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*Central repair workshops in developing countries**

General functions

Compared with industrial enterprises in developed countries, industrial enterprises in developing countries encounter special difficulties in maintaining, servicing and repairing their mechanical equipment and fleets of cars. Enterprises in industrialized countries have the advantage of being located relatively near the manufacturers of their mechanical equipment and have a well-functioning transport system at their disposal. Thanks to the dense road and rail network and highly efficient postal and telephone systems, it is possible to order and receive spare parts within a very short period. Orders placed by telephone or teleprinter reach the producer within minutes, and a well-organized enterprise can dispatch the order on the day it is received. When ordering spare parts, the machine operator can consult an illustrated catalogue in which the spare parts are listed. Thus, he can quickly find the order number of the damaged part and place his order.

The entrepreneur in an industrialized country can also take advantage of the well-organized repair service that equipment suppliers generally provide to their customers. Its well-trained personnel, operating special customer-service vehicles equipped with tools and spare parts render prompt assistance when called upon. In addition, there are specialized workshops that can carry out heavy and specialized repair work.

In developing countries, distances between the manufacturer and the purchaser of the machines are usually very great. There are generally very few machine producers in the country so that most of the machines and equipment must be supplied from producers abroad. Thus, the transmission of orders to the producer depends on the means of communication available. The communication with the foreign producer can frequently be very time-consuming. Inquiries—which are quickly dealt with in industrialized countries—may take weeks in developing countries. Furthermore, operating instructions, data on mechanical equipment and spare part catalogues are not always available or printed in the language of the country concerned. Obviously, translations may easily lead to misunderstandings. Regular customer services are still lacking in most developing countries.

The delivery of spare parts can be delayed not only through the complicated communication to the foreign supplier but also through the obstacles for obtaining the necessary import permits and custom clearance etc. as well as through the inefficient transport system within the country.

Special problems have arisen in developing countries because they have obtained from industrialized countries, to a large extent through bilateral assistance programmes, a variety of machine makes, all of which differ considerably from one another in their servicing and maintenance requirements as well as their spare parts. It even happens that a machine has gone out of production and the spare parts required are no longer available.

The solution to these problems would be to make the consumer as independent of the manufacturer as possible with respect to spare parts and repairs. The basic problem here is how to manufacture and repair the machine parts needed by small businesses when there is a lack of skilled workers and the necessary equipment. Owing to the lack of personnel and materials, industrial enterprises in developing countries are generally unable to maintain their own mechanical engineering shops. Small enterprises are also unable to provide full-time employment for skilled repair workers.

Some of these difficulties may be overcome by establishing central workshops, which, once equipped with skilled personnel and adequate machinery, are able to

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repair machinery that has broken down and even produce the required emergency spare parts. Central repair shops are specialized repair shops servicing various industries and other establishments in a specific region. The repair shops can be of great use in regions where there is a relatively great concentration of industries in particular, small-scale industries that have similar repair requirements.

The location of a central repair shop obviously depends on the location and density of the industries it services and on what means of transport and communications are available. The customer, that is, the enterprises for which the repair shops are intended, should be able to contact the repair shop quickly. The proximity of an airport is another factor that may influence the choice of location. Another important factor in determining the location of the central repair shop is the availability of a mains electricity supply. Generating equipment belonging to the repair shop could, however, replace the mains electricity supply. The supply of water is also a factor to be considered. When selecting the location of the central repair shop, attention must finally be paid to the transport facilities to the closest housing area.

The tasks of a central repair shop can be divided into three groups:

(a) Repair of machinery and equipment and the production of certain spare parts;

(b) Training of apprentices, skilled workers, masters, unskilled workers through organized courses and demonstration of machinery;

(c) Carrying out work as subcontractor.

The main function of the central repair shops is thus to repair machinery and equipment of small enterprises and to manufacture replacement parts such as gear wheels and all other parts requiring turning and milling operations that can be carried out with the mechanical equipment available. In addition, various emergency spare parts can be produced. In this way central shops can carry out repair work beyond the technical scope or economic means of an individual enterprise. In particular, this concerns repair work requiring heavy repair equipment and/or highly skilled labour. Thus, the central workshop can economically use this heavy equipment and employ the skilled labour.

The second important function of the central repair shops is to train skilled workers. A well-equipped central repair shop can easily prepare 20 to 30 apprentices per year for the skilled worker's examination. That means that with an apprenticeship of three-and-one-half to four years the shop will always have 80 to 120 apprentices in training. A well-equipped workshop is necessary for the first two years' training of mechanics, precision mechanics and toolmakers, blacksmiths, motor mechanics, electricians and perhaps also joiners. The number of apprentices is determined by the size of the shop, its mechanical equipment and, not least, the number of skilled workers able to pass on their knowledge and skill to another person. The future technological development of a country depends on the quality of training given to apprentices, and it is essential that those who set the standards appreciate this fact.

Advanced training courses for skilled workers leading to a master's certificate should be held in addition to apprentice training courses. Short training courses for unskilled workers should be held in conjunction with apprentice training courses, in order to create a labour force capable of carrying out work that does not require a craftman's skill. This will considerably reduce the cost of repair work.

The further training of workers for specialized work must also be considered. The training of workers in special skills such as autogenous and electric welding, shielded arc welding, is in the interest of the central repair shops, because it will enable small enterprises eventually to have repair work carried out locally. This will then reduce the central repair shop's work load.

The planning of a central repair shop must be based on the expected volume of repair work. If the inflow of work is not continuously in correct proportion to the size of the shop, additional work of a different type may be undertaken. For instance, the manufacture of certain consumer goods could be commercially feasible. They could be produced on the presses available, and this would fill the gaps between repair work. Care must be taken, however, not to allow repair work on vital machinery and equipment to suffer as a result of the production of consumer goods. Repair work and the production of replacement parts must always be given priority.

The central repair shop should be equipped with a sufficient number of machine tools of different sizes and working capacities and of the most straightforward design and construction, possessing all the usual fittings, together with special attachments, and a complete set of tools. Special-purpose machines that remain unused most of the time, and therefore represent a bad investment, and also automatic and semi-automatic machines, should be avoided and preference given to manually operated machinery, since work sent to the central repair shops is so varied in character.

The central repair shop will need the following shops and equipment:

(a) Machine tools—lathes of various types; bench and column-type drilling machines; milling and planing machines of various sizes; grinding machines of various types, e. g. tool grinding, cylindrical grinding, surface grinding, double wheel stand grinders; sawing machines;

(b) Welding shop—electric and autogenous welding

and cutting equipment, spot welding equipment;

(c) Smithy—blacksmith's forge, anvil and swage blocks;

(d) Tinsmith's shop—tin shears, multipurpose machine, folding press, embossing and bending machine, flanging and wiring machine, hydraulic presses;

(e) Joinery—planing machines, band saw, circular saw, carpenter's benches;

(f) Toolroom—a variety of hand-operated electric machine tools and complete tool sets;

(g) Apprentice workshop—workbenches and vices;

(h) Classroom—appropriate equipment.

Should the planned central repair shop be extended to include vehicle repairs, the following shops and equipment will be needed:

(a) Engine repair shop—equipment required for repair of valves, cylinders and pistons;

(b) Shop for the repair of electric units—test stand for dynamo and starter;

(c) Battery-charging station—battery-charging equipment;

(d) Chassis repair shop—pits, lifting stages, lubricating bays, brake testers, tire repair equipment, balancing machines;

(e) Car-washing plant;

(f) Paint-spraying plant.

The above-mentioned list of equipment does not claim to be complete. It is intended to show what equipment a good repair shop should have if it is to carry out a wide range of repair work and cannot exactly anticipate the tasks with which it will be confronted.

When the repair shop is being planned, it must be ensured that sufficient materials and tools that are subject to wear are available. Special emphasis must be placed on the supply of technical gases. Owing to the large number of machines and equipment obtained from various countries, tools of both the metric and the British systems must be available. This applies above all to drills, screw taps, reamers and spanners.

Precautions should be taken against fire, theft and accident; sanitary installations must be provided. Office space must be provided for the technical management, administration and personnel office. In addition, meeting rooms, recreation rooms and canteens are needed.

There is no doubt that in most developing countries there is a real demand for central repair workshops. Much has been done in the field of training, especially the training of apprentices, but there is no agency where repairs, training and perhaps the production of consumer goods are carried out under the same roof; the establishment of such an agency would be desirable.

Nevertheless, the establishment of a central repair workshop raises certain problems. In many regions where businessmen are already operating relatively simple machinery, it is possible to find workers who are prepared to carry out repairs on this machinery but their equipment for doing so is primitive. Under these circumstances, the repairs, which can be made in a central repair shop in a few hours, require many days of laborious work. These workers lose their jobs when a central repair shop is established.

There is, on the other hand, a danger that in a modern enterprise like a central repair shop the administration may develop out of all proportion to the size and profitability of the enterprise, with the result that the cost of the jobs to be done will be high. The customer will have to consider carefully whether the repairs may not be cheaper when carried out in the traditional way with hammer and chisel, even if he has to wait longer.

Another question to be decided is whether the central repair shop should be a governmental or private enterprise. Who is to provide the funds and administer the enterprise? Are funds available from development aid or will the Government have to provide the money? If the enterprise is to be run privately, how can prices be controlled?

Mention should finally be made of the mobile workshop, which has proved its value all over the world and which should be particularly important for developing countries. Industrial enterprises in developing countries are often spread over a wide area or are located far from the industrial and transport centres. Under these conditions, mobile workshops can significantly assist individual establishments in carrying out repairs and even maintenance.

A mobile workshop is generally mounted on or in a normal vehicle, such as a lorry or station wagon, or a vehicle with special features is used. The size and the equipment obviously depend on the type and volume of the jobs to be carried out. The vehicle should not only serve to transport the equipment but also to provide working space for several craftsmen. The craftsmen, including the driver, should be trained in as many skills as possible.

The functions of the mobile workshop are to diagnose mechanical defects and to carry out the necessary repairs on the spot. The craftsmen decide whether they can make the repair with the equipment of their particular workshop or whether a part must be brought to the central workshop. Straightforward repair work and the production of simple spare parts can usually be carried out on the spot. In other cases the damaged part must be removed and brought to the central workshop to be repaired or remade. If the whole machine is found in need of a general overhaul, it generally must be sent to the central repair shop. For this purpose a fleet of transport vehicles belonging to the central repair shops must be available on request. To determine how many of these vehicles are requi in a region and what their capacity should be is often problematic. The requirements can in most cases be definitely determined first after the elapse of an initial period of operation.

Central workshops, mobile workshops, transport facilities for the central workshops as well as the supplies of material and spare parts for these repair shops and the shops within industrial enterprises must be regarded as necessary elements of a complete system for repair. The establishment of such a system requires thorough planning with due regard to the present and future industrial structure and location and the resources available.

Repair workshops in India

Rural Areas

The changes that have been taking place in Indian agriculture in recent years are the result of a conscious policy of the Government to encourage mechanized farming. Initially, the Government advanced a large number of loans to farmers for the purchase of tractors and equipment, and the effect of this policy on farm productivity has been heartening. However, because of inadequate maintenance facilities, much costly equipment has remained underutilized. For the farmer in a remote village, it is by no means easy to make arrangements for the repair of his tractor, implements and pump etc. when they break down. The nearest workshop, which itself is poorly organized and has the scantiest facilities, is perhaps miles and miles away, and no quick and economical means of transport and communication are available. With the growth of mechanized farming, repair and maintenance, which used to be the domain of the village *mistri* (technician skilled through experience alone), the blacksmith and the carpenter, is changing its character. With the ever-increasing number of tractors, implements, pumps, motors and the like, the need for better facilities for maintenance is beginning to be felt.

The increasing affluence of the village farmers and the conventional repairmen has led to the evolution of a new class of entrepreneurs, the once skilled *mistri* becoming the owner of a small workshop having a lathe or two in addition to a few other machines. Many such workshops have sprung up in areas where skilled craftsmen were concentrated; for example, Ludhiana in northern India, which was once famous for its artisans, has become a sizable industrial centre with numerous small factories manufacturing sewing machines, bicycles and even machine tools, besides many other consumer goods. Many of the small workshops working as ancillaries to the larger manufacturing units can provide the necessary maintenance facilities for farm machinery.

In the rural sector, the need for proper repair and maintenance of farm and other equipment is, however, hardly recognized, owing to the farmers' lack of experience. The small village workshop owners are equally ignorant when it comes to maintenance of their own machines. Both groups are only now becoming aware of the advantages of increased machine productivity resulting from better maintenance, perhaps because a son or a relative of the farmer or the workshop owner has received formal training in mechanics at the nearest industrial training institute. Much, however, remains to be done to improve the maintenance facilities for tractors, implements and the like.

Since farms are scattered, and this is particularly true of a sprawling country like India, it is not economically feasible for each farmer to have his own well-equipped maintenance facilities because of the large initial investment involved.

In general, each of the tiny workshops run by the skilled tradesmen, which now exist in the nearest small towns, specializes in a specific trade, e. g. a person with some knowledge of turning may have one or more lathes only. Similarly, the blacksmith and the carpenter have the skills of their respective trades only. Thus, having a tractor repaired, for example, is especially difficult because the farmer has neither the means of transportation nor the time to go from place to place to collect the necessary spares and to bring them to a repair workshop.

For equipment like tractors and pumps and equipment used in small metalworking factories, it is essential to have a set of spares handy if long downtimes are to be avoided. This implies stocking of important spares, which involves tremendous cost and would be a most uneconomical undertaking for the individual farmer or the small industrialist.

The establishment of maintenance workshops by private entrepreneurs and farmer co-operatives

It is urgent that the Government encourage the setting up of comprehensive maintenance workshops in the small towns most accessible to villages nearby. Enterprising private individuals and/or agricultural and industrial co-operatives could establish such workshops, in which the most frequently required spares could be stocked. To encourage such action the Government could:

(a) Make credit available on favourable terms to individuals or co-operatives to enable them to purchase machines for maintenance. Those granted credit should have demonstrated their technical and administrative ability.

(b) Provide at subsidized rates plots of land, with an assured supply of power and water, for setting up maintenance workshops.

(c) Give incentives to trade apprentices in the various industrial training institutes in the vicinity to accept employment in village

workshops. Such employment could perhaps be made a condition of admission to the institutes.

(d) Besides the training in specific crafts that workers receive at the industrial training institutes, it is also desirable to have courses for training mechanics in various fields. This can obviate the necessity of employing many specialized craftsmen in small workshops.

Mobile workshops run by companies selling farm equipment

Mobile workshops are extremely useful for servicing an extensive area. Such workshops, which perhaps contain a lathe, a drilling machine, a shaper, welding set, working table and workmen's important tools and instruments etc. are set up in specially constructed trucks. The power for running the machines is provided either by an independent diesel engine generating set or is taken from the engine of the truck. In areas where there are no roads suitable for motor vehicles, animal-driven carts are used.

