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**REPORT ON THE SITUATION
OF THE MACHINE TOOL INDUSTRY
IN BRAZIL**

by

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POLICIES AND GENERAL BACKGROUND
SITUATION IN THE MACHINE TOOL SECTOR
INTRODUCTION

Brazilian industry was built up largely in response to the fluctuations in international demand in the primary sector which directly affected the country's capacity to import.

The period of the world-wide depression beginning in 1929 brought the real establishment of industry, which was able during that period to count on a steadier domestic, as compared with foreign, demand because the exchange rate remained constant, and it was therefore possible, with the reduction in imports of foreign goods, to offer better prospects for the remuneration of domestically invested capital.

In the years after 1939, the domestic market came to be the main dynamic factor in the Brazilian economy. In this phase, the first machine tool industries were established, but still in rather small numbers (less than 10).

During the Second World War, the difficulties in keeping plants operating owing to the need to import parts and accessories and also capital goods to make possible the production of these parts and accessories in the country made it necessary for the machine tool industry to be able to meet the immediate requirements arising.

The maintenance of a steady exchange rate during the Second World War, together with other factors affecting the economy, created a situation which was extremely favourable to investments in industries linked to the domestic market. This situation gave the stimulus for the increase in the rate of capitalization and an intensification of the process of industrial growth which took place in the period from 1945 to 1955.

Between 1956 and 1961, the industrial structure underwent profound and rapid changes. These changes were related to the import substitution process and also resulted from government plans, above all in regard to the establishment of the automotive industry. Despite the growth rate achieved, the machine tool industry was not in a position to cover the full share of the domestic market which should have been its at that stage in its development, in view of the market preference for imported machines.

A very important factor for domestic industry as a whole was undoubtedly the introduction of the concept of national comparability. However, in the case of machine tools in general, this concept of comparability did not decisively affect the sector, since imported machines were financed under rather favourable terms, and this induced their purchasers to present a number of arguments to prove the technical superiority of the imported machines.

The factors in the technological lag of domestic machine tool enterprises in 1961 were:

- Inadequate enterprise size;
- Diversification of lines of production, with small-scale operation;
- Low efficiency of the production process;
- Shortage of financial resources; and
- Inadequate administrative structure.

In 1961, the production profile was as follows:

	Machines operating by stock removal	Machines operating without stock removal	Total
Number of machine tools	12,704	2,813	15,517
Weight (tonnes)	8,264	4,987	13,251
Value (thousands of US\$)	-	-	25,500
Average weight (kg/machine)	650	1,772	854
Specific value (US\$/kg)	-	-	2.0
Proportion (by units)	81.9	18.1	100
Proportion (by weight)	62.4	37.6	100

Source: The manufacture of industrial machinery and equipment in Latin America - II. The machine tools industry in Brazil, ECLA, 1962.

PROFILE OF INDUSTRIAL POLICY

Location

The machine tool industry was originally established in the immediate vicinity of the metalworking and mechanical engineering industries, with a heavy concentration in the State of Sao Paulo. In the meantime, the industrial development of these areas, the increase in the value of their land, the need to expand existing plants and the establishment of new enterprises have made it preferable to set up enterprises in areas remote from the large agglomerations. Hence, in 1967, the regional distribution of manufacturing enterprises was as follows:

Location	No. of enterprises	Percentage
City of Sao Paulo	43	51.8
Outskirts of Sao Paulo	13	15.7
State of Sao Paulo	17	20.5
State of Santa Catarina	1	1.2
State of Rio Grande do Sul	5	6.0
State of Parana	4	4.8
TOTAL	83	100.0

Source: The machine tool industry in Brazil, 1970, Institute for Economic and Social Planning (IPEA).

Enterprise structure

A comparison between the enterprise structure in the machine tool industry in 1961 and in 1968 reveals the following:

- (a) Reduction in the number of enterprises;
- (b) Reduction in the number of enterprises in which sales of machine tools accounted for 75 to 100 per cent of total revenues;
- (c) Increase in the total number of persons employed;
- (d) Increase in the number of persons employed per enterprise.

Although these changes have been gradually taking place, the growth in average enterprise size still falls short of the minimum recommended international level.

Economic and financial structure

The constant need for circulating capital resulting from the inflation through which the Brazilian economy has been passing since the establishment of the machine tool industry, and also from the lack of a rigid cost-control system, obliges enterprises to bill periodically under disadvantageous terms, and this weakens those with a more fragile structure. Hence, the sector is not in a position to finance a growth in the volume of production, to improve products technically or to bring out new models and to achieve economies of scale with better productivity.

