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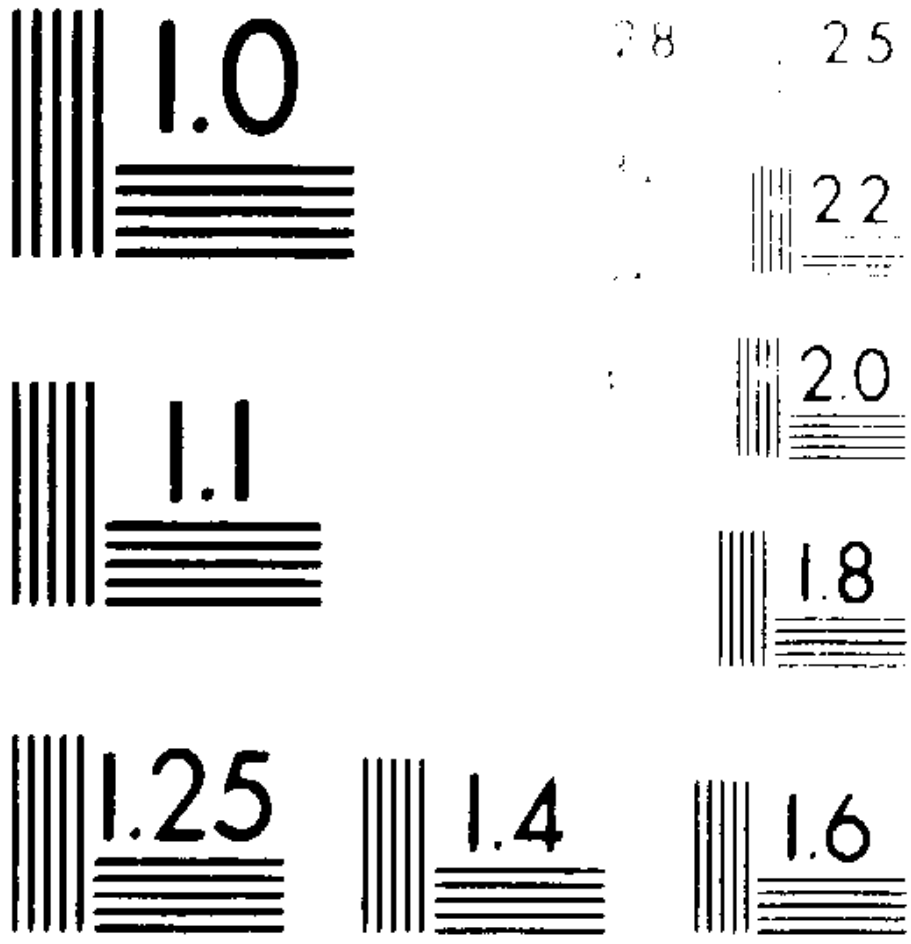
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

MEASURES TO OVERCOME MACHINERY AND SPARE PARTS SHORTAGES FOR THE FOOD-PROCESSING INDUSTRY BY EXAMPLE OF THE VEGETABLE OILS AND FATS INDUSTRY IN DEVELOPING COUNTRIES *)

Discussion paper for the Expert Group Meeting from 6th to 9th February 1984 as a preparatory meeting to the Second Consultation on Food Processing.

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C O N T E N T S

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I. INTRODUCTION

1. Machinery and spare-parts shortages can be considered as one of the key-problems with regard to the industrialization of developing countries. In view of their important impact on the economic and social situation of these countries, special attention should be given in this respect, to agro-based industries, and in particular food-processing industry. The present paper aims at contributing to analyse this particular problem in the sector of vegetable oils and fats.

2. Among the main agro-based industries, the food-processing industry forms the major part accounting for an average of 60% of their output. The food-processing industry is a leading industrial sector, and for several decades to come it is likely to remain the largest industrial sector, particularly for most developing countries.

The share of the developing countries in the world-production of vegetable oils and fats (50% of total world-production in 1975)[1] shows the importance of this sector.

3. A considerable percentage of the vegetable oils and fats processing factories in developing countries are operating under capacity. One of the reasons of the underutilized capacity is a poor technical availability of the equipment, estimated between 30 and 40%. Experience shows that 80% of the unavailability is due to maintenance problems in the broadest sense, especially in newer plants.

