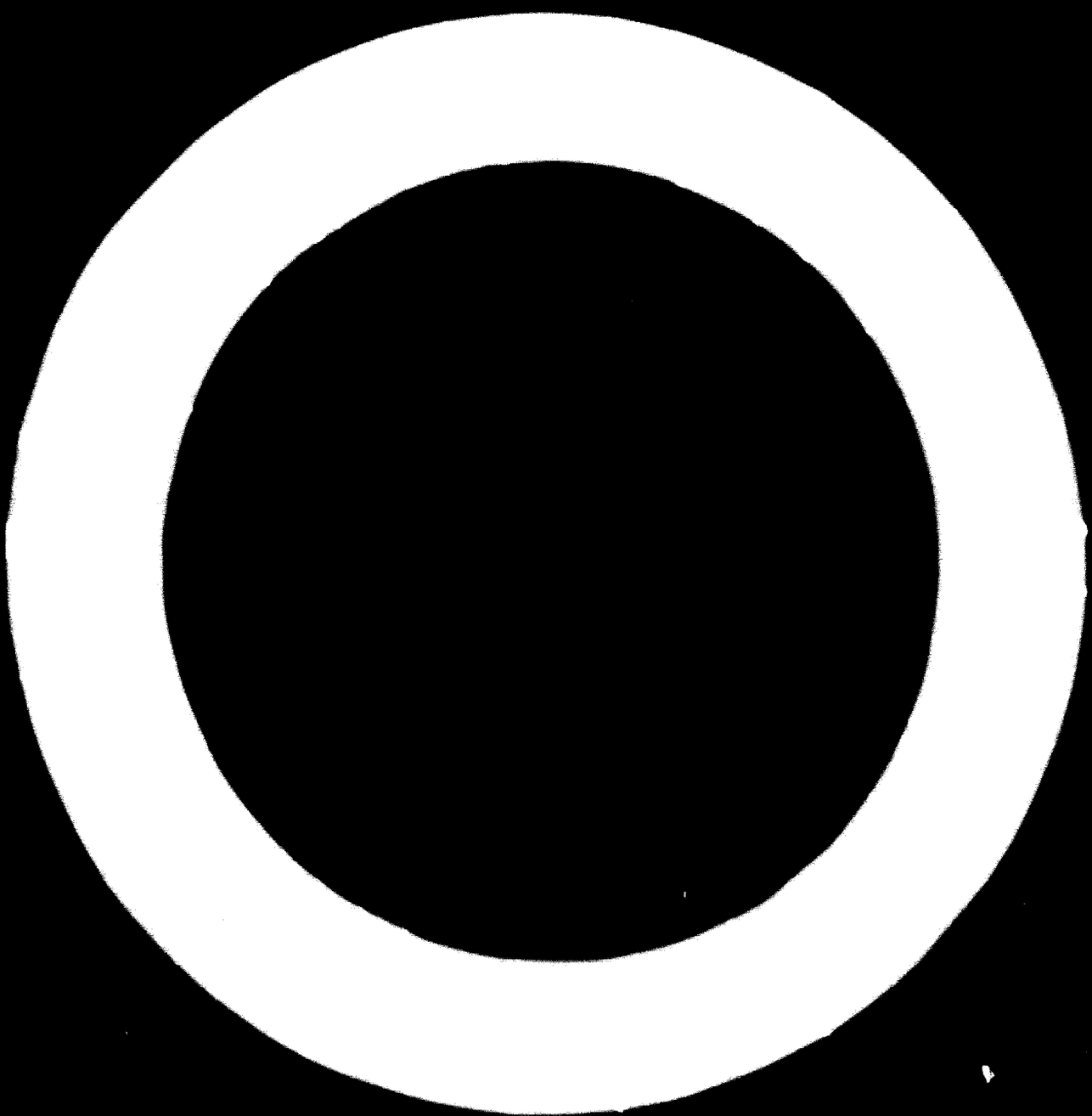

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CHAPTER I

INTRODUCTION

The perceptive industrialist, even after only brief activity, acquires the awareness that under the manifold rules and laws of commerce and the enormous complexities of technology, lies a truth common to all branches of business: a successful enterprise, reduced to its simplest metaphor, is like a well-constructed house. Both are set on firm foundations. A fine house will be of durable materials rising on a strong framework, erected along well-designed lines, and finished with tasteful touches; so will a sound industrial enterprise be laid upon solid cornerstones and built along the elemental lines of established, sound principles, business acumen, and discernment. The essentials, based on tried and true formulas, are the point of departure; what management contributes in individual capability and methods applied as innovations and improvements, is superstructure. Carrying the analogy through its graduated stages onto the finer points, the industrialist realizes that once the foundation is firm, the ensuing steps, refinements and "last touches" become more an more a matter of personal choice and decision. While such choices, too - aside from the exigencies of circumstance - depend upon a groundwork of education, experience and plain common sense, without the support of a stable foundation, they lack substance: they have no realistic place of application, no validity, no ultimate usefulness.

This study attempts to illustrate what, in the vegetable oil industry, constitutes that firm foundation; it also offers guidelines for the task of "seeing things through" after the important foundation has been laid.

For any projected industrial operation, the initial requisite is of course raw material. Before undertaking a new industrial venture, one must be certain that raw material is available in sufficient quantities and at satisfactory prices. Next, the market must be surveyed in order to ascertain need for the product, become familiar with selling methods and techniques, know the consumption-levels and limits, and learn prevailing prices. After the preliminary data has been collected, the know-how must be obtained for manufacturing the product in the required amount and quality; financial needs for production must be determined; bids must be solicited for the plants; and finally, a forecast prepared of estimated financial success during the first several years of operation.

The purpose of this study is to present methods of obtaining the required knowledge prior to establishing a vegetable oil factory, as well as to point out subjects which must be considered in order to avoid pitfalls and errors. Geographical, economical, sociological and technical conditions vary greatly from country to country. It is well-nigh impossible to proffer a single formula applicable in all countries which contemplate establishing a new vegetable oil industry. However, I have given here some general recommendations on what to do and what to avoid, and have outlined the process of planning a new investment in that field. Special circumstances may arise, of course, in which the manager of a new company will reach conclusions other than those cited in this paper; even so, examining the suggestions offered here would be of value. Few studies of this or any other kind make the immodest claim of being definitive or exhaustive; nor does this paper pretend to be the absolute last word. It does hope to serve the function of an informative and useful guide.

Vegetable oil is a product of prime necessity, and the smooth functioning of this industry is of considerable importance to public welfare. Governments safeguarding public weal should ensure, on one side, that national resources of agricultural products be used in advantageous and beneficial ways; and on the other side, that nourishment necessary to the consumer be available in products of good quality and at reasonable prices. Therefore government authorities, especially those in developing countries, are watchful that the new industries producing vegetable oil be conceived on sound bases; allowing the industrialist a fair profit margin and offering him assistance in developing his industry; paying for the help he receives from financial institutions and recompensing his own initial work and risk-taking; and at the same time, protecting the public interest. The present study may also offer helpful ideas to such authorities, who may not possess expertise on all the pertinent levels. It well may be that for experts in the field, the study will not afford many new facts nor any unique information; nevertheless, a new point of view may often contain a revelation, or, hopefully, show a new facet of a familiar fact, thus proving of value.

This paper was prepared for discussion at a symposium organized by UNIDO, which is frequently asked to send experts from many countries throughout the world to assist local authorities or investors in decision-making on new industries. I sincerely trust that my study on pre-investment considerations in the planning of a new vegetable oil industry, together with the other papers presented at the Symposium, will be of aid in the work of these experts as they evaluate and adapt to successful practice the facts gathered in the countries of their activity.

CHAPTER II

THE RAW MATERIAL: OILSEED

1. The fat consumed by mankind as part of its diet is composed of so-called "invisible fat" - that is, fat substance which is found in food items; and of "visible fat," or fat used in the preparation of food, or is eaten with bread, but not consumed alone. Today, the major portion of invisible fat originates from oilseeds, and is prepared in vegetable oil factories.

2. To speak in terms of "oilseeds" or "oilplants" is not scientifically exact, since practically every part of the plant, and the plant as a whole, contains fat. "Oilplant" is the commercial denomination for the few types of plants which have been adapted for cultivation, can be harvested relatively simply, and give reasonably high oil-yields under current methods of production.

3. Oilplants are cultivated in both temperate and tropical climates, at sea-level and even at 1,000 meters above sea-level. Each plant produces its characteristic composition of fatty acids; but this composition in the same type plant varies according to the geographical, latitude, climatic, altitude - and to a much lesser extent, the soil - conditions of the region where it is grown. At higher altitudes, the relative quantities of unsaturated fatty acids in a plant's composition are generally higher; consequently, its iodine values are increased. This is revealed when comparing the same type plant grown at higher and lower latitudes. Similarly, oil from plants cultivated in cooler climates will have a higher iodine value than oil from the same kind of plant grown in the tropics. At higher levels above sea, unsaturation of the oil is more pronounced, but this may be in natural correlation with

cooler climates prevailing at higher altitudes. The quantity of oil produced is somewhat higher at lower than at higher temperatures, at the same time resulting in a lower carbohydrate content. Temperature conditions substantially affect the linolenic acid content of oil; its linoleic acid content, slightly; and its oleic acid content, minimally.

4. Humidity is an important agent combined with the soil quality and the climate. Usually, higher humidity in the soil produces more fat, with higher iodine value, in the seed, but excess humidity will kill the plant by inhibiting respiration of the roots.

5. A very significant fact - and perhaps for the future, an overwhelming one - is the daily-increasing knowledge on plant genetics, which produces true miracles in adapting plants to the most variable growing conditions, developing types which resist diseases, insects and fungi, which lend themselves readily to mechanical harvesting, and which render high yields. It seems that genetics, together with controlled artificial irrigation, will make possible the production of enough oil-producing plants to satisfy fat-consumption needs of the growing population possibly for the next few decades at least, and probably for the coming century. To look further ahead could be only on a highly speculative basis and would prove factually inconclusive, because noone can guess at population figures for that far ahead, nor gauge accurately the effect of inevitable advances in agricultural and chemical technology.

6. Let us now take a look at some of the most important oilseeds and their respective edible oils; at the properties of some animal fats; and have a glance also at the synthetic fats.