The financial problems of the enterprises in this sector have been aggravated in some cases by competition with similar imported products, resulting in sizable fluctuations in the volume of sales. This is the case, for example, with milling machines and grinders, both of which are products which require a certain amount of time to capture the market, compelling the producers to devote a very long period of time to the elimination of the technical defects in their products.

Thus, the economic and financial problems point to the need to increase the average size of enterprises so that they can perform their functions more effectively in conjunction with the metalworking and engineering industry.

SELECTION OF TYPES OF PRODUCTION ON THE BASIS OF EVALUATION OF LINES OF PRODUCTION

During the period in which the metalworking and engineering industry was being established, small repair and maintenance shops for machine tools were set up. In subsequent periods, natural selection favoured the production of machinery with a low technological content. Initially, there was therefore a preference for engine and bed lathes, portable and pillar drills, planing machines and others which are easily manufactured.

At the present time, there is still a distinct diversification of lines of production. All the same, the trend is towards greater specialization by manufacturers in order to take maximum advantage of factors of production.

MACHINE TOOLS WHICH SHOULD BE PRODUCED AND MACHINE TOOLS WHICH SHOULD BE IMPORTED

Data on the sizes and features of the types of machine tools to be produced and/or imported by the country in this decade in order to meet the requirements of the future consumer market show a significant increase in the complexity of the machine tools concerned. These machine tools will have a greater technological content owing to the steady development of semi-automation, the increase in average weights and the distinct improvement in quality levels.

It is enterprises of adequate size with a constant concern for medium-term and long-term planning and the organization of activities aimed at the creation of sophisticated national know-how which will be able to develop most rapidly and, consequently, to meet the requirements of the metalworking and engineering market.

AUXILIARY INDUSTRIES

The industries which provide parts and raw materials are in a position to supply what is needed for manufacturing machine tools, but at prices which are higher than those in the developed countries.

In some cases, suppliers try to round out their lines of production with commercial and common components because the machine tool industry has not been able to become commercially and technically attractive owing to the specialization of the use of parts and also to the fact that scales of production are still small.

STATE POLICY REGARDING MACHINE TOOLS

As regards government policy, measures relate to three areas, namely: (a) technology, (b) finance and (c) tax incentives.

The Brazilian Machine Tools Institute, related to the Mechanical Engineering Division of the Sao Paulo Technological Research Institute, was set up in 1968 to promote the development of national machine tool technology.

The purpose of this Institute is to provide technical assistance to manufacturing enterprises so that they can improve the quality of their machine tools.

The financial measures include the financing of sales, circulating capital, renewal of equipment and the reorganization of machine tool enterprises out of official development funds.

In order to achieve government goals, on the basis of a law promulgated in 1970, the Ministry of Industry and Commerce, working through the Industrial Development Council, established a number of tax incentives for machine tool enterprises wishing to renew their industrial equipment and also those desiring to develop new models of machines considered to be of national interest. In summary, these incentives consist of exemption from taxes on the purchase of domestic machinery and equipment. In the case of machines which cannot in the initial phase be wholly manufactured in the country the Ministry of Industry and Commerce grants exemption from the various taxes imposed, in accordance with previously established nationalization plans, to imported parts and/or components.

By means of these measures, and others aimed at the foreign market, the Government is endeavouring to accelerate the import substitution process, make it possible for domestically produced machinery to compete internationally and offer domestic users machinery at more accessible prices.

FOREIGN TECHNICAL ASSISTANCE FOR THE DEVELOPMENT OF THE DOMESTIC MACHINE TOOL INDUSTRY

Technology is transferred mainly through licensing agreements, which include technical assistance, patents, manufacturing licences and national trade marks, and also movements of specialized personnel, technical documentation, foreign investment projects and the import of machinery and equipment.

The machine tool industry in the country uses the above-mentioned licensing agreements more often than any other method to achieve transfer of technology.

However, it should be pointed out that when the entrepreneur applies micro-economic criteria in connexion with imported technology, this is not always the most rational approach from the macro-economic point of view. Furthermore, in order to overcome the production and product engineering deficiencies existing in the sector, the entrepreneur tries to solve his problems in connexion with keeping up with the latest technology by means of manufacturing licences. As a result, the selection of licences is often not in keeping with the requirements of the consumer market.

Hence, the establishment of foreign machine tool enterprises is advisable in so far as this means the introduction of more advanced technology and more efficient organizational structures for the sector, and also provided these foreign enterprises make their subsidiary companies in Brazil responsible for meeting the demands of the various existing export markets.