It will be in the interest of companies selling tractor and farm equipment to run mobile workshops as a regular part of their after-sales service. These workshops, operating from a central location, can cover an area of about 60 square miles. The companies can also store centrally the necessary spares and maintenance materials.

In India, the government-run small industries service institutes (SISIs) in the various states have set up many village extension centres and mobile workshops. These centres and mobile workshops provide repair and maintenance facilities for mechanized equipment in remote villages. Even if there were a sufficient number of well-equipped workshops in the nearest towns, they could not economically meet the maintenance needs of these villages. Small-scale industry in rural areas consists mostly of manufacture of agricultural implements, wooden and steel furniture, toys; processing of agricultural produce; fabrication work etc. The maintenance facilities described so far will serve the purpose of all such units fairly well.

Urban areas

Small-scale industries in urban areas have special features of their own. The two main types of small units are: ancillary industries, which are feeder units for the large-scale sector; and general-purpose units manufacturing a large variety of consumer and other goods. Both types of unit have grown substantially over the last twenty years.

Most small units have no separate maintenance section, and in most cases there may not be sufficient justification for having one. The machines—sometimes quite modern and sophisticated ones—are maintained either by the operators themselves or at best by a few fitters/electricians who have very little knowledge of the machine, not to mention the repair and maintenance it requires. In any case, repairs are made only when the machine breaks down. When production is urgent, the owner/manager devotes considerable effort to getting the machine repaired, but if production is not urgent, the costly machines and equipment are normally left entirely to the care of the fitters. It is quite common to hear that extremely costly and sophisticated equipment, imported by small units only after overcoming enormous difficulties, is lying idle or grossly underutilized because of poor or no facilities for maintenance.

Facilities within factories

Most factories rely on their production operatives for maintenance of the machines. This is particularly true of industries employing basic machine tools (lathes, shapers, milling machines, grinders) in their production processes. Here production and maintenance interests normally clash, and the owners/managers tend to favour production at the expense of maintenance.

Factories using special-purpose machines for producing consumer and other goods do have some semblance of maintenance crews, but their function is usually to repair as quickly as possible machines that have broken down. The quality of maintenance is generally ignored.

Wherever basic machine tools are employed in production processes, production is too frequently interrupted in order to make the spare parts required for maintenance. But industries employing special-purpose machines for production seldom have maintenance machining facilities of their own on account of the large initial investment involved.

Outside maintenance facilities

Small units have their maintenance machining jobs done by outside factories in the vicinity or in the nearest small industries service institute. They employ their own maintenance personnel, however, as the skills required by a particular unit are seldom available from outside.

The disadvantages of using outside maintenance machining facilities are:

(a) It is usually difficult to get precision jobs done satisfactorily by outside parties because the operator making the spare part will have no knowledge of its functional importance.

(b) Only small units, which are generally inefficient, normally take on small maintenance machining jobs. The poor service they provide can lead to loss of precious production time for the unit purchasing the service.

(c) The cost of odd jobs done by outside small units would be generally exorbitant because of the non-repetitive nature of the jobs.

Whether it is better to have the maintenance machining facilities within the industry or to purchase outside services will depend upon:

(a) The availability of facilities in the vicinity;

(b) The cost of downtime of the production equipment. Industries working at capacity may opt for their own facilities in spite of the heavy initial investment involved;

(c) The extent to which outside sources have the skills necessary to undertake jobs requiring quality and precision.

Since the machining facilities required for most maintenance jobs are highly capital-intensive, the development of specialized maintenance workshops (common facility centres) should be encouraged. As mentioned earlier, a specific problem in the setting up of outside facilities for repair is to determine whether they should be private or public. The experience gained so far in developing countries like India shows that it is generally very difficult to maintain the economic viability of commercial workshops because of the uncertainty regarding the work load. Privately owned workshops that take on some regular manufacturing activities in addition to the maintenance service they provide to other factories find it easier to remain in business. The viability of the workshops also depends on how efficiently they are planned and managed. In the vicinity of all the important centres of small-scale industrial activity there will always be a great need for their services, in particular for precision jobs.

Government agencies like small industries service institutes, which are mostly located near the areas where small units are concentrated, and prototype production-cum-training centres provide very useful maintenance services. The main advantages these public agencies have over the privately owned workshops are:

(a) They have all the machines and equipment required for maintenance jobs.

(b) They do not lack trained and skilled personnel because the stability offered by governmental service continues to be attractive for most people.

(c) They generally encounter fewer difficulties in procuring scarce and imported materials and spare parts to keep their machines and equipment in running order.

Nevertheless, the efficiency of the services they provide to small units is not what it should be. This is mainly because the personnel in these agencies lack incentives to give good service promptly.

The following tables give the estimated costs for a village block workshop, a mobile workshop for rural areas and an urban common facility maintenance shop for small-scale industries in India.

Table 1

REQUIREMENTS OF TYPICAL VILLAGE BLOCK WORKSHOP IN INDIA

Initial cost of land, buildings and equipment	*Estimated cost in US dollars*
Land, buildings, power and water connexions etc.	2,600
Centre lathe	5,000
Drilling machine	1,500
Welding equipment — both gas and electric	1,000
Bench grinder	400
Testing equipment for fuel injection system	7,000
Miscellaneous facilities (fitting bench and vice, tools etc.)	500
Conveyance (motorcycle) for providing the necessary mobility to the mechanics	600
Total cost	18,600
Working capital	
Cost of stocking necessary spares for tractors, pumps, motors, diesel engines, and normal materials required for maintenance	2,000

Personnel

In addition to the owner/manager who should be a person with technical background and should be responsible for organizing and maintaining the facilities, purchasing, billing and collection, trouble shooting and general administration functions, the following staff is needed:

	Yearly salary in US dollars
One general-purpose machinist who can operate lathe, drill, grinder and welding equipment	800
One general-purpose mechanic or fitter specialized in automobile maintenance. (The number of such mechanics can be increased depending upon the work load.)	900
One general-purpose helper	300
Total cost	2,000

Table 2

REQUIREMENTS OF TYPICAL MOBILE WORKSHOP FOR RURAL AREAS IN INDIA

Plant and equipment	*Estimated cost in US dollars*
3- or 5-ton truck with special body	5,000
Centre lathe	5,000
Drilling machine	1,500
Welding equipment both gas and electric	1,000
Bench grinder	400
Shaper	600
Workbench, tools etc.	1,500
Electric generating set diesel (optional)	2,000
Heat-treatment furnace and forge	2,000
Total cost	19,000
Working capital	
For special steels, spares and other material for maintenance, travelling, fuel oils and other charges	2,000

Personnel

It is proposed that the mobile workshops be operated by SISI under the supervision of extension officers specially trained for maintenance. The salary of such personnel is not accounted for. Other personnel required are:

	Yearly salary in US dollars
Truck driver-cum-generating set operator	900
Machinist	900
Turner	900
Welder/heat-treatment operator	900
Fitter, forgeman	900
General-purpose worker	900
Total cost	5,400

Table 3

REQUIREMENTS OF TYPICAL COMMON FACILITY MAINTENANCE SHOP FOR SMALL INDUSTRIES IN URBAN AREAS IN INDIA

Initial cost of land, buildings and equipment	*Estimated cost in US dollars*
Land and buildings	7,000
Two centre lathes—one for precision jobs and the other for general-purpose turning jobs	10,000
Universal milling machine	8,000
Surface grinder	6,000
Shaper	1,200
Drilling machine—which can also work as a vertical boring machine	3,000
Bench grinder	400
Welding equipment—both gas and electric	1,000
A heat-treatment furnace and a small forge	2,000
Miscellaneous equipment for fitting jobs (benches, vices, tools etc.)	1,000
Office equipment and furniture etc.	800
Other miscellaneous initial expenditure	600
Total cost	41,000
Working capital	
For stocking the normal spares, tools and materials for maintenance jobs, electricity, gas etc.	2,000

Personnel

In addition to the owner/manager who should be a person with technical background and who will be responsible for the utilization of facilities, purchasing, billing, collection, recruitment and training of staff and general administration, the following technical personnel is needed:

	Yearly salary in US dollars
Two turners ($900 each)	1,800
One machinist	900
One welder/heat-treatment operator	900
One general purpose fitter/forgeman, with some training in electrical jobs	900
One die fitter	900
Two helpers for general-purpose jobs ($600 each)	1,200
Total cost	6,600

The exact number of persons however should depend upon the work load; it is most important to control closely the utilization of maintenance workers.

A compendium of industrial plant models

Introduction

Experts engaged in the task of scanning and screening specific project proposals for industrial planning are constantly in search of relevant reference data, especially data concerning the techno-economic characteristics of a great variety of industrial plants or establishments. In a way, every expert has his own "compendium of plant models", partly noted in his memory, partly stored on his shelves, partly to be recovered from his professional contacts etc.

These compendia, held as a personalized stock of knowledge and experience, are often no more than a hotchpotch of engineering handbooks, partial blueprints of factories, financial reports of corporations, scraps from trade journals, and even chit-chat. Despite its critical role in guiding each expert's work and judgement, one can seldom attach any rigorous concept of "norms" to such a personal compendium. And, just as tantalizing as its conceptual looseness is the fact that its coverage, in terms of various industrial branches and of national and regional environments responsible for differential characteristics of plant performance, is limited.

This article will address itself to the issue of "personal compendia" of plant models by reviewing in detail one example of such compendia. The tabular projection given by the compiler was the product of his research effort, rather loosely controlled but sustained for many months on the strength of his personal interest. The example thus represents a personal compendium that is quite extensive in coverage.

The compiler of this particular compendium admits that the parameters characterizing most of the models are no more than a loose compound of the features of industrial firms he has observed in various localities and his theoretical expectations based on the engineering handbook type of information, used for adjustment purposes. Although the compiler's own notes included observations on individual cases such as "economically feasible", "believed to fall short of the minimum economical size" etc., these statements were not necessarily based on a formal analysis of given plant parameters. It seems that the compiler himself did not have an opportunity to examine his entire compendium in terms of profitability under reasonable factor price conditions.

This article offers a profitability analysis of the data in the same compendium. It uses a simple and quick graphical method, which may be easily applied to the plant or enterprise characteristics expressed by a limited number of parameters. While the method is extremely simple, it can guide the search for compilation errors, accidental cases, misleading observations etc. and thus locate any serious ambiguities and biases in the available information.

A continuing concern of UNIDO in carrying out its technical assistance activities for the developing countries has been to clarify data pertaining to plants and enterprises. The publication of the *Profiles of Manufacturing Establishments*[1] can be mentioned as one such effort. The UNIDO profiles programme itself has evolved with the broader aim of promoting and supporting co-ordinated field action in individual developing countries by unearthing more and better "micro-data" for industrial programming. The latest developments in the UNIDO profiles programme will be briefly reviewed at the end of this article.

Personal compendium: an example

A specialist in industrial location planning recently devised what he called a "system of techno-economic

[1] ID/SER.E/4 (Vol. I) and ID/SER.E/5 (Vol. II) have already been published (Sales Nos. 67.II.B.17 and 68.II.B.13, respectively). Vol. III of this series, containing a collection of data from a different group of countries, will be published soon.

indicators". The author, Ivan Krestić,[2] was unaware of the existence of the UNIDO profiles programme, which, although broader in scope, has the same objective as the Krestić study, namely to help planners in orienting and programming industrial development. His collection was much less ambitious in its scope and coverage than the UNIDO *Profiles* and consequently less flexible in its utility as reference data. It has so far covered 100 "models", or, more precisely, "specimens" of Yugoslav industrial enterprises. A tabulation of the "indicators" of these models is given in the annexes to this article. A few characteristics of this tabulation may be noted.

First, most of the individual models are based on observations of plants or enterprises currently operating in Yugoslavia. There are a few exceptions, such as no. 46 (integrated oil refinery) and no. 96 (thermal power plant), which include some extrapolations based on technological or engineering estimates. Most models reflect the socio-political features of the Yugoslav economy during the years of reference (the second half of the 1960s—mostly 1966) as well as local peculiarities of the individual cases. In translating actual cases into "models", the compiler attempted to normalize the estimates in each case by smoothing out random shocks or elements susceptible to temporary fluctuations. The normalization was performed mostly in a loose manner; sometimes the compiler used statistical averages, sometimes arbitrary adjustments of performance records for engineering norms (e. g. production adjusted for normal capacity utilization). A vaguely prescribed mixture of engineering and economic considerations is characteristic of this type of personal compendium.

Second, the sampling of reference plants was not systematically linked to the characteristics of the Yugoslav population (e. g. taking the quartile, quintile etc. of the size distribution of plants in each branch) nor to the trend and pattern of technological variations at the world level. For some industries, the compiler managed to find a few comparable cases representing different technologies and plant sizes producing similar products, but for other cases, he was unable to find the necessary data. The compendium is thus highly incomplete in its coverage.

Finally, the number of parameters from which each model is constructed is quite small. For some reason, the author failed to include data on the value of raw materials, which makes it difficult to establish the value added through the operation of specific plants. The parameters included in the compendium are as follows:

(*a*) Fixed and working capital—expressed in terms of the US dollar equivalent and based on the price level prevailing in Yugoslavia around 1966. Note that a significant proportion of industrial equipment has been domestically produced and its price is comparable to the international price. The price of imported machinery includes customs duties up to 30 per cent.

(*b*) Site requirements—measured in square metres and distinguished as between roofed and non-roofed sites.

(*c*) Labour requirements—broken down into highly skilled (managers, professional engineers etc.); skilled (skilled workers, technical and administrative personnel); and unskilled (workers with no formal education and training). No information pertaining to the average wage levels is given.

(*d*) Value and quantity of output—given for all the major products of a plant as total monetary value and weight (usually metric tons) of annual output.

(*e*) Electric power and industrial water consumption.

(*f*) Major raw materials—identity and weight (metric tons) given to indicate the basic production in each plant.

(*g*) Transport requirements—classified as input-output ratio in terms of gross physical weight of the purchased raw materials and of the final products of a plant.

An analysis of economic efficiency

The omission of data indicative of commercial viability may have been intentional, but this is quite unfortunate if one wishes to distinguish between economically viable and non viable "models" under the given circumstances. Therefore, the analyst made an effort to guess the approximate value-added content of the production for each case, using other sources of information relating to the cost of raw materials. Once this information is given, the compendium easily lends itself to a synoptical analysis of the relative "economic" positions of the plants included in it.