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1) Sources : FAO, USDA, Oils World Weekly

4. The problem of spare-parts and machinery shortages was recognized by the First Consultation on Food-Processing Industry as one of the important constraints negatively influencing the efficiency of the food-processing industry, particularly the vegetable oils processing factories' operations under the potential capacity.

5. Taking into consideration that the production of oil seeds, processing and marketing should be completely integrated, the shortages of spare-parts and frequent machinery breakdowns create enormous bottlenecks.

Oilseed production constraints due to maintenance problems of technical equipment such as irrigation pump stations, rolling stock, mechanized production equipment and communication equipment, should not be under-estimated. These constraints apply both to the production of the individual farmer (lack of adequate skills and of knowledge of the importance of maintenance) and to the country as a whole (limited capital resources). These constraints, added to deterioration of oil seed quality due to bad storage conditions, cause one of the major problems facing the oilseed processing in developing countries, i.e. continuity of supply of raw material[1].

Inadequate maintenance of oil seed processing machinery and equipment causes at least poor oil recovery but in many cases production stops. This bottleneck results in oilseeds being completely wasted because of unavailable and/or inadequate storage facilities, prior to plant operations.

All this results in a consequent increase of production costs, which will normally be passed on to the consumer and effectively limits the market for the end-products. On the other hand, a poor quality and irregular quantities will

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1) "Draft World-wide Study on the Vegetable Oils and Fats Industry - 1975 - 2000" UNIDO/ICIS.46

decrease the demand for the product at the domestic level and will interfere with favourable patterns of trade at the international level.

II. MAIN CONSTRAINTS FACING DEVELOPING COUNTRIES IN THE PROPER PROCUREMENT, MAINTENANCE AND REPAIR OF MACHINERY AND EQUIPMENT, PARTICULARLY IN THE VEGETABLE OILS AND FATS INDUSTRY

II.1. Differentiated problems from the geographical and economical situation view point

6. Results of an evaluation study in seven selected developing countries[1] as well as discussions with representatives of the vegetable oil industry and relevant consultations[2] indicate that the more advanced the developing country, the better is the overall technical (spare part) situation of the vegetable oil industry. The situation, however, becomes more and more problematic with the decreasing level of development. Furthermore, even the availability of foreign exchange is no guarantee for a developing country's vegetable oil industry's appropriate technical condition.

7. The solvent extraction technology and/or a combination between solvent extraction and mechanical pre-pressing is pre dominantly used in developing countries with a higher level of development. The mechanical pressing system is dominating in the least developed countries and developing countries on a lower level of development[2].

This fact is very significant as the spare-part supplies and maintenance costs for mechanical pressing plants are unproportionately higher.

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1) Paraguay, Peru, Indonesia, Korea, Nigeria, Egypt and Syria - UNIDO Project US/INT/78/073

2) Source : "The Spare-parts Requirements of the Vegetable Oil Industry in developing countries". UNIDO/IO/R.71.

8. The situation in Asia differs considerably from country to country[1]. A country like Korea which has a large-scale modern oils and fats industry and has facilities and highly qualified personnel available, is in a similar situation as developed countries. In Indonesia, on the other hand, the situation is more difficult and can be considered characteristic of Asian developing countries. Some larger capacity plants are fairly well maintained because they represent a traditional industry partly operated with foreign participation or expert personnel. Smaller production units (mainly expeller plants) face considerable difficulties in their spare-parts supplies.

9. In Africa the situation is in general more difficult than in Asian countries. In North Africa and especially in Algeria, larger modern factories face a difficult maintenance problem due to use of a sophisticated technology and absence of adequate management and qualified personnel. In West Africa a lot of countries have less spare-parts supply difficulties because of their special relations with members of the European Economic Community. They face more organizational and personnel problems. This is not the case with the least developed countries of West Africa, such as Guinea and Guinea-Bissau which face enormous maintenance difficulties and in particular spare-parts supply problems because of lack of foreign currency. This situation occurs in the same sense in the rest of Africa in countries such as Sao Tome & Principe, Madagascar, Angola and Mozambique. In some countries of East Africa (for instance Kenya) and of the South of Africa (Zambia, Zimbabwe), the situation is better but in general the dominating small and medium-scale production plants in a large number of countries in Africa are in a bad condition with mostly obsolete equipment. Maintenance systems hardly exist, skilled personnel are not

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1) Op.cit. page 5, (2)

available and the spare-parts problem is catastrophic.