Coconut, Copra

7. The coconut tree is a typically tropical plant. It grows on plantations of up to 25° latitudes, on both sides of the equator, because it needs a hot climate with 22° C. average temperature and never below 10° C., as well as a great deal of sunshine. Humidity can be variable, depending on the soil. The coco will already bear some fruit after one year of growth, but seven to ten years are required before it attains full yield, and remains productive for another ten to fifteen years. Therefore, discerning seed-selection is of maximum importance, because it will have a very long-range effect on promoting rich harvests. The distance between trees should allow for complete insolation. In order to utilize somewhat the space between the trees, coffee and cocoa planting has been done recently. The plantation needs periodically a large number of laborers, but a much smaller regular labor force. The fruit - coconut - is harvested mainly by picking up the fallen nuts from the ground. These are opened by hand, dried in the sun or in specially-constructed ovens, and then the dried endosperm, or copra, is removed. The yield for an average plantation should be around 1,000 to 2,500 kg. of copra; based on an oil-content of around 65%, this should come to some 650 to 1,500 kg. of oil per hectare. Because the tree is prey to a number of insects and contagious diseases, careful preventive and therapeutic measures must be exercised at all times in order to ensure permanent production.

8. At the factory, the copra is cleaned and milled in a hammer-mill; then follows the usual processing. The oil contains more than 60% lauric and myristic acid, some oleic and palmitic acid, and very little stearic acid. The melting point of the refined oil is 24° C.; it is used as an oil in tropical

countries, and packaged as fat in the colder climates. Besides being a comestible, the fat is used in industry, especially soap-making and in cosmetics preparations; and today, it is also being transmuted into chemical products.

9. Its by-product in the factory is meal, which contains only 20% protein. At the plantation coconut milk is converted into an alcoholic beverage, but only for local consumption. The fiber is also used locally, but oil remains the overwhelmingly important product of coco.

Palm oil. Palm-kernel oil

10. For many of the people of Equatorial Africa and Indonesia, the African palm forms the main part of the diet. The African palm grows in all regions where the climate is hot and humid enough, but yields can be obtained only at plantations, because this tree is quite sensitive. Again, as with coco, seven to ten, even fifteen years must elapse before the tree reaches full maturity; but then, if well cultivated and protected against insects and diseases, the plantation can yield some 2,500 to 3,000 kg. of oil per hectare - under optimum conditions, even 4,000 kg. have been obtained.

11. The oil palm, African palm - or Guinean palm, as it is called - needs an even hotter climate than the coco; it prefers an average of 24-26° C., with 14° C. the lowest acceptable temperature. Humidity should be high - 1,500 to 3,000 m/m per year - and evenly distributed. Insolation is very important. Because of the plant's high fertility, it needs also very rich soil, which after a few years must be bolstered with fertilizers.

12. These plantations need much manpower, not only for the sowing and maintenance, but also for harvesting, done entirely by hand. A plantation in Venezuela can occupy full time a year-round work-force of 300 for 2,500 hectares, producing some 5,000 tons of oil. The bunches are harvested throughout the year, with two peaks in production. Since the oil in the harvested fruit acidifies within a matter of hours, the fruit must be processed immediately - obviously, the factory must be at the plantation.

13. Palm oil is in the pulp, from where it is collected after sterilization of the fruit, and separation by hydraulic presses and centrifuges. The remaining oil in the fiber is sometimes solvent-extracted, after the fiber has been dried and pelletized.

14. Palm oil is semi-liquid and contains high amounts of palmitic and oleic acid. It is dark yellow or red due to a considerable amount of carotinoids. It is an excellent raw material for shortening and margarine, and can be used as oil if it is separated from its solids by winterising. A large quantity of palm oil is used also in soap, especially if the oil is low-priced.

15. The kernel of the fruit is processed by breaking it in a mill, separating the hard hulls from the kernel, then pressing the latter in a continuous press. Palm-kernel oil is similar to coconut oil, but has a somewhat higher iodine value and melting point. The proportion of palm oil to palm-kernel oil will depend on the type of palm, but the kernel oil is around 10% to 25% of the palm oil.

<u>The Ground-nut</u>

16. This plant is found in many parts of the world,

because it is highly adaptable to varied conditions. The tree is usually planted at latitudes of 45° N. to 30° S. The climate should be warm, though not necessarily tropical, but the plant will not withstand frost. Humidity should be evenly distributed during the time of cultivation - around 90 to 130 days - but excessive rainfall would favor the upper part of the plant while inhibiting the fruit. Best results have been obtained through an elaborate irrigation system which provides uniform supplies of the needed moisture.

17. Soil should be sandy and light, not so much because the plant prefers it, but because heavy soil would make harvesting difficult. Sowing time must be calculated to ensure that the harvest will fall due during a dry period. The yields are around 2,000 to 3,000 kg. of fruit per hectare, corresponding to 1,300-1,800 kg. of seed.

18. Harvesting is carried out in three stages: first, the plant is pulled out of the ground; then it is dried; and lastly, the fruit is separated. All the work, from the preparation of the soil and sowing to the entire harvesting, is done mechanically, and no more than two-three work days are needed per hectare. In warm countries, a second but differing crop is grown on the same ground in the same year.

19. The ground-nut is susceptible to a number of diseases, most of them of fungus origin, and is also attacked by various insects which periodically cause great damage to the crop. These are controlled by insecticides, but also by developing resistant strains.

20. The uses of ground-nut are manifold. First of all, the seed contains approximately 52% of oil of a very fine quality and low acidity, which is simple to refine. The meal

contains around 40% proteins and is used for animal feed. The seed also can be consumed in its original form, after being toasted, or as a raw product in bakeries. A large percentage of the ground-nut produced in the United States is converted into peanut-butter. The leaves of the plant are dried, yielding around four to five tons of fodder per hectare.

The Soybean

21. Despite the quantities of soybean-oil produced as oil or in hydrogenated form as fat, the soybean is grown for its meal, and even though the oil is valuable, it is only a by-product.

22. Soya is the most adaptable oilplant of all, and can be grown in Indonesia as easily as in the United States. Certainly, the plants grown in these two places would not be identical, but it is easy to develop suitable species for the different climates, latitudes and soils. Growth-time is again between 90 and 140 days, so that in the tropics it is rotated with other crops during a single year.

23. It, as the other plants discussed, is attacked by various diseases, insects, fungi and viruses, but species have been developed which resist one or more of the different diseases and plagues.

24. Yields are 1,500 to 2,000 kg. per hectare, but this produces only 300-400 kg. of oil. The harvest is completely mechanised, necessitating very few work days.

25. The soybean contains around 15% of oil, of high iodine value. It is used as salad oil, but has to be stabilised by a slight hydrogenation and winterization. Hydrogenated to an iodine value of 80, it is a very good base for shortening and margarine. The oil or its fatty acids are

utilized in the production of paints and resins, because of its linolenic acid content. A by-product of the refining is the lecithine used for margarine, cosmetic preparations, and a great many other products. Meal is the main product, because of its rich 45-50% protein content, of adequate composition for animal food. The meal can be prepared for human consumption also, by dehulling the bean and toasting the meat.

The Sunflower

26. The sunflower is the most resistant of the oil plants to conditions of climate, soil and latitude, flourishing from the tropics to Canada. It can withstand equally well short periods of frost and drought. Therefore, it is natural to find the biggest sunflower fields in the European part of Russia. Of the non-European countries, Argentina is one of the important growers. The work is completely mechanized, and once the right seed is chosen, very little other effort is required.

27. During the latter years, notable advances have been made in improving the oil-yield of the sunflower plant, as well as in its morphology, in order to facilitate production. The yields in large fields are 800 to 1,000 kg. of fruit per hectare, with around 35% of oil. The dehulled seed contains about 48% of prime-quality oil. It is one of the best salad oils, especially due to its high linoleic acid content; but for the same reason, it must be refined and stored carefully to keep it stable for several months' duration. The meal is around 38% protein. This plant is used as forage, and gives a yield which may be as high as 50 tons per hectare.

The Safflower

28. Only for a decade has safflower been grown in larger quantities, although Indians have cultivated it over as many

as 200,000 hectares, but strictly for local consumption. A favorable characteristic of the plant is that it not only resists extremely arid climates, but actually prefers dryness: heavy rains or high humidity can destroy the plant. It also resists frost, and can be cultivated between latitudes of 40° N. and 40° S. The interval between sowing and harvesting is 110-140 days. Unfortunately, the safflower in its actual form is susceptible to diseases and insects, but here again, genetics may provide the solution, eventually.

29. The dehulled seed contains approximately 50% oil, and the meal around 35-40% protein; but the dehulling needs special machinery. The oil makes an excellent salad oil and is easy to refine. It contains 70% linoleic acid and only 2% linolenic, with 6% solid acids. It is especially suitable for diet oil, as well as for mayonnaise and salad dressings.

30. Space limitations requiring adherence to the priority of subjects specifically relevant to the oil factory, prevent a lengthy description of every kind of vegetable oil. Brief mention follows of those not heretofore treated:

Sesame oil

31. This easily-refinable oil of very good stability is produced in East Africa, the Indies, and Central America. In Mexico and Venezuela it is used as salad oil. In some other countries it is a requirement to add 1% of this oil to margarine, because a special chemical reaction makes easy the detection between margarine and butter. Sesame meal contains 42% proteins and is therefore used for animal feed.

Rapeseed oil

32. Rapeseed can be grown both in the tropics and in colder climates. It has a special mustard-like flavor,

originating from a sulphur-containing substance, allyl-isocyanate, found in mustard-seeds always growing together with rapeseed. This oil needs higher deodorization temperatures than other oils in order to render it tasteless. It is also difficult to hydrogenate, and its high content of erucic acid makes it less digestible than other oils. The meal has some glucosides which are not tolerated by animals; therefore it can be added only in limited quantities to the usual animal foods.

33. During the past few years, an old variety of rapeseed, the crambe, appeared again, and was grown in Sweden and Canada, producing oil without erucic acid and the sulphur-compound. That plant might become important because of its high oil-yields per hectare.

Cottonseed oil

34. This is a true by-product of the plant, which is cultivated only for the cotton. Plantations are diminishing as a result of the replacement of cotton by synthetic fibers. The oil suffers high losses during refining, especially if the seed is humid when stored. It is easy to hydrogenate and deodorize, and is used as salad oil as well as in shortening and margarine; after winterizing it can be used for mayonnaise as well. The meal contains gossypol, a substance poisonous to certain animals.

Rice oil

35. Rice oil is also a by-product, of rice, but it is being produced in ever-increasing quantities. Polishing rice results in rice-bran, which contains approximately 14% oil. To destroy some of the enzymes, it is necessary to heat the rice bran during the first half hour to about 80°-90° C. in

order to avoid the formation of acidity, which can attain 15% if the bran has not been sterilized. The bran is then pelletized and solvent-extracted. The oil contains 3% waxes, which once removed, leave a good quality oil. The remaining meal has 25% proteins, and smaller quantities of other valuable ingredients, making it a good source of animal food.

Corn oil

36. This oil is a by-product of corn, in which the endosperm contains around 20% oil; but calculated on a total corn-yield, only 1.5%-2% oil is rendered. Corn oil is good oil, which contains some waxes. Its iodine value is around 115, and it cannot be stored for long periods after packaging. It has achieved some fame during the past years as a diet oil combating cholesterol.