Figure I, a scatter diagram, shows the amount of capital and labour employed per dollar's worth of net output (value added) in each plant (identified by the attached numeral). The two co-ordinates for the scatters are:

Vertical axis—total value of both fixed and working capital divided by net output;

Horizontal axis—total man-years of labour (unit: 1/1,000) adjusted for skill composition divided by net output.

The adjusted man-years represent unskilled labour equivalent; i. e. highly skilled and skilled workers, respectively, were counted as five and three times the

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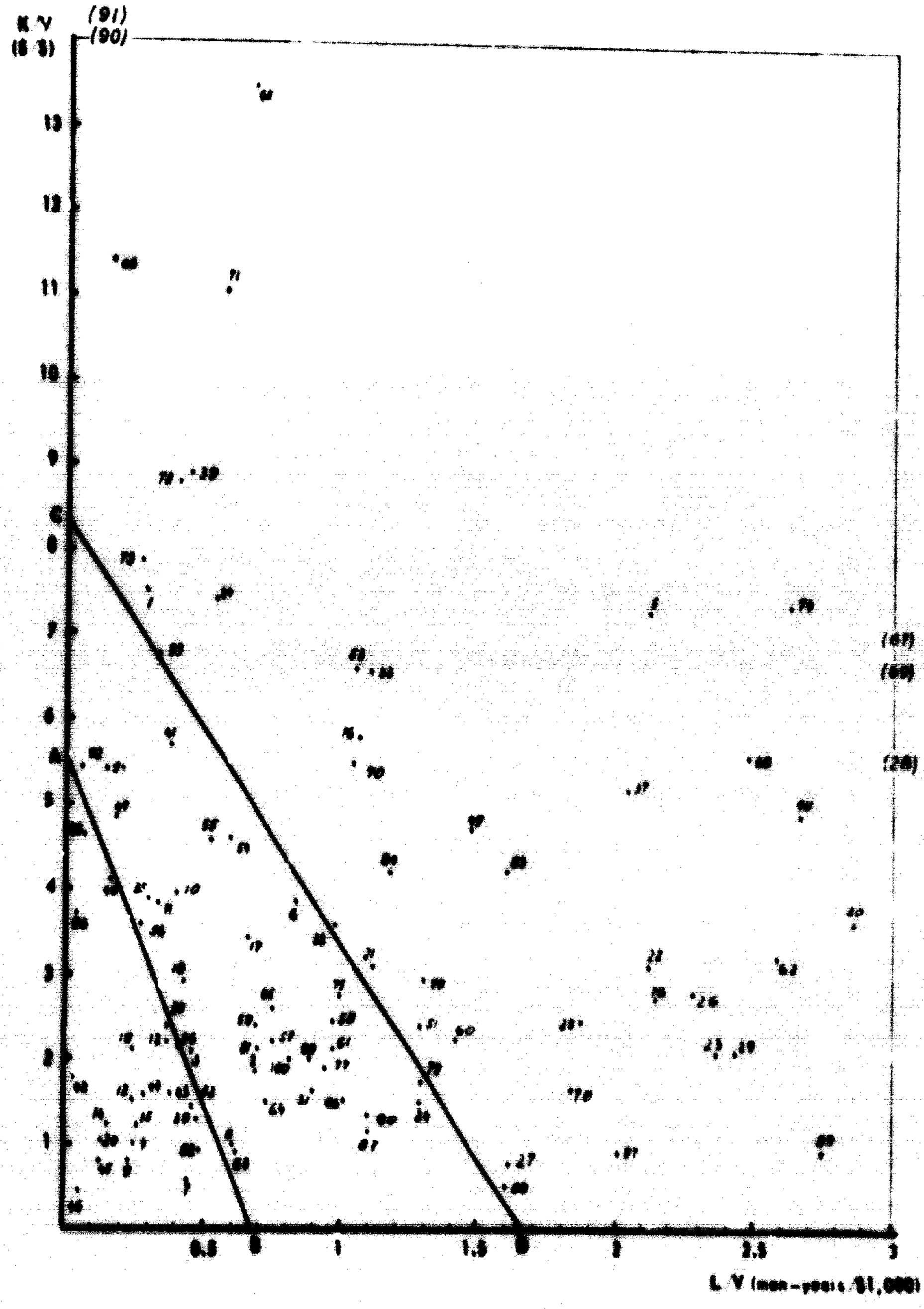
Figure 1

CAPITAL AND LABOUR PER DOLLAR'S WORTH OF OUTPUT AND ISO-COST LINES



K = Capital; L = Labour; V = Value added

equivalent of unskilled workers. (The weights are related to the average wage and salary levels applicable to the different skill categories.)

The plotted points may be called "iso-income" (= $1) points, since they indicate different combinations of capital and labour required to earn one dollar of value added. These iso-income points are then contrasted with the aid of two sets of factor-price assumptions. The lower iso-cost line (line A—B) is drawn on the assumption that the average yearly cost of financing and maintaining the original investment will not exceed 18 per cent of the total capital requirements, and the wage for one man-year of unskilled labour will be about $1,500. The higher iso-cost line (line C—D) assumes the cost of capital to be 12 per cent per year and the yearly wage to be $600. These assumed figures are probably reasonable for Yugoslav enterprises. Note that any point on these iso-cost lines represents the combination of capital and labour at their given prices that a one-dollar annual budget can afford. The area bounded by the two separate iso-cost lines indicates, therefore, the entire range of different input combinations that can be purchased per dollar (per annum), if the input prices remain within the specified bounds. Needless to say, the general slope of such an iso-cost belt differs from country to country and depends on the relative factor supply situation in each country. The width of the belt depends on the competitiveness of factor markets within the country, and this in turn depends on banking systems, labour mobility etc.

If a simple commercial profitability criterion is used, the diagram makes possible a quick comparison of the economic efficiency, in commercial terms of individual plants. According to the conceptual construction, plants operating with the input combinations represented by any point below the iso-cost belt are clearly profitable, while those with the input combinations found in the area above the iso-cost belt are in difficulty. Plants operating within the iso-cost belt are borderline cases, either making profit or loss depending on the actual input prices they happen to be paying. But they will not suffer losses provided that the wage rates for unskilled labour are no higher than $600 per annum and the depreciation and interest charges together do not exceed 12 per cent per annum.

The diagram clearly reveals that some of the "models" in the compendium are simply bad models—the plants are either technologically obsolete or their management is poor.[3] There are even a few cases (nos. 90 and 91) lying beyond the upper margin of the diagram and another few (nos. 28, 67 and 69) beyond the right-hand margin. One may well suspect that these extreme cases are either subject to errors in observation or refer to firms on the verge of bankruptcy. Most of such poor cases are in fact noted by the author of the compendium as being "uneconomic" or "obsolete" models. But a clearer indication of how poor those poor cases are would be of great help to those using such a compendium.

Relative efficiency of plants in each industry group

The economic analysis presented in figure 1 is equally applicable to a comparison of the efficiency of firms in different branches of industry and of those within any particular branch. Since the compendium is intended explicitly to point out the existence of alternative plant models producing either identical or similar products, the changing pattern of factor input combination as between the alternative models within each industry group can itself be an important object of study.

In figure 2, those points representing alternative models producing identical or similar products are connected by straight lines. For visual clarity, unique cases which cannot be compared with others in the compendium have been omitted in figure 2. Heavy dots denote the most efficient plants in each of the different industry groups indentified in the compendium. For example, the brewery industry has four alternatives: nos. 16 to 19. The most efficient brewery plant (no. 19) is located below the iso-cost belt. The second and third most efficient plants (nos. 18 and 17) are located within the belt. The least efficient brewery (no. 16) is located above the belt and appears clearly unprofitable.

Price efficiency and technical efficiency

The relative efficiency of individual plants can be measured by their relative distance from the origin of the diagram. However, the path connecting different models in each group (such as 16—17—18—19; 48—49—50 etc.) does not necessarily point towards the origin; its slope varies from group to group. If this path should have a negative slope, one might be tempted to associate it with the "production function" of the given industry or the so-called "iso-quant" showing alternative factor combinations to produce the same output. Such points may be considered to have equal technological efficiency, their relative efficiency varying only in terms of "price efficiency"—i. e. the extent to which they are fit to given relative factor prices (slope of the iso-cost line).

Connexion lines with negative slopes occur in a few cases in figure 2: two plastic articles plants, nos. 86 and 87; two bakeries, nos. 7 and 9; two lime plants, nos. 59 and 61; and two dairy products firms, nos. 2 and 3; etc. Of these cases, nos. 7 and 9 seem to have different product mixes (no. 7 produces biscuits and wafers at a relatively high price per kilogram of output, while no. 9 produces bread and rolls, the average price per kilogram of which is only one fourth of that of the products of no. 7).[4] Apart from this complication, there is a chance that each of these pairs will be regarded as being indifferent in terms of "technological efficiency". Especially, locus 86—87 has a slope comparable to that of the iso-cost belts, so the efficiency of these two points may be considered comparable both technologically and economically.

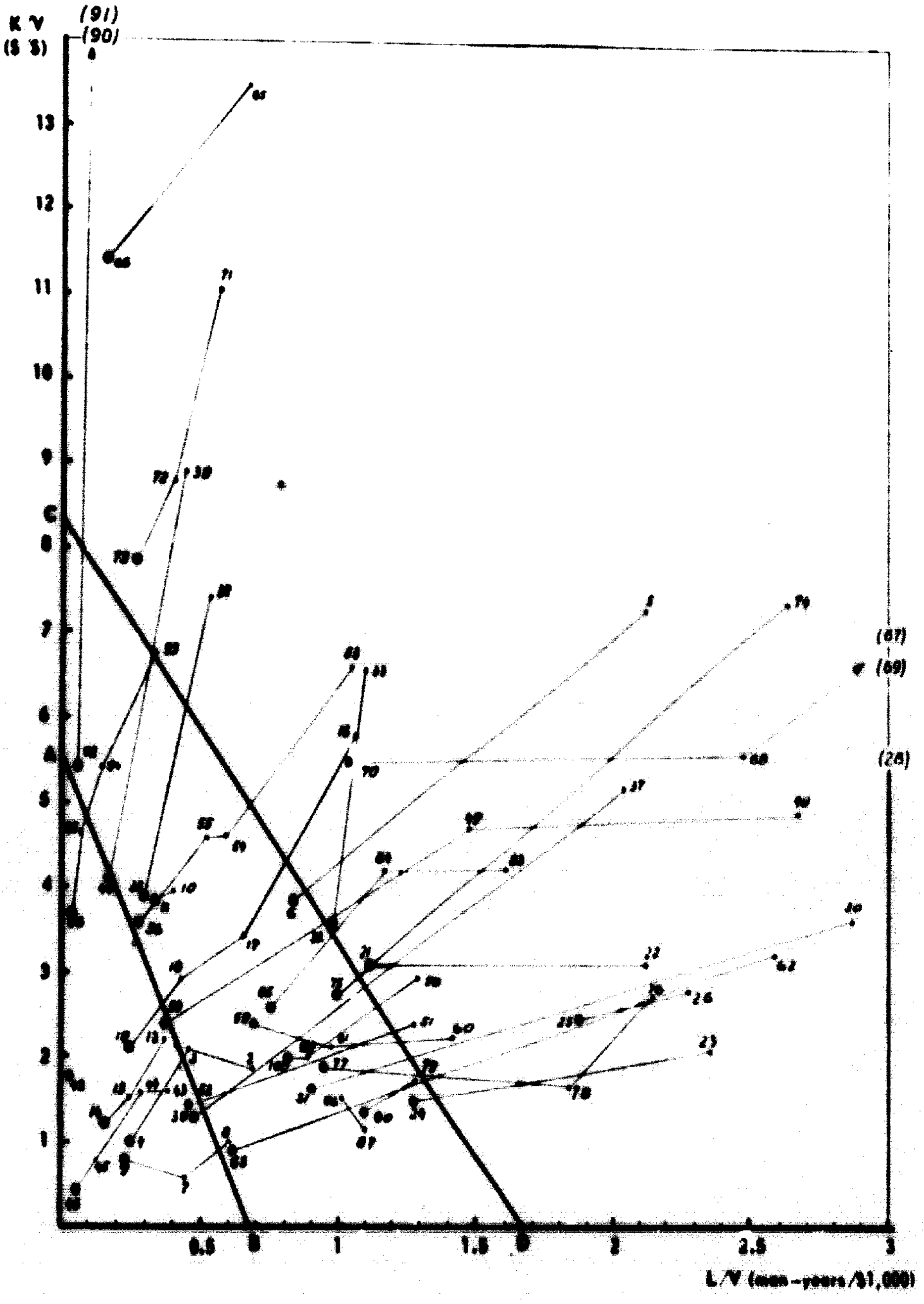
The relative profitability positions are rather obvious for those points connected by lines running from north-east to south-west. But for the purpose of measuring

[3] "Over-employment" of labour is not a very surprising phenomenon under Yugoslav conditions around 1966. Also, one might suspect that the horizontal scatters would be sensitive to the relative weights attached to different skill categories in obtaining the adjusted man-year data. However, this does not prove to be the case; giving a lower weight to skilled labour does not result in any notable improvement in the relative positions of those problematic models.

[4] Also, No. 42 (benzene plant) should be so isolated from Nos. 43—46 (petroleum refineries).

Figure 2

THE RELATIVE EFFICIENCY OF THE MODELS GROUPED BY INDUSTRY



K = Capital; L = Labour; V = Value added

relative profitability in terms of any quantitative index, both the general slope of the plant path for each group and the slope of the relevant iso-cost line should be taken into account. In fact, the precise way of measuring the relative profitability is to draw a family of parallel iso-cost lines going through every point to be compared. The relative distance of these parallel lines from the origin then readily gives the relative efficiency index for each point. Such indexes can, of course, be established for points belonging to different industry groups as well. For example, the economic efficiency of plant no. 96 (thermal power plant), although its iso-income point is located farther from the origin than that of no. 19 (brewery plant), is quite comparable to the economic efficiency of no. 19, if the prevailing relative factor price is represented by line A—B.

Technological change and economies of scale

The slope of the connexion line for each group may be interpreted as indicating the development path of technology in that industry. The diagram reveals that the technological development path in this sense, as envisaged in this compendium, has been both labour- and capital-saving or rather "neutral", although there are a number of cases in which capital-labour ratios tend to increase as efficiency increases.

Though not so explicitly indicated in figure 2, the data in the compendium reveal the tendency for higher efficiency to be associated with larger plants. Economies of scale thus appear to play a prominent role in the process of "modernization". The notable exceptions are two footwear plants (nos. 25 and 26), of which the modern, large-capacity plant proves to be inferior in terms of economic efficiency (possibly because of over-employment of labour); two plants producing plastic articles (nos. 86 and 87) differ in scale of production in the ratio of nearly 1 : 3 but are almost equally efficient.