10. Except only in a few countries the situation in Latin America is generally more satisfactory. A comparatively well functioning engineering industry exists which to some extent has been established with the assistance of developed countries whose traditional engineering industry is well represented. A rather high percentage of the oils and fats industry consist of large scale processing plants with the required organizational settings. But still quite a number of the traditional small scale factories continue their production and it is this particular production sector which also faces the spare-parts supply problem[1].

II.2. Obstacles at factory level, branch level and national level, external impediments

11. When reviewing the different obstacles, which affect operation and maintenance of vegetable oils and fats plants in a developing country, one must make the distinction between 4 major groups:

- personnel constraints;
- problems related to the technical equipment
- technical documentation and spare-parts constraints;
- constraints related to the local economical and social infrastructure and logistic support.

Each of these problems will be briefly examined hereafter.

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1) Op. cit. page 5, (2)

Personnel constraints

12. The extent of the personnel problem in most of the oil processing plants in the third world is important and the complexity of the problem is often under-estimated. Apart from the problems of motivation and attitude towards the job (e.g. discipline), the technical qualification of the personnel is generally extremely low, especially at the level of craftsmen and foremen. The lack of technical schooling, and above all the absence of an industrial tradition and thus experience, make the daily maintenance in many countries a serious problem. This is in particular the case in solvent extraction plants, which require considerably more discipline and skill in handling than mechanical pressing plants.

13. The magical word of training appears therefore in block letters in every contract of construction. Training at the suppliers is in many cases reduced to a more or less vacation stay, or to a completely inadequate training. The training is mainly given to the top-level personnel of the future plant. The foremen and specialized craftsmen who have to be able to maintain and repair the machines are neglected.

14. The few technically educated people are often badly used. The maintenance organization is most of the time inadequate and not followed. A maintenance system does rarely exist. In addition, the mentality of the personnel towards the requirements of a modern industry is a very difficult and delicate problem indeed. Personnel who have demonstrated remarkable selfdiscipline in an agrariar or an artisanal environment, do not succeed in acquiring a collective discipline, which is essential for every industrial pattern of

society. The high turn-over of operation and maintenance staff adds to the problem.

15. Problems of motivation exist, which have different reasons, among which the low salary-level is certainly not to be disregarded. Another reason is the lack of industrial tradition and also the fact that many of the workers do not fully understand the importance of their proper job (example: the very important greaser function).

16. Personnel problems are sometimes solved by experts or technical assistance. But apart from the fact that it is very difficult and thus very expensive to expatriate good experts, one must face the fact that technical assistance cannot be a definitive solution and must be considered as a palliative.

Problems related to the technical equipment and contracts

17. Generally problems with equipment find their origin at a very early stage. They are often caused by a poor investment policy, or by the lack of knowledge of plant operation conditions in developing countries by the manufacturers whose machines are technically unsuited to these countries. The plant location is often bad (the plant is built in areas where from a technical point of view this should be prohibited: lack of energy or water,
corrosion problems, drainage problems, etc.). The equipment is frequently of a too advanced technology for the country concerned (especially in solvent extraction plants) or in other cases already outdated.

18. Too little attention is paid to the future maintainability of the plant (accessibility - repairability, etc). In addition, the lack of national standards (e.g. for technical equipment and constitutive elements) and the variety of suppliers, constructors and sub-contractors, create a basic problem of spare parts.

Another result of the lack of industrial experience is that the machines are badly operated and nearly never maintained, so that the life time cycle is very short. Generally there are no policies for renewal of equipment, which result in frequent machinery breakdowns.

19. It should be noticed that in different countries the purchaser of equipment has very little to say as far as the choice of the equipment is concerned, especially when it concerns projects financed through soft loans or by donor countries. In those cases, the purchaser is obliged to accept the equipment of the supplying country without taking into consideration other installations which may already exist in the country or the region. Standardization of the equipment is therefore ignored and even the reliability of the imposed technology is not considered. Moreover, one notices that many donor countries take this opportunity to get rid of their old stocks, which results in a completely outdated technology and a very expensive operation.