Olive oil

37. This is a typically Mediterranean oil of exceedingly high stability. It has a special taste when the olives are pressed cold: this unique flavor is what makes it sellable at higher prices than the other oils.

Animal fats

38. Tallow, lard and fish oil are the most important animal fats. Around sixty years ago, they were used mainly for human consumption, but they have since been replaced by vegetable oils. Refined tallow and lard are still used in cold countries as shortening, especially in industrial bakeries. They contain fatty acids with an uneven carbon-chain, and can be detected with gas-chromatography.

39. Fish oils became important in the last twenty years in some fish-oil-producing countries, as raw material for edible fat. In order to eliminate its fishy taste, the oil must be hydrogenated to a melting point above 40° C. If

hydrogenation is sufficiently selective, the shortening produced will not reverse the odor and food prepared with such shortening will also remain odor-free. However, due to its fatty acids with 22-24 carbon-chains, it is not very easy to digest, so fish oil is likely to remain only a raw material for cheap shortening, with limited uses.

40. Mention must be made of full synthetic fats. Fat or oil is an ester-combination of fatty acid and glycerol. Glycerol of such fine quality is already being produced on an industrial scale, that it is beginning to invade even the cosmetics field. Fatty alcohols also are produced from ethylene, and rapid strides are being made in the technique of separating the even from uneven carbon-chains. Through oxidation of fatty alcohols, fatty acids result. Whether fatty acids with uneven chains can be easily digested by the human body, has not as yet been clearly shown; but evidence seems to be to the contrary. During the war, synthetic fats were produced in Germany, but only in limited amounts for human consumption. It may be that developments in the petrochemical industry will arrive at a process for producing refined and pure even-chained fatty acids, with the double liaisons in the right place, in which case natural oils could be replaced by synthetic fats in industrial quantities. This will certainly not be resolved within the next twenty or thirty years, but I would dare prophecy fifty years. However, there is no doubt that in twenty or thirty years, oil congresses will already be discussing such processes.

41. Semi-synthetic fat made from glycerol and natural fatty acid is produced today, but for the moment it appears that the process is too expensive for the resulting product

to compete favorably with natural oil, especially since fatty acids have their industrial uses also. However, through esterification, inter-esterification, hydrogenation and selective crystallization, tailor-made fats can and are being produced, with completely different properties from the natural oils.

CHAPTER III
THE MARKET

1. A new industrial project is initiated through the availability of raw material or an existing market. It is not even essential that there be a market; a reasonable possibility for the development of production of raw material, or a need for the product, will suffice.

2. In the preceding chapter we discussed necessary growing conditions for certain typical oilseeds; now we will examine market possibilities for selling vegetable oil or fat to be produced. Where oil-seed production is high, the local market may not be able to consume the total of it; therefore, export avenues must also be explored when planning the size of the factory. However, in my opinion the basis of a vegetable oil industry should always be the calculated local market needs, to such an extent that, provided export conditions are unfavorable and the foreign market is closed or very low-priced for a time, the break-even point should not be reached. The export market is quite variable and needs especially careful observation and precautionary measures, as we will see presently. The domestic market, on the other hand, is rather stable and should register no great variations from year to year, in normal times. Undoubtedly, there may be exceptions, when the local market is so small that it is insignificant compared to exports, as for example palm oil in the African countries, copra in the Philippines or tung oil in Paraguay. However, the production of copra should be considered more an agricultural project than a vegetable oil industry, and at the palm oil plantations, the palm oil factory is secondary to the agricultural scheme and is needed only because of the peculiar characteristics of the fruit.

The same company in Paraguay operates an edible oil production plant that produces tung oil, and even so has had great difficulty due to an unfortunate export situation and disproportionate relations between the export and the local markets. Another extreme is when a country has no oilseed production of its own, or only a small one, as is the case in a number of European countries, and, to the utmost degree, in Curaçao and the Dutch Antilles. In places such as these, only the local market can come into account from the point of view of a new factory. Under any circumstances, the local market has to be appraised very carefully, and the results exert great influence on the feasibility of a project.

3. To begin the market survey, we would be interested in the per capita consumption of vegetable oil, vegetable fat, animal fat, butter and margarine - in other words, the annual production of these items - since the population figure is generally known. First of all, official statistics can be taken as a basis, even if they are sometimes incomplete. The figures can subsequently be corrected through speaking with local manufacturers; it must be taken into account that they would, naturally, give a somewhat pessimistic estimate. Quite reliable sources are: the publications of the United Nations, FAO, and some almanacs - the latter compile only data from other publications, comparing and evaluating these; but they are often out of date a few years. Additional information may be obtained through examining data from the various ministries of the country where the project is to be planned: the ministries of industry, commerce, agriculture and finance. Thus, fat-consumption may be calculated and compared with other data, through figures on agricultural production; while

data on the exporting and importing of products can be gathered by consulting export-import companies and local and international banks, who are usually very cooperative because they are interested in new business-possibilities. This rounds out the initial information and at the same time gives a rough picture of capacity and actual production of existing companies.

4. The next step is to ascertain the country's eating habits, purchasing power, the types and quality of its products, and the kinds and sizes of packing used. Here, one should follow the classic methods of market research. Besides studying official statistics, one must engage in personal research in supermarkets, groceries of various sizes all the way to the smallest ones, in two or three large cities and in a few smaller ones, towns and communities, depending on the geography of the country. This work can be effected in about six to ten days, and will afford sufficient information for a pre-investment study. The personal visits to the stores are extremely important, because they will offer a much better view of the commercial situation than any paper could, at the same time enabling one to familiarize himself with prices, discounts and commercial habits. Managers of supermarkets and groceries are quite frank, since they are interested in new competition on the production side.

5. It is surprising, however, that information on eating habits and product structure has no decisive bearing on planning: such habits can easily be changed through clever marketing and publicity. For example: in the developed, affluent countries, the use of fat - especially animal-fat - has been pushed aside by the substitute edible oils, as a result of well-publicized new findings on the medical front and by the dietary sciences. On the other hand, in underdeveloped

countries with less purchasing power, packaging and prices are of prime concern, and will rapidly determine eating habits. One of the advantages of fat over oil lies in its packaging: because it can be packaged in paper, and more easily purchased in small quantities, calculated on small amounts it is much cheaper than products which must be packed in metal containers or even plastic bottles. In the marketplaces of countries with small-income, large populations, as for instance the bazaars of Arabian countries, fat is delivered in 40-50 lb. tins, but is distributed in small pieces of paper, in individual portions amounting to the average daily ration of a family. This method was developed in Venezuela by the industry to produce units as small as twenty-five gram bars, proportionate to the daily purchasing power of a big segment of the population. Handling oil in the same manner is difficult, and the economic limit is about 100 grams. There is another method - such as is used in Ecuador - which utilizes 30-50 gr. plastic pillows, but it has not become widespread on other markets.

6. Exactly because of the socio-economic conditions in Venezuela, described earlier, the eating habits of one portion of the population were changed from the use of oil to fat; whereas in the wealthy United States, as a consequence of publicity regarding the dangers of cholesterol, eating habits were altered from the consumption of fats to that of oil, and from butter to that of margarine. The facts cited obviously bear out the necessity of a new company planning a factory in a developing country, of considering hydrogenation facilities and large-velocity fat-packing machines.

7. Attempting to transform habits through advertising only, is very costly and needs not only large investments but also high skill and especially a good communication-system in the entire country. Advertising should be accompanied by improved packaging systems for the consumer, and better discount offers for the retailer.

8. Operating in highly competitive and developed markets, any new vegetable oil factory should consider the production of margarine. Usually, the quality of butter is poor in developing countries, especially tropical ones, because of lack of proper facilities, techniques and quality-control; and also because of the heat, lack of a refrigeration-chain and ideal temperature and humidity for the culture of bacteria. In such places margarine finds an ideal market, having the commercial advantage of packagability in small units. Thanks to its aroma, margarine can be eaten without cooking, like certain animal fats. Also, its water content is 16%. However, having the same selling value as fat, the profit to the company due to this water content is not as high as it would seem, as a result of higher cost of ingredients, investment costs in equipment and refrigeration, and the necessary higher skill required in production. A new factory, at least in developing nations, should reserve a place for margarine equipment, but should not begin producing it until being solidly established in the oil and fat markets. What I propose is not necessarily axiomatic: conditions are variable as to time and place. For example, the most important fat-producing company in Venezuela began only with margarine, before producing oil and fat; whereas the leading oil company in Santo Domingo is making margarine after twenty years of producing only oil and fat. Nevertheless, in deciding

future policy, it seems to me that any new company would do well to adapt the scheme advocated above, regarding the production of margarine.

9. From an investment point of view, a sound plan is to anticipate capturing initially no more than 25-50% of the estimated share of the oil and fat market. The total expected share usually will not be gained until three years after inception of operations. This applies when an already reasonably well-organized production exists on an industrial production basis. There may be places where no industrial production exists, or only a very small one; yet one must keep in mind that regardless of this, people there are already using in their diet oil or fat, but they are produced in small workshops or at home, and even the more effective new factory must be aware also of the traditional means of production.

The Meal

10. All seed, with the exception of palmfruit, after crushing yields meal in a quantity of from 30 to 80% of seed-weight, besides oil. Meal is usually obtained in oil factories and sold to factories producing animal-feed. The preparation itself is simple; more complicated are the making of formulas and the adaptations of compositions to the needs of animals, such as poultry and cattle, to be utilized for complete or supplementary feeding, at an acceptable price. Simultaneously, it should be understood that animal feed is a cheap and high-volume product and is not easily distributed. The manufacturing of feed itself is only a mixing and grinding process; machinery, on the other hand, is quite expensive because there are high-volume and solid materials to be

transported and stored. Storage and transportation of liquids can be accomplished with pumps, relatively small tubes, and tanks. Granular powders must be stored in steel or concrete silos which, when calculated per weight unit of material stored, are approximately three times as expensive as the former. To transport powders, ventilators, airlifts and sometimes bucket or chain-elevators, or worms, are used. Oil and water are transported at velocities of about 5-10 kg./cm^2/min., while granular powders such as presscake in worms have only 0.5 - 2.0 kg./cm^2/min. velocity. The calculations for pneumatic transporters are similar to those of worms.

11. For liquids, transportation methods are pumps, which prove more economical and use less energy than the methods given above, calculated on the same capacities. Finally, mixing of liquids can be accomplished rapidly with simple agitators in small tanks; whereas solids need pneumatic devices, steel rollers and rotating drums, and mixing powders uniformly, requires around thrice the time as working liquids. Now, presscake, or solventised meal, when ground to be sold to animal-feed manufacturers, can be stored on the floors of warehouses, simply protected from wind and rain, and eventually transported in trucks. If bagging is required because the receiver has no storage space, only a small hopper is needed which fills bags of prescribed weights. All of this shows that outlay in an animal-feed factory is relatively high, and production should not be considered competitive against an existing, efficient animal-feed factory. But if no such factory exists, again the domestic market should be surveyed first, before a decision is made to export all the meal, as is, considering the inherent complications and difficulties

of foreign markets and world-wide competition.