One should note that an "industry group" in the present context is a much more homogeneous concept than what would normally obtain with the statistical classification, say, on a two- to three-digit level. Evidence of scale economies becomes less systematic when firms engaged in similar lines of activity have different product mixes and process mixes. Examples are: no. 32 (chipboard) and no. 33 (fibreboard); no. 42 (benzene plant) and no. 44 (petroleum refinery); no. 62 (prefabricated building elements) and no. 64 (insulation materials for building); no. 76 (tools for machines) and no. 78 (materials-handling equipment); no. 75 (hardware) and no. 79 (metal containers); etc.[5]

Government price and subvention policies

Of the 100 specimens in the compendium, as many as 46 have proved to be uneconomic. Most of these represent smaller and less efficient plants in various industries, whose more efficient plants have no problem in earning moderate to high profits. Some of these inefficient plants, if actually surviving, must have already written off their original investments, or they may be granted special subsidies in open or hidden forms. In fact, the revenues of some of these plants are not even large enough to cover wages. This means that the plants are using workers whose wages are substantially [illegible] standard or whose wages are supplemented by various subsidies mentioned above.

On the one hand, some industries in the compendi[illegible] are represented by rather inefficient specimens, [illegible] even the most efficient one in each group located ab[illegible] the iso-cost belt (alumina and aluminium plants, no[illegible] and 66; steelworks, nos. 71, 72 and 73; iron foundr[illegible] nos. 67, 68, 69 and 70; footwear, nos. 25 and 26). [illegible] the other hand, there are some "glamour" indust[illegible] whose constituent firms invariably do well (feedm[illegible] nos. 12, 13 and 14; petroleum refineries, nos. 42, 43, 45 and 46; etc.).

To a certain extent, every economy is bound to ha[illegible] some troubled or "sick" industries along with m[illegible] modern and progressive industries, especially when t[illegible] pace of industrialization is accelerating and the structu[illegible] of demand radically changing. Sometimes official price control can be responsible for an apparent profitability disparity between industries. Sometimes a "new" basic industry may be forced to keep its product prices at an arbitrarily low level for some reason, thus receiving heavy subsidies. A country's over-all trade policies, tax and subsidy schemes, employment policies etc. are meant to achieve efficiency in the economy as a whole, but it is important constantly to review the impact of these policies on the individual plant or firm while these policies are being implemented.

Conclusions

Not all the data given in this compendium represent economically feasible plant models. Some models are obsolete and some are about to go bankrupt. The technical parameters of these problematic models may still have some reference value if substantiated by a proper post-mortem analysis of the individual cases. The usefulness of the compendium would be greatly enhanced if the compiler appended to each model, whether or not it is economic, information regarding managerial competence, governmental intervention, capital vintage, locational peculiarities etc.

Of course, there cannot be a single "best" way of producing, for example, ball-point pens. A process proposed as a technologically optimum prototype must still be combined with other related technical and organizational requirements before an "enterprise" [illegible] a real economic unit—can be based on it. A complete plant layout that has proved highly economic [illegible] der particular local conditions cannot be assumed to [illegible] so under other local conditions. The difficulty of [illegible] b- lishing programming norms in terms of strictly [illegible] er- ministic, single-value parameters is well known. [illegible] st- ment programming thus consists of an iterative [illegible] ss of searching and screening a broad range of techn[illegible] al and economic possibilities. This process can [illegible] es

[5] Recall that production capacity is in this context measured in terms of value added. When capacity is measured in physical units of output or of major input material, relative efficiency indexes may change, reflecting any significant differences in the unit prices of outputs and/or inputs. For example, No. 22 (cotton-spinning mill), which is a relatively small-capacity unit with 22,000 spindles, sells its products [illegible],200 t) at an average price of $3.3[illegible] per kg, while No. 21, whose capacity is nearly 2.5 times as large as the [illegible] of output (2,880 t), earns a 25 per cent [illegible] owing to the lower prices of its products. Similarly, No. [illegible] steelworks) has a physically larger capacity, and [illegible] product price, than No. 72 (integrated [illegible] these examples, the larger plants are sh[illegible] more efficient

from all possible sources and one important source is knowledge of industrial firms in various countries.

A personal compendium, taken largely as a hotch-potch of vaguely screened plant models, is seldom exposed to a systematic examination and may thus suffer lacunae not only in terms of its coverage but also in regard to the analytical substance required for feasibility considerations. The particular collection considered here happens to be lacking in the data necessary for assessment of value added. As a result, extremely profitable cases have been included along with utterly unprofitable ones, with little indication of factors accounting for these gaps. This collection had originally been intended for the programming of industrial location alone, and thus the requirements of site, water and electricity and physical weights of output and input materials were the major concern of its author. However, the data on labour and equipment, collected on the side, happen to show that nearly one half of the compiled cases must be unprofitable models. Great care ought to be taken, therefore, in using the entire compendium.

The analytical exercise conducted on these data in this article is indeed a very simple one, requiring only a plausible set of assumptions regarding wage rates and capital costs. But the method is quite expeditious in evaluating the relative positions of different plants and enterprises in terms of economic efficiency, and thus pointing out what kind of additional information will be needed if one wishes to translate particular experience to accommodate the needs in different economic situations.

The scope of personal compendia is severely limited to what each individual has encountered in his professional experience. On the one hand, economists, even if they are supposed to play an active role in investment programming and promotion, seem to be of little help in dealing with plant-level problems, nor do they take the initiative in searching for specific investment opportunities. On the other hand, engineers may have far deeper knowledge of specific ways of doing things in the industries in which they are specialized, but they do not concern themselves much with what goes on in other industries and show little interest in the variation of market conditions from one place to another. As close co-operation between these two professions is essential in industrial programming—particularly project development—the concept of plant models ought to be evolved in such a way as to facilitate mutual communication between them. An explicit presentation of personal knowledge in profiles, compendia, or other forms of programming data would certainly broaden the possibilities for such professional co-operation.

THE UNIDO PROFILES PROGRAMME

If personal compendia of plant models could be compiled in comparable form, great savings in the time of experts working in industrial project development could be achieved. The UNIDO series *Profiles of Manufacturing Establishments* was initiated primarily to serve as a catalyst in promoting a broader recognition of the practical usefulness of such statistics and in stimulating co-ordinated action at both the national and the multinational levels. It has already had considerable impact.

The institutions for industrial project programming and promotion in a number of developing countries have shown their interest in the profiles type of data collection covering local industrial enterprises as well as new investment opportunities. As a result, the UNIDO profiles programme now includes, for countries requesting it, the provision of technical assistance in designing special approaches to data collecting suitable to local needs and in training the necessary field study staff.

It is important to note that the profiles compilation should be handled rather differently from the conventional census type of statistical survey. The depth of information to be collected should be adequate to permit a professional assessment of the techno-economic problems and potentials of each individual plant and enterprise considered, and this requirement can be met only with active support from the authorities who are themselves the primary users of the resulting profiles. Ideally, industry profiles at the plant or enterprise level should be compiled by those who are rendering consulting services for individual enterprises in productivity, management and technological matters.

UNIDO is working jointly with the Industrial Development Centre for Arab States (IDCAS) to design "productivity profiles"; this is an example of field operations carried out under the UNIDO profiles programme. A joint UNIDO-IDCAS preparatory working group met first in Beirut from 4 to 7 May 1970 and formulated the basic guidelines for the development of an analytically oriented version of the profiles to support the IDCAS productivity programme, the goal of which is to promote and co-ordinate productivity extensions services for industrial enterprises at the national and the multinational levels. The "profiles" component of the productivity programme in this region is now intended to offer: *(a)* a set of techno-economic guidelines for evaluating factory performance; *(b)* yardsticks for comparing the technological and economic efficiency of different firms; and *(c)* an evaluation scheme to pinpoint strong and weak points in each firm. The standard format for such profiles is designed on an industry-by-industry basis jointly by technologists, engineers and accountants experienced in each branch of industry. A workshop on productivity profiles was held in Cairo, 6–30 July 1970, dealing with three branches of industry: spinning and weaving of cotton, processing of vegetable oils and fats, and milling of grain. It is planned to hold a second workshop in 1971 to cover other industries such as cement, glass and ceramics, food-canning, printing etc., and these workshops are to be followed up by an annual evaluation session for the field study teams in various countries.

Government authorities need an appropriate form of communication with the management of individual enterprises in order to determine what measures are necessary to promote development. The scope of information flowing through the existing reporting system from enterprises to central planning authorities varies from country to country. In a state enterprise system, the current reporting may already cover information elaborate enough to affect over-all budgetary control at the state level. In a private enterprise system, the reporting routine may be limited mostly to the census type of statistical surveys. In both cases, the existing reporting systems could be greatly improved to facilitate decisions regarding structural changes within an enterprise or a group of enterprises, such as new investment proposals, rehabilitation proposals, multinational trade and co-operation agreements etc. Adoption of the profiles approach to data gathering would facilitate the formulation of industrial development programmes and policies.

In 1970, a joint UNIDO-Bulgarian working group* conducted an experiment with a view to improving the enterprise profiles to be used by the Bulgarian planning authority entrusted with investment project appraisal. The experiment included: *(a)* an examination of the comparability of basic economic and accounting terminologies between the NAS (Western) and the MPS (Eastern European) systems within the framework of relatively simple, multi-industry type of enterprise profiles such as those appearing in the UNIDO *Profiles*; and *(b)* the compilation of "intra-firm input-output tables"—a new format for analytical presentation of capacity and performance data at detailed plant and sub-plant levels. The material balances and capacity specifications for individual departments or units classified with reference to each industry's basic process flow chart, the process-costing techniques framed according to the standard cycle of productive activities including factory overheads etc.—these major topics or sub-profiles for structural and performance diagnosis can be more or less readily incorporated in a single input-output table compiled for each enterprise. It is hoped that the approach tested under this project will find practical applications in the various echelons of national industrial-development management, especially to facilitate transition from the detailed accounting and engineering data of individual enterprises to diagnosis and programming at the sectoral level.

The UNIDO profiles programme, which was originally no more than a publication of general-purpose source books, is thus being given the broader mission of improving the organization and utilization of micro-data on industrial activities. This is not the place for reporting in detail on those latest developments connected with the UNIDO profiles. A full progress report and technical materials of general reference value will be published in due course in future issues of either this Bulletin (ID/SER. A) or the profiles series (ID/SER. E). Meanwhile, interested readers may wish to write for further information to: Industrial Policies and Programming Division, United Nations Industrial Development Organization, P. O. Box 707, A-1011 Vienna, Austria.

* The Bulgarian counterpart was composed of technical staff from the State Planning Committee of the People's Republic of Bulgaria and a few state industrial enterprises.

ANNEXES

ANNEX I

LIST OF 100 PLANT MODELS IN THE EXAMPLE CONSIDERED

Plant no.	ISIC[a]	Type of plant	Annual capacity
1	201	Slaughterhouse	38,000 t
2	202	Dairy	60,000 l of milk processed
3	202	Dairy	100,000 l of milk processed
4	202	Dairy	300,000 l of milk processed
5	203	Fruit-juice plant	1,600 t
6	203	Fruit-juice plant	3,900 t
7	206	Biscuit and wafer factory	2,600 t
8	206	Bakery	8,500 t
9	206	Industrial bakery	15,000 t
10	207	Sugar plant	20,000 t of sugar
11	207	Sugar plant	40,000 t of sugar
12	312	Soybean oil plant with animal feed factory	60,000 t of soybeans processed
13	209	Feed-mixing plant	33,000 t
14	209	Feed factory	66,000 t
15	212	Wine cellar	30,000 hl
16	213	Brewery	50,000 hl
17	213	Brewery	100,000 hl
18	213	Brewery	500,000 hl
19	213	Brewery	1,000,000 hl
20	214	Soft drinks plant	180,000 hl
21	231	Cotton-spinning mill	20,000 spindles
22	231	Cotton-spinning mill	22,000 spindles
23	232	Cotton knitwear factory	200 t
24	231	Weaving and finishing mill	1,300 t
25	241	Footwear factory	600,000 pairs
26	241/300	Leather and rubber footwear	1,500,000 pairs
27	243	Wearing apparel factory	3,300 t or approximately 10 million m²
28	251	Plywood factory	4,000 m³
29	251	Sawmill	15,000 m³
30	260	Furniture factory	12,000 units or approximately 5,000 t
31	260	Metal furniture factory	6,000 t
32	271	Chipboard factory	7,000 t
33	271	Fibreboard factory	13,000 t
34	271	Pulp and paper mill	33,000 t
35	271	Pulp and paper mill	150,000 t
36	272	Paper products plant	6,000 t
37	291	Leather tannery	660 t
38	291	Leather tannery	1,200 t
39	311	Integrated petrochemical works	20,000 t of ethylene and 20,000 t of other products
40	311	Petrochemical works	200,000 t
41	311	Fertilizer plant	470,000 t
42	321	Benzene plant	115,000 t
43	321	Petroleum refinery	300,000 t of crude oil to be processed
44	321	Petroleum refinery	500,000 t of crude oil to be processed
45	321	Petroleum refinery	2,000,000 t of crude oil to be processed
46	321	Integrated petroleum refinery	5,000,000 t of crude oil to be processed
47	329	Coke plant	660,000 t
48	331	Brickworks	10 million units or 20,000 t
49	331	Brick and tile factory	25,000 to 30,000 t or 15 million units
50	331	Tile factory	43 million units or 45,000 t
51	332	Glassworks	11,000 t
52	332	Glassworks	27,000 t
53	334	Portland cement factory	110,000 t
54	334	Portland cement factory	220,000 t

[a] United Nations, *International Standard Industrial Classification of All Economic Activities*, St/STAT/SER. 7/4/Rev. 1/Add. 1, Sales No.: 59.XVII.9.