20. At the occasion of contract negotiations for the purchase of vegetable oils and fats factories, the point of view of the maintenance engineer is rarely requested and actually never considered. Moreover, results of contracts for the turn-key type factories have on the whole disappointed the

client who was usually not technically equipped to operate his plant and nad to pay dearly for further assistance from the construction engineer. "Product in hand" contracts have not proven to be better either, since the same problem exists once the construction engineer has left after the initial period of management. Such management assistance is mostly given on a very short term basis (the duration foreseen by contract) without allowing for a lasting arrangement or being adapted to local conditions.

21. In general, one notices that the contract clauses referring to maintenance (organization, training, technical documentation, spare-parts) are too often vague or non-existent.

As far as food-processing is concerned, there is a lack of systematic exchange of information and experiences regarding maintenance and the adequate choice of equipment, both on a national, regional or international level. It frequently happens that factories face problems which have already been solved in other countries or other parts of the same country.

Technical documentation and spare-parts constraints

22. Experience has proven that lack of adequate technical documentation is one of the most serious handicaps which developing countries have to face when trying to master technology. Moreover, an incomplete documentation hampers maintenance highly and makes local manufacturing of spare-parts impossible. Too little attention is given to this matter in the purchaser's contract clauses and detailed specifications for the technical documentation do not exist.

23. The reasons for spare-parts shortages in a vegetable oil processing plant in a developing country are of a different nature. First of all, there is the element of vulnerability of the installations under prevailing conditions. A difficult climate and natural environment, human shortcomings, lack of local technical support, a poor raw material quality and very often badly chosen equipment make the relative consumption of spare parts much higher than in the industrialized countries. In addition to this, the purchasing of spare parts creates enormous problems: the identification and codification of the parts is almost an impossible job to language problems, and the inadequacy of technical documentation which is most of the time incomplete, not clear and vague. Enormous problems exist in finding a supplier for one or another spare part: these problems start with the difficulties in finding the name of the supplier or manufacturer and end with the difficulties to persuade him to separately sell the parts in question, especially when small amounts are concerned. In fact, very often parts which cost a few cents may well cause the breakdown of whole plants, and a supplier may not be interested to undertake all the steps necessary for selling small quantities on the international market. Moreover, there exists the problem of import licences, international banking transfer, long delivery times, custom clearing and sometimes unbelievable bureaucracy which slows down the commercial transaction, up to a point where it is at a stand-still. When finally arriving, no storage facilities are available or the parts must be stocked in bad conditions, and arrive in stores with a very poor infrastructure causing waste or dammage.

In addition to this, it should be noted that the lack of foreign currencies in some countries make a sufficient and continuous import of spare-parts impossible.

Local economical and social infrastructure and logistic support constraints

24. As to the last group of problems, infrastructure and logistic support, one can be short. Housing and transport problems for personnel, shortage of medical facilities, supply problems, power cuts, absence of telephone lines, lack of local sub-contracting facilities, bureaucracy, inefficiency, slowness and in many cases corruption: all elements which make operation and maintenance of technical equipment in the third world difficult and frustrating.

III. ILLUSTRATION OF BASIC MACHINERY, EQUIPMENT AND TOOLS, INDESPENSABLE FOR OIL PROCESSING, MECHANICAL PROCESSING (EXPELLERS), SOLVENT EXTRACTION, OTHERS

25. A detailed description of different machinery used in the vegetable oils and fats processing industries would be out of the scope of the present paper. It should be mentioned, that reasons for diversification in machinery depend on the size of factories, sorts of oil-seeds or oil-crops, level of overall economic development, foreign exchange situation, availability of skilled personnel etc. Most of these aspects are well known by the engineering companies, and are well taken into account. Nevertheless, it should be stressed, that the lack of skilled personnel and of spare-parts is generally completely overlooked. Engineering of vegetable oils and fats plants should more and more be based on a realistic study of local operating conditions. Solvent extraction technology needs more developped skills than mechanical pressing plants and the initial investment is relatively higher. Moreover, solvent extraction is carried out on a large scale only in continuous systems which are entirely automatic in operation.

Both mechanical pressing and solvent extraction processing technologies have wear and tear problems, common to all industries and specific to each technology.

In a solvent extraction plant, the spare-part problems concern mostly mechanical parts such as bearings, couplings, V-belts, gears, gaskets and packings, etc. Corrosion problems are frequent in this type of installation and require regular replacements of piping and accessories.