12. A different type organization is needed for domestic distribution of feed than that for oil, to accommodate completely different consumers. Often, animal-feed can be sold to the same customer that buys oilseed. In this case, salesmen should acquire some knowledge of cattle and poultry breeding, especially since at the beginning of feed-buying, every mishap resultant of breeding will generally be blamed by the buyer on the short-comings of the new animal-feed. The employment of a vetenarian at least as adviser, is extremely useful; and where specialized know-how is lacking, the assistance of an experienced company or adviser could bring results so successful that the animal-feed production may grow to be as valuable as the oil factory.

13. Market research will begin at the ministry of agriculture and be followed through at the biggest ranches and cattle farms. If the animals are at pasture, free on the fields, the market survey will very probably carry negative results. For the farmer, pasturing appears cost-free, whereas he must pay for prepared animal feed and years may elapse before he can see any improvements. Nevertheless, there are always progressive farmers and open-minded, foresighted vetenarians who will help break a path for such a future market. Therefore, a factory for the animal-feed market should start on a small scale and be begun when no other such factory exists.

14. Another market to examine in this connection is that of poultry-raising. If there is no animal-feed factory in the country, poultry-raising is done at the farm-houses only. Consequently, the oil factory may begin, together with animal-feed production, poultry-breeding on an industrial scale instead

of exporting meal abroad; thus it will contribute to the country's meat production and initiate other similar industries.

Soaps

15. The second by-product of vegetable-oil manufacturing is soapstock. This is obtained during the neutralization of oil, but in rather small quantities. The usual free fatty acid content of oils varies from 0.5 to 5%; calculating a 1.5 - 2.0 refining factor, the fatty acids of soapstock will come to 1.5 - 10% of the vegetable-oil production, corresponding to approximately 20 to 150 kg. of finished soap per ton of oil produced. Usually, 60 to 80 kg. of soap will be produced per ton of oil, and the soap will not be of high quality. Discarding soapstock would be a waste of money; but at the beginning of soap-making, equipment should be simple: only a kettle and steel forms to cool the soap are needed. Afterwards the soap will be cut into appropriate sizes, and packaged.

16. Since the source of soap is vegetable oil, even when it is charged with a lot of silica the soap will remain somewhat soft and quite dark; still, it will be well suited for cold-water washing. Eventually, if the soap business proves profitable, it is worthwhile to consider investing in more complicated and costly installations for the continued production first of laundry soap; and later, in a second line of machinery for the making of toilet soap. For the latter, some tallow, coconut oil or coconut soapstock would be necessary as a base, or possibly, some cheap hydrogenated fat.

17. Selling the soap is easy, since the buyer is the same as that of the oil. Logically, a more advantageous scheme could be selling the soapstock or the acidulated stock - "acid oil" - to an already established soapmaker; but the low cost of installing a simple soap kettle, and facility of

distribution, are the reasons why soapmaking is frequently practiced in a new oil factory.

18. Market research on soap will be carried out simultaneously with that on edible oil, and the results, together with the previously-mentioned considerations, will decide the type of industrialization on the soapstock of the factory.

19. Using acid oil as a basis for a fatty acid factory may be contemplated in an already sophisticated economy. However, such a step should be understood to be a new investment, because it is not feasible as the sole project with fatty acid production; further facilities must be added, such as hydrogenation, glycerol-distillation, separation of acids, and the like; as well as a complete new study procured of market possibilities.

20. Exporting of acid oil is out of the question; it must be stored in stainless steel drums or similar containers, and since it is a cheap product in industrialized countries, cost of long transportation would annihilate profit.

The export market

21. Characteristic of the export market is its instability. The situation on the local market - harvests, changes in economy, and other purely domestic contingencies - are easily controlled and sometimes forecast; but adaptation to the world-market makes imperative the up-to-date possession of accurate, precise, but less easily accessible information. Rapid dissemination of news, yet again the difficulty of authenticating or confirming the reliability of such information, make the export market, just as all of the stock market, extremely unsteady.

22. Because liquid oils can be hardened into shortening through hydrogenation, inter-esterification and winterizing, combined with very selective ydrogenation they offer the shortening, margarine, but also the salad oil manufacturers a wide choice in supplying their factories with raw materials imported from the most suitable sources around the world. The broad interchangeability of raw materials causes oilseed-producing countries to be influenced, relative to prices, by outside events, which in turn are brought about by such unpredictable and varied factors as a hurricane in the Philippines or the commercial actions of big oil companies and the ministries of commerce of centrally-organized governments. Day-to-day and even hour-to-hour price fluctuations narrow selling-decisions down to a matter of hours. Big oilseed-production centers are generally far from the grain markets; therefore the producer must depend on his broker, as well as on his financial acumen and storage capacity, in order to judge the right moment for selling. The value of great quantities of oilseed, oil or meal to be handled, is so high, a producer needs excellent bank connections to advise him also concerning the fluctuations of foreign exchange and world-wide interest rates.

23. In order to take advantage of the best opportunities, large storage capacity and sometimes also oversized production facilities are of immense importance. In this connection, the question often arises: which would be better to store, seed or oil? The harvesting of seed takes a few weeks, perhaps as long as one or two months; this means that seed can always be stored. Oil and meal-storage is not more expensive than seed-storage on a weight-by-weight basis, and it would be worth-

while to crush and extract as much seed as possible during harvesting, if production facilities are adequate to handle the volume. The tanks should be able to hold a four to six weeks' supply of oil; more than that is usually superfluous. For the export market, however, a large store holding the production of several months, might be paid out very quickly if the oil were to be offered late in the season between two harvests.

24. Meal is easier to store than seed and oil, and is less susceptible to deterioration than seed. If meal is to be exported, also, a high crushing-capacity is of importance, because the seasons for meal and oil do not necessarily coincide, so that optimum prices for each are obtained at differing times. For the domestic market, 20-30% higher production capacity than the average monthly selling volume, is sufficient; for the export market, on the other hand, even 100% could be inadequate - in other words, high-capacity installations are needed, but they could pay through flexibility in marketing.

25. If exportation is to be the major portion of business, it would be wise to locate the plant beside a river or near the seaport. Naturally, the seed also has to be transported to the factory, so the cost of seed-transport should be weighed against the expenses of oil and meal transportation. Regardless, to locate the factory beside the port will maintain its savings-factor, even when the production site of the seed is changed and the seed is grown in another part of the country. At least a small storage facility at the port is always very helpful for easier loading of ships; and since the storage room has to be super-

vised and administered, choosing the port as the factory-site also has its obvious advantages.

26. We have learned that different types of oil are interchangeable, as are types of meal. The value of meal is determined primarily by its protein content, then, to a much lesser degree, by its protein composition. Therefore, fishmeal may be used as a substitute for vegetable protein originating from presscake or solvent-extracted meal. Also, meal lacking various types of proteins can be enriched economically with synthetic proteins. Consequently, there are quite considerable price fluctuations of meal on the international market, whereas the domestic market is rather conservative, following international events cautiously, or not at all, being manipulated by the government in order to assure the consumption of the domestic agricultural products and price stability of the finished oil. Here again, the share of the domestic market held by the manufacturer improves greatly the equilibrium of the company, enabling it to await the auspicious moment for exporting.

27. Another question often asked is: Why should seed be crushed at all, and not exported simply as seed? The answers are various: Today, transporting oil in bulk presents no problems; oil needs less room than seed, and room is the determining factor in the cost of transportation. In the past, land transport was complicated when bags and drums had to be used; but such problems have been eliminated for these high-volume, low-priced products through the utilization of closed trucks and tank-cars with pumps.

28. Oil and meal separated can be sold at a better price if the time is opportunely chosen. Crushing and solvent-

extraction costs are only a small percentage - not even as high as 10% - of the seed-value, so that marketing flexibility will outweigh any difference which might arise through somewhat lower operating costs at huge plants, and plants which are not too small, that is, with about 200 tons per day crushing capacity.

29. I have pointed out many of the problems involved in exporting; however, one of its biggest advantages should be mentioned. The domestic market needs quite an extensive organisation, with salesmen, billing offices, facilities for collection and payment control, advertising departments, and clerical staff; exporting needs only a small number of skilled employees, and success depends mainly upon the ability of a few directors operating from one small office.

CHAPTER IV
PRODUCTION COSTS

1. The success of vegetable oil factories depends first of all on discriminate buying of seed: good-quality seed at the most favorable prices; on a good yield of the finished product, with as little refining loss and oil loss in the meal, as possible; on realizing a high selling price through a high-quality product; and on a good distribution organization. Low production costs are only secondary in influencing success. Effective production costs from crushing to filling are not higher than 5-10% of the selling price, compared to equal costs for advertising and much higher expenses for distribution and financing. But given in actual figures, 5-10% of a mass product is a great deal of money, and certainly must be taken into consideration.

2. Initially, the site of the plant should be very carefully studied. From the point of view of transportation costs, the factory can just as well be at the locality where the seed is grown as at the consumption centers. By modern methods, taking either the seed or oil to the city represents no significantly different cost. Taking seed to the consumer centers will have some drawbacks: very possibly, the meal may not be used there, and must be taken back to the provinces, adding considerably to transport costs. Also, there may be a geographical change in agrarian production as new fields are used, or different types seeds grown. The seed production of a country may not suffice for its population, necessitating the importation of oil or seed. Then again, there might be so much excess seed that part of it must be

exported as seed, oil or meal. The possible contingencies affecting factory-site decisions are so numerous that they cannot all be listed here individually; but general considerations can be defined.

3. If import or export is to be an activity, at least one part of the factory - where crude oil and meal are produced - should be at the port or near a railway station which connects with a river or seaport. Taking for granted that the seed-growing site will remain the same for decades, this part of the factory can be near by; but possibly the most sensible decision would be to build the factory where the meal is to be used, or sold as is to the farmer or to an animal-feed factory.

4. Facilities for crude oil production and the refinery can very well be separated, even when some of the installations - such as the boiler, cooling tower for water, and the electrical installations - must thereby be duplicated, raising nominally the cost of technical management. From a technical standpoint, again, refinery and filling equipment can be housed together with crushing facilities; but if all this is far from consumer centers, at least big deposits should be arranged for the cities; and an efficient telephone or radio communication system should exist between the two locations in order to avoid confusion and to ensure cooperation between technical and commercial management. There remains the disadvantage of general management's being unable to have an eye on the factory and distribution; as a result, one of the two will have too much independence. A widely-accepted solution - previously cited is to have the silos for the seed, the presses and the

solvent-extraction facilities near the locale where the meal is to be utilized. The refining and filling sections, with the hydrogenation, shortening and margarine production, are placed close to consumer centers, where the commercial and distribution managements are also located. It might be discussed then where neutralizing and soap production should be carried out, but that question is of lesser importance.