Plant no.	ISIC	Type of plant	Annual capacity
55	334	Portland cement factory	330,000 t
56	334	Portland cement factory	850,000 t
57	339	Structural clay product factory	60,000 m³ granules
58	339	Plaster plant	25,000 t
59	339	Hydrated lime plant	27,000 t
60	339	Lime plant	27,000 t
61	339	Lime plant	33,000 t
62	339	Prefabricated concrete building material	44,000 t
63	339	Masonry with a concrete product manufacturing unit	1,000 dwelling units
64	339	Building elements (insulating materials)	125,000 t
65	342	Alumina plant	100,000 t
66	342	Alumina and aluminium plant	200,000 t of alumina and 100,000 t of primary aluminium
67	341	Foundry	3,000 t of iron to be processed
68	341	Foundry	6,000 t of iron to be processed
69	341	Foundry	12,000 t of iron to be processed
70	341	Foundry	20,000 t of iron to be processed
71	341	Steelworks	1 million t in terms of crude steel
72	341	Integrated steelworks	2 million t in terms of crude steel
73	341	Steelworks	4 million t in terms of crude steel
74	350	Forged steel products	5,000 t
75	350	Hardware factory	6,000 t
76	350	Tools for machines and other special steel products	250 t
77	350	Machine tool plant	2,000 t
78	350	Materials-handling equipment factory	1,600 t
79	350	Metal container factory	10,000 t
80	360/370	Household appliance factory	7,500 t
81	370	Transformer plant	Up to 18,000 t
82	383	Car parts plant	4,000 t
83	384	Car service shop	5,000 services
84	384	Car repair shop	10,000 cars
85	384	Car service and repair shop	20,000 cars
86	399	Plastics factory	330 t
87	399	Plastic articles plant	1,000 t
88	400	Plumbers' workshop	230,000 working hours
89	400	Building contractors	1,000 dwelling units
90	511	Hydroelectric power plant	80 MW
91	511	Hydroelectric power plant	80 MW
92	511	Hydroelectric power plant	200 MW
93	511	Thermal power plant	45 MW
94	511	Thermal power plant	125 MW
95	511	Thermal power plant	200 MW
96	511	Thermal power plant	500 MW
97	833	Architectural design agency	20,000 working hours
98	854	Laundry	280 t
99	854	Laundry	500 t
100	854	Industrial laundry	2,400 t

INDICATORS OF CHARACTERISTICS

Plant no. (*ISIC*):		*1* *Slaughter* *(201)*	*2* *Dairy* *(202)*	*3* *Dairy* *(202)*	*4* *Dairy* *(202)*	*5* *Juices* *(203)*
Capital						
Equipment (K_e)	(US $ million)	1.51	0.45	0.93	1.46	0.61
Building and land improvements (K_s)		1.52	0.29	0.50	0.72	0.41
Total working capital (K_w)		1.00	0.09	0.16	0.26	0.17
Total capital requirement (K)		4.03	0.83	1.59	2.44	1.19
Site						
Roofed sites (S_r)	(000 m²)	27.0	4.5	8.6	15.0	6.9
of which for production (Srp)		15.0	3.1	6.3	11.6	3.7
Total sites (S)		120.0	6.0	20.0	30.0	15.0
Employment						
Managers and highly skilled (L 1)	(man-years)	60	14	20	23	17
Skilled (L 2)		320	70	70	137	80
Unskilled (L 3)		260	36	35	60	23
Total employment (L)		640	120	125	220	120
Total skill adj: (L*)		1,520	316	345	586	348
Production						
Quantity (Q_t)	(000 t/year)	35	3	10	13	1.5
Value of production (Q_s)	($ million/year)	23.7	1.6	2.6	8.0	0.72
Est. value added (V*)		5.4	0.45	0.77	2.5	0.16
Main raw materials						
M_t (1)	(000 t/year)	50	20,000*	38,000*	110,000*	5
(2)		—	—	—	—	—
Electricity and water						
Electricity (E)	(million kWh/year)	2.8	0.3	0.4	1.2	0.3
Water (W)	(000 m³/year)	324	250	530	1,500	260
of which: drinking water (W_d)	(m³/d)	1,080	850	1,800	3,800	1,800
Transport requirements						
Input materials (T_m)	(000 t/year)	54	28	46	136	8
Products shipment (T_q)		35	3	11	16	2
Ratios						
Capital/output ratio (K/Q_s)		0.2	0.5	0.6	0.3	1.7
Equipment per person (K_e/L)	($ 000)	2.4	3.7	7.5	6.7	5.1
Buildings and land improvement cost per m² of roofed site (K_s/S_r)	($/m²)	56	64	58	48	60
Percentage composition L 1	(%)	9	12	16	11	14
L 2	(%)	50	58	56	62	67
Average value per ton (Q_s/Q_t)	($/t)	677	557	265	526	480
Electricity consumption per ton of output (E/Q_t)	(kWh/t)	79	93	43	79	213
Water consumption per ton of output (W/Q_t)	(m³/t)	9	89	55	99	173
Main raw materials per ton of output (M_{t1}/Q_t)	(t/t)	1.43	7.14	3.80	7.24	3.33
Total transport per $ of output (T_{m+q}/Q_s)	(kg/$)	4	20	21	19	14

Note: ISIC refers to United Nations, *International Standard Industrial Classification of all Economic Activities*, St/STAT/SER. 7/4/Rev. 1/Add. 1, Sales No.: 59.XVII.9.

* 000 litres.

OF 100 PLANT MODELS

6 *Juices* *(203)*	7 *Bakery* *(206)*	8 *Bakery* *(206)*	9 *Bakery* *(206)*	10 *Sugar* *(207)*	11 *Sugar* *(207)*	12 *Oil* *(312)*	13 *Feed* *(209)*	14 *Feed* *(209)*	15 *Wine* *(212)*
0.42	0.27	0.33	0.54	5.40	10.99	1.66	0.32	0.60	0.13
0.22	0.14	0.19	0.20	2.69	3.88	0.86	0.34	0.44	0.17
0.10	0.03	0.02	0.08	1.08	2.34	0.80	0.18	0.30	0.04
0.74	0.44	0.54	0.82	9.17	17.21	3.32	0.84	1.34	0.34
3.3	2.9	4.7	3.1	15.2	20.1	6.0	3.5	4.8	8.0
1.8	1.6	2.7	2.8	5.4	9.8	3.0	2.8	3.8	8.0
8.0	6.0	6.0	7.1	245.0	305.1	50.0	6.0	8.8	15.0
7	8	14	2	50	83	20	10	12	3
35	86	76	50	240	377	140	25	33	15
18	16	20	43	60	120	50	15	25	7
60	110	110	95	350	580	210	50	70	25
158	314	318	203	1,030	1,666	570	140	184	67
3.5	2	8	14	34	40	55	30	60	3
0.84	1.3	0.99	1.8	5.8	11.6	7.6	2.2	4.2	0.55
0.19	0.71	0.53	0.98	2.4	4.8	1.5	0.58	1.1	0.28
5	2	6	11	150	300	60	22	39	4
—	—	—	—	—	—	—	9	23	—
0.3	0.4	0.4	0.5	5.8	10.2	5.8	1.3	2.1	0.02
300	8	13	14	1,610	2,250	1,500	1	2	4
1,700	4	4	11	30	65	200	3	4	50
6	3	10	12	200	368	85	34	65	5
4	2	8	14	35	71	56	30	60	3
0.9	0.3	0.5	0.5	1.6	1.5	0.4	0.4	0.3	0.6
6.9	2.5	3.0	5.7	15.4	19.0	7.9	6.4	8.6	5.1
68	47	41	65	177	193	144	97	92	22
12	7	13	2	14	14	9	20	17	12
58	78	69	53	69	65	67	50	47	60
240	560	120	131	167	290	137	72	70	184
100	158	44	39	168	255	104	43	35	7
86	3	1.6	1	47	56	27	0.04	0.04	1.3
1.42	0.99	0.77	0.8	4.35	7.5	1.08	0.7	0.7	1.33
12	4	18	10	41	38	19	30	30	14

ANNEX 2 *(continued)*

PLANT No: *(ISIC):*		*16 Brewery (213)*	*17 Brewery (213)*	*18 Brewery (213)*	*19 Brewery (213)*	*20 Soft Drink (214)*
Capital						
Equipment (K_e)	(US $ million)	0.96	1.11	3.78	5.62	0.81
Building and land improvements (K_s)		0.48	0.54	3.04	4.20	0.72
Total working capital (K_w)		0.16	0.22	1.00	1.76	0.40
Total capital requirement (K)		1.60	1.87	7.82	11.58	1.93
Site						
Roofed sites (S_r)	(000 m²)	11.0	12.1	20.1	32.9	4.9
of which for production (S_{rp})		5.0	5.8	13.3	25.3	2.9
Total sites (S)		25.0	32.1	66.8	98.9	9.9
Employment						
Managers and highly skilled (L 1)	(man-years)	11	15	34	48	7
Skilled (L 2)		74	85	300	317	54
Unskilled (L 3)		15	30	96	145	73
Total employment (L)		100	130	420	510	134
Total skill adj: (L*)		292	360	1,156	1,336	270
Production						
Quantity (Q_t)	(000 t/year)	5	10	50	100	15
Value of production ($Q_\$$)	($ million/year)	0.54	1.1	5.3	10.8	3.5
Est. value added (V*)		0.28	0.55	2.7	5.5	1.8
Main raw materials						
M (1)	[b] (000 t/year)	1	2.5	9	17	2
(2)		—	—	0.5	1	—
Electricity and water						
Electricity (E)	(million kWh/year)	0.6	1.1	3.6	9.0	1.0
Water (W)	(000 m³/year)	250	400	850	1,320	80
of which: drinking water (W_d)	(m³/day)	140	200	300	500	40
Transport requirements						
Input materials (T_m)	(000 t/year)	8	11	65	123	35
Products shipment (T_q)		12	18	101	199	44
Ratios						
Capital/output ratio ($K/Q_\$$)		3.0	1.7	1.5	1.1	0.6
Equipment per person (K_e/L)	($ 000)	9.6	8.6	9.0	11.0	6.0
Buildings and land improvement cost per m² of roofed site ($K_s S_r$)	($/m²)	44	45	46	42	147
Percentage composition L 1	(%)	11	12	8	9	5
L 2	(%)	74	65	71	62	40
Average value per ton ($Q_\$/Q_t$)	($/t)	108	108	106	108	235
Electricity consumption per ton of output (E/Q_t)	(kWh/t)	130	110	72	90	63
Water consumption per ton of output (W/Q_t)	(m³/t)	50	40	17	13	5
Main raw materials per ton of output (M_1/Q_t)	(t/t)	0.23	0.25	0.2	0.2	0.1
Total transport per $ of output ($T_{m+q}/Q_\$$)	(kg/$)	38	27	31	30	22

[b] 000 m³.

21 *Spinning* (231)	22 *Spinning* (231)	23 *Knitwear* (232)	24 *Weaving* (231)	25 *Footwear* (241)	26 *Footwear* (241 300)	27 *Clothes* (243)	28 *Plywood* (251)	29 *Sawmill* (251)	30 *Furniture* (260)
2.04	2.24	0.41	0.95	0.57	1.25	0.98	0.46	0.14	0.64
0.67	1.52	0.11	0.34	0.31	0.88	1.52	0.30	0.30	1.15
0.53	0.71	0.38	0.36	0.38	0.81	4.01	0.09	0.06	0.20
3.24	4.47	0.90	1.65	1.26	2.94	6.51	0.85	0.51	1.99
12.0	22.5	2.3	8.5	5.2	11.5	23.9	4.0	6.6	20.0
9.5	19.7	1.7	6.1	2.7	6.2	12.9	2.2	1.0	14.5
40.0	50.0	10.0	32.0	10.0	15.0	50.0	13.0	39.6	35.0
30	80	25	60	65	190	440	30	20	55
330	870	290	340	170	370	4,020	150	140	395
40	50	10	100	185	400	60	40	60	120
400	1,000	325	500	420	960	4,520	220	220	570
1,180	3,080	1,005	1,420	1,020	2,460	14,320	640	500	1,500
3	1	0.2	1	0.3	0.75	3	3[b]	10	4.8
3.0	4.0	1.0	3.1	1.7	4.2	26.3	0.44	0.48	1.5
1.1	1.4	0.43	1.1	0.55	1.1	8.9	0.16	0.24	0.55
3	2	0.2	0.2	0.3	1.5	2.5	10[b]	30[b]	5
—	—	—	—	—	—	—			
6.1	7.8	0.2	1.4	0.3	0.8	2.2	0.6	0.5	1.0
80	290	80	52	8.1	17.4	90	16	100	60
15	40	15	20	20	40	180	10	10	24
6	4	0.3	5	0.9	2	8	15	15	12
3	1	0.2	1	0.4	1	3	3	10	6
1.1	1.1	0.9	0.5	0.7	0.7	0.2	1.9	1.1	1.3
5.1	2.2	1.3	1.9	1.4	1.3	0.2	2.2	0.7	1.1
56	68	49	39	60	76	64	76	46	58
8	8	8	12	15	20	10	14	9	10
82	87	89	68	41	39	89	68	64	69
1,031	3,360	6,143	2,613	5,617	5,547	7,976	147	48	308
2,118	6,500	1,250	1,133	1,150	1,074	676	208	48	200 *
28	242	476	43	27	23	27	5	10	13
1.2	1.5	1.5	0.2	0.9	2.0	0.8	3.3	3	1.0
3	1	0.5	2	0.8	0.7	0.4	41	52	12

PLANT No.		31	32	33	34	35
		Furniture	*Chipboard*	*Fibreboard*	*Pulp and paper*	*Pulp and paper*
(ISIC)		(260)	(271)	(271)	(271)	(271)
Capital						
Equipment (K_e)	(US $ million)	0.65	0.66	1.76	12.8	23.4
Building and land improvements (K_b)		0.56	0.20	0.58	3.2	7.0
Total working capital (K_w)		1.12	0.08	0.16	1.2	3.2
Total capital requirement (K)		2.33	0.94	2.50	17.2	33.6
Site						
Roofed sites (S_r)	('000 m²)	7.6	3.4	8.8	14.5	52.5
of which for production (S_{rp})		5.6	2.0	7.3	8.0	24.2
Total sites (S)		12.0	7.0	21.0	134.5	590.0
Employment						
Managers and highly skilled (L 1)	(man-years)	40	16	26	60	170
Skilled (L 2)		290	50	86	250	500
Unskilled (L 3)		270	34	28	200	280
Total employment (L)		600	100	140	510	950
Total skill adj: (L*)		1,340	264	416	1,250	2,630
Production						
Quantity (Q_t)	('000 t/year)	5.4	7	12	30	106
Value of production (Q_s)	($ million/year)	3.6	0.72	1.2	5.4	20.0
Est. value added (V*)		1.5	0.27	0.38	2.3	8.6
Main raw materials						
M_t (1)	('000 t/year)	5	9	16[c]	160[c]	450[c]
(2)		–	1	—	—	—
Electricity and water						
Electricity (E)	(million kWh/year)	1.8	2.3	7.2	41.4	190
Water (W)	('000 m³/year)	30	66	400	100,000	50,000
of which: drinking water (W_d)	(m³/day)	60	8	10	20	80
Transport requirements						
Input materials (T_m)	('000 t/year)	8	14	36	230	741
Products shipment (T_q)		6	7	12	35	175
Ratios						
Capital/output ratio (K/Q_s)		0.7	1.3	2.1	3.2	1.7
Equipment per person (K_e/L)	($'000)	1.1	6.6	12.6	25.1	24.6
Buildings and land improvement cost per m² of roofed site (K_b/S_r)	($/m²)	74	59	65	221	134
Percentage composition L 1	(%)	7	16	19	12	18
L 2	(%)	48	50	61	49	53
Average value per ton (Q_s/Q_t)	($/t)	659	109	100	181	189
Electricity consumption per ton of output (E/Q_t)	(kWh/t)	333	349	596	1,379	1,792
Water consumption per ton of output (W/Q_t)	(m³/t)	56	10	40	333	472
Main raw materials per ton of output (M_{t1}/Q_t)	(t/t)	0.9	1.4	1.3	5.3	4.2
Total transport per $ of output (T_{m+q}/Q_s)	(kg/$)	4	29	40	49	46

[c] '000 m³.
[d] million m³.