The specific spare-parts, required for solvent extraction installations consist basically of control and measuring instruments, valves and fittings and explosion-proof electrical equipment (electric motors, electric power distribution equipment, etc.) The lack of this particular type of spare-parts does not only influence a factory's production efficiency but more often causes the need for production stoppage.

In a mechanical pressing process the common spare-parts are about the same type, but the wear and tear problems are more substantial. Specific spare-parts, such as pressure cones, hydraulic steering equipment, press cage shells, twin screws and clamping bars need a lot of maintenance or must be replaced frequently (for instance cages must be removed and cleaned every 600 hours, upper and lower clamping bars must be replaced at least every six months, screws must be rebuilt by welding or must be replaced every 4000 to 6000 hours, provided good maintenance is carried out, etc.).

26. Some examples of specific machinery and equipment for solvent extraction plants are percolation extractors, evaporators, desolventizer-toasters, leaf pressure filters, rotary drum filters, centrifugal separators, exchanger-desaerators, explosion-proof electric equipment.

27. Some examples of specific machinery and equipment for mechanical pressing systems are open and closed batch presses, continuous screw presses (expellers), centrifuges, steam sterilizers, pickers, vibrating strainers, digesters. Among the presses, the continuous screw presses dominate more and more because they require less labour than hydraulic systems, they eliminate the need of press cloths, they are adaptable to a wide

variety of raw material and they produce a higher yield of oil. On the other hand, they have relatively high power requirements, need skilled labour for operation and maintenance and are not adapted to intermittent operation.

28. Machinery equipment and tools of general application concern all kind of control and measuring instruments, stainless steel piping material and tanks, valves, centrifugal pumps, filter presses, reduction gear boxes, hydraulic equipment, dosing screws and equipment for utilities (power generation, water treatment, boiler house, etc.).

29. There exists a very little number of engineering companies specialized in the manufacturing and supply of complete vegetable oils and fats factories. Most of these companies are situated in developped countries and have their own processing technology. Some are specialized in the processing of a few number of raw materials.

Prevailing types of contracts in the vegetable oils and fats industrie are the turn-key or semi-turn-key contracts, and since a few years "the product-in-hand" contracts.
In turn-key contracts, the whole plant is built and supervised by the contractor and after having carried out the performance tests, the plant is handed over to the buyer who takes over operation responsability.
In semi-turn-key contracts, the buyer has to supply parts of the plant, for instance civil-works, road facilities, water, energy, etc. The engineering company is responsible for the turn-key construction of the processing installations and in some cases of the utilities.

The "product-in-hand" contract is a turn-key contract with an initial management period (varying from 1 to 3 years) by the engineering company. The supplier must introduce a complete organization of the plant, must train personnel and must run the plant during the initial period with buyer's personnel.
Mixed types of those contracts have also been established and new types, such as "guaranteed product" or "guaranteed market" have been tried out.

IV. ACTIONS AND MEASURES NEEDED TO OVERCOME EXISTING SHORTAGES OF MACHINERY AND SPARE-PARTS IN THE VEGETABLE OILS AND FATS INDUSTRY

IV.1. Introduction

30. Before examining detailed measures to overcome spare-parts shortage, attention should be drawn to the fact that the maintenance problem in a developing country is an integrated problem. Improving only one of the constraints will not solve the whole problem. In fact, it is almost certain that action in one limited area will not even have a palliative effect. The maintenance problem exceeds the scope of the vegetable oils and fats factories or even of the food processing industry branch. The problem even exceeds the scope of industry and should be considered at a national and general level in all developing countries. In other words, in order to be succesful, any remedial action will need to cope with a national maintenance strategy . The following seven paragraphs describe in a general way -but applicable to the vegetable oils and fats industry- the outline for the remedial actions to be taken in the various fields.

31. It should be avoided that plants, built in developing countries, are designed for operating and maintenance conditions, standards of personnel, availability of spare-parts, in short, conditions which prevail in developed countries. It is necessary to involve in the design and setting-up of a plant staff who know what it is to run and maintain industrial equipment in a developing country. As long as copies of plants from industrialized countries will be built with just a very small allowance for some complementary training, or some

spare-parts, the problem will not be solved. A completely new strategy must be adopted, which aims at a total technology transfer which not only allows the production of quality products at a reasonable cost, but also enables local personnel to run and maintain the plant over a normal lifetime.