5. Steam and water-needs in a vegetable oil plant are not very great as compared to other industries. Nevertheless, estimates by machine constructors are usually far too low and have had at times to be augmented 100% in order to fulfil actual needs. In addition to the steam needed for processes such as neutralization, extraction, bleaching, deodorizing, and so forth, one must take into account heat losses in order to maintain the oil and fat in tanks above their melting points. Other heat losses resulting from faulty valves, loose-fitting joints and similar technical flaws, are difficult to avoid. Practically speaking, steam-consumption should be calculated at 1.5 - 2.3 tons per ton of oil produced, depending on the size of the plant, type of insulation, the care taken in maintenance, and whether the process is more or less continuous. The capacity of the boiler is determined by the process being either continuous or batch-wise, and must be calculated at 2.5 - 6 t/hr. of steam per ton of oil produced per hour. The fuel used will be what is available in the country. In Venezuela, natural gas, the most suitable and cleanest of fuels - is utilized; in other countries fuel oil must be used. Coal is too troublesome for the rather small boilers, but sometimes even the hulls of seeds are burned for fuel. This seems quite economical, since the

value of hulls is very low and they attain a heating capacity of 4-7,000 kilocalories per kilo. However, before use they must be dried and pelletized to a convenient form; and they have the disadvantage of leaving large deposits of ash, necessitating burners and boilers of a special design. Because hulls and shells can be sold as manure or mixed with meal, before deciding to use them for heating material, one must estimate if the resultant savings would be high enough to justify the costlier boiler and maintenance than that which gas or oil heating would require.

6. The cost of one ton of steam will be about 150-250 times the price of one kilo of fuel oil, or one cubic meter of gas, which figure includes cost of maintenance and supervision of the boiler, depreciation, and preparation of water for the boiler. Therefore, the cost of steam used in producing refined oil will come to less than one per cent of the value of the oil; for this reason, the certainty of a working boiler and constantly available steam might overshadow the economy-factor of steam-production.

7. The importance of water from an economic standpoint is even less than that of steam, but, for obvious technical reasons, it must be available in sufficient quantities. The total amount of fresh water a factory will need is only about 3 to 5 cubic meters per ton of oil produced. Four types of water are used in an oil factory: cooling water, water for the boiler, water for cleaning the factory, and water for the margarine, which will be the same kind as drinking water. It will always be passed through a cooling tower, which can be more or less complex, with drift produced either by ventilation or natural means, the latter

cooling the water to about 2-3° C. above the temperature of the humid thermometer. Water temperature to be used as a basis for the designing of the plant will have the maximum humid-bulb temperature during 330 days of the year. This means that during the remaining 35 days, the factory may have some hotter water than the design-temperature of the machinery; but designing the factory in accordance with the hottest possible predictable water temperature could turn out costlier than simply accepting contingent temporary difficulties.

8. If the water is extremely hard, softening the entire quantity needed might be useful; but complete treatment of the cooling water is not necessary, and the cost would prove much higher than the resulting savings in maintenance of tubes. For general cleaning of floors, the same water can be used as for cooling; but the water for cleaning margarine apparatus should be at least clear and free of bacteria. Treatment with carbon, chlorination or ultra-violet rays is beneficial. The boiler water must be treated very thoroughly in the usual manner, with ion-exchangers and some chemicals, because upon the quality of that water depends not only the life of the boiler, but sometimes the quality of the deodorized oil as well. In some oil factories, where water is plentiful and not excessively difficult to treat, the condensed water from heat-exchangers is discarded, because only a small rupture in a tube can contaminate the boiler water and cause much trouble throughout the factory. Finally, the water for margarine and drinking purposes must be sanitary and bacteriologically examined several times weekly, or preferably, daily.

9. The biggest electricity-consuming processes of a vegetable oil factory are the crushing of seed and hydrogenation, if the hydrogen is produced by electrolysis of water. But besides these, one is always astonished to realize what a large number of pumps and motors are installed in a factory.

10. During seed-crushing, even when there is to be solvent-extraction and therefore the crushing is done with open presses to obtain cake with 18-22% oil content, the electric energy used - including cleaning and preparation - is about 150 KWh per ton of seed. Refining, shortening and margarine production, hydrogenation without hydrogen production, and packaging come to about another 100 KWh per ton of oil. Lastly, producing hydrogen by electrolysis, together with compressing of the gas and pumping of water and lye, needs about 6 KWh per m^3 hydrogen, or an average of 300 KWh per ton of shortening. If electricity is very expensive, the hydrogen can be produced quite safely and in high purity from natural gas, but only medium to large-sized plants could afford the high initial costs and could guarantee the constant use of equipment purchased for that purpose.

11. Calculating the average oil, shortening and margarine production, beginning with seed-crushing; and including electricity for lighting of offices as well as the factory - a very rough estimate would come to a total electricity consumption of 330 KWh per ton of oil, fat and margarine produced. We conclude that the cost of electric energy is not a determining economic factor in the production of oil; of far greater importance is that electricity be available at all times. A failure of but an hour's duration

carries damaging consequences: all the presses must be opened and cleaned; neutralized oil may be contaminated with soapstock; bleaching-earth will deposit on the agitators; oil in the deodorizer oxidizes -- all of which represents more expense than a couple of days' total electricity consumption.

12. The electricity also should be of good quality, that is, without high-voltage fluctuations, which can burn motors and stop production.

13. Water, steam and electricity costs taken together will not amount to as much as 3% of the value of the oil; therefore, even if those utilities are costly, any savings in energy and water would not compensate 1% loss of oil. Practically speaking, then, one should not ignore steam consumption in solvent-extraction and deodorizing, and electricity consumed by the presses or the centrifuges during neutralization; but he should rather and primarily be concerned that the plant attain a good yield of high quality products.

14. The above principle may be applied to manpower in a factory. More or less the same number of workers are needed for a daily oil-production capacity of between 50 and 200 tons. Crushing, solvent-extraction, refining and margarine and shortening production need around 40-60 laborers; these workers need no specific knowledge but should have some intelligence and be willing to learn and acquire skills. The handling of facilities is not particularly difficult, the machines and operations are not complex, so, within a month's time, a new man should be able to perform his duties, without problems. Supervision and

laboratory control are vital. In a factory of the above size, there will be one or two supervisors on each shift, with an additional one for margarine-production. The laboratory requires five persons, of whom at least one should be a chemist. For packaging, warehouse, shipping and receiving, and in the workshop, there will be positions for another 25-30 men.

15. The technical manager should be a chemical engineer, with a degree in chemistry; if he does possess a degree, the laboratory chief could be of a lower professional grade, although, actually, a university degree there would also be desirable. The supervisor need not be a chemist, since less chemical than general industrial knowledge is involved in the routine work. There are pump, motor, tube and valve-failures to be repaired, vacuum-leakage causes to be discovered, transporters to be changed, etc. Chemical work in the laboratory consists of research for new formulas; hydrogenation-control; margarine-production; decision-making regarding new raw materials - and the technical manager should be able to understand all of the problems and their solutions.

16. Total costs for wages and salaries in the production will vary in relation to the size of the factory, the selling volume, and the number of different products manufactured; generally, it will be about 3-7% of turn-over.

17. Maintenance expense will be low or high, depending on the skill and technical level of the workmen. One should anticipate annual maintenance and repairing costs of up to 4% in technically developed countries, and up to 9% in developing countries, of the value of newly installed machinery.

18. Depreciation of machinery can be rather lengthy. As mentioned before, the apparatus is not complicated; when there are moving parts, such as in the centrifuges, they are simple in construction. Technical development in the field is relatively slow, and there are very few findings which render an existing machine obsolete. But the market is growing rapidly due to the world-wide population explosion and increased standard of living; consequently, factory capacities tend to be insufficient after a few years, and machinery which today might do very well, will be too small within the space of several years. All this considered, a very safe calculation would seem to be to amortize machinery and installations in ten years, and even fifteen years might be allowed; twenty years are usually planned for buildings.

19. All these costs taken together will come to approximately 10% of the sales value of the oil and its derivatives. Thus, by saving 20-25% of the variable costs - which amounts to a great deal of money and can be achieved only through extremely cost-conscious production - no more than 2-3% of the sales value of the oil can be saved.

20. A much more significant factor than any heretofore discussed, is the cost of packaging. There are many different packaging materials on the market: glass and plastic bottles; resin-coated metal cans in round and rectangular forms; and even small pillow-like plastic cases such as those used for shampoo. For shortening and margarine, paper and carton can be used in addition to metal and plastic. Today, the most economical packaging for oil is plastic bottles, and paper for the hard fats. Plastic bottles have many advantages for the oil manufacturer: they are light-weight, disposable, and

cheap. If production is big enough, the comparatively low-cost machines and simple processes, these plastic bottles can be made in the factory itself. This scheme not only decreases the cost of packaging material, but also saves factory-space in the storage of empty bottles: the bottle-blowing machines work two to three times as fast as the filling equipment, and with the above arrangement, the bottles can be blown just the day before their filling is scheduled. The factory might gain extra business by manufacturing bottles for some other, smaller user also, whose capacity does not allow proper manufacturing of bottles. Plastic bottles have their disadvantages, however: they are more breakable than metal containers, but with proper weight and wall-thickness, that problem can be overcome. Plastic bottles, like glass ones, are transparent, which means that the oil they contain must always be clear, free of waxes at any temperature at which they are used, and always uniform in color. Finally, they cannot be destroyed, remaining therefore as waste. Cleaning them would be costlier than making them new, so they are not returnable; burning them pollutes the air with hydrochloric acid fumes. Perhaps this pollution-factor is the most serious handicap in highly populated, industrialized countries. The maximum commercial capacity of a plastic or glass bottle is two liters. For larger quantities of up to 20-25 liters, prepared for restaurants, small metal drums or rectangular cans are made, and plastic cans manufactured from high-density polyethylene, have also been tried. This is a commercial problem, and it is the duty of general management, perhaps in cooperation with competitors, even, to restrict the proliferation of types and sizes of packaging.

They must put up strong resistance when their salesmen request special sizes for special customers. Four sizes - 0.25 liter, one liter, four liters and 20 liters - should be sufficient even in countries where a big part of the consumers cannot afford the one-liter size.

21. Margarine and shortening can be sold in sizes of 100 grams, 0.5 kg., in cartons of 20 kg., and in drums for industrial users.