36 Paper prod. (272)	37 Tannery (291)	38 Tannery (291)	39 Petro-chemicals (311)	40 Petro-chemicals (311)	41 Fertilizers (311)	42 Benzene (321)	43 Petroleum refinery (321)	44 Petroleum refinery (321)	45 Petroleum refinery (321)
1.03	0.17	0.70	38.4	161.3	33.6	6.48	4.48	8.32	16.9
0.56	0.19	0.36	8.0	31.2	5.6	0.47	0.64	0.96	1.3
0.96	0.23	1.03	3.2	30.8	3.2	1.24	0.64	0.80	2.8
2.55	0.59	2.09	49.6	223.3	42.4	8.20	5.76	10.08	21.0
4.7	3.6	3.9	19.0	742.7	48.0	0.6	60.0	65.0	100.0
3.5	1.9	2.3	8.0	392.0	30.0	0.3	20.0	25.0	40.0
7.8	10.6	10.4	1,000.0	1,402.7	900.0	1.4	250.0	350.0	800.0
28	8	32	170	662	190	18	90	110	190
84	60	176	580	1,770	570	30	280	360	700
120	12	100	100	620	140	12	80	130	210
232	80	308	850	3,052	900	60	450	600	1,100
513	232	788	2,690	9,240	2,800	192	1,370	1,760	3,260
5.5	0.6	1	40	415	450	105	274	485	1,960
3.6	0.45	6.5	18.4	164.7	22.6	9.7	7.8	13.8	56.3
1.2	0.11	1.6	6.1	54.3	7.5	4.5	3.6	6.4	26.0
6.5	1	7	60	640	100[d]	240	300	500	2,000
—	1	—	—	114	70	—	—	—	—
0.6	0.2	2.0	54.8	450	244	11.1	7.8	18.0	61.0
6	36	225	2,500	14,400	5,100	180	300	660	1,650
12	8	36	40	550	40	18	45	60	110
7	2	7	123	1,200	240	252	310	510	2,015
6	1	2	41	448	450	230	280	450	1,850
0.7	1.3	0.3	2.7	1.4	1.9	0.8	0.7	0.7	0.4
4.4	2.1	2.3	45.2	52.9	37.3	108.1	10.0	13.9	15.4
118	54	92	421	42	117	726	11	15	13
12	10	10	20	22	21	30	20	18	17
36	75	57	68	58	63	50	62	60	64
655	757	5,949	460	401	50	92	29	29	29
105	280	1,864	1,370	1,084	542	106	28	37	31
1.2	60	205	63	35	11	1.7	1	1	1
1.2	1.8	6.1	1.5	1.74	222	2.28	1.1	1.03	1.02
3	6	1	9	10	30	50	75	69	69

PLANT No. (ISIC):		46 Petroleum refinery (321)	47 Coking (329)	48 Bricks (331)	49 Bricks (331)	50 Tile (331)
Capital						
Equipment (K_e)	(US $ million)	35.2	11.8	0.32	0.48	1.6[illegible]
Building and land improvements (K_s)		3.2	4.3	0.28	0.40	1.73
Total working capital (K_w)		6.4	1.8	0.03	0.05	0.3[illegible]
Total capital requirement (K)		44.8	17.9	0.63	0.93	3.71
Site						
Roofed sites (S_r)	(000 m²)	150.0	35.1	5.1	6.5	9.2
of which for production (S_{rp})		70.0	30.0	4.5	5.7	8.2
Total sites (S)		1,500.0	160.1	15.0	11.0	20.0
Employment						
Managers and highly skilled (L 1)	(man-years)	310	56	10	10	33
Skilled (L 2)		1,120	116	72	70	127
Unskilled (L 3)		270	68	78	30	20
Total employment (L)		1,700	240	160	110	180
Total skill adj: (L*)		5,180	696	344	290	566
Production						
Quantity (Q_t)	(000 t/year)	4,900	600	20	26	45
Value of production ($Q_\$$)	($ million/year)	185.6	15.5	0.18	0.28	2.2
Est. value added (V*)		85.7	3.8	0.13	0.20	1.6
Main raw materials						
M_t (1)	(000 t/year)	5,000	800	25[c]	37[c]	105
(2)		—	—	—	—	—
Electricity and Water						
Electricity (E)	(million kWh/year)	140	10.0	0.7	1.1	2.0
Water (W)	(000 m³/year)	3,950	4,500	12	15	20
of which: drinking water (W_d)	(m³/day)	1,700	72	10	8	12
Transport requirements						
Input materials (T_m)	(000 t/year)	5,025	802	43	64	112
Products shipment (T_q)		4,615	639	21	28	46
Ratios						
Capital/output ratio ($K/Q_\$$)		0.2	1.2	3.4	3.3	1.7
Equipment per person (K_e/L)	($ 000)	20.7	49.3	2.0	4.4	8.9
Buildings and land improvement cost per m² of roofed site (K_s/S_r)	($/m²)	21	122	54	62	188
Percentage composition L 1	(%)	18	24	6	9	18
L 2	(%)	66	48	45	64	71
Average value per ton ($Q_\$/Q_t$)	($/t)	38	26	9	11	50
Electricity consumption per ton of output (E/Q_t)	(kWh/t)	29	17	35	40	44
Water consumption per ton of output (W/Q_t)	(m³/t)	1	8	1	0.6	0.4
Main raw materials per ton of output (M_{t1}/Q_t)	(t/t)	1.02	1.3	1.25	1.4	2.3
Total transport per $ of output ($T_{m+q}/Q_\$$)	(kg/$)	52	90	350	329	71

[c] 000 m³.

51 Glass (332)	52 Glass (332)	53 Cement (334)	54 Cement (334)	55 Cement (334)	56 Cement (334)	57 Clay products (339)	58 Plaster (339)	59 Lime (339)	60 Lime (339)
1.02	1.72	2.64	3.68	6.30	11.32	0.70	0.34	0.40	0.30
0.57	0.84	1.76	2.40	3.01	6.80	0.42	0.24	0.20	0.16
0.15	0.27	0.28	0.48	0.64	1.60	0.14	0.06	0.06	0.06
1.74	2.83	4.68	6.56	9.95	19.72	1.26	0.64	0.66	0.52
13.0	17.2	14.5	18.0	33.0	44.0	2.1	1.5	1.1	0.4
5.9	7.2	8.0	11.0	15.0	18.0	1.7	0.9	0.8	0.3
50.0	50.0	120.0	160.0	200.0	250.0	9.0	4.6	3.0	3.0
50	30	19	24	30	75	13	8	6	10
190	210	207	220	300	350	102	63	47	75
100	40	34	56	70	100	65	13	22	55
340	280	260	300	400	525	180	84	75	140
920	820	750	836	1,120	1,525	436	242	193	330
10	25	100	200	300	800	75	25	25	25
1.2	3.2	1.6	3.1	4.8	12.0	0.80	0.36	0.40	0.34
0.72	1.8	0.71	1.4	2.2	5.4	0.58	0.25	0.28	0.23
13	18	160	320	430	1,100	50	32	33	37
—	14	—	—	—	—	18	—	—	
1.6	1.3	12.0	21.0	30.0	80.0	2.1	1.0	1.1	0.75
44	130	60	110	416	280	40	3	7	1.2
41	34	20	30	45	60	9	7	6	6
18	70	220	480	610	1,110	75	36	41	55
11	26	105	210	300	800	77	26	26	26
1.4	0.9	3.0	2.1	2.1	1.6	1.6	1.8	1.7	1.6
3.0	6.1	10.2	12.3	15.8	21.6	3.9	4.0	5.3	2.2
44	49	121	133	91	155	199	160	182	356
15	11	7	8	8	14	7	10	8	7
56	75	80	73	75	67	57	75	63	54
125	127	16	16	16	15	11	14	16	13
160	52	120	106	100	100	28	40	44	30
4	5	0.6	0.6	1.4	0.4	0.5	0.1	0.3	0.1
1.3	0.7	1.6	1.6	1.4	1.4	0.7	1.3	1.3	1.5
23	30	208	221	190	159	190	174	167	241

PLANT No. (ISIC)		61 *Lime* (339)	62 *Building elements* (339)	63 *Building elements* (339)	64 *Building elements* (339)	65 *[illegible]* (34[illegible])
Capital						
Equipment (K_e)	(US $ million)	0.36	0.22	0.51	1.6	[illegible]
Building and land improvements (K_b)		0.16	0.30	0.17	0.3	[illegible]
Total working capital (K_w)		0.06	0.05	0.44	1.2	[illegible]
Total capital requirement (K)		0.58	0.57	1.12	3.1	[illegible]
Site						
Roofed sites (S_r)	(000 m²)	0.9	4.0	3.6	18.1	35.0
of which for production (S_{rp})		0.6	2.5	2.5	10.0	15.0
Total sites (S)		3.0	8.5	20.0	54.3	120.0
Employment						
Managers and highly skilled (L 1)	(man-years)	8	12	24	50	50
Skilled (L 2)		70	118	200	381	350
Unskilled (L 3)		22	45	51	72	100
Total employment (L)		100	175	275	503	500
Total skill adj.: (L*)		272	459	771	1,465	1,400
Production						
Quantity (Q_t)	(000 t/year)	30	40	50	114	100
Value of production ($Q_\$$)	($ million/year)	0.41	0.44	3.1	5.0	7.2
Est. value added (V*)		0.28	0.18	1.3	2.1	2.1
Main raw materials						
M_t (1)	(000 t/year)	45	35	18[f]	115	225
(2)		–	7	18	–	30
Electricity and water						
Electricity (E)	(million kWh/year)	0.9	0.1	0.5	2.5	43.0
Water (W)	(000 m³/year)	1	10	13	90	1,400
of which: drinking water (W_d)	(m³/day)	5	10	15	25	75
Transport requirements						
Input materials (T_m)	(000 t/year)	66	42	50	117	362
Products shipment (T_q)		31	41	50	115	101
Ratios						
Capital/output ratio ($K/Q_\$$)		1.4	1.3	0.4	0.6	4.0
Equipment per person (K_e/L)	($ 000)	3.6	1.2	1.9	3.2	41.0
Buildings and land improvement cost per m² of roofed site (K_b/S_r)	($/m²)	168	76	47	15	183
Percentage composition L 1	(%)	8	7	9	10	10
L 2	(%)	70	67	73	76	70
Average value per ton ($Q_\$/Q_t$)	($/t)	14	11	62	44	72
Electricity consumption per ton of output (E/Q_t)	(kWh/t)	30	2	9	22	430
Water consumption per ton of output (W/Q_t)	(m³/t)	0.03	0.3	0.3	0.8	14
Main raw materials per ton of output (M_{t1}/Q_t)	(t/t)	1.5	0.9	0.4	1.0	2.25
Total transport per $ of output ($T_{m+q}/Q_\$$)	(kg/$)	238	189	32	46	[illegible]

[f] 000 m³.

66 Titanium and aluminium (342)	67 Foundry (341)	68 Foundry (341)	69 Foundry (341)	70 Foundry (341)	71 Steelworks (341)	72 Steelworks (341)	73 Steelworks (341)	74 Forging (350)	75 Handtools (350)
117.8	0.78	1.24	1.04	1.60	199.9	349.7	192.9	0.83	2.04
15.8	0.40	0.44	0.60	0.76	73.4	116.6	101.5	0.29	0.88
12.4	0.64	0.68	0.96	1.00	32.8	60.0	44.6	0.26	0.84
146.0	1.82	2.36	2.60	3.36	306.1	526.3	339.0	1.38	3.76
170.0	4.5	3.7	6.0	8.0	350.0	550.0	208.0	2.5	7.0
150.0	3.0	2.5	4.0	6.0	150.0	200.0	98.5	1.8	5.0
500.0	8.0	7.0	10.0	15.0	2,500.0	3,000.0	1,100.0	4.5	11.0
200	50	40	70	35	600	900	848	25	75
450	333	250	450	125	4,000	6,400	1,961	100	290
250	47	90	180	100	400	700	771	65	135
900	430	380	700	260	5,000	8,000	3,580	190	500
2,100	1,296	1,040	1,880	650	15,400	24 400	10,894	490	1,300
100	3	5	10	18	745	1,450	4,030	4	5
44.0	1.7	2.6	3.3	3.8	164.0	332.0	253.6	1.2	3.3
12.8	0.3	0.4	0.5	0.6	27.6	59.9	42.7	0.2	1.4
450	3	6	12	20	1,375	2,600	6,000	5.5	6
175	—	—	—	—	750	1,600	500		—
1,700	2.4	12.0	3.1	5.8	350	750	481	3.3	4.1
2,100	18	40	72	145	31,000	65,000	101,000	10	30
105	43	50	105	40	1,000	1,600	895	25	50
660	8	9	18	33	2,620	5,400	9,762	6	8
120	3	5	11	20	980	1,800	4,592	5	6
3.3	1.1	0.9	0.8	0.9	1.9	1.6	1.3	1.2	1.1
130.8	1.8	3.3	1.5	6.2	40.0	43.7	53.9	4.4	4.1
93	89	119	100	95	210	212	488	115	126
22	12	10	10	13	12	11	24	13	15
50	77	66	64	48	80	80	55	53	58
440	634	520	316	211	220	229	63	276	651
17,000	906	2,400	295	322	469	517	119	786	803
21	7	8	7	8	42	45	25	2	6
4.5	1.07	1.12	1.14	1.11	1.84	1.80	1.5	1.31	1.23
18	7	6	9	14	22	22	57	9	4