32. The choice of adequate technology is a part of that new strategy, and must provide for the equipment to be operated and maintained correctly under the given human and natural circumstances. One should be extremely careful with highly sophisticated machines, which are very hard to maintain under most of the conditions prevailing in developing countries. This does not mean that an obsolete technology should be adopted but rather that a strong, modern and reliable technology, adapted to the needs of the country should be used. In this respect, there is also the need for a strict application of national and/or plant standards. One cannot insist enough on maintainability of the equipment, on accessibility of spare parts or on easier repair; in one word, on the necessary action at the conception stage, to prevent that the plant will be a stillborn.

33. Adequate organization can "soften" the terrific personel problems which exist. Experience in developing countries has proven that centralization of all-plant maintenance activities in one department is the most efficient way of working. In addition, it is very important that this maintenance department be placed sufficiently high in the organizational chart of the plant that it is independent of the production department. Very detailed, nearly "religiously" carried-out elaboration of job-descriptions are necessary on to the lowest level, at the same time forgetting all industrial experience and all automation which may be used by more

qualified people. A simple but strict organization should be applied and one should insist on planned, and in particular on preventive maintenance, based upon an efficient data collection and transmission system.

34. The cost of operation, and in particular of maintenance should be estimated realistically, an oversight which very often exists when evaluating industrial projects. One should not accept the principle that existing local subcontracting costs nothing, but be aware that for the slightest repairs, modification or extension one may well have to require the presence of an extremely expensive expert from abroad. A new concept of personnel training is also needed, which is psychologically justified, and which is adapted to the local difficulties. Such training is surely not a matter of technical qualification of the engineers alone, but must promote training of foremen and skilled labour.

35. A special attention must be given to a clear and complete, but at the same time as simple as possible, technical documentation, in the right language, with exploded views and simple instructions for unexperienced personnel. This documentation should be centralized at the plant level and a strict administration and management system (filing, handing-out, updating), is necessary to assure that no document will be lost.

36. One must also insist on the supply of a realistic quantity of spare parts, not only the expensive and bigger parts, which hardly ever break down, but also the vital and unobtrusive parts which cost nothing but may reduce all other efforts to nil. In this respect, developing countries should

also get workshop-drawings for the manufacturing of spare parts. At the plant level a solid stock management system, based on a correct designation and codification and a realistic stock forecast must be introduced. Measures to ease imports on a national level must be considered.

37. The supply of an industrial plant is not any longer the supply of the equipment plus a number of other services. It is more than that. It is an integrated process during which the future production -that is to say the operation and the maintenance- must be adequately provided for.

IV.2 Establishment of a spare-parts management system at the factory and on branch level

38. At the factory level, the first thing to do is the selection and identification of the parts to be stored. A special service, staffed with qualified technicians, will deal with the study of all drawings and elements of the equipment, in order to make a forecast regarding parts to be supplied. In mechanical pressing plants, this team will mainly be composed of mechanics while for solvent extraction installations the share of control and measuring craftsmen will be more important.

39. The parts will then have to be correctly designated and codified, in order to provide a uniform language between user, buyer and supplier. One must distinguish broadly between standard parts which have to be designated according to a standard, or in a way that makes their purchase possible from the manufacturer of the part, and specific machine parts which will be so designated, to allow their purchase from the manufacturer of the machine. A morphological codification gives

the best results. The code of the specific articles (e.g. screws, cones, cage shells, etc.) will moreover be based upon the devision of the factory in several sections and machines according to the process (e.g. in a solvent extraction plant: storage, preparation and conditioning, solvent extraction, degumming, de-acidification, refining, hardening, bleaching, recovery from earth, winterisation, deodorisation, physical refining, conditioning and storage).

40. Reliable stock management systems must be introduced, based on simple models which allow a stock inventory control and forecast under the given conditions of long deliveries, instable consumptions, etc. Data collecting and evaluation about stock movement and a daily follow-up and control of the stock control cards are the only way to reorder in time the necessary parts. A special stock-management model should be applied for expensive parts with long delivery times, such as expeller screws, tubular plates from heat exchangers, special shafts for gear boxes, different parts in special alloys, etc.

41. Adequate storage facilities in the plant and cleaning and preservation methods will avoid premature obsolescence or damage to vulnerable parts.