22. The variety of packaging sizes offered determines necessary stock in packaging material and finished products; obviously, the fewer types of containers to be filled, the less frequently filling machines need be changed, thus saving time, machinery, money and personnel, both on the production and the distribution ends. Generally, the cost of packaging should be between 12-20% of the commercial value of the finished product.

23. How much space does an oil factory occupy? The working part of it, from crushing to refining, can be constructed on an astonishingly small area. Cleaning of the seed and the presses for a crushing capacity of from 80 to 300 tons daily, needs no more than 500 - 1,000 m^2 of space. The solvent-extraction plant itself can be located on 150-300 m^2, but for security reasons, there should be a free area of 10 m^2 around the plant; so, total space occupied will be 1,000 - 1,500 m^2. Refining, shortening and margarine manufacturing, filling equipment and the boilers (there should always be two of them) can be located on two or three floors. Anticipating 40 to 150 tons of daily oil-production, the entire installation can be erected on 1,000 - 3,000 m^2. This makes a total factory area of 3,000 - 6,000 m^2. Larger in-

stallations, provided they are not several times the size of those mentioned here, will not need more than 1,000 - 2,000 m^2 additional space, especially since their processes will all be continuous and not batch-wise.

24. The big space-consuming items are the storage of seed, oil, packaging material and finished products, with the necessary passage-ways for pay-loaders, trucks and other kinds of transportation. Once the storage capacity need is estimated, the space for it can be calculated by counting on approximately 1 m^2 for around 7-10 tons of oil, or three tons of seed, or 1.5 - 3 tons of finished products, and an equal area for the corresponding packaging material.

25. All of the estimates given in the present outline of production costs allow considerable tolerance between the lower and higher figures. Costs must be calculated in each individual case; but these figures can offer an initial idea concerning the order of magnitude of the different cost elements; and taking the higher figures, one will be on the safe side even for smaller plants.

CHAPTER V
FINANCING

1. The capital of a company consists of its fixed assets: what was or will have to be used for the purchase of land, buildings, machinery and installations; as well as the working capital for purchasing raw materials, packaging materials, and for paying salaries, utilities, repairs and maintenance, insurance, duties, transportation, and selling expenses.

2. Financing methods vary greatly from country to country, and even more from company to company. But let us discuss the efficacy and possibility of using outside capital for different items in the cost factors.

3. A loan is always an advantage if the interest rate is lower than the earnings calculated on the total capital. It is acknowledged that if a company is not earning more than the bank loan interest, it is performing badly and there is no private economic justification for its existence, especially if no change in status can be foreseen for the relatively near future. So we must assume that the earnings will be higher than the bank loan interest, and consequently as large a loan as possible should be procured. Certainly, there are limitations on loans; a bank will not allow more than an amount on which it can be sure of repayment. Thus, a part of the risk must be borne by the borrower. Conversely, the company should not depend too much on the bank, the attitude and politics of which might shift due to altering conditions on the financial market, other business possibilities and needs of the bank, or simply because of new management in the bank or the company. Vigilance over the fluctuations of

foreign capital is one of the important tasks of management and the board of directors; and effective, alert control can be nearly as decisive to financial success as the efficiency of the commercial or technical management.

4. Let us now examine different parts of the financial structure, discussing relations in the proportion between the company's own capital and outside financing.

5. Before ordering installations, the site or sites of the new factory and the size of the area needed, are determined. The value of the land is only 5-10% of the entire cost of installations, but it is easy to obtain a long-term loan for around 50-70% of its value. Constructors of machinery and installations are always offering three to five years of credit. It is often very tempting to accept this, but on close examination such credit offers frequently prove very expensive: generally speaking, they should not be used if long-term loans can be obtained from local or foreign sources. First of all, foreign constructors need insurance for credit given, initially adding 1-3% to the price of the machinery. As the new company is not yet functioning, no records exist concerning its performance; therefore, a local bank guarantee will be asked by the foreign insuror, and the cost of such a long-term bank guarantee amounts to around 0.5 to 2% per year. The constructor cannot insure more than about 70-80% of the loan, so that he retains 20% of the risk, which he must take into account when calculating his price. Finally, the constructor's own credit possibilities are limited. Offering cash payment, for example 20-25% down payment; 65-70% against shipping documents; and 10% after successful on-stream operation - one can bargain on the price of the

installations and perhaps lower it by 5-10%. With all these savings, it is good business to pay 2-3% more interest on a local loan and not use constructor's credit.

6. Sometimes, as a result of export stimulation measures on the part of an industrialized country, low-interest, long-term credits are offered for buying machinery; in such cases, it would be well to attempt procuring the necessary credit directly from the foreign bank, perhaps with the help of one of the local banks or of the local authorities, rather than seek credit from the constructor through offering the above-mentioned cash payment. In all likelihood, the constructor would be relieved, since his business is the building of machinery and installations and not "playing creditor."

7. Offers from some constructors, or more frequently through their representatives, with extremely low interest rates, must be carefully examined: usually the difference in the interest rate is calculated into the price of the machinery.

8. Loans for machinery and installations should not be of longer term than three to five years; longer terms are not sound, and are also expensive, because the bank must calculate too heavy a risk in granting such credit. Obtaining credit from local sources has the added advantage of erection costs being included.

9. To estimate the total cost of the plant, one can take the value of the machinery, including tubes, fixings, control instruments - but without the boiler and water installations - and double it. The final total cost will not vary much from this simple cost estimate.

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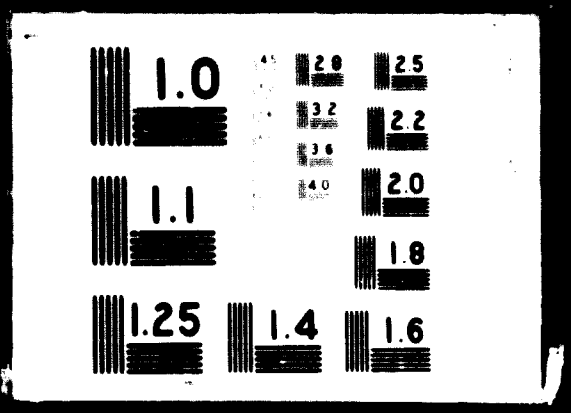


10. The biggest portion of the working capital is the value of the raw material. Here again, a number of different ways exist for financing, and we mentioned some of them in Chapter III, dealing with the market. Paying cash from company funds for the whole harvest once a year, binds too large a portion of its capital. Raw material is a tangible product, of permanent value: it can be weighed, it can be seen, therefore a bank will accept it as guarantee against a loan. If the company is not yet well known to the bank, it will request control over the disposition of the raw material on which it is granting credit, and the company will repay the loan in proportions equivalent to the withdrawal of the raw material, but at the latest within a year of the time of the new harvest-collection.

11. Packaging material can be bought on terms of 30 to 60 days, which means that financing this part of the costs is done by the manufacturer of the packaging material.

12. The remaining production costs, such as salaries, energy and water, maintenance; selling costs such as salaries for salesmen and office personnel; general office expenses; transportation costs; management fees; taxes - all are to be paid as they arise and usually no loan will be received to cover them.

13. Generally, merchandise cannot be expected to be paid for in cash, although in some countries, where only one or two factories exist, merchandise is sold in smaller quantities and thereby, paid for in cash. Payment terms of 30 to 90 days are usually accepted conditions; the company must therefore find a way to finance the large sum which these terms represent. One part of the consumer credits can be used

as guarantee against a bank loan for working capital, either through requesting drafts from some of the bigger clients, or by presenting the bills directly to the bank. Once a company is firmly established, a bank will accept its total outstanding credits as guarantee against a loan; but the client's own capital must be used as security against a part of the credit.

14. How can the necessary initial capital be estimated? Supposing the value of the land, buildings, machinery and installations is returned within three years after beginning production - which should be the case if the project is sound; and assuming there was a credit granted for five years on the land and for three years on the buildings, machinery and erection: the company would have to pay off 40% of the value of the fixed assets during the first year after inception. Even when arrangements cannot be made to pay for the raw material by gradual withdrawal, there will remain in the factory an inventory of from four to six weeks' selling volume in raw material in process, semi-finished, and finished products. Taking into account, further, that the bank will not finance more than 70% of the outstanding credits, there will remain three weeks of selling volume to finance via the company's own capital. In effect, estimated very roughly the working capital should be around one-sixth of the yearly selling volume; or, better yet, one-fifth, anticipating fluctuations in production and on the market.

15. There remains the subject of prospective shareholders in a new company; in other words, what type joint ventures are preferable. First of all, there is the possibility of seeking the cooperation of an existing vegetable

oil company which may be poorly managed, or does not have sufficient capital at its disposal to exploit fully the market opportunities. In that event, the new company can offer capital, or technical or marketing knowledge; while the existing company offers its actual share of the market as the initial basis on which to build, as well as its local manufacturing and marketing experience. This type of joint venture is the most successful, provided the partners are honest in their cooperation, do not overestimate their contribution, and are of about equal strength so that neither has to fear being absorbed by the other. There is a Chinese proverb which says that two partners work well together if each is grasping the beard of the other. This is the crucial point in all joint ventures, but especially in the fusion of two similar companies.

16. In developing countries, private capitalists are not excessively eager to risk their money in a new activity, where they feel insecure as a result of lack of knowledge. Yet the national economy needs the new factory urgently. In such a case, it is the state that has to take the initial steps. Backed by the state, private investors would be encouraged toward new investments: they would enjoy bigger credit facilities; customs protection; land under advantageous terms; and export-assistance. However, the cooperation of the government should be restricted to that of shareholder, with representation on the board of directors in order to watch operation and management - but it should not be allowed to interfere with daily business. A completely government-owned company in a non-socialist country seldom functions well, because of overwhelming political influence in management;

whereas the managing of a company should be on a strictly economic basis, directed and controlled along lines of philosophy worked out by the board of directors. A joint venture between a private group of investors and a government can work very well if both sides stay within the limits of their functions. Thus the private group, benefiting from state help, reciprocates by sometimes making sacrifices in prices for the good of the whole country.

17. Another formula which has been very successful in many cases is cooperation with an existing marketing company. It must first be ascertained that the marketing company have a genuine interest in the venture; an adequate sales force; capital; and also management-time to cover the country completely. Another decisive factor is that the selling of the new product be essential to the partner company, so that it will be obliged to do its part of the job well. The best formula is for the producing company to be interested financially as a minority shareholder in the marketing business. Certainly, the above is the superior scheme when the group of investors in the vegetable oil industry are more technically oriented or have not enough financial or personal capacity to ensure distribution in the country, nor sufficient export know-how. There remains the danger of the marketing company ending up dominating the factory; therefore, the factory owner must at all times be prepared to take over the marketing also, if necessary.