PLANT No: *(ISIC):*		76 *Toolings* *(360)*	77 *Machine tools* *(360)*	78 *Handling equip.* *(360)*	79 *Containers* *(350)*	80 *Household appliances* *(360/370)*
Capital						
Equipment (K_e)	(US $ million)	0.96	0.94	0.28	1.52	1.04
Building and land improvements (K_s)		0.27	0.58	0.24	0.62	0.76
Total working capital (K_w)		0.59	1.00	0.36	0.92	0.80
Total capital requirement (K)		1.82	2.52	0.88	3.06	2.60
Site						
Roofed sites (S_r)	(000 m²)	1.2	9.3	3.0	3.4	5.1
of which for production (S_{rp})		0.8	6.5	2.0	2.7	3.1
Total sites (S)		3.0	20.3	6.0	6.0	10.0
Employment						
Managers and highly skilled (L 1)	(man-years)	130	110	50	65	75
Skilled (L 2)		270	210	230	590	555
Unskilled (L 3)		70	50	20	245	70
Total employment (L)		470	370	300	900	700
Total skill adj: (L*)		1,530	1,230	960	2,340	2,110
Production						
Quantity (Q_t)	(000 t/year)	0.2	2	1.5	9	7
Value of production ($Q_\$$)	($ million/year)	1.7	3.2	1.2	4.3	5.2
Est. value added (V*)		0.7	1.3	0.5	1.8	1.9
Main raw materials						
M_t (1)	(000 t/year)	0.2	0.9	1	12	8
(2)		—	2	—	—	—
Electricity and water						
Electricity (E)	(million kWh/year)	2.4	0.8	1.1	1.8	1.0
Water (W)	(000 m³/year)	20	26	9	40	20
of which: drinking water (W_d)	(m³/day)	47	48	30	90	65
Transport requirements						
Input materials (T_m)	(000 t/year)	1	4	2	16	10
Products shipment (T_q)		0.3	3	2	12	7
Ratios						
Capital/output ratio ($K/Q_\$$)		1.1	0.8	0.7	0.7	0.5
Equipment per person (K_e/L)	($ 000)	2.0	2.5	0.9	1.7	1.5
Buildings and land improvement cost per m² of roofed site (K_s/S_r)	($/m²)	221	62	80	181	149
Percentage composition L 1	(%)	28	30	17	7	11
L 2	(%)	57	57	76	66	79
Average value per ton ($Q_\$/Q_t$)	($/t)	7,709	1,756	827	480	776
Electricity consumption per ton of output (E/Q_t)	(kWh/t)	10,909	444	733	200	149
Water consumption per ton of output (W/Q_t)	(m³/t)	91	15	6	4	3
Main raw materials per ton of output (M_{t1}/Q_t)	(t/t)	1.14	0.50	0.80	1.33	1.1[illegible]
Total transport per $ of output ($T_{m+q}/Q_\$$)	(kg/$)	1	2	4	6	3

[g] 000 cars.
[h] 000 units.
[i] 000 GWh.
[j] 000 m³.

81 nsformers (370)	*82 Car parts (383)*	*83 Car service (384)*	*84 Car repair (384)*	*85 Car serv. and repair (384)*	*86 Plastics (399)*	*87 Plastics (399)*	*88 Plumber (400)*	*89 Building (400)*	*90 Hydro. power (511)*
4.32	1.18	0.07	0.16	0.24	0.31	0.52	0.06	0.94	4.40
3.64	1.08	0.15	0.24	0.48	0.06	0.22	0.03	0.29	10.00
5.20	1.86	0.10	0.16	0.36	0.08	0.26	0.002	0.72	0.08
13.16	4.12	0.32	0.56	1.08	0.45	1.00	0.09	1.95	14.48
30.3	9.1	1.0	1.1	2.5	0.6	4.6	0.7	3.0	49.0
21.3	7.7	0.9	1.0	2.0	0.4	2.5	0.6	1.7	1.2
90.0	19.1	2.5	4.0	6.0	1.5	9.6	1.5	7.5	65.0
360	55	10	16	25	10	42	15	330	12
390	610	22	23	57	70	198	66	1,480	30
620	98	5	7	10	35	150	9	90	10
1,370	763	37	46	92	115	390	90	1,900	52
4,370	2,203	121	156	306	295	954	282	6,180	160
15	3.4	5[a]	10[a]	20[a]	0.3	0.9	0.3	0.9[b]	0.2[a]
16.4	12.1	0.15	0.26	0.80	0.68	1.8	0.30	5.6	1.0
6.3	4.5	0.76	0.13	0.41	0.29	0.86	0.18	2.2	0.66
10	5.5	–	0.09	0.17	0.45	0.9	–		
6	2	–	–	–				–	700,000
12.0	1.5	0.02	0.03	0.09	0.35	1.3	0.02	0.9	0.6
96	36	2.4	4	6	2	16	1	120	700,000
75	60	1.5	2	4	6	18	3	80	4
20	8	63	85	163	5	1	4	130	
17	4	3	5	7	3	1	3	25	
0.8	0.3	2.2	2.2	1.3	0.7	0.6	0.3	0.4	13.9
3.2	1.5	1.9	3.5	2.6	2.7	1.3	0.7	0.5	84.6
120	119	160	218	192	102	49	46	98	204
26	7	17	35	27	9	11	17	17	23
28	80	59	50	62	61	51	73	78	58
1,065	3,597	30	26	40	2,267	1,944	1,013	6,222	5,200
779	448	4	3	4	1,167	1,344	50	944	3,000
6	11	0.5	0.4	0.3	6	17	3	133	3,500,000
0.7	1.64	–	0.01	0.01	1.5	0.9	–	–	3,500,000
2	1	0.4	0.3	0.2	1.3	1	2	28	–

PLANT No. (ISIC):		91 Hydro. power (511)	92 Hydro. power (511)	93 Thermal power (511)	94 Thermal power (511)	95 Th[illegible] pow[illegible] (51[illegible]
Capital						
Equipment (K_e)	(US $ million)	5.20	11.20	6.40	15.20	21[illegible]
Building and land improvements (K_s)		16.40	23.20	2.40	3.20	4[illegible]
Total working capital (K_w)		0.12	0.16	0.64	1.20	1[illegible]
Total capital requirement (K)		21.72	34.56	9.44	19.60	27.[illegible]
Site						
Roofed sites (S_r)	(000 m²)	83.9	95.0	16.0	17.0	9.3
of which for production (S_{rp})		3.9	4.3	3.5	3.7	4.0
Total sites (S)		130.0	150.0	60.0	62.0	49.3
Employment						
Managers and highly skilled (L 1)	(man-years)	15	18	26	35	42
Skilled (L 2)		33	48	102	115	78
Unskilled (L 3)		12	19	22	30	12
Total employment (L)		60	85	150	180	132
Total skill adj: (L*)		186	253	458	550	456
Production						
Quantity (Q_t)	(000 t/year)	0.2^k	1.5^k	0.2^k	0.6^k	1^k
Value of production (Q_s)	($ million/year)	1.3	8.0	2.8	7.2	12.0
Est. value added (V*)		0.81	5.1	1.8	4.6	7.6
Main raw materials						
M_t (1)	(000 t/year)	$140{,}000^l$	$2{,}500{,}000^l$	125	285	220
(2)		—	—	—	—	—
Electricity and water						
Electricity (E)	(million kWh/year)	1.2	6.0	20.0	40.0	68.0
Water (W)	(000 m³/year)	140,000	2,500,000	1,500	40	63
of which: drinking water (W_d)	(m³/day)	5	6	13	15	12
Transport requirements						
Input materials (T_m)	(000 t/year)	—	—	175	285	220
Products shipment (T_q)		—	—	43	70	—
Ratios						
Capital/output ratio (K/Q_s)		17.0	4.3	3.4	2.7	2.3
Equipment per person (K_e/L)	($ 000)	86.7	131.8	42.7	84.4	163.6
Buildings and land improvement cost per m² of roofed site (K_s/S_r)	($/m²)	195	244	150	188	431
Percentage composition L 1	(%)	25	21	17	19	32
L 2	(%)	55	57	68	64	59
Average value per ton (Q_s/Q_t)	($/t)	6,400	5,330	14,733	12,000	12,000
Electricity consumption per ton of output (E/Q_t)	(kWh/t)	6,000	4,000	105,263	66,666	68,000
Water consumption per ton of output (W/Q_t)	(m³/t)	700,000	166,667	7,894	141,667	63
Main raw materials per ton of output (M_{t1}/Q_t)	(t/t)	700,000	166,667	658	475	220
Total transport per $ of output (T_{m+q}/Q_s)	(kg/$)	—	—	78	49	18

[k] 000 GWh.
[l] 000 m³.
[m] 000 hours.
[n] per hour.

96 …onal …er (611)	97 Architec. design (833)	98 Laundry (854)	99 Laundry (854)	100 Laundry (854)
45.58	0.005	0.02	0.03	0.44
7.36	0.012	0.08	0.11	0.26
3.04	0.001	0.02	0.03	0.06
55.98	0.018	0.12	0.17	0.76
13.1	0.08	0.3	0.4	1.8
7.5	0.08	0.2	0.3	1.3
63.1	0.10	0.4	0.5	2.5
70	5	1	2	6
89	4	11	15	77
18	1	16	18	45
177	10	28	35	128
635	38	54	73	306
2.5[k]	20[m]	0.25	0.45	2
30.0	0.04	0.05	0.10	0.4
19.1	0.02	0.04	0.08	0.4
546	–	–	–	–
–		–	–	–
138	0.001	0.2	0.3	0.8
120	0.08	15	25	95
16	0.3	1.5	2	7
546	–	0.3	0.5	2
–	–	0.3	0.5	2
1.9	0.5	2.5	1.7	1.7
257.5	0.5	0.7	0.9	3.5
562	150	271	265	144
39	50	4	6	5
50	40	39	43	60
12,000	2[n]	192	213	220
…5,200	0.06[o]	800	667	400
48	–	60	56	47
218	–	–	–	–
18	–	12	10	10

Plant 1

A medium-sized industrial slaughterhouse constructed for basic operations only (excludes waste processing)
One-shift operation
M_t (1): Livestock (50,000 t)
(Not profitable)

Plant 2

A small-capacity dairy plant with low degree of automation
M_t (1): Milk (20,000,000 l)
(Profitable)

Plant 3

A medium-sized, semi-automated dairy plant producing pasteurized milk and various kinds of cheese, butter and powdered milk
M_t (1): Milk (38,000,000 l)
(Profitable)

Plant 4

A large-scale automated dairy collecting and processing milk and producing all kinds of dairy products
Continuous operation on three shifts
M_t (1): Milk (110,000,000 l)
(Highly profitable)

Plant 5

A small-capacity, semi-mechanized plant producing both natural and concentrated fruit juice
Continuous operation with seasonal fluctuations in employment
M_t (1): Fruits (5,000 t)
(Not profitable)

Plant 6

A part of a multi-product firm producing soda water and carbonated juice as well as natural and concentrated fruit juice
Continuous operation with seasonal fluctuations in employment
M_t (1): Fruits (5,000 t)
(Profitable)

Plant 7

A small, labour-intensive (mainly female workers) bakery plant of local significance
Two-shift operation
M_t (1): Flour, sugar, salt (2,370 t)
(Highly profitable)

Plant 8

A small, semi-mechanized plant supplying bread and rolls for a small town
Two-shift operation
M_t (1): Flour (6,400 t)
(Profitable)

Plant 9

A large-scale bakery with modern equipment
Two-shift operation
M_t (1): Flour and salt (11,000 t)
(Highly profitable)

Plant 10

A relatively small-scale sugar refinery
Annual output of 34,500 t consists of:

Sugar	20,000 t
Molasses	6,000 t
Bagasse	8,500 t

Three-shift operation for 100 days during the harvest period; two-shift operation in off-season
M_t (1): Sugar beet (150,000 t)
(Profitable)

Plant 11

A medium-sized sugar refinery with a processing capacity of 3,000 t/day of sugar beet
Annual output consists of:

Sugar	40,000 t
Molasses	10,000 t
Dry and crude cossettes	40,000 t

Continuous operation on two shifts
M_t (1): Sugar beet (300,000 t)
(Profitable)

Plant 12

A medium-sized plant with its own refinery
Output consists of soy oil and animal feed
Continuous operation for about 300 days a year
M_t (1): Oilseed (60,000 t)
(Highly profitable)

Plant 13

A medium-sized, partly mechanized feed-meal mixing plant
Basic raw materials are flour-mill by-product cereals (maize, barley and oats), proteins of vegetable and animal origin, and various minerals, vitamins, antibiotics and other additives
Two-shift operation
M_t (1): Cereals (22,000 t)
(2): Proteins, minerals and vitamins (9,000 t)
(Highly profitable)

Plant 14

An automated feed-meal plant
Principal raw materials:

Cereals	39,000 t
Proteins	17,000 t
Minerals, vitamins etc.	6,000 t

Two-shift operation
M_t (1): Cereals (39,000 t)
(2): Proteins, minerals, vitamins (23,000 t)
(Highly profitable)

Plant 15
A partly mechanized wine-cellar for basic grape processing
Three-shift operation during the harvest season; otherwise, one-shift operation
M_t (1): Grapes (4,000 t)
(Highly profitable)

Plant 16
A small, semi-mechanized brewery
Continuous operation with seasonal fluctuations
M_t (1): Barley (1,150 t)
(Not profitable)

Plant 17
A semi-mechanized brewery, small yet economic
Continuous operation with seasonal fluctuation in output
M_t (1): Barley (2,500 t)
(Profitable)

Plant 18
A brewery of an economic size with an annual capacity of 500,000 hectolitres
Water consumption is reduced through partial recirculation
Two-shift operation
M_t (1): Barley (9,000 t)
(2): Hops (500 t)
(Profitable)

Plant 19
A large brewery with an annual capacity of 1,000,000 hectolitres
Two-shift operation
M_t (1): Barley (17,000 t)
(2): Hops (1,000 t)
(Highly profitable)

Plant 20
A soft drinks plant with an annual capacity of 180,000 hectolitres
Two-shift operation with seasonal fluctuations
M_t (1): Sugar (1,800 t) and carbon dioxide
(Highly profitable)

Plant 21
A fully-automated, small (20,000 spindles) cotton-spinning mill
Two-shift operation
M_t (1): Cotton (3,300 t)
(Not profitable)

Plant 22
An automated cotton-spinning mill with 22,000 spindles
Two-shift operation
M_t (1): Cotton (1,800 t)
(Not profitable)

Plant 23
A small cotton knitwear plant employing low-wage female labour
Two-shift operation
M_t (1): Cotton and staple fibre yarn (250 t)
(Not profitable)

Plant 24
A small weaving mill, employing mostly female labour
Two-shift operation
M_t (1): Man-made yarn (200 t)
(Profitable)

Plant 25
A footwear factory with an annual capacity of 600,000 pairs
Two-shift operation
M_t (1): Upper and sole leather (280 t)
(Not profitable)

Plant 26
A large leather and rubber footwear factory with an annual capacity of 1,500,000 pairs
One-shift operation
M_t (1): Leather, rubber and others (1,500 t)
(Not profitable)

Plant 27
A wearing apparel factory located in a large town and employing mostly skilled labour
Two-shift operation
M_t (1): Fabrics (2,500 t)
(Not profitable)

Plant 28
A relatively small-scale plywood plant
Uses beech logs (10,000 m³ per annum)
Two-shift operation
M_t (1): Beech logs (10,000 m³)
(Not profitable)

Plant 29
A small-scale saw mill for beech logs
One-shift operation
M_t (1): Beech logs (30,000 m³)
(Not profitable)

Plant 30
A wooden furniture factory producing a limited range of goods
One-shift operation
M_t (1): Wood and others (5,000 t)
(Not profitable)

Plant 31
A medium-sized metal furniture factory producing a limited range of goods
Two-shift operation
M_t (1): Steelstrip and tubing, and aluminium section (5,000 t)
(Profitable)

Plant 32

A small-capacity chipboard factory

Three-shift operation

M_t (1): Wood and wood waste (9,000 t)

(2): Glue and others (1,000 t)

(Not profitable)

Plant 33

A medium-capacity fibreboard factory

Three-shift operation

M_t (1): Wood and wood waste (16,000 m³)

(Not profitable)

Plant 34

A pulp and paper mill producing ordinary paper on the basis of sulphate pulp; no secondary processing facilities

Besides coniferous wood for pulp, the plant uses 7,200 t of lignite for fuel and 5,000 t of limestone and chemical products as auxiliary raw materials

Continuous operation for 330 days a year

M_t (1): Coniferous wood (160,000 m³)

(Not profitable)

Plant 35

A medium-sized pulp and paper mill

Uses 220,000 t of auxiliary materials (chemicals, limestone, colophony etc.)