The association of domestic enterprises with foreign enterprises possessing know-how in the machine tool field is very important for the country, since it can create better competitive conditions by improving existing products or introducing new ones into the line of production and by bestowing greater independence in relation to circulating capital, renewal of equipment and other technical and economic aspects.

CO-OPERATION AND TECHNICAL ASSISTANCE REQUIRED

The co-operation which Brazil needs from UNIDO can be of various types.

The recently established Brazilian Machine Tools Institute can render the machine tool industry invaluable services with regard to the improvement of machinery now being produced. Thus, financial assistance and also the sending of foreign technicians to give better advice to this organ are urgent.

As regards the question of specialized labour for the sector, in view of the requirements for the coming ten years, the conclusion of agreements with UNIDO for the establishment of technical and vocational schools in the country can accelerate the training of medium-level technicians, making it possible for a larger proportion of personnel to be employed by the metalworking and engineering industries by 1980.

Other types of agreements can also be concluded with the Ministry of Education and Culture (Division of Industrial Training) and the National Confederation of Industry (National Industrial Apprenticeship Service), which supervise the qualifications of personnel in the sector.

Lastly, the low technological content of certain types and models of machine tools produced in the country reflects the shortage of design capacity in the sector, and this is due in part to the large number of small enterprises and the rather small number of high-level designers in the larger enterprises.

Agreements concluded with the Ministry of Education and Culture for the purpose of improving university courses in the industrial engineering and management sector can in the long run make it possible to develop the specialization required for the development of the country.

TECHNICAL ASPECTS

PROBLEMS RELATING TO THE DEVELOPMENT AND UTILIZATION
OF MACHINE TOOLS^{*} DESIGN AND ADAPTION

One of the current problems in the machine tool industry in Brazil is the shortage of planners and designers. Unfortunately, the lag in this know-how is a handicap for the sector at the present time, to the point of to some extent reducing the value of the experience already gained in the manufacturing of products.

* Source: La Transferencia del Conocimiento Tecnico en la Industria de Máquinas-Herramientas del Brasil, ECLA, 1971.

The solution for overcoming the existing technological lag could be a reduction in the number of enterprises by means of association, mergers and complementation agreements, with an attendant increase in the size of each productive unit.

PRODUCTION OF PROTOTYPES

The production of prototypes is an activity which can be carried out by well-equipped shops which have personnel trained in precision work. The mechanical design must be prepared by a design department able to minimize the alterations which will prove necessary in executing the prototype.

The Brazilian Machine Tool Institute, which was established in 1968, can assist the manufacturing enterprises to raise the technical level of their products and in addition can give them support in the development of new types and models of machine tools.

ORGANIZATION OF PRODUCTION

The problems arising from the lack of methods sections in machine tool enterprises directly affect the organization of production in these enterprises. However, the need for a minimum of co-ordination has brought into being a body of know-how which makes it possible to cope reasonably well with this type of planning.

QUALITY CONTROL

There are at present many difficulties, primarily for medium-scale producers, in meeting international quality standards such as Schiesinger's.

In the initial and intermediate phases, control is not systematic and standardized.

In some cases, for example, the manufacturer cannot choose the most appropriate supplier because there is no competition in specialized supply, and he is obliged to take whatever is available.

In the assembly phase, quality control measures are reasonably good but time-consuming owing to the adjustments carried out in the section to ensure that the product will meet international standards.

BETTER UTILIZATION OF THE MACHINE TOOL POOL

Two problems must first be solved in order to achieve the best utilization of the machine tool pool.

The first relates to the characteristics of each piece of equipment available. In stock removal operations using small-capacity machines, power consumption for moving the machines is considerable and is therefore a limiting factor to be taken into consideration.

A second aspect which should be examined is minimization of manufacturing times, with a thorough evaluation of methods used. The selection and location of tools, preparation of manufacturing equipment and selection of speeds must be analysed to ascertain the optimum conditions for the existing equipment in each industry.

As things stand, the manufacturing industry is faced with the problems mentioned above, which must be solved as quickly as possible so that it can keep pace with the development of the country.

REBUILDING, MAINTENANCE AND REPAIR

The rebuilding and repair of machinery in general is a job which does not allow the methodisation of production techniques. It is therefore uneconomical to organise shops with substantial facilities and personnel resources for the purpose of developing this type of activity on a priority basis.

Existing shops organized on a simple craftsman basis will in some cases be able to carry out the functions of maintenance and repair, but without a very high level of productivity.

TRAINING OF LOCAL PERSONNEL

Projections of demand for machine tools in the next few years show that labour requirements are one of the major problems. An effective training programme for design specialists and skilled workers is therefore needed.





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