42. In order to reduce the number of different articles in stock, plant standards for vegetable oils and fats factories and even standards covering common machines to the whole food processing industry should be imposed on the supplier when buying new equipment.

Furthermore, a system of exchange of information and experience about the various spare-parts aspects, should be introduced between vegetable oil and fats factories for specific machinery and between the different plants of the food processing industry for common equipment (such as boilers, transformers, water treatment equipment, heat exchangers, pumps, electric motors, etc.).

IV.3. Provision for spare-parts requirements in contractual agreements

43. At the occasion of each purchase of industrial equipment, a sufficiant budget for the purchase of spare-parts should be considered.
However, one should take care of the following points:

- the contractual volume for spare-parts, which are needed for a year of operation of a vegetable oils and fats factory is different for solvent extraction plants and mechanical pressing factories. Based on different maintenance audits in developing countries and various literature, one could make the following estimations:
  - solvent extraction plants :

- specific parts (security parts included)	5% of the value of the equipment
- standard parts	2,3% of the value of the equipment
- consumables	1,6% of the value of the equipment

- mechanical expeller extraction :
  - specific parts (security parts included) — 8% of the value of the equipment
  - standard parts — 1,4% of the value of the equipment
  - consumables — 1,6% of the value of the equipment

- the selection of the parts which will be purchased in the scope of the general contract shall be made by the engineers of the buyer on the basis of:
  - a forecast of the constructor of the machine;
  - a detailed study of the drawings of the machine and of its assemblies;
  - an exchange of information between other vegetable oils and fats factories in the country or in the region

44. Following contractual clauses about spare-parts should be observed:

- technical documentation must include exploded views and all detail drawings with a list of all components of the machine;
- manufacturing drawings for non-durable parts must be given;
- all parts must be designed with reference of the manufacturer of the part or in conformity with national standards, especially for standard parts;
- various other information, such as number installed, origin, weight, custom code, delivery time, unit price, consumption forecast;

- special attention should be drawn to packing conditions and delivery plannings in case of a new plant;
- supply guarantee for several years with fixed price-revision terms.

IV.4. Role of governments

45.. Appropriate government policies for overcoming existing spare-parts shortages could be summarized as follows:
- create national standards, by adopting new standards or adapting existing standards;
- coordinate actions between all industries to create a uniform designation with common codification system;
- integrate stock-management training-courses in the national education program;
- liberate funds for specialized training of technical personnel in the field of spare-parts designation and codification, stock control systems, storage methods, etc.;
- stimulate exchange of information and experiences between industries on national and international level (e.g. seminars, conferences, workshops, regional commissions, etc.);
- improve communication facilities between suppliers and users;
- facilitate local establishment of dealers to assure servicing;
- create regional stores for standard spare-parts, especially in countries with a centralized market economy;

The import-circuits of spare-parts, require special attention especially in countries with a difficult foreign exchange situation and the role of the government should consist in facilitating administrative procedures and in providing sufficient funds.

In addition, due to the need for a system of exchange of information and experience on the one hand, and in order to tackle the maintenance problem as a whole, it is advisable to create a central body at the national level. This will have the responsibility to coordonate the various remedial actions, to assist and inform the companies in the field of maintenance, etc. This body could, for example, be a central maintenance commission, composed of representatives from industry and from professional associations, as well as from ministries.

IV.5. Domestic production of spare-parts

46. The local manufacturing of spare-parts for equipment and machinery for the vegetable oil industry is much more complex than usually thought. In addition, the import substitution of the parts which can be manufactured locally, should not be over-estimated.

Statistics about manufacturing of spare-parts in vegetable oils and fats industry do not exist but the following figures, which have been estimated at the occasion of a maintenance study in an african country, are very relevant[1]:

About 40% of the spare-parts required each year for industry (mostly standard non-durable parts) can be manufactured locally (provided all additionally mentioned conditions are satisfied). These represent 15% from the total value of annually needed spare-parts in industry, causing an import substitution of only 10% (Because in an industrial spare-parts store, most of the articles only represent a small percentage of the total value of stored items).

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1) UNIDO DP/ID/SER.B/385 "Etablissement d'une stratégie industrielle à Madagascar", 1983.

One should therefore be very careful in the decision of making the necessary investments (in hard currency) for local manufacturing of spare-parts.