Continuous operation for 330 days

M_t (1): Wood (400,000—500,000 m³)

(Profitable)

Plant 36

A relatively large factory supplying paper products for school and office use

Two-shift operation

M_t (1): Paper, cardboard, glue (6,500 t)

(Profitable)

Plant 37

A small leather tannery using mainly local materials and producing sole leather, elk leather and sleeked leather

Two-shift operation

M_t (1): Vegetable tanning substances (1,000 t) and lime

(Not profitable)

Plant 38

A fully mechanized tannery, specializing in upper leather, split leather and lining leather for footwear manufacturers

Two-shift operation

M_t (1): Skins and hides (6,700 t)

(Highly profitable)

Plant 39

A modern but small-capacity petrochemical plant producing ethylene (20,000 t) and polyethylene, polystyrene, phenol and acetone (20,000 t)

Continuous operation

M_t (1): Gasoline (60,000 t)

(Not profitable)

Plant 40

A petrochemical plant producing a number of derivatives of ethylene, propylene and C_4-fractions with the utilization of all by-products, but withou[illegible] an electrolysis facilities

Total annual output amounts to 900,000 t of which 415,000 t are finished products for sale, such as 280,000 t of plastics, 30,000 t of synthetic rubber, and 130 t of other chemical products

Continuous operation for 330 days a year

M_t (1): Gasolene (690,000 t)

(2): Chlorine and other chemicals (114,000 t)

(Profitable)

Plant 41

A medium-sized, fully automated plant producing nitrogen fertilizer

Continuous operation on three shifts

M_t (1): Natural gas (100,000,000 m³)

(2): Superphosphate, potassium salt, lime etc. (70,000 t)

(Profitable)

Plant 42

A benzene plant using reformed gasolene supplied by a nearby refinery

By-products are low-octane gasolene for refineries and waste gases used as fuel for the plant's own operation

Continuous operation for 330 days a year

M_t (1): Gasolene (240,000 t)

(Highly profitable)

Plant 43

A small-capacity petroleum refinery

Facilities include atmospheric distillation and simple vacuum distillation for bitumen production

Continuous operation on three shifts for 300 days a year

M_t (1): Crude oil (300,000 t)

(Highly profitable)

Plant 44

A small-capacity petroleum refinery

Facilities include atmospheric and vacuum distillation and a gasolene reforming plant for bitumen production

Three-shift operation for 300 days a year

M_t (1): Crude oil (500,000 t)

(Highly profitable)

Plant 45

A modern petroleum refinery

Includes atmospheric distillation facilities with cracking and catalytic gasolene reforming installations

ree-shift operation for 330 days a year
M$_t$ (1): Crude oil (2,000,000 t)
(Highly profitable)

Plant 46

Large-capacity petroleum refinery with a wide production programme including primary and secondary processing
Facilities include atmospheric distillation, catalytic cracking, catalytic gasolene reformation for bitumen and high-octane gasolene
Three-shift operation for 330 days a year
M$_t$ (1): Crude oil (5,000,000 t)
(Highly profitable)

Plant 47

A highly automated independent coking plant
Annual output consists of 570,000 t of metallurgical coke and 30,000 t of small coke for foundries and consumers. By-products are: tar, benzene, and others (approximately 38,000 t) and waste gases (about 120 million m^3)
Three-shift operation for 330 days a year
M$_t$ (1): Metallurgical coal (800,000 t)
(Profitable)

Plant 48

A small brickwork plant with a rotating furnace
About 9,000 t of low-caloric coal are required annually for fuel
Three-shift operation for 300 days a year
M$_t$ (1): Clay (25,000 m^3)
(Not profitable)

Plant 49

A roofing-tile and brick factory with a tunnel furnace
Firing with heavy fuel oil
Continuous operation on three shifts for 300 days a year
(Not profitable)

Plant 50

A modern, medium-sized roofing-tile factory
Fuel requirement: 5,000 t of heavy fuel oil a year
Three-shift operation for 330 days a year
M$_t$ (1): Clay (37,000 m^3)
(Profitable)

Plant 51

A very small hollow-glass factory
Continuous operation for 330 days a year
M$_t$ (1): Siliceous sand, stone and cullet (13,500 t)
(Not profitable)

Plant 52

A small plate-glass plant
Continuous operation for 330 days a year
M$_t$ (1): Siliceous sand (14,000 t)
(2): Cullet, limestone (18,500 t)
(Profitable)

Plants 53, 54, 55 and 56

Various-sized Portland cement plants
Continuous operation for 300 days a year
M$_t$ (1): Limestone and clay (plant 53—160,000 t; plant 54—320,000 t; plant 55—430,000 t; plant 56—1,100,000 t)
(Plant 53—unprofitable; plants 54, 55 and 56 profitable)

Plant 57

An acoustic and heat-insulating structural clay products plant
Fuel requirement: 4,800 t of heavy fuel oil a year
Continuous operation on three shifts
M$_t$ (1): Clay (50,000 t)
(2): Cement (18,000 t)
(Profitable)

Plant 58

A medium-sized plaster plant with no secondary processing facilities
Fuel requirement: 4,500 t of coal a year
Continuous operation for 300 days a year
M$_t$ (1): Gypsum (32,000 t)
(Profitable)

Plant 59

A modern hydrated lime plant producing both quicklime and slacked lime ready for use
Fuel requirement: 8,000 t of heavy fuel oil a year
Continuous operation for 330 days a year
M$_t$ (1): Limestone (33,000 t)
(Profitable)

Plant 60

A medium-sized lime plant with a shaft limekiln having an annual capacity of 27,000 t of quicklime
Continuous operation on three shifts for 300 days a year
M$_t$ (1): Limestone (37,000 t)
(Not profitable)

Plant 61

A highly mechanized lime plant with a rotary kiln
Fuel requirement: 10,000 t of coal
Three-shift operation for 300 days a year
M$_t$ (1): Limestone (45,000 t)
(Not profitable)

Plant 62

A prefabricated concrete building block factory producing mainly blocks of a simple shape
One-shift operation
M$_t$ (1): Cement (5,000 t)
(2): Others (1,700 t)
(Not profitable)

Plant 63

A masonry with a small-capacity unit producing concrete products, including concrete blocks of a complex shape

One-shift operation
M_t (1): Sand (18,000 m³)
(2): Clay products (15,000 t) and cement (3,000 t)
(Profitable)

Plant 64
A plant producing boards for partition walls and for thermic and acoustic insulation
Two-shift operation
M_t (1): Cement, wood, particle board etc. (115,000 t)
(Profitable)

Plant 65
A small alumina plant located in the vicinity of a local bauxite mine
Capital investment figure does not include investment in mines and transport facilities; it does include investment in a small thermal power plant
Continuous operation for 330 days a year
M_t (1): Bauxite (225,000 t)
(2): Alkaline additives Na_2CO_3 or NaOH (15,000 t)
(3): Low calorie coal (15,000 t)
(Not profitable)

Plant 66
An integrated alumina and aluminium plant
Continuous operation for 330 days a year
M_t (1): Bauxite (450,000 t)
(2): Alkaline additives (30,000 t)
(3): Coal (145,000 t)
(Not profitable)

Plant 67
A foundry producing tempered castings of 0.1—5 kg to order
Two-shift operation
M_t (1): Gray and scrap iron (2,850 t)
(Not profitable)

Plant 68
A modern foundry equipped with medium-sized electric furnaces producing steel castings of 1—200 kg
Two-shift operation
M_t (1) Gray and scrap iron (5,600 t)
(Not profitable)

Plant 69
A foundry attached to a machine factory producing machine castings of 1—250 kg
Two-shift operation
M_t (1): Gray and scrap iron (1,200 t)
(Not profitable)

Plant 70
An independent foundry producing castings of 1—50 kg
Two-shift operation
M_t (1): Gray and scrap iron (20,000 t)
(Not profitable)

Plant 71
An integrated steel plant producing pig iron, crude s[illegible] and rolling mill products (final products); the ann[illegible] production of 745,000 t represents the rolling m[illegible] products only
Fixed capital includes a coking plant, a power pla[illegible] and an oxygen plant
Three-shift operation

M_t (1):	Iron ore (60 % Fe)	(1,300,000 t)
(2):	Limestone	(250,000 t)
(3):	Scrap iron	(75,000 t)
(4):	Metallurgical coke	(500,000 t)

(Not profitable)

Plant 72
A small yet fully integrated steel mill producing steel sheets and plates as its final output
Three-shift operation

M_t (1):	Iron ore (60% Fe)	(2,600,000 t)
(2):	Limestone	(700,000 t)
(3):	Metallurgical coal	(900,000 t)

(Not profitable)

Plant 73
A steel mill producing crude steel (2,800,000 t) and pig iron (1,300,000 t); has no secondary processing facilities, such as roll mill, and no coking plant
Fuel requirement: 1,952,000 t of coke and 362,000 t of fuel oil for blast furnace
Three-shift operation

M_t (1):	Iron ore	(6,000,000 t)
(2):	Scrap iron	(500,000 t)

(Not profitable)

Plant 74
A small, forged-steel plant producing forged-steel products ranging from 5 to 120 kg in weight and used in machine tool factories
Two-shift operation
M_t (1): Rolled steel (5,500 t)
(Not profitable)

Plant 75
A small, automated hardware plant producing screws, nails, rivets, bolts, nuts etc.
Two-shift operation
M_t (1): Drawn steel (6,300 t)
(Profitable)

Plant 76
A machine tool and special steel products plant
Two-shift operation
M_t (1): Special steel (250 t)
(Not profitable)

Plant 77
A machine tool plant with an annual production [illegible] about 1,450 units of woodworking tools
Has no foundry; castings are done by other indepe[illegible]dent foundries

Two-shift operation
M$_t$ (1): Steel, sheet metal (900 t)
(2): Castings (1,800 t)
(Profitable)

Plant 78

A plant producing materials-handling equipment
Two-shift operation
M$_t$ (1): Rolled steel and castings (1,200 t)
(2): Timber
(Not profitable)

Plant 79

A partially automated, metal drum manufacturing plant
Two-shift operation
M$_t$ (1): Sheet metal (12,000 t)
(Profitable)

Plant 80

A semi-mechanized, household gas stove plant; has no enamelling facilities
Partial two-shift operation
M$_t$ (1): Sectional steel and sheet metal (8,000 t)
(Profitable)

Plant 81

A modern, fully mechanized plant producing transformers
Produces both small (20—60 kg per unit) and large (400—300,000 kg per unit) power transformers
Investment figure represents an initial phase of a multi-stage project and is therefore about 20 per cent higher than the normal case
Two-shift operation
M$_t$ (1): Copper goods and transformer sheets (10,500 t)
(2): Wires and transformer oil (6,000 t)
(Profitable)

Plant 82

An automotive parts plant producing radiators, axles, gear wheels and various cast parts for cars
Serial production possible but without assembly-line operation

Two-shift operation
M$_t$ (1): Steel sheet metal (5,500 t)
(2): Scrap iron (1,800 t)
(Highly profitable)

Plant 83

A specialized service shop for passenger cars
(Not profitable)

Plant 84

A car repair shop specializing in body work
One-shift operation
M$_t$ (1): Spare parts (94 t)
(Not profitable)

Plant 85

A car repair and service shop
One-shift operation
M$_t$ (1) Spare parts (168 t)
(Profitable)

Plant 86

A plant producing plastic articles
Two-shift operation
M$_t$ (1): Thermosetting plastics (450 t)
(Profitable)

Plant 87

A plant producing large plastic articles
Three-shift operation
M$_t$ (1): Plastics (860 t)
(Profitable)

Plant 88

A semi-industrial enterprise engaged in the installation of water supply, gas and central heating facilities
Two-shift operation
(Not profitable)

Plant 89

A construction firm specializing in industrial buildings
Seasonal operation on 1—2 shifts
(Not profitable)

Plant 90

A small hydroelectric power plant
Turbine operations for 300 days a year
(Not profitable)

Plant 91

A hydroelectric power plant with a storage basin of 37 million m^3 of water
(Not profitable)

Plant 92

A hydroelectric power plant with a storage basin of 540 million m^3 of water
Continuous operation with 7,000 hours of peak-load operations
(Profitable)

Plant 93

A small steam power plant with three generator units
Continuous operation at various outputs of electric power
M$_t$ (1): Coal (125,000 t)
(Not profitable)

Plant 94

A medium-sized steam power plant with one large generator
M$_t$ (1): Coal (285,000 t)
(Profitable)

Plant 95

A thermal power plant with one generator
Operation for 5,000 hours a year
M_t (1): Heavy fuel oil (220,000 t)
(Highly profitable)

Plant 96

A modern thermal power plant with two generators
Operation for 5,000 hours a year
M_t (1): Heavy fuel oil (546,000 t)
(Highly profitable)

Plant 97

An architectural design firm specialized in industrial building designs
(Not profitable)

Plant 98

A small laundry plant
Two-shift operation
(Not profitable)

Plant 99

A medium-sized laundry with its own boiler plant to generate steam
Two-shift operation
(Profitable)

Plant 100

An industrial laundry plant serving hospitals, hotels and other institutional customers
Two-shift operation
(Profitable)

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