18. A frequent and very good combination is between bank and industrialist, provided the bank is not majority shareholder, and the industrialist is assured of retaining his original, proportionate share in case of company expansion.

Working with a bank allows for great credit volume and rapid accessibility to funds for taking advantage of propitious market opportunities, as well as stabilizing the ups and downs of business life. A bank can provide much information concerning the credit situation of clients, can bring the management into contact with other industries, and usually possesses more detailed and accurate knowledge on the economic developments of the whole country than might be available to the industrialist himself. Finally, the bank's accounting department will keep close surveillance over the finances of the company, helping it to avoid too large risks, and warning it at an early stage of impending problems.

19. Sometimes, especially when the investor greatly fears technical problems with which he might be faced, he invites the constructor to be a partner. This, in my opinion, should never be done. For the customer, the constructor seems to be someone who knows everything about the business; actually, however, he knows perfectly only the technical side, with but a restricted understanding of the selling and buying of oil and oilseeds. In all probability, he would not be keen on assuming such a risk, since he would have to invest large sums of money better utilized in his own business of constructing machines. He would also have to send one of his top men to the new company, thus losing him. The construction engineer would most likely become an employee of the new company, an end which could have been more easily and economically achieved through direct hiring. Even if the constructor were to accept shares in the organizations of only a fraction of

his clients, he would need enormous capital, and eventually a staff to protect his interests throughout the world. Therefore, constructors are generally declining participation offers from their clients; but when they do accept, the equivalent of such financial participation is probably added as hidden costs to the price of their machinery.

20. The greatest challenge, yet the biggest risk, of course - and involving more effort - is the situation when the group of investors, or the investor, stand alone. The management is engaged in technical problems, as well as in the marketing and selling activities, and must oversee the financial activities of the company. It is useful when the technical and commercial managers of a company participate in earnings, first in the form of a premium based on net benefits, and later, when their status in the company is solid, as shareholders. It is also good policy for some of the most important clients to participate as shareholders, but always with the provision that the running of the company remain firmly in the hands of its own managers. Lastly, the producers of raw material can also be very desirable candidates for shareholders; and it might be most advantageous politically if they were participating and therefore interested in the oil production also, preferably in the form of a cooperative. Participation in the benefits of the industry would show the agriculturally-oriented producers the advantages of fully-organised and predictable work, and the risks of the industry; which could be of great educational value, especially in developing countries. It would help in the understanding of the necessity for changing family enterprises over to organised factory work, in the modern industrialised world.

CHAPTER VI
THE PLANT

1. With market research results, sales volume for the first three years of operation can be estimated in terms of weight units. This will be used as a basis for determining the quantities of seed, oil, meal and the finished product. As we have previously seen, decisions regarding storage volume for the various products depend on the way seed is bought and if exportation is contemplated. Here we are concerned only with the needs of the factory itself, to assure its problem-free operation. Independent of where we plan to place the main storage, in the factory itself we must have about three working-days' capacity of seed stored. Even if the seed is received in bags, the working silo should have a capacity to take seed for 16-24 hours, so that the slightly different qualities will be somewhat mixed. If the seed arrives in bulk, the silo should preferably be big enough to receive seed needed for 48-72 hours. The higher cost of larger seed-storage facilities is more than justified if thereby losses are avoided which might be incurred through transportation mishaps, losses in capacity as well as in electricity and maintenance work, due to shutting down the presses and losing solvent in the extraction-plant.

2. The producing and refining of crude oil takes only a few hours when the whole plant works continuously, but about two days when the process is batch-wise. Theoretically, it is possible to proceed with oil from one step directly to the following one, but as such, all processes must be perfect. In very large and modern plants, storage of oil in the interim between refining steps is

actually small, but a very high grade of organized maintenance is provided. A large German company installed even a computerized system with many feed-back controls; their extremely high costs were nevertheless compensated by the even higher expenses they were spared through not having to transfer the plant - their only other alternative.

3. For a plant of the size we are discussing, and especially for plants in developing countries, a simpler and more conservative organisation should be contemplated. Since speed in the production of oil by crushing and solvent-extraction depends on the type of seed, the ease of working it, and its oil content, the amount of crude oil produced per hour in the plant will not be constant. Batch-neutralisation, with the crushing, can take 12-18 hours, and will vary even with the same type of oil processed if the seed-types differ in quality. Bleaching is finished in about two hours, but a three-hour cessation will be required for the cleaning of the filterpress, if a conventional filterpress is used. Lastly, the deodorising can be a short or long process, corresponding to a low or high-quality oil produced and depending on the nature of the oil itself. For all these reasons, the safest plan is to build tanks of 24-48 hours capacity for the crude, neutralised, bleached and deodorised oil.

4. Meal-storage quantities will also depend on market research estimates, but the factory must have a place to store at least the production of 48 hours, anticipating occasional working Sundays, or temporary lack of transportation. All the above capacities are based on minimum needs; if possible, they should be augmented by 50-100%.

5. Again, market surveys will determine the production capacity of the plant. Excepting unusual conditions - such as exporting, for instance - the daily (24-hour) capacity of the plant can be calculated by dividing the third-year sales volume by 250 and adding 20-30% margin to accommodate sales-peaks, shut-downs due to mechanical failures, and temporary shortage of raw material. Processing plant capacities are normally described in tons per day if the process is batch-wise, or tons per hour; and sometimes in liters: 0.9 kilo to a liter, if the process is continuous. Regardless of process, calculations must be based on a six-day week of 24-hour days: the presses in the plant must function 24 hours a day, anyway, consequently the boiler also, leaving no reason why refining, too, should not be carried on 24 hours.

6. Larger margarine factories also work around the clock; but smaller ones work in one or two shifts if the management does not trust completely the precision of the people involved in preparation of the margarine composition.

7. In a great many countries, night-shift work for women is prohibited; and since women frequently operate the filling-machines, in such countries margarine production on night-shifts would be unfeasible.

8. The choice between refining by continuous process or batch-wise, is often discussed. In my opinion, a small new factory of up to 30 tons daily capacity should begin with two batch neutralisers of about 20-30 ton capacity each. Neutralisers are relatively cheap, simple, free of mechanical problems, and can be big enough to produce 40-50 tons of crude oil daily. Also, their neutralisation process

is quite easy, and with a little skill on the part of the refiner, loss through refining will not amount to very much more than in continuous centrifugal refining. Neutralisers are very useful later on, too, after a centrifugal refining plant is installed as well - to help overcome peaks in the sales, or in case of mechanical failure in the centrifugal plant. In the latter case, the size of the centrifugal plant also can be calculated into the exact needs of the plant, and it does not have to be over-sized, since it is always possible to neutralise one or two charges in the batch-neutraliser, from time to time. Lastly, this planning will allow the treating of two types of oil simultaneously, if need be, neutralising one by centrifuges and the other by batch. If oil-acidity is high, and the amount to neutralise considerable, smaller neutralising loss by the centrifuges would justify the installation of continuous neutralisation already during the second year of operation; yet even so, the batch-neutralisers would not be wasted, for reasons outlined previously.

9. In every plant with bleaching amounts to the maximum of 150 tons daily, a batch-type apparatus is indicated. Continuous bleaching plants are feasible, but they are relatively costly due to the expensive control instruments. Filtration is invariably batch-type with two alternately used filterpresses or closed presses. In new plants, I would not advise the use of filterpresses anymore because of the dirty work necessitated in cleaning them, as well as the constant expense for filtercloth and filterpaper. Initially, closed filters are more expensive than filterpresses, but the difference in cost can be quickly

recovered. In quite large plants, continuous bleaching units may be warrantable because of their independence of human operation; by a small savings in bleaching earth and oil loss in it; and finally, by their rendering a finished product of uniform color.

10. Deodorizers should be continuous, even in small plants. Continuous deodorizers can be very simple and inexpensive. One can begin with the deodorizer itself, adding heat exchangers later on in order to avoid high initial costs. If unhydrogenated soybean oil is utilized, the temperature must exceed 200° C., and the mechanism must be of stainless steel. Palm oil is also bleached and deodorized at 230-240° C., but in all other cases, temperatures below 200° C. are sufficient. I prefer to work with a good vacuum and lower temperature in a simple carbon steel equipment, rather than spend a large sum on complicated stainless steel apparatus. One of the main advantages of a continuous deodorizer over a batch-wise type, is its much lower and very constant steam-consumption, permitting the use of a smaller boiler. Purchasing a smaller boiler will save more money than the difference in cost between continuous and non-continuous deodorizer equipment, eventually offering the additional boon of decreased oil loss and steam consumption during deodorisation.

11. Although in a well-designed continuous deodoriser it is very easy to change from one kind of oil to another, in an efficiently organized factory it should always be possible to avoid changes in a period of less than 24 hours, or better still, 48 or 72. At a later date, a small 5-ton batch deodoriser can always be added for emergency purposes

or the handling of some special products; but the main quantity of oil must be deodorized by continuous process.

12. It is no simple matter for someone without knowledge and experience, to request and evaluate quotations. When experience is lacking, the advice of an expert will always compensate its cost. Constructors always recommend their own machines, but while these may serve excellently as one part of the installations, they may not be the most suitable for other parts. Once the size of daily or hourly production capacity is determined, tenders must be asked for 70% and 150% of determined capacity, also, because possibly, with only minor added cost, a larger plant may be acquired. Even if one is determined to purchase from one certain supplier, he should solicit tenders from at least three. In order to be able to compare thoroughly and effectively one tender against another, one should request that tenders be as detailed in price breakdown as possible. Without profound knowledge and experience of his own, one should never attempt a new process, and should choose well-known constructors with a large number of installed plants to their credit. It might be that a new process is superior to a former one, or a smaller constructor perform better than a bigger one, but only an oil factory with large experience can afford that risk. There is no need to buy everything from a sole supplier; but if several are used, the dominant contractor has to be entrusted with and paid for the coordination. Such a fee will not be high, and will guarantee that nothing is overlooked and that each installation fits in with the others.

13. A simple PERT chart is of great help in timing the orders and very useful in avoiding the overlooking of some important items. If import duties and prohibitions allow, the entire tubing, insulation, electrical material and spare parts should be ordered together with the plant. This will cost approximately 15-25% more than buying directly, but the advantage is that constructors offer the engineering services to do the job, while a new company has no engineering office.

14. Performance-guarantees given by constructors are a valuable tool for comparing quotations, even though today the consumption-figures of all contractors vary little. Guarantees on capacity and utility-consumption must be studied minutely; yet one must keep in mind that it is of much more importance that a plant work efficiently for years, with few technical interruptions and little necessity of repairing, than to be assured of nominal costs of vapor or water consumption at the beginning of operations - which, actually, is difficult to control.