47. Following conditions must be fulfilled before starting local manufacturing of spare-parts:

- availability of manufacturing drawings;
- availability of material testing equipment;
- availability of manufacturing equipment (foundry, forge, metal cutting machines, surface treatment equipment, etc.);
- availability of skilled personnel;
- availability of raw material;
- agreement with constructor (know-how, licences, export rights, warranty);
- availability of transport facilities in the country.

48. On the other hand, a detailed evaluation study should be made on national level, in all vegetable oil factories of the developing country concerned in order to make an assessment of the variety and quantity of spare-parts the local industry might annually require.

Moreover, it should be determined how workshops for local manufacturing of spare-parts must be conceived in order that they may serve other industries. An inventory study about existing manufacturing capacities and engineering companies installed in the country will enable to have an idea of the possibilities on national level.

49. Manufacturing of spare-parts on industrial level will need negotiations by authorities for cooperation with constructors, local engineering companies, research institutes and external suppliers of machinery and equipment, in order to obtain the necessary technical assistance and adequate supporting services, especially for the manufacturing of complex specific spare-parts.

IV.6. Proposed actions to be undertaken by UNIDO

50. UNIDO might be in a position to assist developing countries in overcoming shortages of machinery and spare-parts both on the factory or branch level and on national level. UNIDO's assistance could contribute to the general solution of the maintenance problem (of which spare-parts are only an item) on the national level by assisting governments in:

- creating a national maintenance commission (or institute) the main target of which will be to promote maintenance in all industries, to coordinate actions for improvement of maintenance, to stimulate and sensitize industrial entrepreneurship for upgrading the maintenance function, to exchange information and experiences between different industries on national and international level and to participate at international meetings about actions on maintenance;
- educating population in order to create or stimulate its sense of maintenance by national sensitizing campaigns

UNIDO's assistance could also contribute to the solution of the spare-parts problem in all industries and especially in the vegetable oils and fats industry by following

actions:

- survey of type and quantity of machinery and equipment used in the vegetable oils and fats industry in selected developing countries. This survey should be realized on a regional basis, in order to allow the possibility to develop solutions, valid for different countries at the same time;
- inventory survey of existing manufacturing capacities (machinery, equipment, skills) in selected countries. Based on such inventory, feasability studies could be made for rehabilitation and extension of existing workshops or for creation of new ones;
- based on the two above surveys, a feasibility study related to domestic production of spare-parts could lead UNIDO to assist in the creation of a pilot workshop in a selected country for manufacturing of spare-parts and serving industries of a whole region.
  This pilot project would include machinery and equipment, training of machine-operators, drawing office and engineering staff, training of staff, management;
- stimulate cooperation among countries of one region for manufacturing of spare-parts;
- assist governments in negotiations to reach agreements with constructors of vegetable oils and fats industrial equipment and engineering companies concerning know-how licences, export rights, technical assistance for manufacturing of spare-parts;
- assist governments in obtaining services and assistance from technology centres, research institutes, material testing institutes, etc.;
- introduction of an integrated spare-parts management system in a pilot vegetable oils factory in a selected developing country. Experiences would be communicated to other plants on branch level;

- plant standardization of a pilot vegetable oil factory in a selected developing country. This standardization should not only concern standardization of machinery and equipment, but also of spare-parts;
- elaboration of standard contractual specifications for the purchase of new plant by developing countries concerning :
    - technical documentation
    - spare-parts
    - common equipment for utilities
    - specific equipment for vegetable oils and fats factories.

V. CONCLUSIONS

51. The supply of an industrial plant in developing countries is not any longer the supply of the equipment plus a number of other services. It is an integrated process during which the maintenance function is one of the most important ones.

Technology has to be adapted no doubt about that. But technology is not an isolated element. The best technology is worth nothing if one has no personnel to maintain the machine, no spare-parts, no documentation or no tools.

52. In the vegetable oils and fats industry and in the food industry in general, because of its important share in national economy of developing countries, a special attention should be drawn to all measures needed to overcome existing maintenance problems from the conception stage onward.

Governments should consider that the maintenance problem is not only a technical matter, but as well a political and an economical question.

53. In the scope of the North-South dialogue, a completely new concept of transfer of technology -taking attentively into consideration local operating and especially maintenance conditions- should be at the base for the solution of industrialization problems of many developing countries.