15. When comparing quotations which guarantee equal capacities, one must relate, item by item, the physical size and total weight of the important machinery, which should also be guaranteed with a 10-15% margin. The volume of a neutraliser or deodorizer, the surface areas of heat exchangers, the capacities of the pumps, and the size of the extraction in the extractor-area: all must be written into the final contract; only after determining every technical detail can one begin final price-discussions. The precautions are not an indication of distrusting the contractor - to make a contract with somebody one does not trust, would

be contradictory and pointless. Rather, a thorough, knowledgeable analysis of all facets on this level of planning will avoid the tendency of the contractor to think in terms of close savings on various items in order to ensure the guaranteed capacities, without allowing any margin.

16. Many constructors insist on supervising erection and using their own engineers to set the plant in operation; without these concessions they will not agree to comply with their guarantees. However, even if no such demands are made on the constructor's part, the best and surest method is to utilize the help of the constructor's engineers in erection and setting up operations, because, despite the seemingly high cost of their daily services, time and money will be saved. The latter holds true even if a company has at hand its own expert or experienced engineer. A wise policy is to send two engineers, two or three months prior to the beginning of erection, for training to one of the plants built by the contractor, and later to keep these engineers on the site during the entire erection-time and setting up of operations. Such arrangements may seem costly in many foreign countries; but expenses are quickly recouped through a highly efficient and smooth-working plant even after the constructor's engineer leaves the factory.

17. The incumbent plant manager also should be with the company, at the latest before the final ordering of installations. During the first two-three months, he will not have much apparent work. But after placing of the final order, he will prepare the grounds for the new factory;

contract and supervise the buildings; contract and prepare the energy and water supply; be the contact between the company and constructor on new inquiries or subjects not previously cleared up; organize the receiving of material dispatched by the contractor; choose local people for the mechanical and electrical erection; and last but not least, study the new plant as a whole, in order to prepare himself completely for the beginning of production at the new factory. Once again, all the costs of these preliminary months will be redeemed within a short time after the factory is on stream.

The interim between ordering of the plant and commencing production is between 14 and 26 months. It is difficult to be ready before then, because construction of the machinery will take 8 to 10 months, transportation some one to two months more, and erection 5 to 8 months. It is the most prudent plan to expect 20 to 22 months. If the building is ready by the arrival of the machinery - which ideally should be the case - the unpacking of crates and the placing of apparati will take a month. Having three to four groups of welders and the same number for heat-insulation, the tubing and insulation will be ready within another four to six months. Setting the plant in operation and instruction of the foremen and some of the operators are usually accomplished in one month. Around three to four months more will elapse during which the plant will not yet function adequately; but after that, the routine of smooth operation will be established and the plant will begin its normal life of production.

CHAPTER VII
FEASIBILITY STUDIES

1. This, final chapter presents in précis form all of the foregoing research as it might be interpreted through figures. The feasibility study is an attempt at forecasting how the company will fare financially during its first three to five years. Its main purpose is the prediction of capital return and estimated earnings. The resume, although based on current data, is still a projection, and therefore all factors which might influence its results, should be thoroughly analyzed again before being utilized for actual financial planning. In that way, the study will help detect weak spots and enable the prediction and prevention of crises. In effect, a solid financial forecast should clearly set forth calculated risks as well as supply sufficient coverage for the uncalculated ones.

2. Information on current market conditions is compiled and worked out in relation to the company's financial structure and forecast: figures are known concerning present consumption, eating habits, prices, etc. Once the plant's production limit is fixed, a very rough estimate is made on future development. Now, a more exact examination is needed, that of planned growth for the nearer future, i.e. the next three to five years. All available techniques employed toward approaching feasible figure forecasts, are based on the interpretation of statistical data on consumption, population, standard of living and so forth, compared over a period of several years. If pertinent data are available, a graph should be drawn reflecting the previous 1, 2, 3, 5 and 7 years' figures. The graph could then be extrapolated to include estimated consumption data for the succeeding

1, 2, 3 and 5 years. Also, the share in the market must be calculated for the corresponding period, taking into consideration existing competition, the influence of advertising, and the technical and marketing potential of the new company. Special attention must be given to the inception period. The initial stage of operation generally constitutes a critical phase, which we must take into account and prepare for. So, our first forecasts should be moderate, since the figures are going to determine the cash-flow preview in the initial period. Also, the sales forecast for the first two years of operation should be quarterly, in order to allow raw material quantity programming and proper financial previewing. The sales forecast will be a guide toward determining production levels, which govern the fixed unit costs, as well as the personnel needs in the commercial operation.

3. In the above connection, familiarity with break-even point and marginal costs, would be helpful. The break-even point is the production volume when the sales value of the production is equal to the sum of the fixed costs and variable costs. In other words, there is no profit and no loss at that point. One could express this situation as being the sold finished product level which is required to cover expenses. As we have seen, production costs in a vegetable oil factory are not very high; therefore, the value of the product in the factory shows noticeable differences only at extremely high or extremely low production levels. Now, it might happen that while producing and selling in accordance with planned and financially profitable patterns, a special opportunity arises for selling an

additional amount of the semi-finished or finished product; but obtainable prices are low and would not bear fixed costs. In such a case, since fixed costs are already paid by current production, one could take into account only the variable costs and calculate if then the price offered would be acceptable. The cost of products in which only the variable expenses are included, is called the "marginal cost." In the feasibility study, the marginal costs at different current production levels, with the corresponding current factory values of the product, must be calculated, in order to predict how competitive the new company will prove in a critical situation.

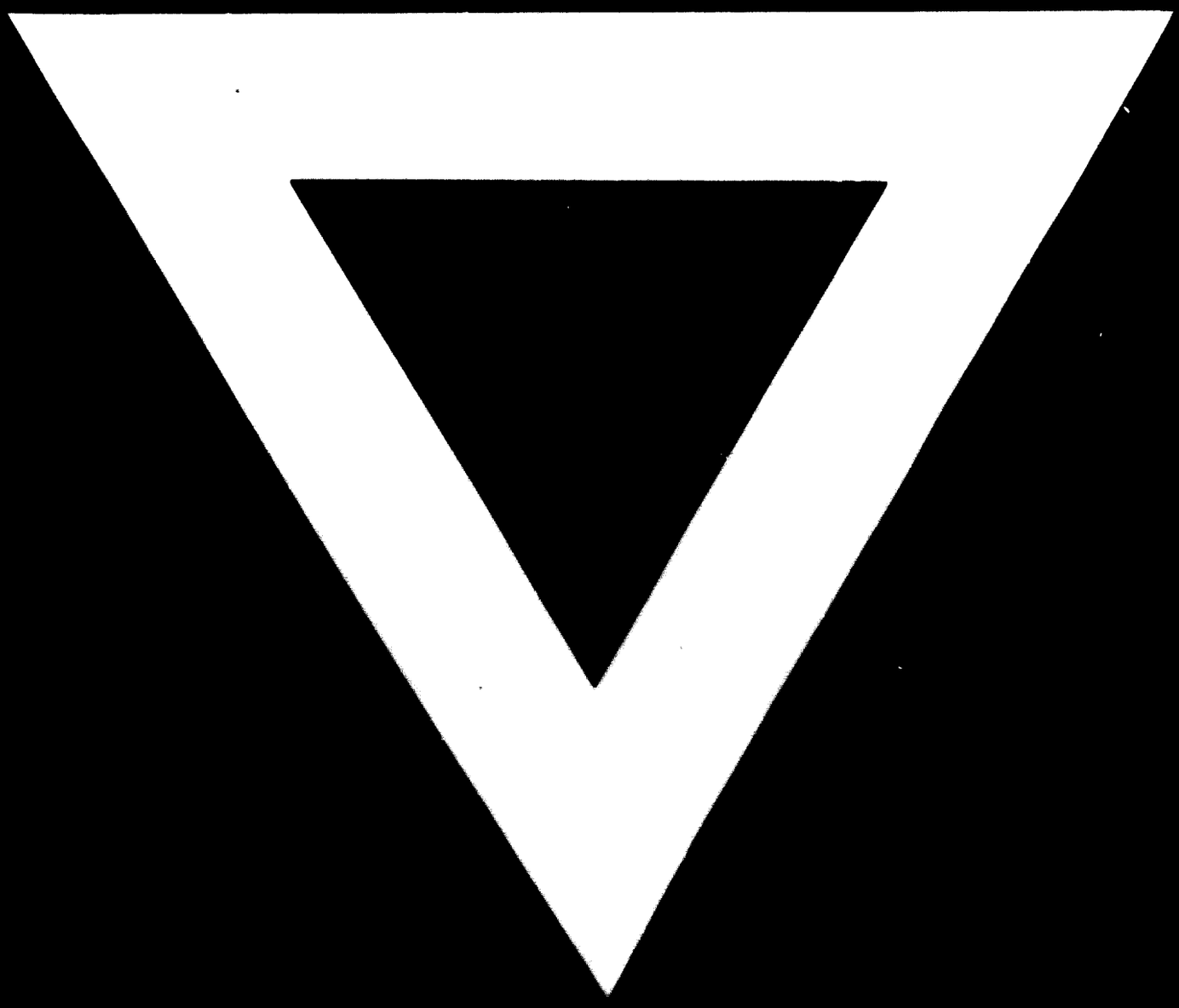
4. When preparing the feasibility study, one must take into consideration both the calculated and uncalculated risks. The calculated risks can be estimated by examining the fluctuations of raw material and packaging material prices, on one side, and the degree to which sales prices can be altered under changed economic conditions. Current wages and social security expenses should be considered in the light of possible increases during the subsequent five-year period. Labor laws, unions and collective labor contracts should also be kept in mind.

5. The most important uncalculated risks are political events, changes in a country's economic policy, and climatic factors which affect the production of raw material. In addition, there is a necessary element of uncertainty in a financial forecast which depends entirely on the accuracy and completeness of market research data in estimating the cost of building the factory, calculating the fixed and variable costs, and predicting accessible prices. To take these uncalculated risks into account, it is wise to estimate the

outflow higher and the inflow lower, or more pessimistically, than would actually be expected. This discount can be 5% but also 30%, if the study of the entire project was been on a very rough basis.

6. The cash-flow chart, as the comparison of inflow from sales and outflow resulting from costs, will indicate the amount of working capital required. It should also facilitate decisions on the projected financial structure of the company, the selection of sources of capital - as short, medium or long-term credit - and the investors' share of the capital. Then a pro forma opening balance must be established, showing fixed and circulating assets and sources of investment. Finally, from the cash-flow chart and profit and loss preview, a general balance sheet to the end of five consecutive years, will be worked out, reflecting the estimated financial standing of the company during those years, and it will also serve as a guide for comparison in cross-checking.

7. All of the previous groundwork will have been prepared expressly to lay a reasonable and realistic foundation on which to judge the feasibility of a project; and it remains only to make the final decision on commencing a new venture.



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